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# Travellers' Preferences and Attitudes to understand Travel Behaviour and define Market Segmentation

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# Declaration

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Valerio Operti

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* This dissertation is presented in partial fulfillment of the requirements for **Ph.D. degree** in the Graduate School of Politecnico di Torino (ScuDo).

*I would like to dedicate this thesis to Tatiana, she knows why.*

# Abstract

The climate change is the challenge that our society has to face in the next years. All human activities are involved to reduce their Green House Gas emissions, included the transport field. In the European Union agriculture, industries, residential and services obtained, in the last twenty years, a greater reduction of their emissions than that recorded in transport sector. Nowadays transport is cause of a quarter of the produced Green House Gases. Among the transport modes, road transport is responsible of 70% of all emissions. Transport still depends too much from fossil sources: the 94% of its energy is produced with oil.

The current mobility is not sustainable and its change immediately required, but European Commission and national governments are undertaken into huge projects (like TEN-T Network), which require large investments and long time before to see effects and results. For this reason, at the same time, other actions are committed by European Union and States to improve mobility together with the current infrastructures. One of these measures is the promotion of integrated mobility: all modes of transport (road, railway, cycle path, etc.) are seen as one single network and people travel using them, changing several modes of transport. The aim is the optimisation of the current transport services and the reduction of emissions, thanks the increase of soft modes and public transport use. The integrated mobility has a main drawback: it requires a change of travellers' habits about the modal choice. A deep analysis of the travel behaviour is necessary for understanding how to promote this change.

The research is carried out in the above context and the main objectives of the work are: a) the analysis of the attitudes influences on the travel behaviour, and b) the research of the most important constraints to implement a more sustainable mobility. The adopted methodology is composed by two steps: the collection of data and the data analysis design. The information is collected through a survey, Computer-assisted web interviewing (CAWI), and it is called "Come Ci Muoviamo". The design of the web-questionnaire includes an original contribution: the General Ecological Behaviour (GEB) questionnaire has been modified, according to the outcomes of previous researches, to shorten it where information were not so useful and including, instead, new items, relevant for this research. The study area of the survey is the Piedmont region and survey administration collected more than 4.500 answers. The data analysis starts with an Exploratory Factor Analysis (EFA) that allows to discover the major latent

constructs on the attitudinal variables collected in the survey. Then, a Cluster Analysis (CA) is carried out on the factor scores computed by EFA. The obtained clusters are the base of the new market segmentation based on travellers’ attitudes. The description of the new profiles is completed with the social-demographic information of respondents. The final aim of this new market segmentation is the definition of some guidelines and suggestions to policy makers and transport operators to be more efficient to foster a modal shift towards more sustainable modes of transport.

The attitudinal latent constructs and the new travellers’ profiles are compared with the first market segmentation carried out seven years ago in a restricted part of the study area. Notwithstanding the different sample and area, there are several common outcomes, which corroborate the methodological approach. Indeed, five profiles are found and four of them are comparable with previous ones for their attitudes and travel behaviour. With this new market segmentation, it is possible to explain the mode choice of the respondents. At the end of the analyses, some suggestions to policy makers and transport operators are provided, tailored to each profile.

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# Glossary

EFA: Exploratory Factor Analysis

PCA: Principal Component Analysis

Polito: Politecnico of Torino

PT: Public transport

AV: Autonomous vehicles

CA: Cluster Analysis

WTP: willingness to Pay

EU: European Union

GHG: Green House Gas

CCTV: Closed-Circuit Television

# Introduction

Our modern world has to face several problems, one of these is the Global Warming. The Global Warming is caused by different gases, but the largest impact is due to carbon dioxide ($CO_2$), the most produced by human activities: it is responsible for 64% of man-made global warming (EC, European Commission, DG Clime and action, 2016).

Indeed, the Global Warming is a reality: the global average temperature is 0,85 °C higher than pre-industrial age (19th century) (EC, European Commission, DG Clime and action, 2016). For instance, each of the last three decades has been warmer than all the previous ones. If the increase does not stop shortly, the impacts of this change will become not sustainable for human society. The target that has not to be overcome is 2 °C growth as regards to $19^{th}$ century temperature.

The scientific literature, generally, holds to be true that the main cause of global warming is human activities. For this reason, the international community adopted some protocols (Kyoto Protocol, 1997) (Paris Agreement, 2015), to regulate efforts for the reduction of greenhouse gases.

In this context, the European Commission has set some targets from 1990 levels of greenhouse gas emissions, as reported below and in Figure 1:

- for 2020, reduction of 20%;
- for 2030, reduction of 40%.

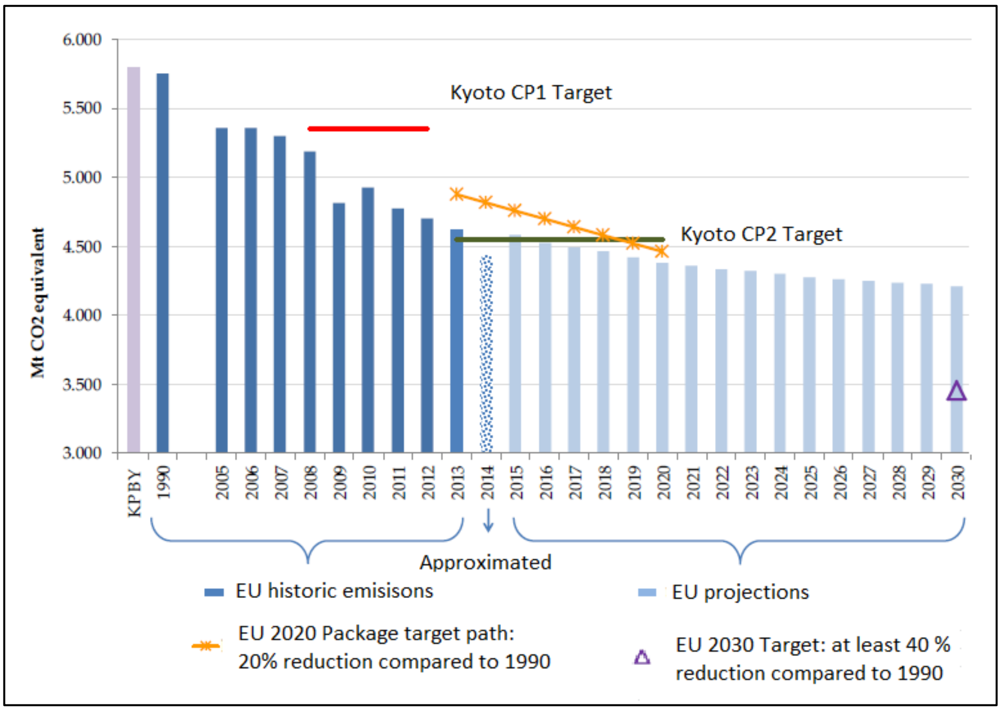


Figure 1 - Progress towards meeting Europe 2020 and Kyoto targets.

To achieve these targets, the European Commission is focused on the human activities that produce a large quantity of greenhouse gases. Among them, there is the transport sector: the mobility represents approximately a quarter of Europe's greenhouse emissions. In particular, road transport is responsible for 72,8 % of transport emissions (Figure 2).

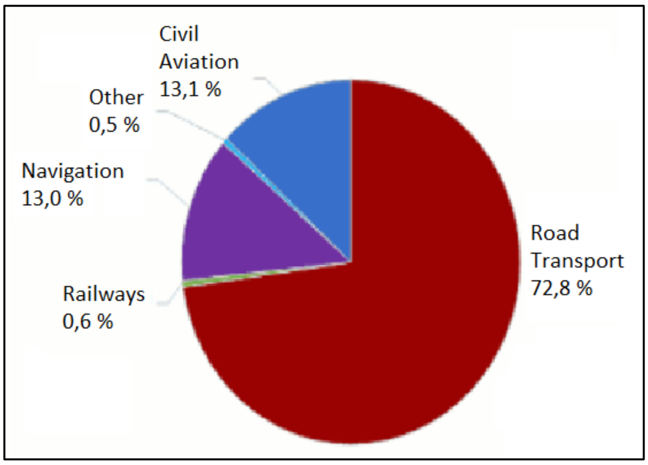


Figure 2 - Greenhouse gas emissions from transport by mode in 2014.

In addition, the trend of transport emissions does not show same decrease of those from other human activities, as represented in Figure 3. For this reason, there is strong effort of European policy to improve reduction of impacts caused by mobility. On the other hand, the low-carbon strategy in the transport sector has to maintain Europe competitive and able to ensure to people the mobility services, that are increasing in number and typology.

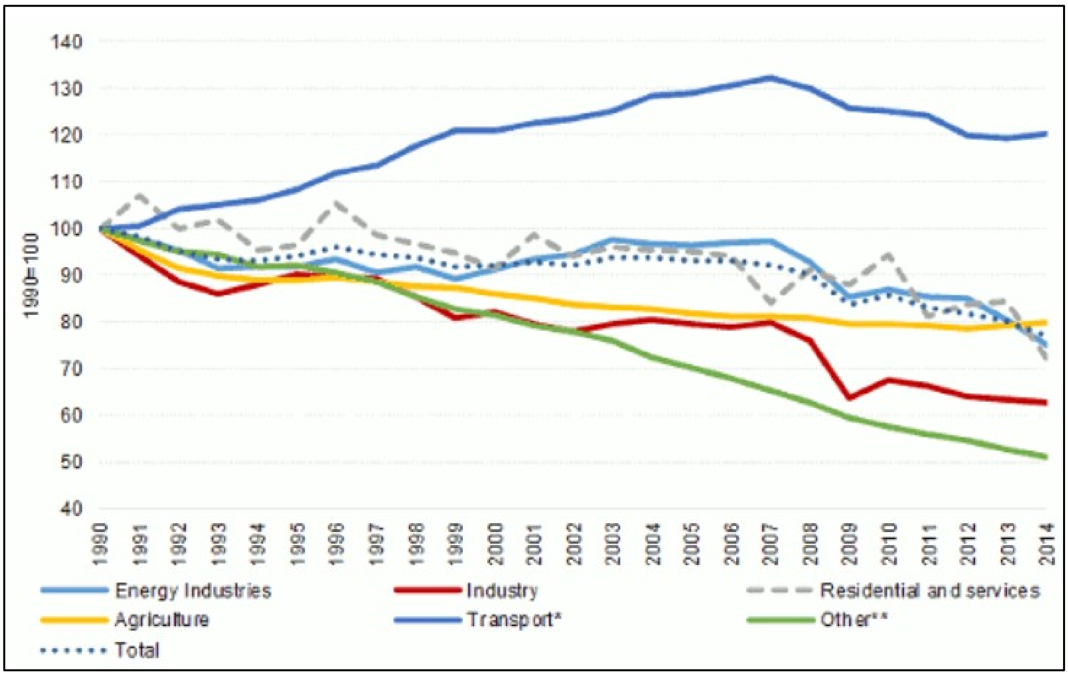


Figure 3 - Emissions from different human activities from 1990 to 2014.

To make transport sector more sustainable, huge investments have being undertaken in infrastructure and transport means, not only by public bodies as European Organisations or Member States, but by the biggest transport companies overall the world. Nevertheless, results from these investments cannot be immediately effective and they could be not sufficient in the medium-long period without other complementary actions. Indeed, the optimisation of infrastructures and transport services is a key point to fit actual transport demand, which is more flexible than in the past. A way to solve the above issue is thinking the mobility as a connected and integrated system, formed by all modes of transport, for which specific rules have to be defined to reach greenhouse emission targets.

The PhD work aims to investigate the mobility patterns in an area including urban, suburban and rural territories, focussing on mode choice and travel behaviour, to define a market segmentation based on travellers' preferences and attitudes.

To reach this goals, the methodology is composed by four phases:

- definition of study area;
- survey design;
- sample administration;
- data analysis design.

In the first chapter, an overview of state of the art of behavioural theories applied to transport field is presented: the focus of the review is on the application of behavioural theories to mode choice and the role of psycho-social variables in influencing the travel behaviour. At the end of the chapter, a previous market segmentation based on attitudes, carried out in Piedmont region, is reported.

The second chapter illustrates the objectives and the methodology adopted by this research. This chapter gives information about the design of the survey and the data analysis, which allow reader to fully understand the outcomes, shown in chapter 3.

To conclude, last chapters are dedicated to the discussion and to the conclusions.

# Chapter 1

# Travellers' profiles definition

Nowadays, we know the challenges deriving from megatrends:

- adaptation of urban areas;
- social inclusion and urban democracy and transport equity;
- economic vitality and society based on knowledge;
- sustainable infrastructures, building, networks and smart mobility.

To face these challenges, a key policy goal is often to foster a change in human behaviour, but it is a difficult task, so policies often fail and do not reach their targets. Indeed, many barriers exist:

- existence of habitual actions;
- financial constraints;
- societal expectations or norms;
- life and family commitments;
- lack of access to the facilities necessary to enable positive action.

The change of behaviour relies on incentives and personal motivations, like financial savings or social norms or just a "feel-good" factor in taking positive actions. Nevertheless, the individuals and groups within society are heterogeneous as regards their attitudes, preferences and motivations, so they have different reactions. As matter of facts, when some taxes (or other policies) are removed, for certain people previous behaviour come back. In addition, time is an important factor and the holistic effect has not to be forgot: an array of policies is more incisive over both the short or long term than an single policy.

The policies can be based on external drivers, like financial incentives (e.g. taxes, subsidies, etc.) and regulations (e.g. prohibition, standards, etc.), so they reflect, re-enforce and shape attitudes, motivations and norms within a community. In addition, each individual has an intra- and inter-personal driver (e.g. social desirability, familiar influence, etc.).

At individual level, the most used approach is the microeconomic approach. The characteristic can be summarised as follows:

- each individual has a full set of consistent preferences which determines the choices;
- perfect information and perfect competition;
- individual constraints: budget, prices, service's availability.

In this context, to have more effective policies it is necessary to study and understand how the behaviour is generated and what influences it. Transport field is not different: nowadays growing attention is paid to transport planning and management of policies which aim to reduce environmental impacts and observe new constraints set by international community.

About transport environmental concerns, the major problem is the massive use of private vehicles. The promotion of the modal diversion needs an adequate knowledge about reasons which lead to car use. The most significant factors will be object of the policy actions. Only through this analysis the policy could be more effective (Steg, 2005).

A lot of literature tries to identify the profiles of travellers who could change their behaviour. The majority of the approaches is to start from a segmentation based on socio-economics or demographic variables (Pronello & Camusso, 2011). The advantages of this approach are several: the main ones are data availability and consolidated methodology. On the other hand, this way does not allow to explain the motivation of behavioural change. To reach this goal, in the psychological research the attitude-behaviour relationship is the bedrock of all models. In the transport sector a users' segmentation based on this relationship is very rare and uncommon, even though psychological determinants of transport modal choice are targets of several studies (Hunecke, Haustein, Bohler, & Grischkat, 2010).

Complexity affects people's choices about transport mode, so they become gradually less rationally explainable (Pronello & Camusso, 2011). The most common approach, based on economic logic and fully rational thoughts, cannot properly describe the collected data. Indeed, the theory of individual choice behaviour, based on the economic consumer theory, considers that irrational actions (excepts for casual mistakes) are included in the random utility. These aspects of behaviour cannot be explained by economical or mathematical models (Ben Akiva & Lerman, 1985). Nevertheless, a researcher cannot ignore totally economically undescribed behaviours: perceptions, personal feelings and attitudes may be complementary to explain and predict travel behaviour (Wedel & Kamakura, 1998).

A lot of researches on travellers' preferences have reported that internal and external factors affect choices of transport modes, changing the perception of the alternatives. For instance, general attitudes, travel experiences and emotions are relevant to explain travel behaviour (Handy, Weston, & Mokhtarian, 2005) (Sheller & Urry, The 'new mobilities' paradigm, 2006).

Therefore, the definition of travellers' profiles based on psychological and sociological variables could allow the implementation of new policies, each one tailored on a different group (Pronello & Camusso, 2011).

The next sections propose an analysis of the main publications on travel behaviour and a literature review of the most relevant psycho-social variables used to describe behaviour. At the end of this chapter, the most important market segmentations based on travel behaviour in the study area are described.

## 1.1. Travel Behaviour, how approach to use it?

Socio-demographic attributes have been the main factor used to describe the travel behaviour. However, recently perceptions, attributes and individuals' personality have been taken into account to predict it.

Among the first researchers employing perceptions and attitudes to provide a travellers' segmentation, there are Pas and Huber (1992): they studied the rail commuters, classified in groups in function of their willingness to change travel behaviour. This analysis is focused on one specific user typology, while a first study about dynamics behind transport mode choice under a sociological point of view was carried out by Jensen in 1999. She examined influences of attitudes and perceptions on the travellers' behaviour. Her results are summarised in six clusters, defined by information collected through 20 in-depth interviews: the passionate car drivers; the daily life car drivers; the leisure time car drivers; the wholehearted cyclist/public transport users; the cyclist/public transport users of convenience; the cyclist/public transport users of necessity.

Next researches deepened the travel behaviour under psychological and sociological point of view, and psychological behaviour theories began to be used into the transport sector. For instance, the commuting modal choice was studied through the most common behaviour theories by Wall et al. (2007, 2008): the Theory of Planned Behaviour (TPB) (Ajzen, From intentions to actions: A theory of planned behavior, 1985) and Norm Activation Theory (NAT) (Schwartz S. , 1977).

The Norm Activation Theory, originally proposed by Shalom Schwartz, states that an individual to respect a norm needs two conditions. The first is *awareness of consequences*: she/he is aware about good/bad consequences of own actions. The second is *personal responsibility*: when person believes to have a own responsibility to the issue. To take a moral decision, the awareness of consequences and the personal responsibility are necessary, but not sufficient.

The Theory of Planned Behaviour considers travel behaviour function of perception of social norms, attitudes and perceived behaviour control. The definition of attitudes could be negative (or positive) beliefs (or evaluations) about something which may affect behaviour. Behavioural, cognitive and affective components are typically included by attitudes (Parkany, Gallagher, & Viveiros, 2004). Studying people's attitudes could provide a valuable, but not infallible, way to predict their behaviour, because intentions to act seem to be influenced by attitudes, but behaviour remains constrained by context and circumstances (Ajzen & Cote, Attitudes and the prediction of the behaviour, 2008).

The NAT is more based to altruistic behaviour and moral considerations, while the TPB theory is more linked to attitudes and behaviour.

For instance, the car use of students going to university can be affected by some aspects which change attitudes, subjective norms and perceptions of behavioural control (Bamberg & Schmidt, 2003). If the conditions are constant over time, the past travel choice becomes an important factor to predict travel behaviour. Indeed, habits provide a huge contribute to explain people's modal choice, but also other features appeared significant. A noteworthy influence on the intention to use private car is provided by perceived personal characteristics of this transport modes (e.g. flexibility, less stressful, etc.). The habit influences less than self-generated and perceived external social expectations the intention to go by car to university. Probably, adults are less sensitive than young to perceived social expectations, so students can hold more sustainable behaviours and they show favourable attitudes to change their mode of transport.

As already stated, knowing behavioural mechanism allows to decision makers to better foster more sustainable users' modal choices. Indeed, in transport planning the policies do not focus only to instrumental reasons of car use, but various social causes should be taken into account (Steg, 2005). The modal diversion has to face other obstacles, due to personal constraints, like family needs and work typologies.

The change from car to more sustainable transport modes meets also other obstacles, like habits and daily life. Certainly, a rigidity against the change could be caused by the habits, notwithstanding there were favourable context towards a new more sustainable mode of transport. Especially for the everyday trip, the repetition of same mode choice makes gradually very hard to change it (Aarts, Verplanken, & Van Knippenberg, 1998). On the other hand, when there is a disruption of routine (change of work place or home), people are more open to behavioural change (Harms, 2003) (Karash, et al., 2008).

In this research the habit is studied through the analysis of the most important trip during a representative week. From literature and manuals, this usually concerns home-to-work trips or commuting. In addition, in the most important trips, repetitiveness and frequency make travellers' attitudes more important for travel liking than other parameters, which are more tangible (Ory, Mokhtarian, Redmond, Salomon, Collantes, & Choo, 2004). For instance, from analysis of a commuters' sample in Sweden, three attitudes (one towards comfort, one related to eco-friendly and the last related to flexibility) are emerged as most important factors to choose modes of transport (Johansson & Heldt, 2006). In other cases, the results show which features are more relevant to facilitate use of private car as regards public transport: self-esteem, independence, personal security, social image (Ellaway, Macintyre, Hiscock, & Kearns, 2003). For this reason, to foster more sustainable transport, it is necessary that public transport become more comfortable, reliable, appealing and flexible. Otherwise, the other options continue to prevail, because the car like status-symbol is too strong to be defeated only through rational way.

In addition to the psychological contributes, the external factors are complementary elements to fully understand travel behaviour. For instance, the spatial distribution of the origins (e.g. home) and destinations (e.g. work place) influences mode choice (Stradling & Anable, 2008). Also the spatial environment through its residential structure is directly correlated to the choice of transport mode (Meurs & Haaijer, 2001).

However, if public transport supply does not allow efficient transfers, people rarely chose it and they search alternatives, also in the big cities. For example, a comparison among Boston, Los Angeles and Tokyo highlighted that very different parts of metropolitan area are covered by public transport service. The analysis is focused on the number of job places achievable within 30 minutes by PT. In Tokyo the average accessibility to work place is more than six times upper than in two USA cities (Kawabata & Shen, 2006). The public transport supply is clearly an aspect which influences modal choice: it can prompt more car use than PT one, producing very important social inequalities and economic differences among city neighbourhoods.

The PT supply is not always perceived by citizens: people's modal choice is influenced more by their perception about actual PT alternatives than by real presence of these transport services (Hesse & Trostorff, 2000) (Kuhnimhof, Chlond, & Von Der Ruhren, 2006). This aspect is confirmed also in other researches (Pronello & Camusso, 2011) and it is observed to light also in this research.

The relationship between attitudes and behaviour is built on several factors, as shown by literature. Furthermore some latent constructs interact each other, so the behaviour prediction becomes very complicated (Pronello & Camusso, 2011). Then, there is a gap between attitudes and travel behaviour and to explain it a lot of elements have to be taken into account. In particular, various attitudes can induce the same behaviour, because other elements occur, like external context, habit, etc. To overcome the attitudes-behaviour connection, the relationship between behavioural intention and behaviour is proposed (Fujii & Garling, 2003). This new bond is more accurate to predict behaviour because the behavioural intention is based on a commitment towards an action, which is more binding than a slight preference. Anyway, two errors endure: *error of commission* and *error of omission* (Fujii & Garling, 2003). The first error is due to a failure during the choice process: the person does not follow the alternative, declared as the most favourite. This is due to a weak intention, optimism bias, low actual behavioural control and unreal planning of action to perform target behaviour. The second error is when a person does not act as previously (s)he stated. A strong habit or impulsiveness are generally the main causes of this error. In addition, there are also social desirability and strategic responding bias (Pronello & Camusso, 2011), which increase the complexity of the analysis.

## 1.2. Review of psycho-social variables

As already stated in the Introduction, one of the main causes of Greenhouse Gas emissions (GHG) is transport, which is still largely dependent from petrol and other non-renewable resources (International Energy Agency, 2016). This situation has to be faced, so that transport will be converted to consume sustainable sources. In the same time, mobility has to continue to improve accessibility to work places, shopping and leisure activities, etc. without decreasing of quality of life.

To reach these two opposite goals a change of transport policy paradigm is necessary: from car use to PT and soft modes. To this end, a deeper knowledge about transport mode choice from a socio-psychological perspective could allow transport policy to be more efficient (Pronello & Gaborieau, 2018).

Several behavioural theories are developed since the 90's by social and environmental psychological researchers and they are applied to transport to describe modal choice as much as possible, with high attention to what mechanisms change travel habits towards pro-environment behaviour.

These behavioural theories start from the determinants of transport mode choice, which are the psycho-social variables considered key-factors in the individual decision process (Pronello & Gaborieau, 2018). In this section a review of the most common determinants of travel behaviour is given, to quantitatively interpret the people's transport choice. More attention is given to those psycho-social variables which explain pro-environment behaviour. In particular, the focus of this review are the reciprocal relationships among the determinants of the travel behaviour.

The decision-making process about the choice of the transport mode is very complex: individual behaviour is influenced by social pressures and psychological states. To stress this point of view, the determinants of modal choice are the psycho-social variables.

When researchers analyse choice of transport mode, they have to face some irrational aspects, like the car dependence or travel habits, which are very hard to explain with logical and rational theories, like economic consumer one. Probably, the explanation of this process has to include also psycho-social variables, which can become key determinants of travel behaviour.

However, understanding the psychological process, that leads individual decision is a hard task. It requires a lot of subjective characteristics that have to describe why people are so diverse. This information is very different, their impacts change during the time with new experiences and they affect at several unconscious levels. However, a classification is proposed in eight classes (Pronello & Gaborieau, 2018):

1. *knowledge and beliefs*, which are not always in agreement with rationality (Hines, Hungerford, & Tomera, 1987);
2. *values*, considered as personal interpretation (even if influenced by social context) of high level concepts: justice, ethics, etc. (Messick & McClintock, 1968) (Schwartz S. H., Universals in the content and structure of values: Theoretical advances and empirical tests in 20 countries., 1992);
3. *worldviews*, seen as own individual vision of the world, based on an unconscious framework (Maslow, 1943) (Inglehart, 1995) (Douglas & Wildavsky, 1982) (Steg & Sievers, 2000) (Sherkat & Ellison, 2007);
4. *norms*, which are defined as direct and objective effects of other people on the individual (Cialdini, Reno, & Kallgreen, 1990) (Ajzen, The theory of planned behviour, 1991);
5. *personality traits*, composed by personality and lifestyles, which determine the decision-making, according to the self-identification process. The personality is a set of individual features and characteristics, while lifestyles are a group of consistent patterns (Allport & Allport, 1921) (Goldberg, 1990);
6. *emotions and personal stories*, considered as grounded private background which shapes sensitive aspects of the behaviour (Carrus, Passafaro, & Bonnes, 2008) (Bamberg, Fujii, Friman, & Garling, 2011) (Chawla, 1999);
7. *attitudes and intentions*, understood as proximal variable of behaviour (Allport G. , 1935) (Ajzen, The theory of planned behviour, 1991);
8. *habits and past behaviours*, even if they cannot be defined as psycho-social variables, their role in this issue are not negligible (Aarts & Dijksterhuis, The automatic activation of goal-directed behaviour, 2000) (Verplanlen, 2006).

The Figure 4, from Pronello and Gaborieau (2018), illustrates the role of these classes: each set of psycho-social variables has a specific contribution in the determination of the behaviour.

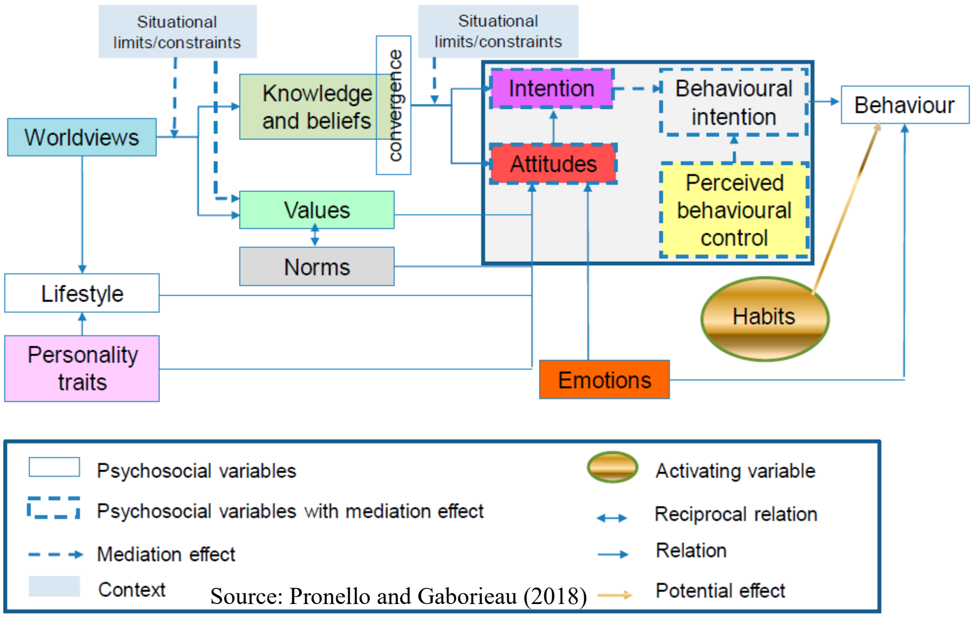


Figure 4 – Role of each variable class in behaviour explanation.

From empirical side, the behaviour exhibits low correlation with *knowledge*, especially between sustainable behaviour and knowledge (Hines, Hungerford, & Tomera, 1987). Knowledge is better correlated with intention, if the situational restrictions are considered (Kaiser, Ranney, Hartig, & Bowler, 1999). The knowledge have various forms, like procedural, declarative or effectiveness, which can increase or decrease its final effects on behaviour (Pronello & Gaborieau, 2018). If they are concurrently convergent (necessary condition, but not sufficient), the knowledge can lead to ecological behaviour (Kaiser & Fuhrer, Ecological behaviour's dependency on different forms of knowledge., 2003). The contribution of knowledge on behaviour explanation is indirect: it is intermediated by intentions and attitudes (Kaiser, Wolfing, & Fuhrer, Environmetal attitude and ecological behaviour, 1999).

Ones of the most significant precursors of attitudes (particularly environmental ones) are the *values*. However, the observed behaviour can be very different, even opposite, from what attitudes suggest, because their contribution is mediated by many other variables, like cultural background (Aoyagi-Usui, Vinken, & Kuribayashi, 2003) and situational limits (Dietz, Stern, & Guagnano, 1998).

As values, also *worldviews* have not a direct contribution to behaviour. They are an overall abstract scheme about cause-effect relation, but the situational limits can affect their role in the individual decision-making. The worldviews participate to shape the knowledge, values and lifestyles. Their influence on attitudes is very weak.

There are two classes of *norms*: personal or social. The first have a huge impact on the behavioural model, but also the social ones play a role. At beginning, norms are social. They come from prescriptive laws and rules of the society. They are internalised when the individual live in a group and (s)he feels accepted, so they become personal norms because (s)he starts to live according to the norms. In this way, the relationships among social norms, personal norms and behaviour are stronger, more the social norms are spread and anchored (Bamberg, Hunecke, & Blobaum, Social context, personal norms and the use of public transportation: Two field studies., 2007).

About *personality traits* a lack of common definition persists (Engler, 2013) and there is not a common method to measure them. However, it is clear that personality traits play an important role to explain individual behaviour and activity patterns (Pronello & Camusso, 2011), although not in a direct way, but through attitudes and *lifestyles*.

The *emotions* can have a direct influence on observed behaviour, also in the case of the modal choice. Indeed if the a certain transport mode is associated to a strong emotion, the choice can be influenced by it. In addition, the role of emotion can be reinforced by cultural and symbolic patterns (Sheller, Automotive emotions feeling the car, 2004) (Steg, 2005).

The *attitudes* are a key element in social psychology. Despite a huge amount of literature, their definition is not always the same and sometimes it is confused with opinions or values (Bergman, 1998) (Fishbein & Ajzen, Attitudes and opinions, 1972). Their definition could be: hidden psychological states of a person, not directly observable, but that can be partially measured by preferences, statements, feelings, etc. (Pronello & Gaborieau, 2018). At the beginning of social psychology, attitudes were believed as predictors of behaviour, but progressively the evidences proved that this relationship was inconsistent (Wicker, 1969). Then, a new variable with mediation effect was introduced: behavioural intention (Fishbein & Ajzen, Attitudes, Intention and Behavior. An Introduction to Theory and Research, 1975). In this way, the observed behaviour is a function of the intention: stronger it is, higher are the possibilities that the predicted behaviour occurs. In addition, to take into account other external factors, the perceived behavioural control is added. It refers to the perceived difficulty to perform the correlated behaviour.

The *habits* are not a social-psychological variable, but they can play a primary role in the decision-making. From a cognitive point of view, when a behaviour is repeated a few times, it becomes habitual and the mental choice process is substituted by recalling past experience, to minimize individual effort and to reduce time response (Aarts, Verplanken, & Van Knippenberg, Habit and infromation use in travel mode choices, 1997) (Verplanken, Aarts, & Van Knippenberg, 1997). In this context, the importance of habits is predominant in some cases, like modal choice in commuting trips.

In transport sector, the analyses so far have included only few psycho-social variables. About some of them the research does not still understand how much they influence travel behaviour (Pronello & Gaborieau, 2018). For instance, in Europe, the knowledge about negative impacts from private vehicle use are widely spread and shared, but it is not sufficient to inspire a modal shift from car to PT or soft modes. Then, in analysis of modal choice decision-making, the convergence of the different kinds of knowledge is more important than large availability of single knowledge.

## 1.3. Profiles in the study area

As detailed and explained in chapter 2, the objective of the research is the definition of a market segmentation only based on attitudes and preferences, not on social-demographic features. In literature there are already some works and publications that provide some methods; in this section one of them is deepened.

In a restricted portion of the study area of this research, in 2011, a travellers' profile definition was carried out by Pronello and Camusso (Pronello & Camusso, 2011). The main results are described in this section to allow a comparison with and possible confirmation from outcomes of this research.

The aim of this previous study is to understand the role of attitudes on the travel behaviour in Alessandria, a city located of north-west of Italy. This scope is reached through a methodology summarised in two steps:

- the first is the analysis of attitudinal variables through an Exploratory Factor Analysis (EFA) to find latent constructs;
- the second is the definition of homogenous groups of people, using a Cluster Analysis (CA) on factor scores of the latent constructs.

The data are gathered by a survey and the sample is stratified using age, job status and residential location. The total population of Alessandria was about 85,500 inhabitants and the obtained sample was made up of 690 respondents, corresponding to the 83% of the estimated one. It provides an error parameter at 3% with a 95% interval of confidence.

The EFA provided the latent constructs shown in Table 1. They explain the 87.2% of total variance.

Table 1: **Latent constructs on Alessandria.**

| Factors | Variable Code | Variable Description |
|---|---|---|
| 1. Travel pleasure | funofit | I usually move for the pure liking of travelling |
| | newroute | I usually move to experiment different alternative routes to arrive to the same destination |
| | relax | I usually move to relax |
| | thinkal | I usually move to think, to meditate and to enjoy the loneliness |
| | newplace | I usually move to visit new place |
| | behav | Statement linked to users' personality (e.g. preference to stay at home, travel for need, travel to look for new or other places, etc.) |
| | doactiv | Importance of doing activities during the trip (e.g. reading, listening music, etc.) |
| | landscap | Importance of the pleasantness of the route scenery |
| 2. High time saving desirability | timrem50 | more than 50% travel time reduction |
| | timred50 | 50% travel time reduction |
| | timred40 | 40% travel time reduction |
| | timred30 | 30% travel time reduction |
| 3. Environmental willingness to pay | wtpairpe | WTP to reduce air pollution by 30% |
| | wtpnoise | WTP to reduce noise by 30% |
| 4. Low time saving desirability | notimred | no travel time reduction |
| | timred10 | 10% travel time reduction |
| | timred20 | 20% travel time reduction |
| 5. Mode performance | modefast | I feel it is the fastest and more adequate mode |
| | modecomf | I feel myself more free and comfortable as regards to the other modes |
| | speed | Importance of travel speed |
| | modejdest | The most important thing is to arrive to destination with the used mode |
| 6. Mode pleasure | modeland | I like the connection with landscape it allows |
| | mode_env | I use this mode to respect the environment |
| | modesake | I like driving, going by car (car)/I do not like driving and I prefer the train/bus (train/bus)/1 use this mode to be in form (bike, foot) |

The first factor is labelled "*travel pleasure*" and it mainly measures the general attitudes towards mobility. In particular, this factor tries to evaluate how much people enjoy to travel, experiment new alternative paths, reach new destinations, appreciate the loneliness to travel alone, etc. Respondents who belongs to this cluster travel not only to satisfy a need, but also for a wide set of reasons: enjoyment of a trip, research of variety, curiosity, etc. A similar attribute of travel profile is emerged also in other studies (Mokhtarian & Salomon, 2001).

The second latent construct is named "*high time saving desirability*" and it is related to the specific attitude about willingness to reduce the duration of the most important trip.

*Environmental WTP* is the name of the third factor. It is composed by two different variables, willingness to pay for a decrease of noise pollution and an improvement of air quality in Alessandria.

The fourth factor, "*low time saving desirability*", is similar to the second one because it refers to the same specific attitude: saving time in the most important trip. The difference between the two factors is due to the variables which composed them: the second factor is made up of variables that measure a high willingness to reduce travel time, vice versa the fourth.

The fifth factor is called "*mode performance*" refers to the perception that mode used in the most important trip is the fastest, the most adequate, the most comfortable and provides a sensation of autonomy and independence.

The last factor is named "*mode pleasure*" and it refers to the used mode of transport in the most important trip. This factor explains the satisfaction due to the travellers' connection with landscape and the perceived sustainability of their favourite transport mode.

These six latent constructs become new variables, so their factor scores are computed and a cluster analysis is performed on them. The result is the definition of four clusters.

The firs one is composed by respondents who feel high pleasure when travelling, especially in adventure trips and visiting new places. In addition, for these travellers, the trip is an opportunity to relax, to think and to stay alone. They enjoy the trip and the contact with landscape. They think that trips are not only a derived demand but also a pleasant activity. For these reasons, they are named "*travel pleasure addicts*".

The second is composed by travellers who have very high score on factor "environmental WTP". Then, they are available to spend more to reduce impacts on environment from their trips. For this exceptional characteristic, they are labelled "*paying ecologists*".

The third cluster includes respondents with elevated scores in both factors about time saving. This clear difference from other groups lead to label them as "*time addicts*".

The fourth cluster includes people who do not feel pleasure from travelling and they seek own comfort and speed, without paying attention to time saving or environmental impacts. For this features they are called "*Timeservers*".

These profiles are reported here to be compared with the results of this research in the discussion.

# Chapter 2

# Objectives and Methodology

Greenhouse gas emissions and other externalities related to the transport sector, notably noise and air pollution, continue to grow together with globalisation and the transport demand. Indeed, the transport sector is not sustainable (European Commission, 2011) and changing the paradigm in the transport sector and in mobility practices will be essential to achieve the targeted reduction of 60% of greenhouse gas emission within 2050 (European Commission, 2011). At the same time, commercial transport plays an important role in maintaining the European Community competitiveness in the global market place and personal mobility greatly influences the perceived quality of life.

Achieving the conflicting objectives of sustainability and economic growth is not a trivial task; however, the future transport needs to be coherent with the Sustainable Mobility definition (Black, 1996):

"*Satisfying current transport and mobility needs without compromising the ability of future generations to meet these needs.*"

Transport evolution will require strategic planning, long-period investments in trans-European networks and on new vehicles. Another complementary way to reach same goal is to promote the Integrated Mobility, notably for metropolitan areas. Briefly, Integrated Mobility means to connect all transport modes among them to create a single multimodal network. From this perspective, the travel can be a trip chain, composed by different and several means of transport.

Building an integrated mobility has several positive consequences as regards the aforementioned issues: it requires lower investments, it has immediate impacts and it allows to optimize networks and infrastructures already built. On the other hand, the integrated mobility has one main drawback: it needs a change of traveller habits. To this end, to promote and support the integrated mobility, it is needed to know:

- how traveller attitudes towards transport influence travel behaviour and modal choice;
- what are the main barriers hampering the integrated mobility.

The aim of this research is to try to answer to the above points, while the two objectives are:

1. to analyse and understand the influence of attitudes in the transport mode choice. More in details, included in the first objective, the research aims to update the General Ecological Behaviour questionnaire (GEB) (Kaiser & Wilson, Assessing People's General Ecological Behavior: A Cross-Cultural Measure, 2000) and to test different behavioural models (Gaborieau, 2016)
2. to find the most relevant obstacles which causes a gap between intention to perform an intermodal trip and real behaviour.

The final goal is to propose some guidelines to overcome the aforementioned barriers and how to export the interventions found so far to other contexts.

The next sections present the methodological approach defined to answer to the research questions and, in detail, the different steps of the methodology, as follows:

1. definition of study area;
2. survey design;
3. survey administration;
4. data analysis design.

## 2.1. Definition of the study area

The study area is formed by the Piedmont region, located in the North-West of Italy, (red area in Figure 5). The region borders on Liguria on the South, on France on the West, on Valle d'Aosta and Switzerland on the North and on Lombardia and Emilia-Romagna on the East. The region capital is Torino.

Figure 5 – Piedmont region in Italy.

The surface of Piedmont region is around 25,400 square kilometres. In Piedmont, the Alps are placed on the borders on West and North. On the South there are the hills: Langhe, Roero and Monferrato. In the centre and on East, there is the West sector of Padania Plain (Figure 6).

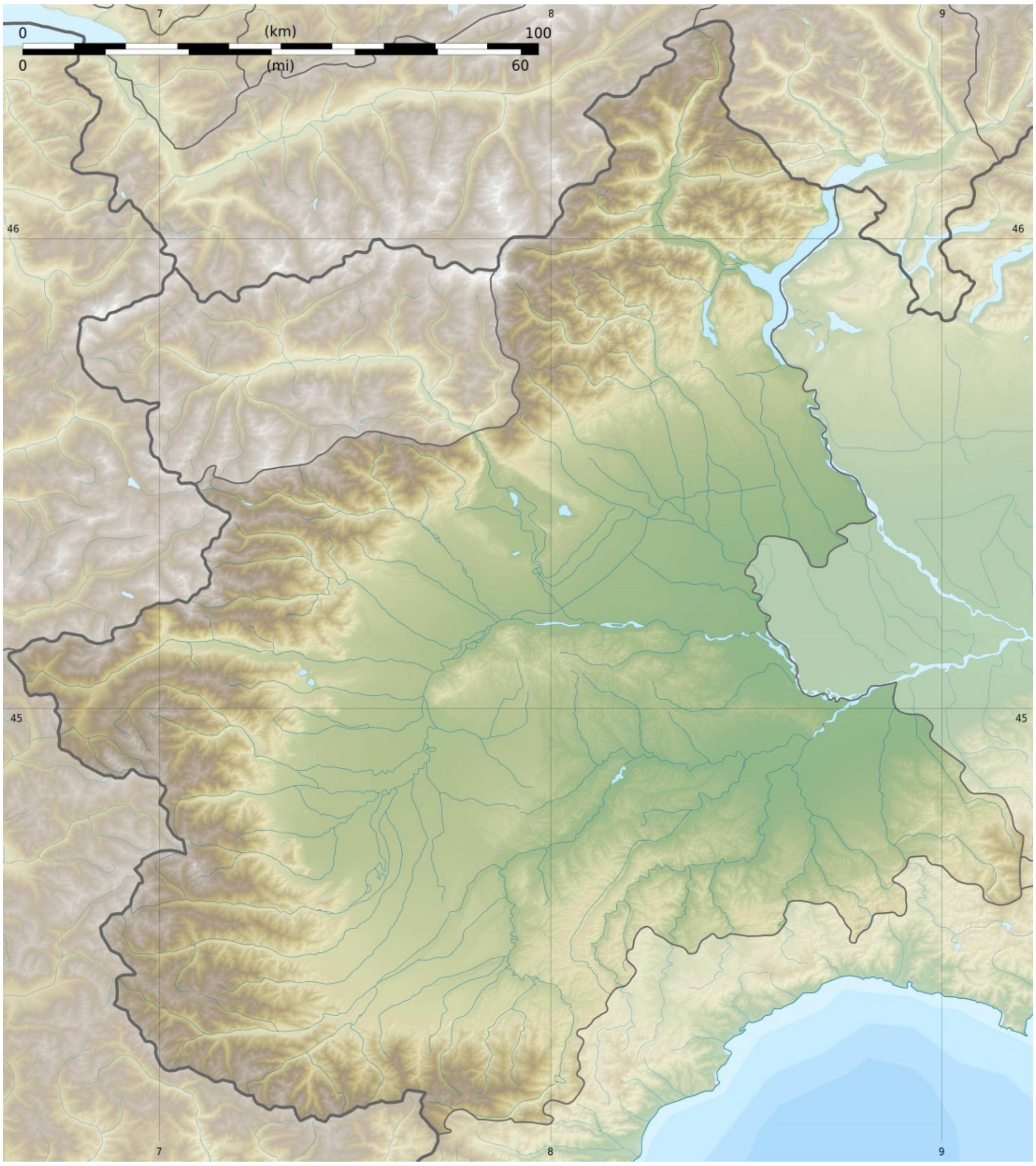


Figure 6 – Physical map of Piedmont

The population living in Piedmont is about 4,400,000 inhabitants[1], almost the 7.2 % of the Italy inhabitants, as reported in Table 2. Women overcomes men both in Italy and in Piedmont, but in the study area the difference is higher than in the country: 3.8% in Piedmont versus 3.4% in Italy.

Table 2: **Distribution of population in the study area.**

| | Population | | |
|---|---|---|---|
| | **Men** | **Women** | **Total** |
| **Piedmont** | 2,104,988 (48.2%) | 2,258,928 (51.8%) | 4,393,916 (100% / 7.2%) |
| **Italy** | 29,229,148 (48.3%) | 31,228,761 (51.7%) | 60,457,909 (100% / 100%) |

The population of the study area has been analysed according to the following variables:

1. residential location (metropolitan, suburban and rural area)
2. gender;
3. age;
4. income;
5. level of education;
6. household size;
7. work force and unemployment rate;
8. university students;
9. used mode of transport;
10. owned cars.

Data come from ISTAT Warehouse[2] and they were collected in 2011, for Italian National Census.

### 2.2.1. Residential location

The population is spread in irregular way over the area: the highest density is in Torino and in its suburbs. As depicted in Table 3, the major towns (>30,000

[1] Source web-site of ISTAT Warehouse: http://dati-censimentopopolazione.istat.it/Index.aspx
[2] Idem third note.

inhabitants) are very few (just 19) and they are predominantly located in the sub urban area.

Table 3: **Major Towns of Metropolitan area in Piedmont.**

| Area | Town | Inhabitants [/1000] | Area | Town | Inhabitants [/1000] |
|---|---|---|---|---|---|
| Capital | Torino | 872 | Province seat | Alessandria | 89 |
| Suburbs | Chieri | 36 | | Asti | 74 |
| | Collegno | 49 | | Biella | 44 |
| | Grugliasco | 37 | | Cuneo | 55 |
| | Moncalieri | 56 | | Novara | 102 |
| | Nichelino | 48 | | Verbania | 30 |
| | Rivoli | 49 | | Vercelli | 46 |
| | Settimo Torinese | 47 | | **Totals** | **351** |
| | Venaria Reale | 34 | Others | Alba | 31 |
| | Chieri | 36 | | Casale Monferrato | 35 |
| | Collegno | 49 | | Pinerolo | 35 |
| | **Totals** | **1,228** | | **Totals** | **101** |

The maps in Figure 7 and Figure 8 show the positions of these major towns.

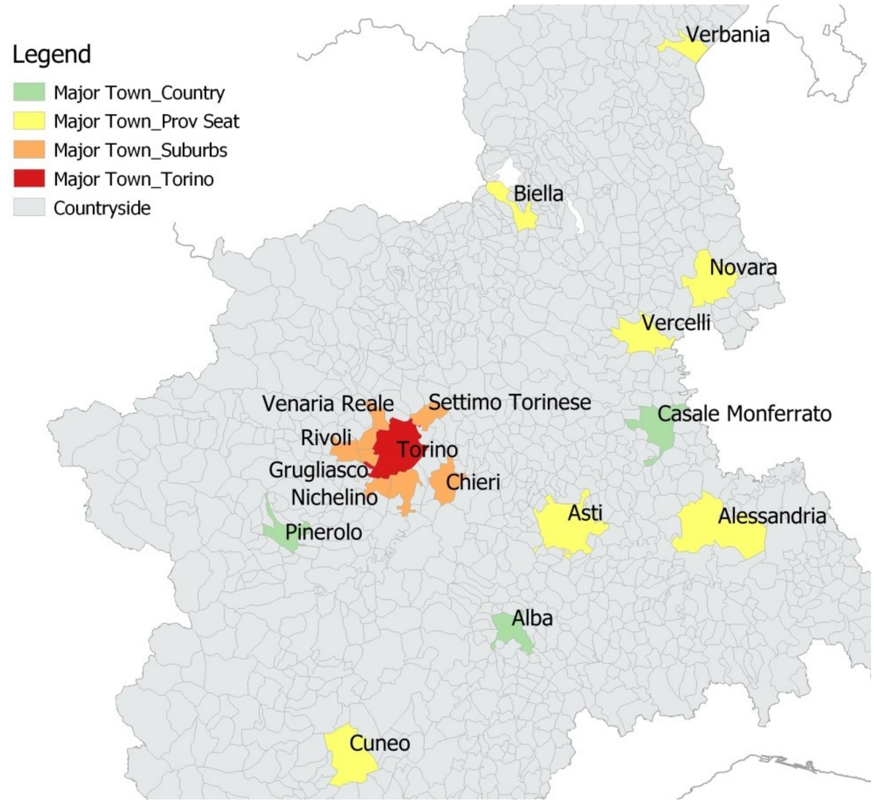


Figure 7 – Major Towns in Piedmont Region.

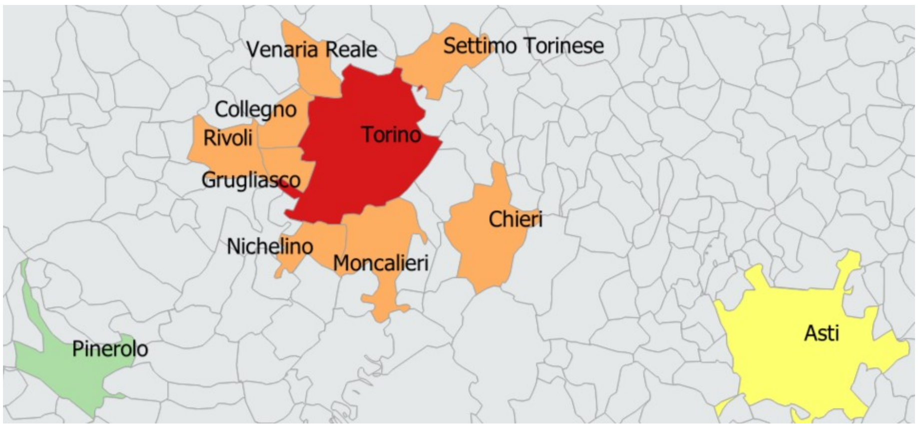


Figure 8 – Focus on Suburban Area.

To taking into account the above conditions, the study area is organised in four sectors with very different densities, as explained in Table 4 and shown in Figure 9.

Table 4: **Homogeneous sectors of Study Area.**

| Sectors | Inhabitants [/1000] | % of Piedmont | Density Mean |
|---|---|---|---|
| Torino | 872 | 20% | 6,710 |
| Suburbs | 554 | 13% | 1,197 |
| Other Major Towns | 541 | 12% | 638 |
| Countryside | 2,396 | 55% | 128 |
| **Piedmont** | **4,364** | **100%** | **157** |

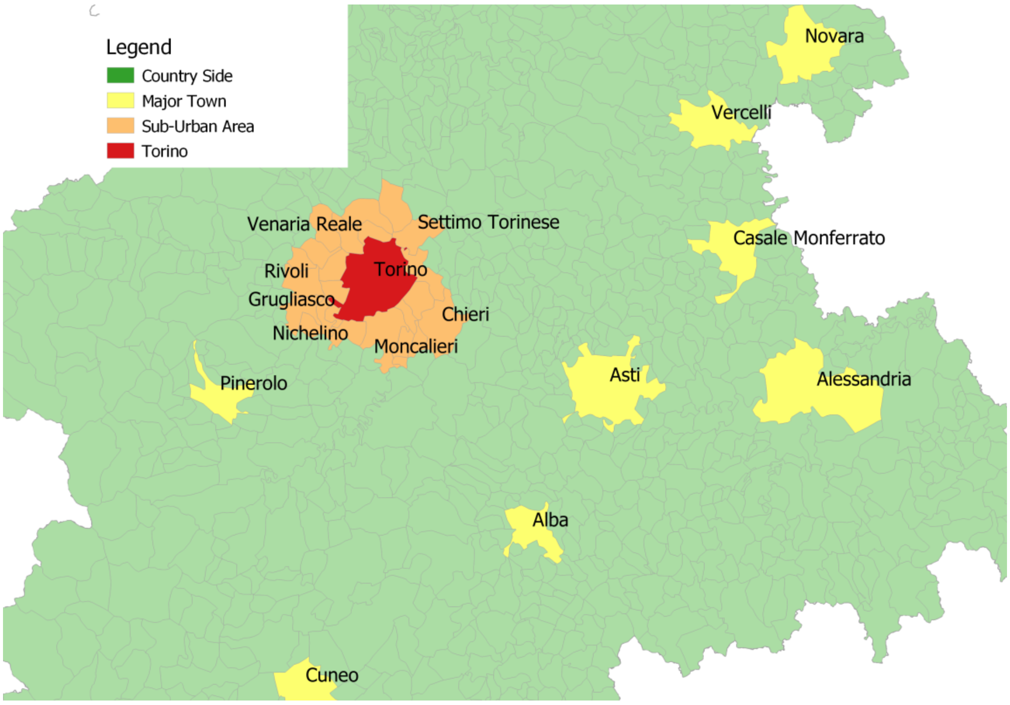


Figure 9 – Sectors over Study Area.

The suburbs and Other Major Towns are composed by the following municipalities:

- Suburbs, 23 municipalities: Alpignano, Baldissero Torinese, Beinasco, Borgaro Torinese, Cambiano, Caselle Torinese, Druento, Leini, Orbassano, Pecetto Torinese, Pianezza, Pino Torinese, Rivalta of Torino, San Mauro Torinese, Trofarello, Chieri, Collegno, Grugliasco, Moncalieri, Nichelino, Rivoli, Settimo Torinese e Venaria Reale;

- Other Major Towns, 10 municipalities: seven Province Seats (Alessandria, Asti, Biella, Cuneo, Novara, Verbania and Vercelli) and three other towns (Alba, Casale Monferrato and Pinerolo).

To confirm this zoning of the Study Area, the density is shown in Figure 10, where it can be observed the maximum density of inhabitants is in *Torino*. Immediately around the Piedmont capital, there are several municipalities with medium-high level, which are included in *Suburbs* sector. In the other municipalities the density is very low, but there are some hotspots, which are called the "*Other Major Towns*".

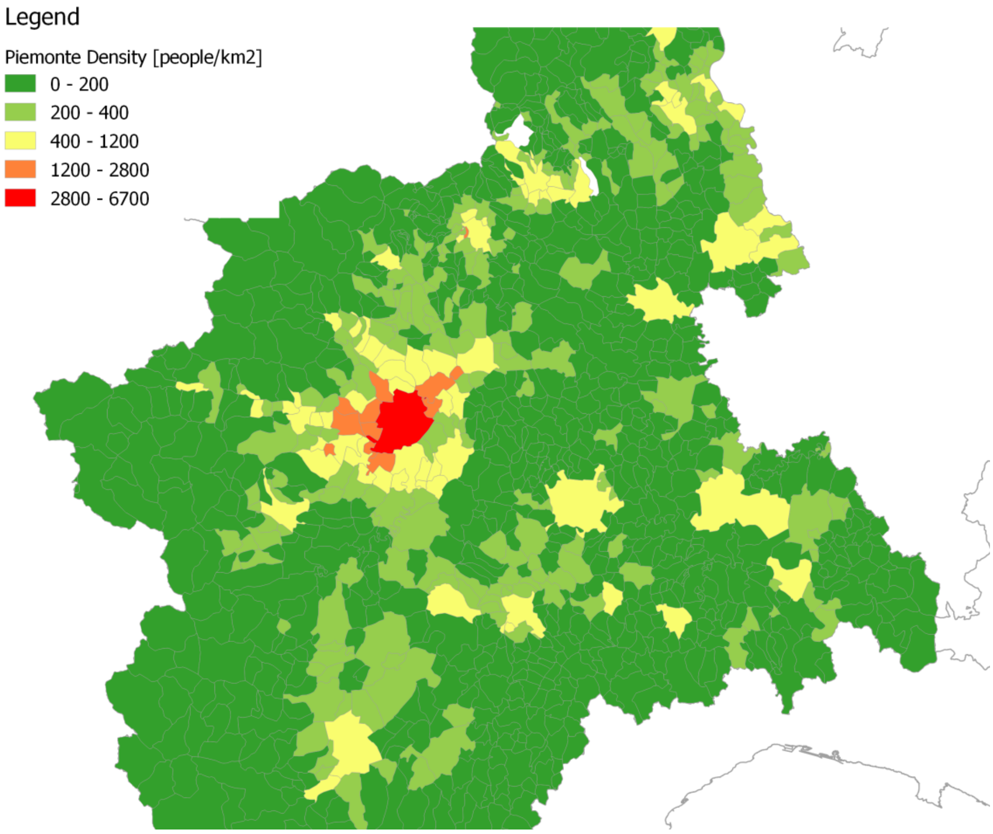


Figure 10 – Density of inhabitants in Study Area.

This zoning of study area is useful to describe the next variables and the sector names will be recalled.

### 2.2.2. Gender

As anticipated in Table 2, the gender distribution in Piedmont is not well balanced. There is a little, but significant, majority of female: 51.8 % versus 48.2 %. Among the different zones of the Study Area, there are some differences, as reported in Table 5. The Countryside shows the highest percentage of males: in this sector there are some municipalities where male percentage exceeds the 50 % (Figure 11), but the females continue to be in majority in the overall average.

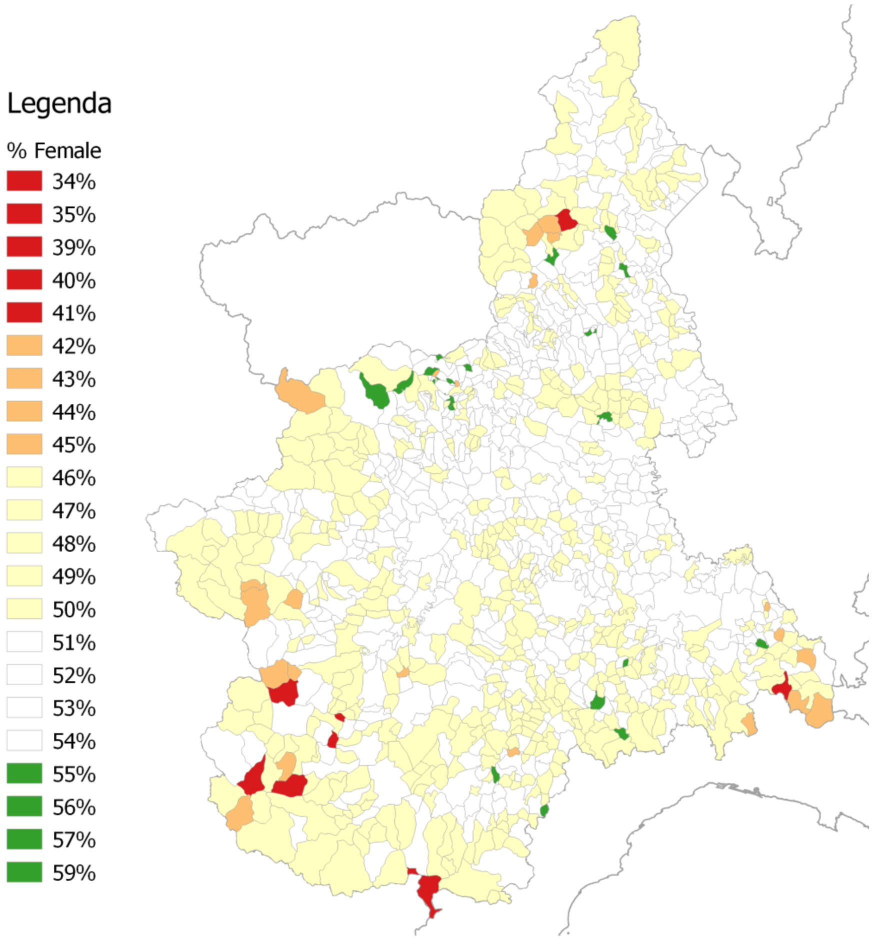


Figure 11 – Female percentage.

Table 5: **Genders distribution of Study Area.**

| Sectors | Inhabitants [/1000] | % of Female | % of Male |
|---|---|---|---|
| Torino | 872 | 52.7% | 47.3% |
| Suburbs | 554 | 51.7% | 48.3% |
| Other Major Towns | 541 | 52.9% | 47.1% |
| Countryside | 2,396 | 51.2% | 48.8% |
| **Piedmont** | **4,364** | **51.8%** | **48.2%** |

### 2.2.3. Age

To study age distribution on the Study Area, some particular age intervals will be used. They are chosen taking account the survey administration: the main components of the sample are university students and work-force people. For this reason, there is focus on age between 18 and 25 years and less attention is paid to children and elderly. The inhabitant distribution is described in Table 6 and Table 7. As it can be observed, there are some differences among the zones. In the cities, like Torino or Other Major Towns, there are less children and more elderly.

Table 6: **Age distribution (count).**

| | Inhabitants [/1000] | | | | | |
|---|---|---|---|---|---|---|
| | Age Classes [years] | | | | | Total |
| **Sectors** | **Under 18** | **18-25** | **26-40** | **41-60** | **Over 60** | |
| Torino | 141 | 38 | 167 | 253 | 274 | 872 |
| Suburbs | 100 | 25 | 102 | 167 | 160 | 554 |
| Other Major Towns | 90 | 25 | 96 | 162 | 168 | 541 |
| Countryside | 417 | 106 | 437 | 717 | 720 | 2,396 |
| **Piedmont** | 747 | 193 | 803 | 1,298 | 1,322 | 4,364 |

Also a spatial analysis confirms results from Table 7: in the large towns there is an higher age average than in the suburbs. Nevertheless, from Figure 12 you could learn that in mountains and in hills this trend is not respected: there are municipalities with the highest age average.

Table 7: **Age distribution (Percentage Across).**

| | Inabitants [%] | | | | | |
|---|---|---|---|---|---|---|
| | Age Classes [years] | | | | | Total |
| **Sectors** | **Under 18** | **18-25** | **26-40** | **41-60** | **Over 60** | |
| Torino | 16.1% | 4.3% | 19.2% | 29.0% | 31.4% | 100.0% |
| Suburbs | 18.1% | 4.6% | 18.4% | 30.1% | 28.8% | 100.0% |
| Other Major Towns | 16.6% | 4.5% | 17.8% | 29.9% | 31.1% | 100.0% |
| Countryside | 17.4% | 4.4% | 18.2% | 29.9% | 30.0% | 100.0% |
| **Piedmont** | 17.1% | 4.4% | 18.4% | 29.8% | 30.3% | 100.0% |

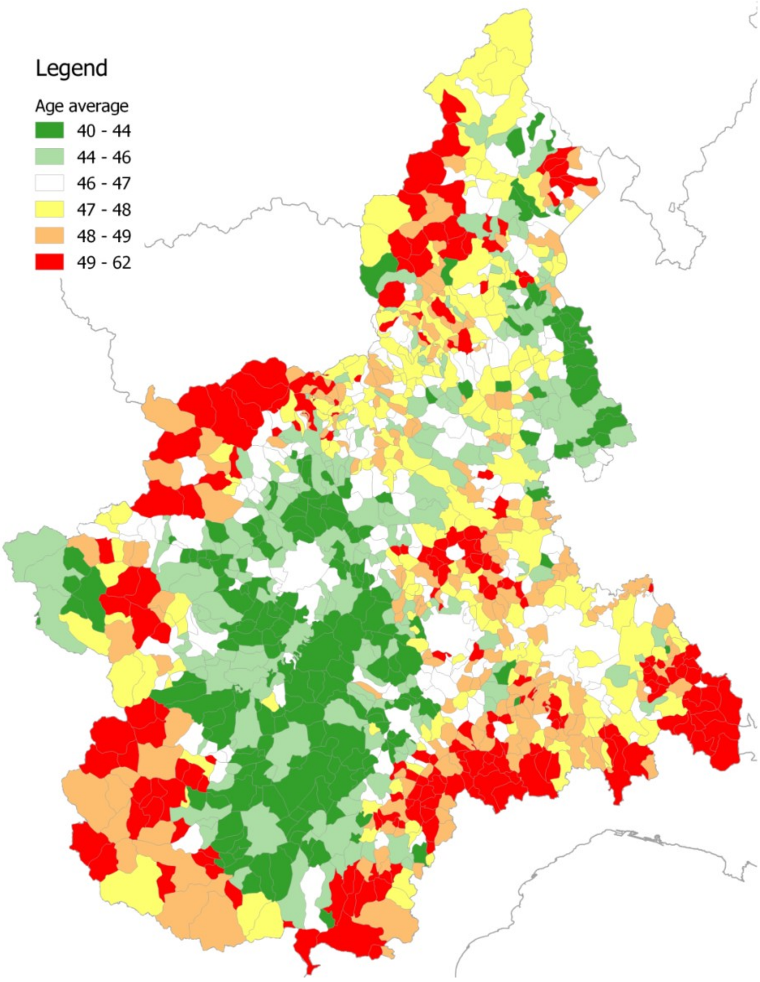


Figure 12 – Age Average on Piedmont.

### 2.2.4. Income

The income distribution is shown in Figure 13. The income is analysed through the income per household (HH). The data are available from I.Stat[3] of ISTAT, updated to 2016. There are some similarities with student percentage, people density, work-force: low incomes are prevalent in mountains and hills. The top values are in Torino and its Suburbs (Table 8). The income per HH mean of whole Study Area is about 33,800 €.

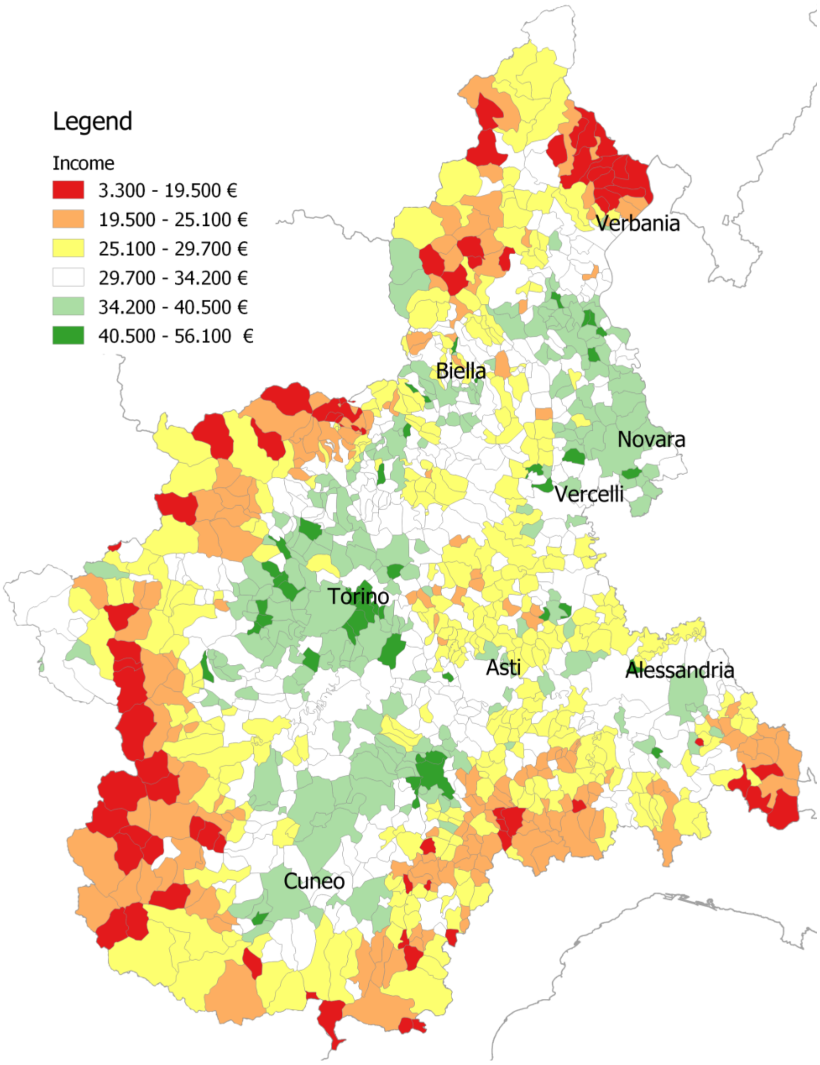


Figure 13 – Income distribution.

[3] http://dati.istat.it/, 24 March of 2019.

Table 8: **Income levels in Study Area.**

| Sectors | Inhabitants [/1000] | Income per HH [€/1000] |
|---|---|---|
| Torino | 872 | 34.8 |
| Suburbs | 554 | 36.4 |
| Other Major Towns | 541 | 34.9 |
| Countryside | 2,396 | 32.5 |
| **Piedmont** | **4,364** | **33.8** |

### 2.2.5. Educational Level

The Educational Level is classified in four categories:

- Primary School or lower Educational Level;
- Secondary School;
- High School;
- Degree or other studies after High School.

There are some differences among sectors of Study Area, as outline in Table 9. First of all, in Piedmont, the majority of population (57%) has the Secondary School or lower Educational Levels. This value increase in the country side, where it reaches 60%. In Torino or in the Major Towns, there are the highest presence of graduates: respectively, +6 % and +2 % regards to the average value in Piedmont. Also observing the High School level, this trend is verified, but it is less evident: Torino has +3% and Major Towns +2%.

Table 9: **Educational Levels in Study Area, percentage about Inhabitants.**

| Sectors | Primary School or lower | Secondary School | High School | Graduates or similar |
|---|---|---|---|---|
| Torino | 24% | 30% | 31% | 16% |
| Suburbs | 26% | 31% | 29% | 9% |
| Other Major Towns | 25% | 28% | 30% | 12% |
| Countryside | 29% | 31% | 27% | 8% |
| **Piedmont** | 27% | 30% | 28% | 10% |

The data presented so far are illustrated in Figure 14 and Figure 15, where the graduate distribution on Piedmont and Primary School or lower one are depicted.

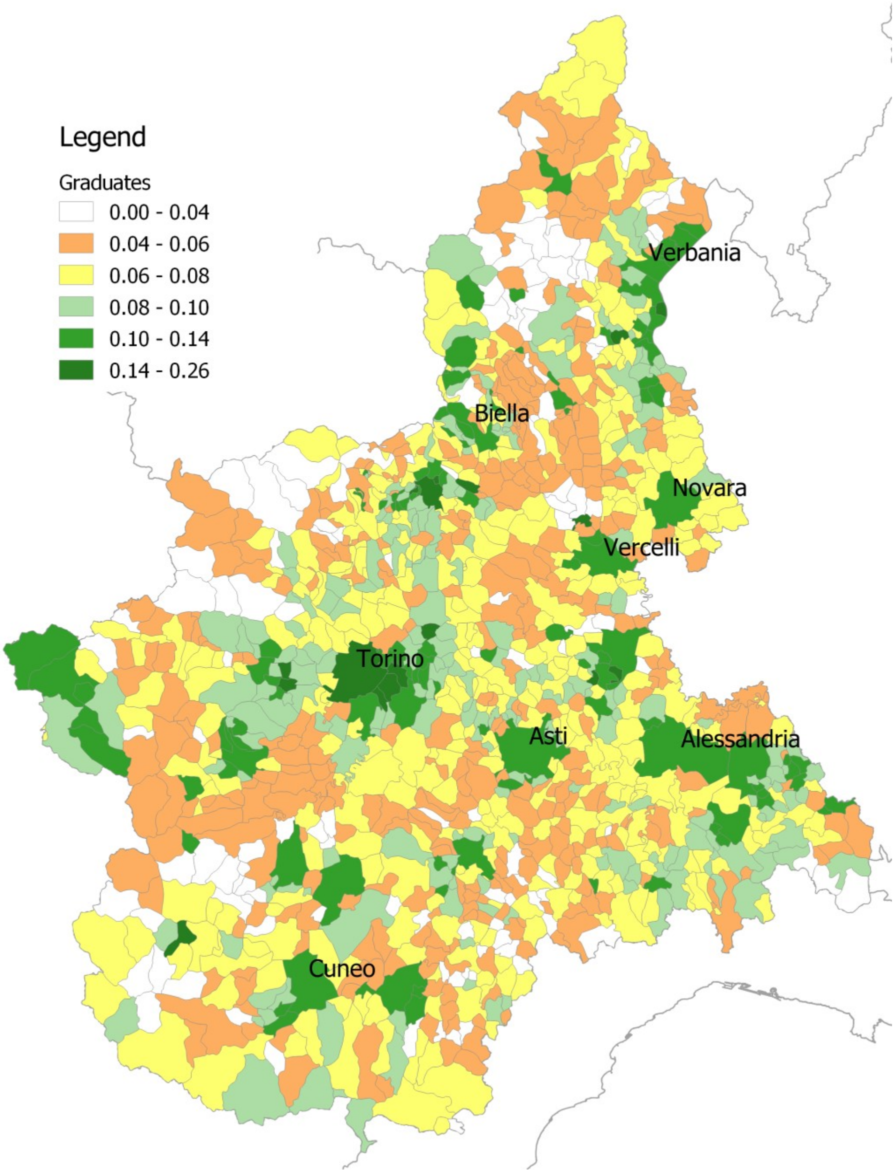


Figure 14 – Graduate Distributions, percentage about inhabitants.

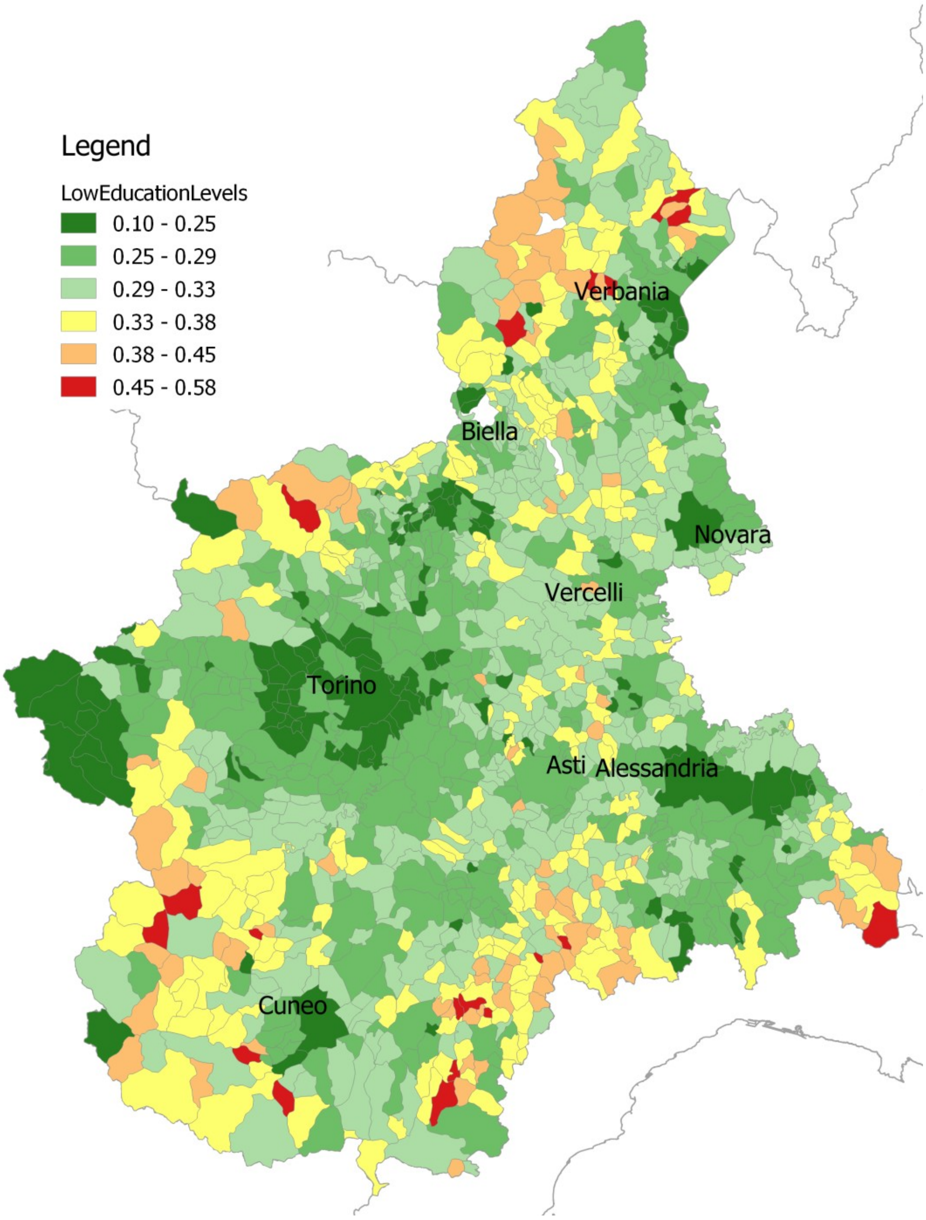


Figure 15 – Low Educational Level Distribution, percentage about inhabitants.

### 2.2.6. Household size

The Size of Households is analysed in five categories, in function of the number of components:

- one member;
- two members;
- three members;
- four members;
- more than four members.

Similarity to Educational Level, there are some differences among sectors of Study Area, as represented in Table 10. First and foremost, in Piedmont the majority of household (64.7%) is made up by one or two components. This value increases in the big cities like Torino and Other Major Towns, respectively +5.5% and 1.9% as regards the Piedmont average. The sector with the most important presence of large households (more than two components) is Suburbs, with +4.3%. In the countryside there are the highest percentage of household with more than four members: 3.9% vs 2.8% of Torino.

Table 10: **Household Size in Study Area, percentage about their totals.**

| Sectors | 1 member | 2 members | 3 members | 4 members | More than 4 members |
|---|---|---|---|---|---|
| Torino | 40.3% | 29.9% | 16.7% | 10.3% | 2.8% |
| Suburbs | 27.7% | 32.7% | 21.6% | 14.9% | 3.1% |
| Other Major Towns | 36.0% | 30.6% | 18.5% | 11.4% | 3.5% |
| Countryside | 33.2% | 29.8% | 19.8% | 13.3% | 3.9% |
| **Piedmont** | **34.4%** | **30.3%** | **19.2%** | **12.6%** | **3.5%** |

In Figure 16 it can be observed that the trends in Table 10 are confirmed, but the map adds some information about countryside. In the mountain and hill areas, there are few large household and in those zones the lowest percentages are recorded.

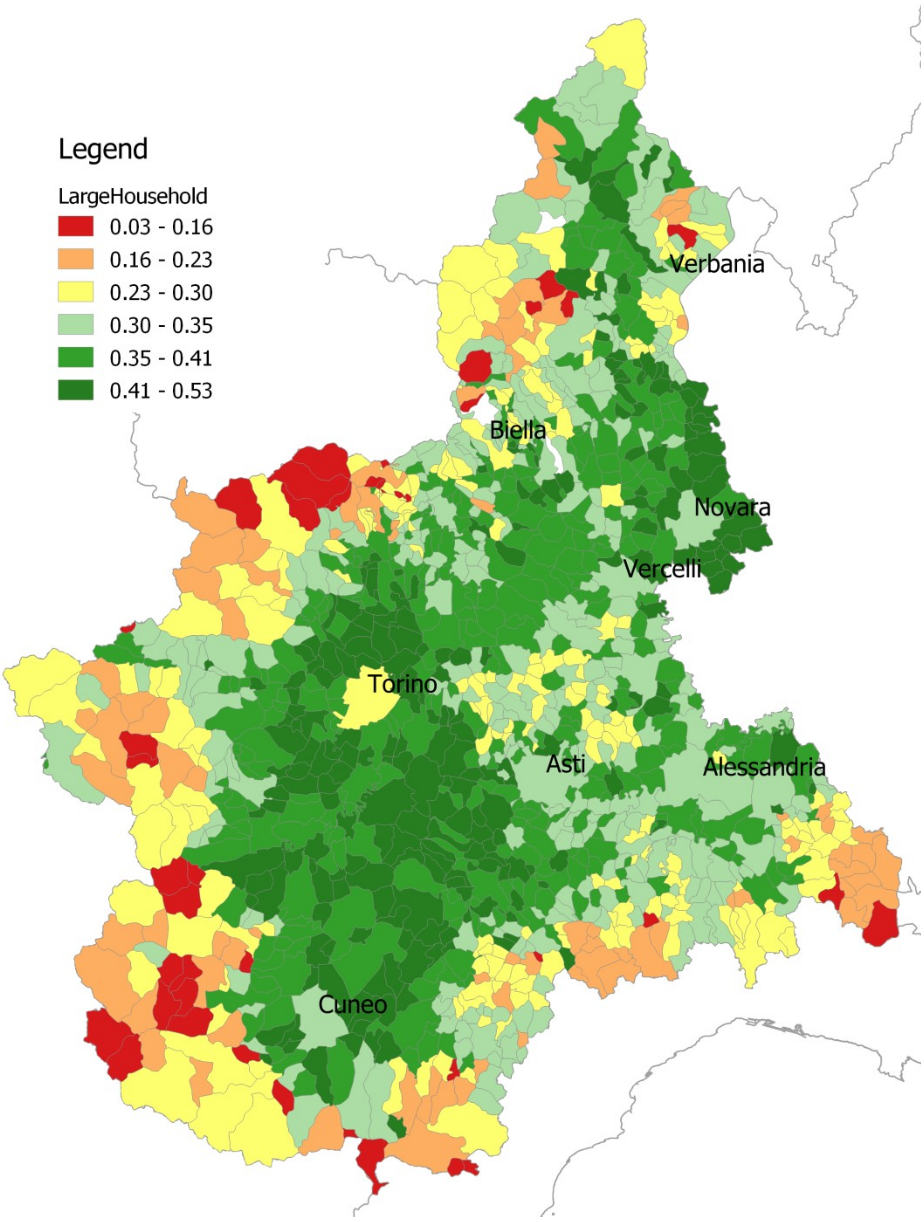


Figure 16 – Large Household percentage distribution on Study Area.

### 2.2.7. Work Force and Unemployment rate

The Work Force distribution is correlated to Inhabitants density, as it can be seen comparing Figure 17 and Figure 10.

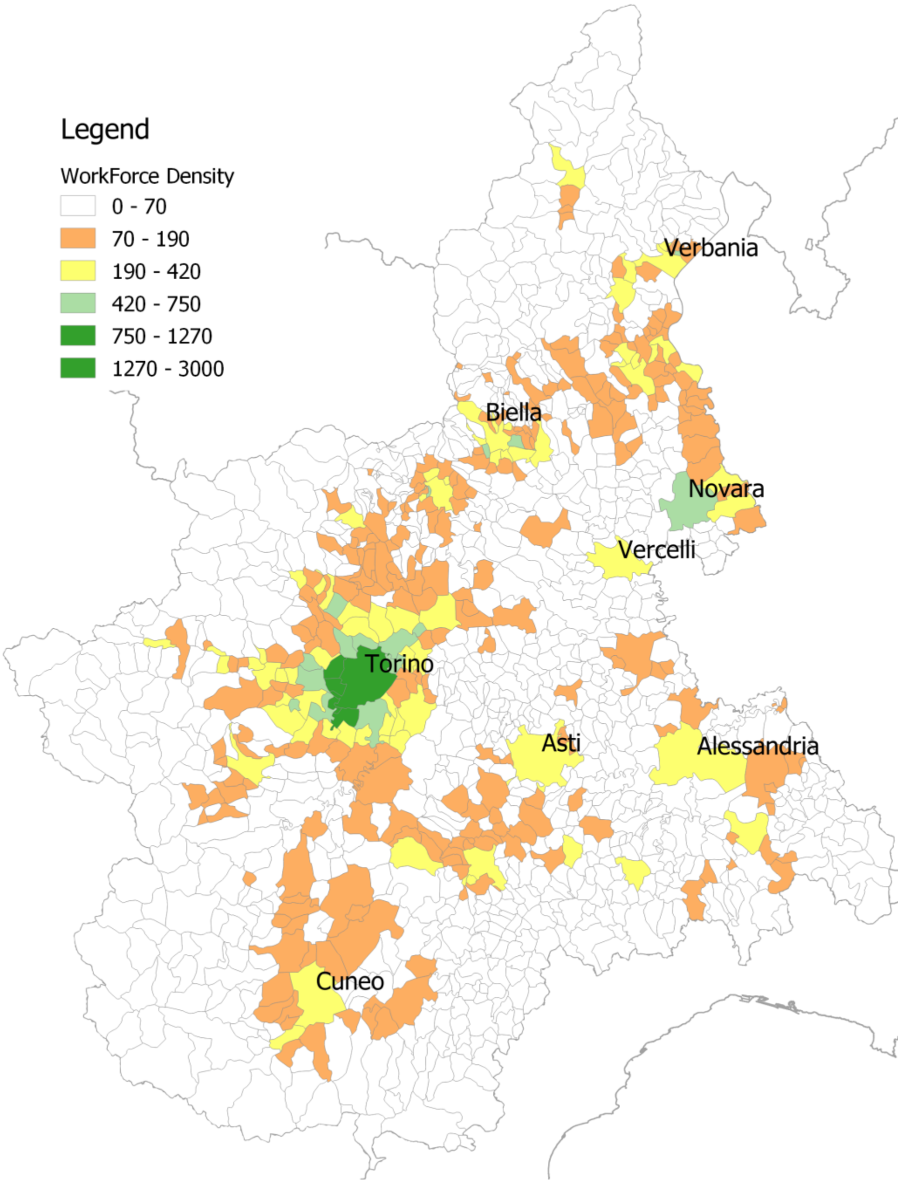


Figure 17 – Work Force Density distribution.

In percentage, work force is higher in Suburbs (+1.0% above the average) and Major Towns (+0.5% above the average) than Torino and Countryside, as reported in Table 11. Anyway, the Work Force in all sectors is less than 50%.

The Unemployment rate, instead, shows the highest value in Torino (+2.1 % above average), in the Major Towns (+1.3 % above average) and in Suburbs (+1.0 % above average), as explained in Figure 18 and in Table 11.

Table 11: **Work Force and Unemployment Rate in Study Area.**

| Sectors | Inhabitants [/1000] | Work Force [/1000] | % about Inhabitants | Unemployed [/1000] | % about Work Force |
|---|---|---|---|---|---|
| Torino | 872 | 390 | 44.7% | 28 | 7.2% |
| Suburbs | 554 | 253 | 45.8% | 17 | 6.1% |
| Other Major Towns | 541 | 245 | 45.3% | 16 | 6.4% |
| Countryside | 2,396 | 1,095 | 44.8% | 60 | 5.0% |
| **Piedmont** | **4,364** | **1,983** | **44.8%** | **121** | **5.1%** |

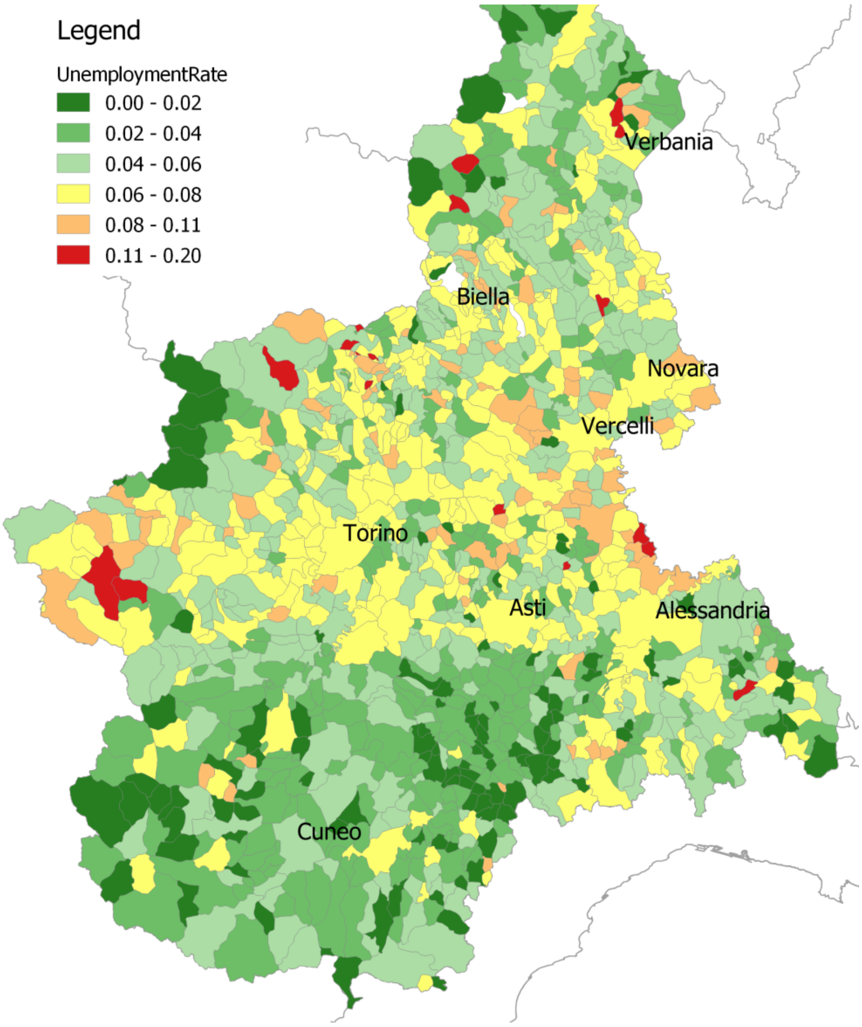


Figure 18 – Unemployment Rate Distribution.

### 2.2.8. University Students

The majority of survey respondents is composed by university students. For this reason, in Figure 19 and in Figure 20, the distribution of university students on Piedmont or in Torino and Suburbs is depicted. The highest percentages of students are recorded in Torino, in its suburbs and in some province zones, while very low presence is observed in mountains and hills, as described also in Table 12.

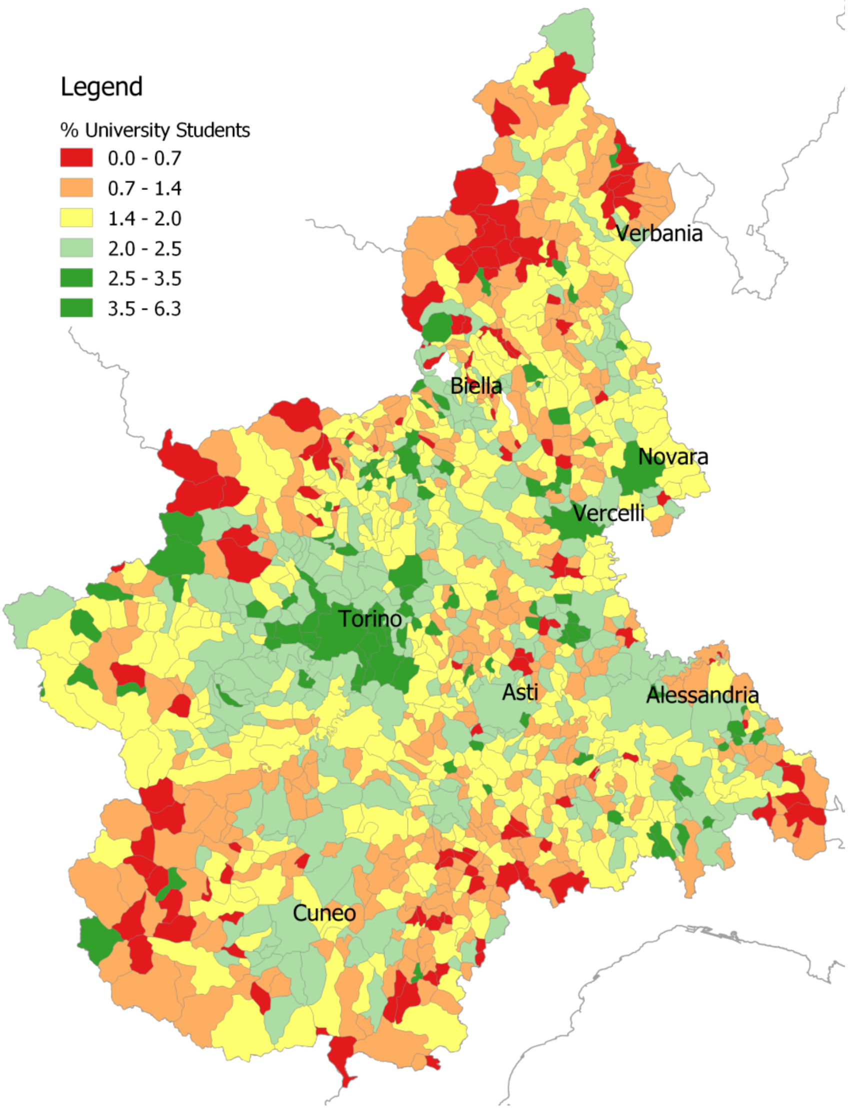


Figure 19 – Percentage distribution of University student.

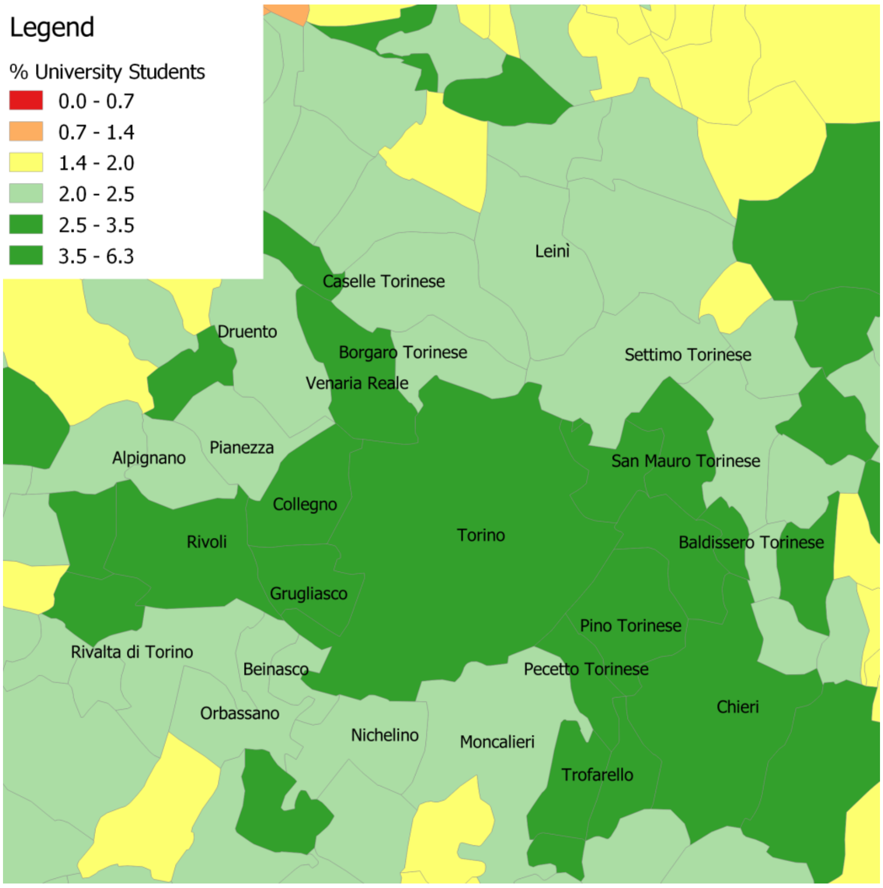


Figure 20 – Percentage of university students in Torino and Suburbs.

Table 12: **University Student in Study Area.**

| **Sectors** | **Inhabitants [/1000]** | **Univ. Students [/1000]** | **% about Inhabitants** |
|---:|:---:|:---:|:---:|
| Torino | 872 | 23 | 2.60% |
| Suburbs | 554 | 14 | 2.50% |
| Other Major Towns | 541 | 13 | 2.30% |
| Countryside | 2,396 | 45 | 1.70% |
| **Piedmont** | **4,364** | **94** | **2.16%** |

### 2.2.9. Used Modes of Transport

The Modes of Transport evaluated by ISTAT warehouse are aggregated as defined in Table 13.

Table 13: **Aggregation of Transport Modes.**

| Mode of Transport | Code | Classes |
|---|---|---|
| Private car, as driver | 7 | Private Vehicle |
| Private car, as passenger | 8 | |
| Motorbike, moped, scooter | 9 | |
| Train | 1 | Public Transport |
| Tram | 2 | |
| Underground | 3 | |
| Urban Bus | 4 | |
| Extra-urban Bus | 5 | |
| Countryside | 6 | |
| Bycicle | 10 | Soft Modes |
| On Foot | 12 | |
| Other | 11 | Other |

The analysis is specified for gender and trip purpose (school or work), to investigate the differences. In this section, the students are those referred to all level of education, not only university.

In Table 14, the transport modes used by the students are described. It can be observed that there are more female PT users (+2%) than male ones, but on soft modes male students are more (+2%) than female ones. Between Torino and the rest of the Study Area, there is a very strong difference in private vehicle use (around 17%). In the Other Major Towns soft modes are used more than in Suburbs and Countryside. For this reason, concerning the soft modes the Other Major Towns are very similar to Torino.

Table 14: **Students' used modes of transport.**

| Sectors | Private Vehicle | Public Transport | Soft Modes |
|---|---|---|---|
| | | **Female** | |
| Torino | 26% | 36% | 38% |
| Suburbs | 45% | 29% | 26% |
| Other Major Towns | 45% | 22% | 33% |
| Countryside | 46% | 34% | 21% |
| **Piedmont** | **42%** | **32%** | **26%** |
| | | **Male** | |
| Torino | 28% | 33% | 39% |
| Suburbs | 46% | 26% | 28% |
| Other Major Towns | 45% | 20% | 35% |
| Countryside | 46% | 32% | 22% |
| **Piedmont** | **43%** | **30%** | **28%** |

In Table 15, the transport modes used by workers are described. There are more gender differences: +8% for male as regards private vehicle use. Like for students, in Torino is private vehicles are less used (around 25%). For workers the favourite alternative to private vehicles are the soft modes, especially in Other Major Towns (+17% for female and +11% for male).

Table 15: **Workers' used modes of transport.**

| Sectors | Private Vehicle | Public Transport | Soft Modes |
|---|---|---|---|
| | | **Female** | |
| Torino | 47% | 35% | 18% |
| Suburbs | 74% | 15% | 11% |
| Other Major Towns | 65% | 9% | 26% |
| Countryside | 77% | 5% | 17% |
| **Piedmont** | **69%** | **13%** | **18%** |
| | | **Male** | |
| Torino | 66% | 19% | 14% |
| Suburbs | 83% | 8% | 8% |
| Other Major Towns | 75% | 7% | 18% |
| Countryside | 80% | 4% | 14% |
| **Piedmont** | **77%** | **8%** | **14%** |

The previous tables are confirmed by spatial analyses reported in Figure 21 and Figure 22.

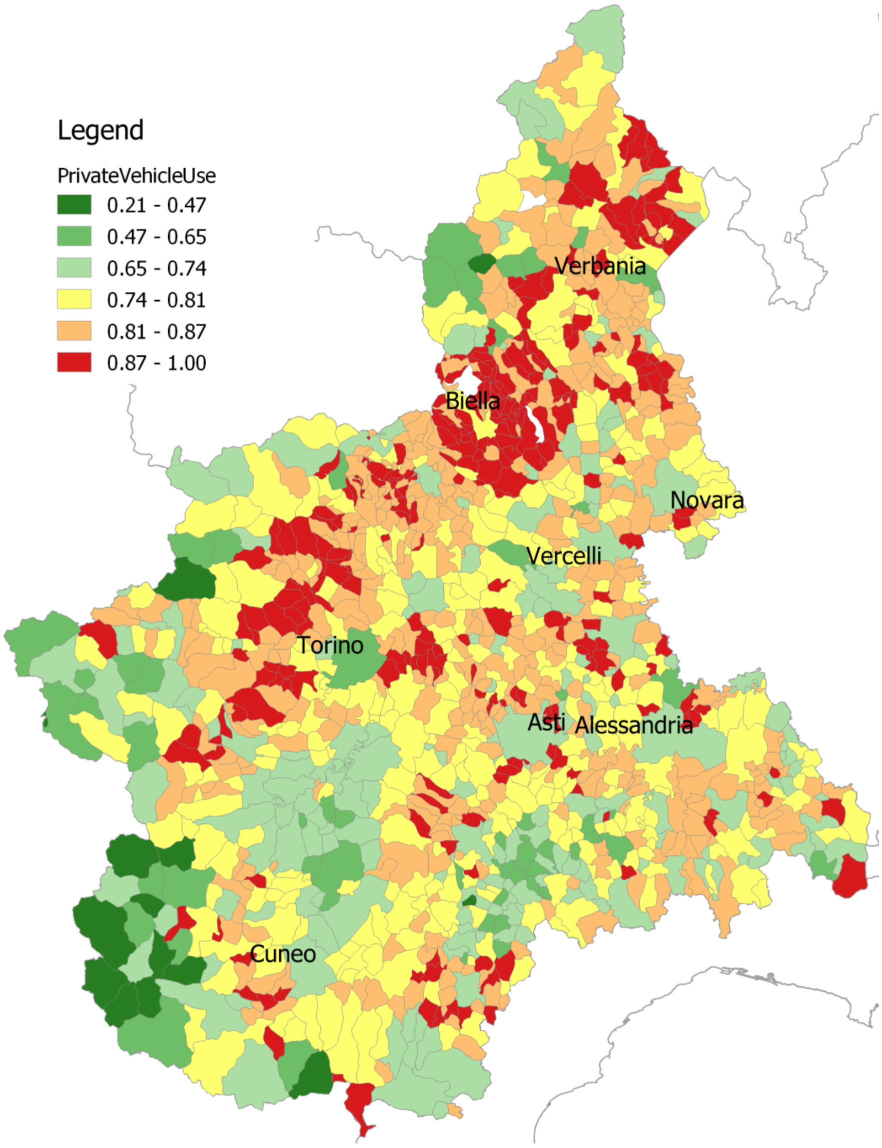


Figure 21 – Private Vehicle use in Piedmont.

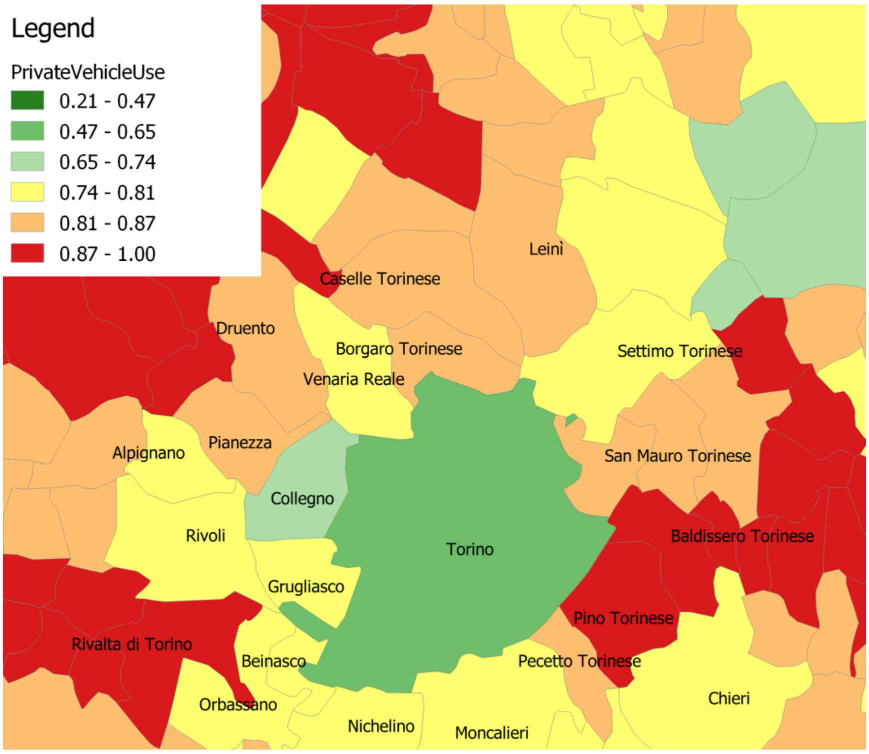


Figure 22 - Private Vehicle use in Torino and Suburbs.

### 2.2.10. Owned Cars

The number of owned cars is almost homogeneous in the Study Area (Table 16). 1,137 municipalities about 1,206 (around 94% of total) are included between 0.56 and 0.80 cars per capita. The most important differences are refer to areas in extreme positions, like high mountains and hills (Figure 23). Among the most populated municipalities, there is an increase of cars per capita in zones with scarce public transport supply and far from Torino and Other Major Towns.

Table 16: **Average of owned cars per capita.**

| **Sectors** | **Inhabitants [/1000]** | **Owned Cars [/1000]** | **Cars per capita** |
|---:|:---:|:---:|:---:|
| Torino | 872 | 567 | 0.65 |
| Suburbs | 554 | 353 | 0.65 |
| Other Major Towns | 541 | 356 | 0.67 |
| Countryside | 2,396 | 1603 | 0.68 |
| **Piedmont** | **4,364** | **567** | **0.68** |

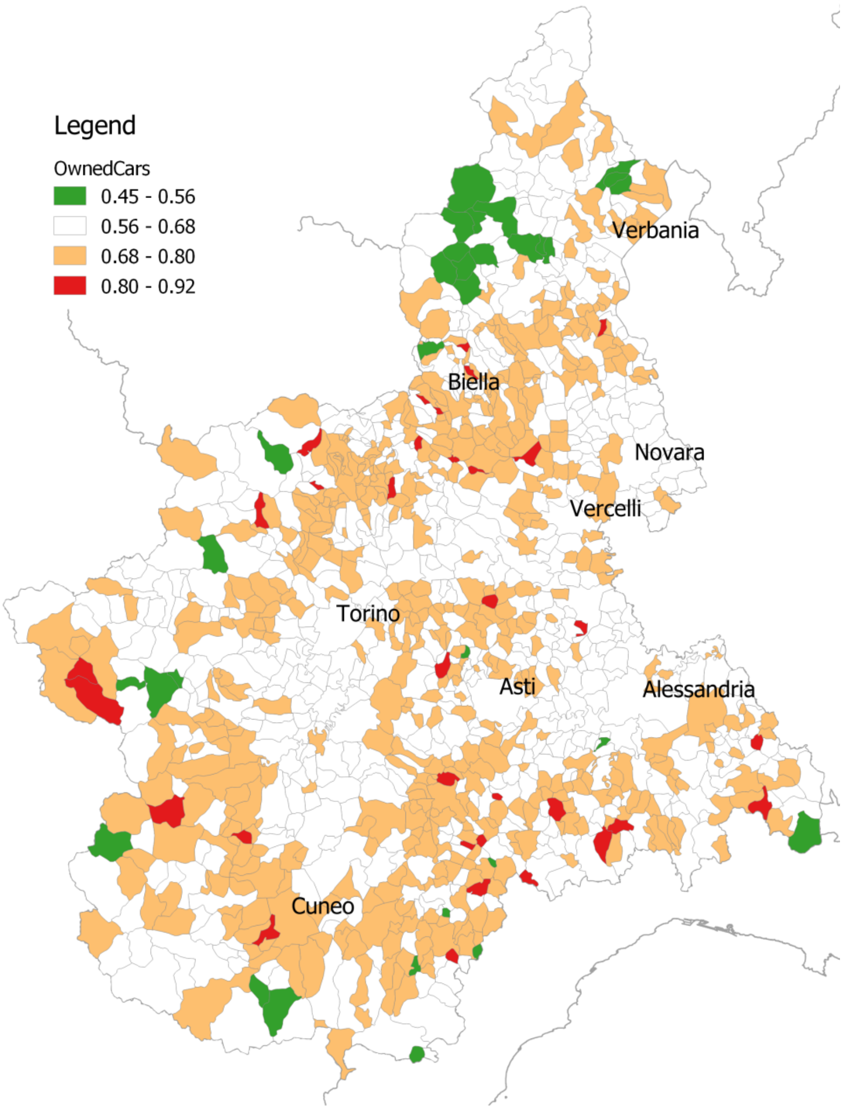


Figure 23 – Owned car per capita.

## 2.2. Survey Design

The survey design phase has been based on a few key decisions: how to collect data, which tools use and what kind of data investigate. This phase is extremely important, because it is the ground of the next steps.

The quantitative approach has been adopted, collecting data through a web-questionnaire aimed to get in depth information related to opinions, intentions, attitudes, lifestyles and preferences. To this end a self-administered web-questionnaire has been designed, named *"Come Ci Muoviamo? …ma soprattutto Come Vorremmo Muoverci?"* (from here on it is reported as "*Come ci Muoviamo*"). "*Come ci Muoviamo*" is composed by two different web-questionnaires. The first includes questions already well established in literature, which can ensure well-grounded comparison. The second one is composed by new questions, derived from recent results from behavioural theories to overcome some gaps observed in previous researches (Gaborieau, 2016) (OPTICITIES, 2014) (Duboz, 2017).

The first section is named *Part A* and it is composed by seven units described in Table 17, while Part B is summarised in Table 18.

Table 17: **The first Web-Questionnaire sections, named Part A.**

| Sections | Description and main questions | N° main questions |
|---|---|---|
| 1° | **Mobility in a Standard week**: trip purposes, the most important one, trip frequencies and used transport means for each trip purpose. | 4 |
| 2° | **Diary of most important trips**: origin and destination, timetables, travelled distance, satisfaction, most used transport modes, past employed transport modes. | 14 |
| 3° | **Integrated mobility**: trip cost, willingness to pay for faster or more ecological travels, major reasons of transport mean choice, knowledge about other transport modes, car parking conditions, activity during the trip, aspire about PT, evaluation of other transport mean use. | 11 |
| 4° | **Mobility as a Service:** car sharing, fair group bought, carpooling, transport service pre-defined packages. | 8 |

| | | |
|---|---|---|
| 5° | **Attitudes and Preferences**: attitude to go out from home, attitudes towards private car, General Ecological Behaviour (GEB). | 3 |
| 6° | **Availability towards research**: voluntary participation to Focus Group, to second web-questionnaire and to know the results. | 3 |
| 7° | **Personal data:** age, income, level of education, job, household size and composition, availability of car, seasonal PT ticket, bike and car sharing subscriptions | 10 |

Table 18: **The second Web-Questionnaire sections, Part B**

| Sections | Short description and main questions | N° main questions |
|---|---|---|
| 1° | **Information about the most important trip**: how information about trip are collected, permanence in intermodal hub, service in intermodal hub, control of meteorological forecast, change of route. | 5 |
| 2° | **Attitudes and preferences**: attitudes to environment and pollution, value of time, cost, security, safety, comfort and technology. | 7 |

The two questionnaires have been in two waves to avoid a single too long questionnaire. The total number of questions is 65, 53 in Part A and 12 in Part B. The Part B is linked to the previous section, so that only who answers to Part A can continue with the second one. To start the Part B, it is necessary to digit own e-mail address recorded at the end of Part A so that the researchers send a personal link to access to Part B and respondent can complete the survey. The key field to connect answers between Part A and Part B is the e-mail address of respondents. The two questionnaires contain 785 variables, as shown in Table 19.

Table 19: **How many variables in the web-questionnaire (Part A + Part B).**

| Type of variable | Number of variables |
|---|---|
| **Categorical** | 365 |
| **Ordinal** | 32 |
| **Interval** | 306 |
| **Ratio** | 82 |
| **Total** | 785 |

The web-questionnaire is designed according to the results of some relevant research projects, as reported below:

- the first two sections about travel diary and weekly mobility are taken from OPTICITIES[4] web-questionnaire;
- the third section about integrated mobility is designed according to previous survey in Alessandria (Italy), in 2011 (Pronello & Camusso, 2011);
- the fourth section is based on the General Ecological Behaviour (GEB) (Kaiser & Wilson, Assessing People's General Ecological Behavior: A Cross-Cultural Measure, 2000) and its modified versions (Gaborieau, 2016), (Duboz, 2017).

The survey design has to face two challenging tasks to reach its goals:

- the evaluation of quality PT services is necessary to study the integrated mobility, then the investigation of the Public Transport Attributes is extremely important. For this reason, in the paragraph 2.2.1 a deep analysis in literature is carried out;
- the object of the paragraph 2.2.2 is the right balance between length of the questionnaire and investigation of all needed information. Indeed, based on the previous results, a reduction of questions is proposed without excluding some themes.

## 2.2.1. Public Transport Attributes

The other main topic to investigate in the questionnaire is what are the most important attributes that Public Transport (PT) should have to be more used.

The evaluation of the quality PT services is a relatively new topic in literature, since the majority of studies are published within the last 20 years (Redman, 2012). Several attributes are proposed to define PT quality and, according to the literature review, they can be categorised as physical or perceived attributes. The physical attributes are marked out without involving PT users, then impacts on PT users can be measured through some assumptions. Instead, the perceived attributes are calculated using directly the PT users' responses (Friman, 2001) or

[4] OPTICITIES, Optimise Citizen Mobility and Freight Management in Urban Environments, is a Research Project founded by European Commission through the Seventh Framework Programme. (www.opticities.com)

indirectly (Balcombe, 2004). The most common physical PT attributes are listed in Table 20 and the perceived ones are shown in Table 21.

Table 20: **The most common Physical Public Transport Attributes.**

| | Attribute | Definition |
|---|---|---|
| **Physical** | **Reliability** | How the actual service follows the timetable |
| | **Frequency** | How often in a certain period the service runs |
| | **Speed** | The time needed to travel for a given distance |
| | **Accessibility** | The degree to which public transport is reasonably available to as many people as possible |
| | **Price** | How much travel costs |
| | **Information Provision** | How much information travellers receive during the trip about route and interchanges. |
| | **Ease of transfers/ interchanges** | How easy transport interchanges are, taking into account time spent waiting |
| | **Vehicle Condition** | The quality of vehicles, including frequency of breakdowns |

Table 21: **The most common Perceived Public Transport Attributes.**

| | Attribute | Definition |
|---|---|---|
| **Perceived** | **Comfort** | How comfortable the journey is (noise levels, air conditioning, driver handling, access to seat, etc.) |
| | **Safety** | How passengers feel during the journey regarding accidents and personal safety |
| | **Convenience** | How simple the PT supply is to use |
| | **Aesthetics** | Appeal of vehicles, stations and waiting areas to travellers' sense |

The main results from the literature review (Redman, 2012) are summarised as follows:

- key traditional quality attributes are: frequency, fare prices and travel speed;
- new quality attribute is the reliability;
- when users are emotionally attached to their cars, the perceived attributes about PT are needed.

According to the above results, "*Come ci Muoviamo?*" includes some questions to better analyse those attributes.

### 2.2.2. GEB: the relevant questions

The amount of collected data is huge and this is valuable for the data analysis, but, on the other side, the two web-questionnaires are very long to be completed, so their design is oriented to reduce, as much as possible, the number of questions.

To limit the tiredness of respondents, the section dedicated to attitudes towards General Ecological Behaviour (Part A) is not the same used in the questionnaires of the previous surveys (Gaborieau, 2016, from now called GB2016) and (Duboz, 2017, from now called DB2017). Indeed, the results of the previous surveys allowed to reduce the number of questions. According to the authors' suggestions, the questions which do not provide sufficient information or which are redundant have not been included in the Part A, as shown in Table 22.

Table 22: **Comparison between the two previous GEB questionnaires.**

| **Question** | **Question code** | **Presence in the questionnaire** | | |
|---|---|---|---|---|
| | | **GB2016** | **DB2017** | **Part A** |
| Sometimes I give money to panhandlers | CS1 | x | x | x |
| From time to time I give money to charity | CS2 | x | x | x |
| If an elderly or disabled person enters a crowded PT vehicle, I offer him/her my seat | CS3 | x | x | x |
| If I were an employer, I would not hesitate hiring a person previously convicted of crime | CS4 | x | x | x |
| If a friend or a relative had to stay in the hospital for a week or two for minor surgery I would visit him or her | CS5 | x | | |
| Sometimes I ride public transport without paying a fare | CS6 | x | | x |
| I would feel uncomfortable if people from another ethnicity were my neighbours | CS7 | x | | |
| I put dead batteries in the garbage | R1 | x | x | x |
| I make use of rechargeable batteries | R2 | x | x | |
| I bring unused medicine back to the pharmacy. | R3 | x | x | |

| Question | Question code | Presence in the questionnaire | | |
|---|---|---|---|---|
| | | GB2016 | DB2017 | Part A |
| I sort paper wastes for recycling. | R4 | x | x | |
| I sort glass wastes for recycling. | R5 | x | x | x |
| I sort plastic wastes for recycling. | R6 | x | x | |
| Before taking a shower, I let the water run so it get to the temperature I want. | AE1 | x | | |
| I prefer to shower rather than to take a bath. | AE2 | x | x | |
| In winter, I keep the heat on so that I do not have to wear a sweater. | AE3 | x | x | |
| I turn off the heat at night. | AE4 | x | x | x |
| I wait until I have a full load before doing my laundry. | AE5 | x | x | x |
| In winter, I leave the windows wide open for long periods of time to let in fresh air. | AE6 | x | x | x |
| I wash dirty clothes without pre-washing. | AE7 | x | x | |
| I use fabric softener with my laundry. | CE1 | x | x | x |
| If there are insects at home, I kill them with a chemical insecticide. | CE2 | x | x | |
| I use a chemical air freshener in my bathroom. | CE3 | x | x | |
| I use specific cleaners for different rooms rather than an all-purpose cleaner. | CE4 | x | x | |
| I use phosphate-free laundry detergent. | CE5 | x | x | |
| I always look to buy vegetables from biological agriculture. | CE6 | x | x | x |
| I re-use plastic bag from the groceries. | RR1 | x | | x |
| I sometimes buy beverage in cans. | RR2 | x | x | x |
| If I am offered a plastic bag in a store, I will always take it. | RR3 | x | x | |
| For shopping, I prefer paper bag to plastic ones. | RR4 | x | x | |
| Usually, I buy water with returnable bottles. | RR5 | x | x | |

| Question | Question code | Presence in the questionnaire | | |
| --- | --- | --- | --- | --- |
| | | GB2016 | DB2017 | Part A |
| I often talk with friends about problems related to the environment. | V1 | x | x | x |
| I am a member of an environmental organization. | V2 | x | x | x |
| I already pointed out to someone his/her un-ecological behaviour. | V3 | x | x | x |
| I sometimes contribute financially to environmental organizations. | V4 | x | x | x |
| Usually, I do not drive my automobile in the city. | T1 | x | x | x |
| I usually drive on freeways at speeds lower than 100km/h. | T2 | x | x | x |
| When possible, I do not use a car for distance lower than 30km. | T3 | x | x | |
| If possible, I do not insist on my right of way and make the traffic stop before entering crossroads. | T4 | x | x | |
| I walk, ride or take public transport to go to work/university | T5 | x | x | x |
| Sometimes, I sell goods which I don't use anymore | CE7 | | x | x |
| Sometimes, I buy second hands goods | CE8 | | x | x |
| Sometimes, I offer goods which I don't use anymore | CE9 | | x | x |
| Sometimes, I accept goods already used from someone who doesn't use it anymore | CE10 | | x | |
| Sometimes, I borrow goods I occasionally use, rather than buy them | CE11 | | x | |
| Sometimes, I rent goods I occasionally use, rather than buy them | CE12 | | x | |
| Sometimes, I lend goods which I occasionally use | CE13 | | x | |
| Sometimes, I rent for free to someone goods which I occasionally use | CE14 | | x | x |
| I eat less meat than years ago | CE15 | | x | x |
| I boycott companies using OGM or pesticides | V5 | | x | x |

The choice of which questions have to be excluded is based on the difficulty of behaviour investigated by each question. As shown in Figure 24 and Figure 25, some questions show the same value on the latent dimension which describes how much each behaviour is difficult to perform. In other words, some behaviours have the same level of difficulty, so it is sufficient to investigate just one of them, because using all does not add other information. For this reason, for each cluster of variables with the same latent dimension, only one question is chosen and included in the Part A of "*Come Ci Muoviamo*".

As an example, the three variables coded R4, R5, R6 and CS5 from DB2017 (Figure 25) show the same value on the latent dimension, so the three behaviours have the same level of difficulty. To reduce the number of questions, the designed web-questionnaire contain just R5 and not any information is lost.

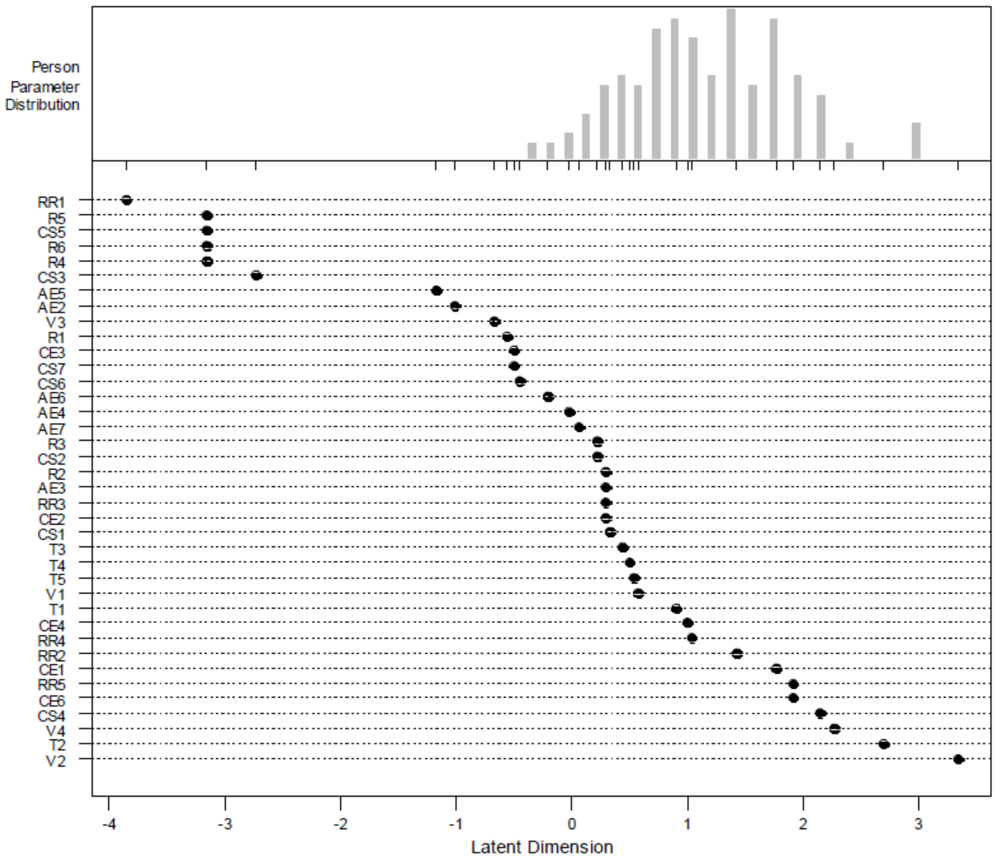


Figure 24 – Person-Item Map of the Rasch Model from GB2016.

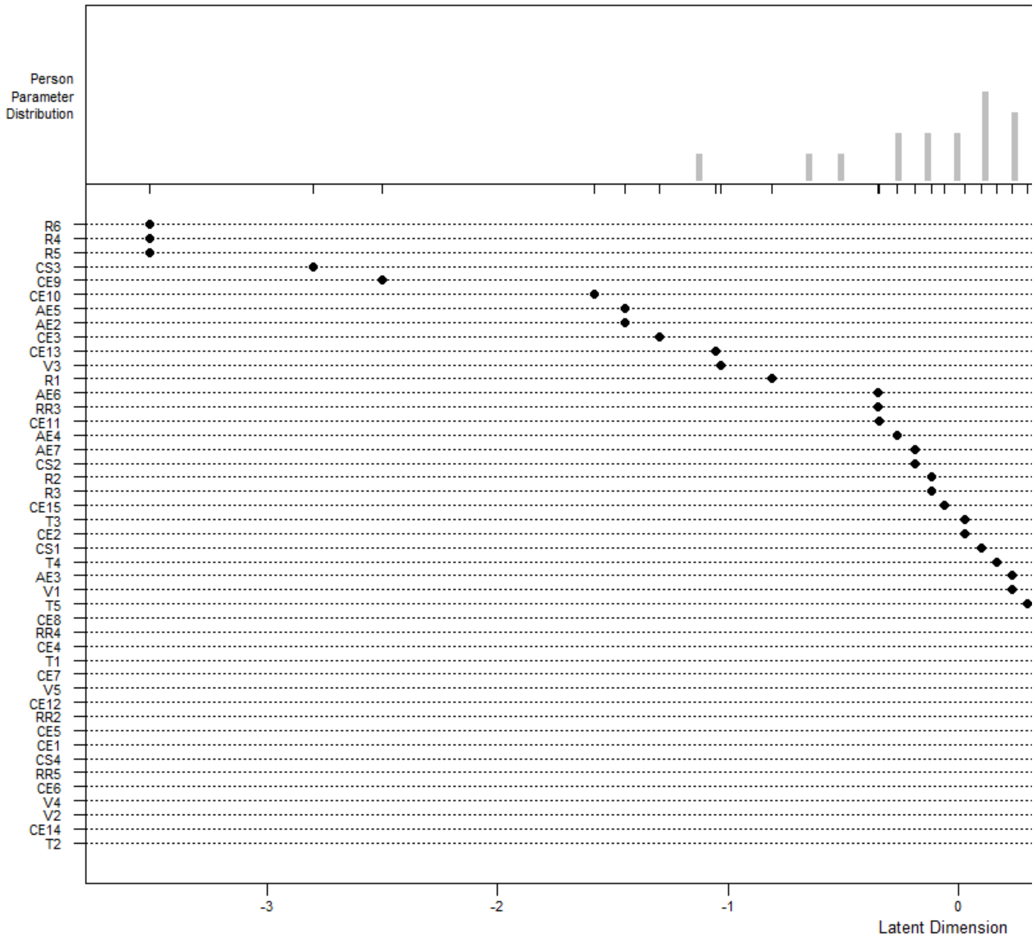


Figure 25 – Partial Person-Item Map of the Rasch Model from DB2017.

After the analyses related to the previous researches, the section which investigates the attitudes towards general ecological behaviour (GEB) is composed by only 27 questions, instead of 40 and 46 of the previous surveys, respectively 68% and 59% of total number of previous investigated items.

## 2.3. Survey administration

The survey administration has been carried out with the method Computer Assisted Web Interviewing (CAWI). The two parts of the web-questionnaire are developed using the software LimeSurvey, provided by Politecnico di Torino (POLITO). The researchers used two versions of Limesurvey, based on different servers of POLITO.

The part A was available on a dedicated web-site (www.comecimuoviamo.it) or people can accede to it thanks to a QR code included in a flyer (Figure 26).


Figure 26 – Flyer to spread the survey.

The survey was launched the 27th of October 2017 and was closed the 24th of April 2018. The majority of data were collected in December and January.

The survey *“Come Ci Muoviamo? ... Ma soprattutto Come Vorremmo Muoverci?”* has been diffused to the population through a campaign managed by researchers. The survey received also the support from the following Local Public Bodies (Figure 27):

- *Regione Piemonte*;
- *Città di Torino*;
- main universities: *Politecnico di Torino* and *Università degli Studi di Torino*;
- some transport operators, which involve their contacts and customers.


Figure 27 – Major promoters of the survey.

The main channels used to administer the survey are the following:

- By email to students and employees in the universities: Politecnico di Torino, Università degli Studi di Torino and Università del Piedmont Orientale;
- By email to employees in the major public bodies: Regione Piedmont, Città di Torino, Città Metropolitana, Agenzia per la Mobilità Piemontese;
- By email to employee in the biggest firms, thanks the contact with their mobility managers and Regione Piedmont;
- Through flyers on the bus and link on Facebook page to customers of major bus public transport operators;
- Through notice on web site to Citizens of some municipalities, which accepted to support the survey;
- By formal notice to employees in Rail Infrastructure Managers;

- Through direct contact with major cultural and sport associations within the study area;
- By newspaper with some articles and interviews of researchers.
- By local radio and Twitter, including the survey in traffic bulletin.

The effects of different actions undertaken during the campaign are reported in Figure 28, where the periods in which peaks of responses occurred are shown.

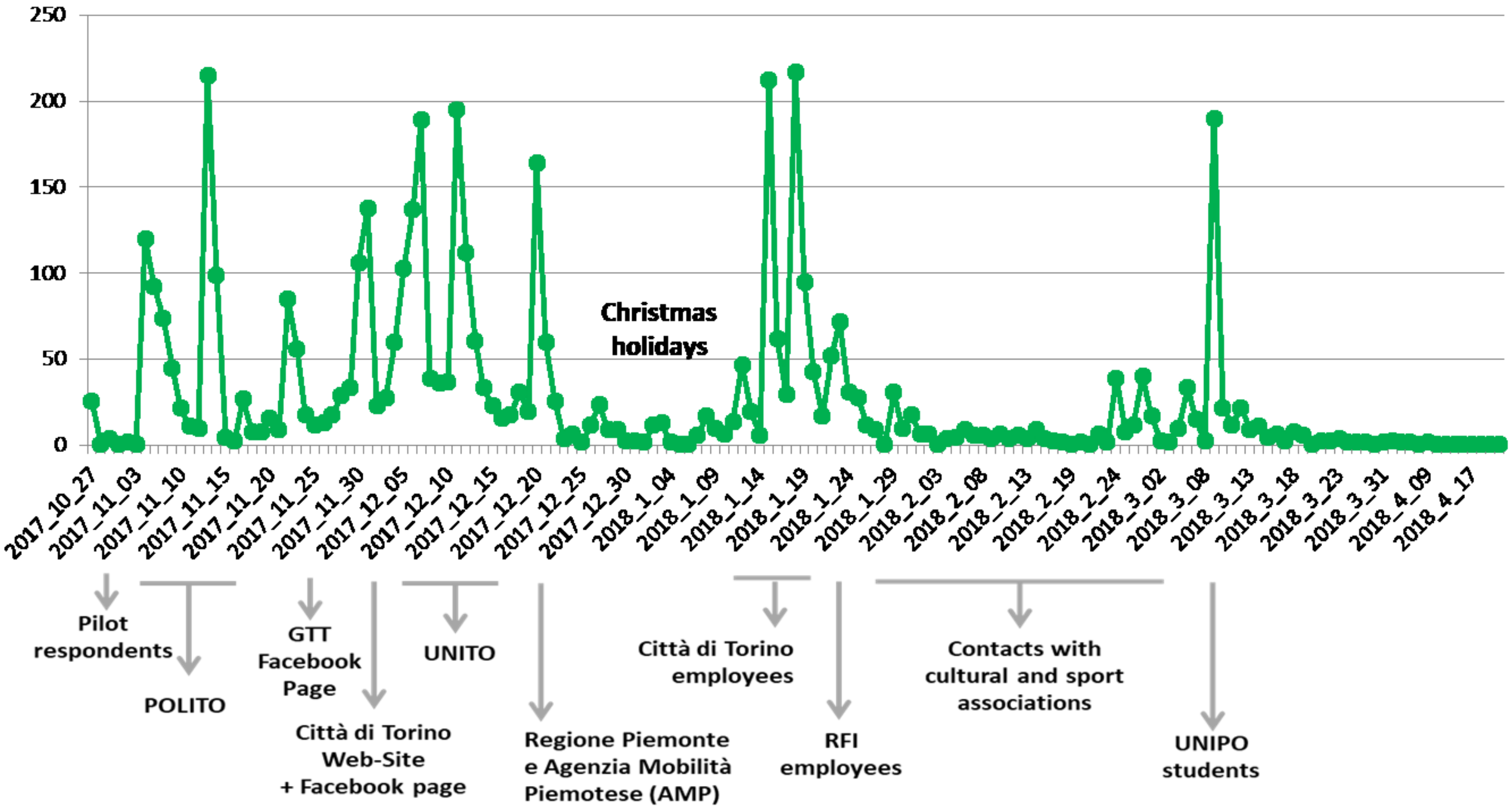


Figure 28 – Survey Campaign.

## 2.4. Data Analysis Design

In this paragraph, all steps of data analysis, with their motivations and expected results are presented. They are summarized as follows:

- *Database Building*, with some sections dedicated to merge the two web-questionnaire (Part A and Part B), variable encoding, outlier detection;
- *Data Descriptive Analysis*;
- *Exploratory Factor Analysis*, with sub-sections about pre-analysis on data, factor extraction, rotation factor and factor score computation;
- *Cluster Analysis* on factor scores;
- *Profile building*, where all sources used to enrich cluster interpretation are explained.

The above process defines how travel profiles are built according to users' attitudes, which are the latent construct, identifying from a battery of measured variables (Fabrigar, Maccallum, Wegener, & Strahan, 1999).

### 2.4.1. Database building

After data collection, the Database (DB) has been built for the successive analyses.

#### Merging Part A and Part B

As explained in the paragraph 2.2, the web-questionnaire has been split in two sections: Part A and Part B. At the end of Part A, the respondents decide if giving their email address to receive a web-link to accede to the Part B. The key information connecting Part A and Part B is the email address. After the Survey Administration, the Part A and the Part B have been merged, to obtain a complete database.

#### Variable Encoding

As seen in chapter 2.1, 785 variables have been investigated considering Part A and Part B. The database automatically generated from Limesurvey is not ready to be used for next analysis, because it includes some texts, which can be transformed in more suitable codes for the following examinations (e.g. "Yes/No" converted in "0 or 1").

For this reason, all answers of each variable are codified to make easier next steps. This "cleaning" activity is summarises as follows:

- *ID question*: number of variable (from 1 to 914). The number is higher than variable number from web-questionnaire because, during this phase, some calculations are done (e.g. trip duration based on departure and arrive times, etc.);
- *Code from Limesurvey:* question code in LimeSurvey Database;
- *Database code:* variable code in the new DB;
- *Question Preview:* a short description which recalls question text;
- *Variable scale:* nominal, ordinal, interval or ratio scale;
- *Variable format:* date, hour, integer, real, text or dichotomous format;
- *Encoding:* rules to read the code;
- *Measure unit:* if applicable (e.g. °C, km, etc).

This part of the research has been very time consuming, but it is of utmost importance.

### Cleaning process

After data encoding, a first analysis has been done to search answers which can be abnormal, irregular or unexpected. The main points are:

- *search of outliers* in open questions, where the respondents could badly fill in some numbers (e.g. distance, costs, etc.);
- *deleting answers given too fast*: in questions with Likert scale, some respondents could answer without reading and paying attention (e.g. all answers with same score and in very short time);
- *questions with "Other" option*, where the respondents could fill wrongly the "Other" option with an answer already shown in the previous list (e.g. mode of transport, occupation, sector of specialisation, etc.).

With this analysis of collected answers, the results will have less variance and they will be more specified (Everitt B. S., 1975).

The methodology applied to find the outliers in open questions consists in the following steps:

- selection of the two best candidate among distributions (Normal, Uniform, Exponential, etc.) through the Cullen and Frey graph (Cullen & Frey, 1999) (Figure 29), drawn by *r* function *fitdistrplus*[5];
- test fit of the designated distributions through three indices:
  - Kolmogorov-Smirnov statistic;
  - Cramer-von Mises statistic;
  - Anderson-Darling statistic;

  They are computed according to *r* function *gofstat*[6], according to (Stephens, 1986)
- computation of the threshold at 95% of the best fitting distribution;
- study of values beyond the thresholds and their possible exclusion from the analysis.

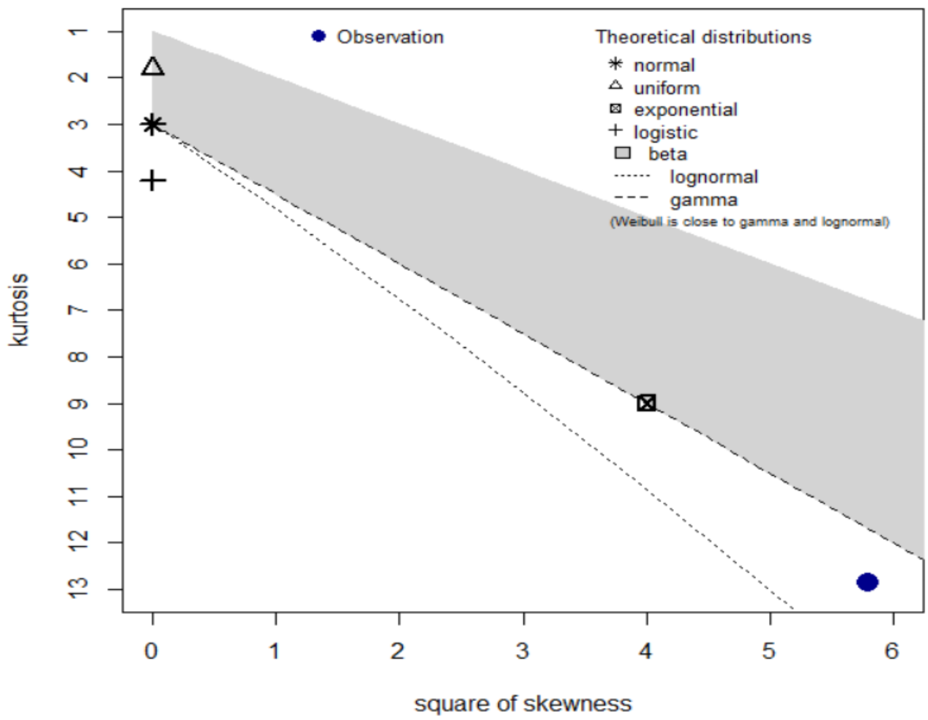


Figure 29 – Cullen and Frey Graph, example from distance distribution by foot.

[5] https://cran.r-project.org/web/packages/fitdistrplus/fitdistrplus.pdf , 27 June 2018
[6] https://www.rdocumentation.org/packages/fitdistrplus/versions/1.0-14/topics/gofstat, 27 June 2018

### 2.4.2. Descriptive Analysis

The first analysis on collected data is the Descriptive Analysis. The aims of this phase are very important: knowing the respondents (who they are, what they do, where they go, etc.) and discovering if (and, eventually how much) the sample is representative over the study area.

The main variables which are crucial for the Descriptive Analysis are those used for study area definition (paragraph 2.1). They are recalled in the following list:

- respondents' origins;
- gender;
- age;
- income;
- educational level;
- size of household;
- work force and unemployment rate;
- university students.

The analysis have to performed according to variable types (categorical, ordinal, interval or ratio), as shown in Table 23. The type for each variable is specified during the Database Building (paragraph 2.4.1).

Table 23: **Variable type, statistic measures and graphs.**

| Variable type | Statistic Measure | | Kind of Graph |
|---|---|---|---|
| | Central tendency | Dispersion index | |
| Nominal | Mode | Dispersion index | Bar graph |
| Ordinal | Median, Mode | Interquartile range | Bar graph<br>Box plot |
| Interval or Ratio | Average, Media, Mode | Standard deviation | Histogram<br>Box plot<br>Frequency polygon |

### 2.4.3. Exploratory Factor Analysis

To explain the motivation which lead to perform an Exploratory Factor Analysis (EFA), in-depth analysis of variable variance is necessary.

Among some variables in a EFA, three kinds of variance can be distinguished in the *Total Variance*:

- *Common variance* or *Communality*: part of variance that can be explained by factors which are common with the other variables in the analysis;
- *Specific variance*: part of variance that is specific of a variable or an item;
- *Error variance*: the last part of variance, which is not included in the previous one. It is due to error measure, etc.

The Specific and Error Variances define the *Unique variance* and their relationships are shown in Figure 30.

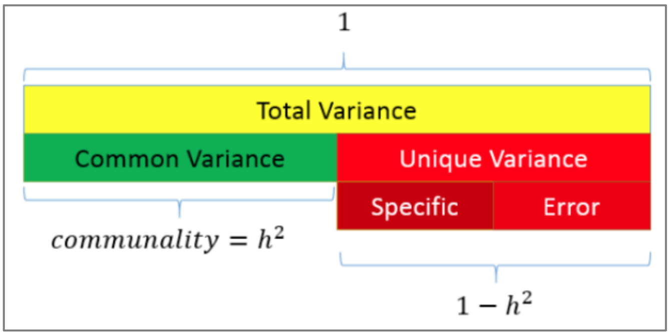


Figure 30 – Communality and relationships with all kinds of variance.

Among reduction factors methods, the most important are the Principal Component Analysis (PCA) and Exploratory Factor Analysis (EFA). The PCA takes into account the Total Variance, without distinguish between common variance and unique variance. In addition, results from PCA are the components, which are real linear combination of examined variables. The EFA evaluate just the common variance, so its results are based only on the Communality among variables. Therefore, the factors are estimated from data and they are not wholly defined by variables. Consequently EFA advantages are (Kline, 1993):

- the separation between unique and common variance;
- the factors are hypothetical and not totally specified.

*For these two main reasons, EFA will be preferred to PCA in this research.*

### Requirement for EFA

The minimum input to perform an EFA is a linear correlation matrix (Ricolfi L. , 2002), computed from a matrix CxV: column C equal to variable number and row V equal to respondents. The variables have to be at least ordinal, but, in psychological research, it is common use almost-ordinal variables (Marradi, 1995). With the survey, designed according to paragraph 2.2, all variables used in the analysis fit these requirements.

In addition, to execute an EFA, each couple of variables have to be normal distributed, then a linear relationship between them come be expected (Piccolo, Statistica, 2000). This restriction will be checked on collected data. Firstly, Kolmogorov-Smirnov and Shapiro-Wilk tests are performed on data. These two tests are very sensitive to large samples: in that case they usually reject normality hypothesis (Germano, 2015). For this reason, another approach is applied: kurtosis and skewness are computed. If these two indices are, respectively, lower than seven and two (West, Finch, & Curran, 1995), the non-normality will can be considered not too severe (Fabrigar, Maccallum, Wegener, & Strahan, 1999).

If data does not respect this requirement, the EFA could still be performed: the minimum condition is that the relationship between variables and latent construct have to be linear (Piccolo, Statistica, 2000).

EFA requires a correlation matrix with absolute values greater than 0,3 (Albano & Molino, 2013). To ensure that performing an EFA is profitable with own starting data, some diagnostic indices are developed:

- Bartlett's sphericity test;
- Kaiser-Meyer-Olkin Measure of Sampling Adequacy;

*These indices are calculated for each set of variables which are included in the EFA.*

Bartlett's sphericity test assesses the hypothesis that correlation matrix is not an identity matrix. If this hypothesis is accepted, examined variables are correlated, so they are suitable to be analysed with an EFA. For this reason, the test has to provide small values of significance level (less than 0.05).

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO measure) is an index that represents the proportion of variance of examined variables that might be explained by underlying factors. Values close to 1,0 indicate that a EFA is profitable on database, instead KMO measure less than 0,50 warns that EFA probably will not be very useful. KMO measure can be calculated for all variables (and it provides information about whole database) or for each one, so the most suitable variables to be included in an EFA can be selected. In literature review, the following values of KMO measure are proposed (Kaiser H. F., 1970):

- less than 0.50 unacceptable;
- 0.50 to 0.59 miserable;
- 0.60 to 0.69 mediocre;
- 0.70 to 0.79 middling;
- 0.80 to 0.89 meritorious;
- 0.90 to 1.00 marvellous.

With a huge number of variables, some authors suggest to accept just value greater than 0.70 (Norman & Streiner, 2014).

Web questionnaire contained 785 variables. Some (about 200) of them will be include in the EFA, but there are some constraints regarding proportion between variables and observations in an EFA.

The minimum dimension of sample for a reliable EFA is 200 (Guilford, 1956), but other authors state that smaller sample could be acceptable: if data show clear factor structure, smaller sample size could be adequate (Kline, 1993). For example, if each factor is overdetermined (e.g. at least three or four measured variables represent each factor) and the communalities are high (over 0,70) the analysis can carry out accurate parameters with sample of 100 respondents (MacCallum, Widaman, Zhang, & Hong, 1999) (Velicer & Fava, 1998). The collecting data has a minimum target of 200 people. How much factor structure is clear will be analysed in the paragraph 3.4, to allow establish if the sample is large enough.

In addition, for mathematic reasons, it’s fundamental that there are more observations (respondents) than variables (questions), otherwise results will not be significant (Kline, 1993). The guidelines in literature about the proportion between variables and observations differ dramatically (Fabrigar, Maccallum, Wegener, & Strahan, 1999):

- Kline proposes a proportion of 1:2 (if the factor structure is clear) (Kline, 1993);
- Gorsuch suggests a ratio of 1:5 (Gorsuch, 1983);

- Nunally and Everitt recommend proportion of 1:10 (Nunally, 1978) (Everitt B. S., 1975).

Another guideline is about the proportion between respondents and factors, which is more important than ratio between observation and variables (Arrindel & Ende, 1985). Among authors, there is a common agreement on the proportion between factor and observations equal to 1:20.

*All this rules are checked on the research data before to perform EFA.*

### Variable Selection

Before to perform the Exploratory Factor Analysis, a variable selection is necessary. To choose the most profitable information the Anti-Image Correlation Matrix are calculated.

This matrix is composed by complementary to one of partial correlation coefficients. The most valuable variables have off-diagonal elements which are very small (<0.3) and high values on diagonal (>0.6). (Geoffrey & Streiner, 2014). In this way, on the diagonal variable, sampling adequacy is found out on the diagonal of the Anti-Image Correlation Matrix.

*The variables which have low values on the diagonal (<0.6) are left out from EFA* (Norman & Streiner, 2014).

### Extraction methods

To calculate factors based on the examined variables the following extraction methods will be evaluated:

- Unweighted Least-Squares Method;
- Generalized Least-Squares Method;
- Maximum-Likelihood Method;
- Principal Axis Factoring.

The Unweighted Least-Squares (ULS) Method minimizes the sum of the squared differences between the observed and reproduced correlation matrices, ignoring the diagonals. The algorithm computes parameters to reproduce correlation matrix as much as possible, taking account just elements out of the diagonal.

Generalized Least-Squares (GLS) Method is similar to the previous one, but the correlations are weighted by the inverse of their uniqueness. In this way, variables with high uniqueness are given less weight than those with low uniqueness.

Maximum-Likelihood (ML) Method computes parameter estimates that are most likely to have produced the observed correlation matrix. It requires that the sample is from a multivariate normal distribution. The correlations are weighted by the inverse of the uniqueness of the variables and an iterative algorithm is employed. To test multivariate normal distribution of variables, Shapiro-Wilk test will be used and kurtosis and skew indices will be computed.

Principal Axis Factoring (PAF) Method is a method of extracting factors from the original correlation matrix, but initial estimates of the communalities are placed in the diagonal. These factor loadings are used to evaluate new communalities that substitute the previous communalities on the diagonal. Iterations continue until the changes in the communalities from one iteration to the next satisfy the convergence criterion for extraction.

Using more than one methods allows to measure reliability of factor structure. In addition, with huge correlation matrix, the difference among them should be negligible (Fabrigar, Maccallum, Wegener, & Strahan, 1999).

*However, if the database respect the condition of ML Method is indicated or in alternative the PAF one. If the number of factors is clear a priori, GLS or ULS methods are very efficient* (Albano & Molino, 2013).

The number of factors to be extracted is crucial point of the EFA, because it can have relevant impacts on the final results (Fabrigar, Maccallum, Wegener, & Strahan, 1999). From literature review (Cattell, The Scientific use of factor analysis in behavioural and life sciences, 1978) and empirical results (Fava & Velicer, 1992), models with few factors have more severe errors than ones with too many factors. Nonetheless, too many factors should be avoided because they can lead the research to postulate constructs with low theoretical value and too complex structure (Comrey, Common methodological problems in factor analytic studies, 1978) (Comrey & Lee, A first course in factor analysis, 1992).

The decision about how many factors have to extract should be relied to multiple criteria (Fabrigar, Maccallum, Wegener, & Strahan, 1999):

- the Kaiser criterion: taking into account all eigenvalues (factors) greater than 1.0 (one). It is the easiest, but it does not take into account examined correlation matrix, so it can lead to underestimate or overestimate the right number of factors (Gorsuch, 1983);
- the Scree Test, where the eigenvalues of the correlation matrix are plotted in descending order and factor number is identified with the drop in the eigenvalues magnitude. It fits the examined correlation matrix, but it is too subjective, because there is no clear explanation of what is defined a substantial magnitude drop (Cattell & Jaspers, A general plasmode (No. 30-10-5-2) for factor analytic exercises and research, 1967);
- the Parallel Analysis, this approach identifies factor number through the comparison of eigenvalues computed from complete random data and ones calculated on real data. (Horn, 1965) (Montanelli & Humphreys, 1976).

*Each criterion has some advantages and drawback, so concurrent use of them could be the better approach and it is adopted in this research.*

### Factor Rotation

To reach a simple factor structure (Thurstone, 1947), the extracted factors will be rotated in the factor multidimensional space. The rotation allows to define a simple structure, which is characterised by:

- each factor is defined by a sub-set of variables, which have high loadings relative to the residual measured variables (high with-in factor loading variability);
- each variable loads with very large value only a sub-set of factors (low factor complexity).

Among the infinite alternative orientations of factors, the final factor rotation reaches the simplest factor structure. There are a lot of analytic rotation methods, the main ones are:

- Varimax;
- Direct Oblimin;

- Quartimax;
- Equamax;
- Promax.

Some of Factor Rotation are classified as *orthogonal*, because their factors have not common communality and among them there is no correlation. The other ones are named *nonorthogonal*.

*To not underestimate the correlation among factors, non-orthogonal rotations (Direct Oblimin) in this research are preferred.*

### Factor Structure evaluation

The choice of the most valuable factor structure is made taking into account several criteria:

- From a statistical point of view: explained variance, parsimony about factor number, efficiency and the Cronbach's Alpha;
- from meaning and relevance point of view: the interpretation is carried out studying grade of simplicity of factor structure, factor over-determination, how many "makers" (when a variable heavily loads just one factor) for each factors.

The explained variance could be reported with sum of eigenvalues. An index to show the parsimony about used factors, could be the index P (Equation 1), where $K_{max}$ is factor number of the most complex solution and $K$ is factor number in the chosen solution (Albano & Molino, 2013).

$$P = K_{max} - K$$

Equation 1 – Parsimony Index P.

To have an efficiency measure, you can adopt the percentage of explained variance or the index $r$ (Equation 2), where λ are eigenvalues and K is factor number. As thumb rule, $r$ index should not be lower than 2 (Ricolfi L. , 1987).

$$r = \frac{\lambda_1 + \lambda_2 + \ldots + \lambda_K}{K}$$

Equation 2 – Efficiency Index $r$.

To measure the internal consistency of the items included in each factor, the Cronbach Alpha is computed. The obtained values are compared with ones suggested in literature, shown in Table 24 (Gliem & Gliem, 2003).

Table 24: **Thresholds for Cronbach's Alpha.**

| Value of Cronbach's Alpha | Evaluation |
|---|---|
| > 0.9 | Excellent |
| > 0.8 | Good |
| > 0.7 | Acceptable |
| > 0.6 | Questionable |
| > 0.5 | Poor |
| < 0.5 | Unacceptable |

The statistical evaluation has to be combined to an analysis of meaning and relevance of factor structure. The starting point is the interpretation of factors. This phase begins from those variables, the *makers*, which much load examined factor. In factor interpretation, the variable importance is defined studying their correlation with factors. Some authors suggest to measure variable usefulness how reporting in Table 25 (Comrey & Lee, A first course in factor analysis, 1992).

Table 25: **Variable Correlation to Factors.**

| Correlation | Explained Variance | Evaluation |
|---|---|---|
| .71 | 50% | Excellent |
| .63 | 40% | Very good |
| .55 | 30% | Good |
| .45 | 20% | Sufficient |
| .32 | 10% | Mediocre |

In addition, there are two thumb rules to properly understand factor meaning (Albano & Molino, 2013):

- factor over-determination: when there are enough variables which show loading statistically different from zero;
- *makers* presence: some variables which heavily load only examined factor.

*A simple factor structure respects perfectly these rules and according to them a critical review of EFA structure is performed.*

### Computation of factor scores

After the determination of the factor structure, it is necessary to estimate factors scores to represent respondents only through the latent constructs. There are some methods (DiStefano, Zhu, & Mindrila, 2009) (Uluman & Dogan, 2016):

- non-refined Methods: sum scores by factor, sum scores above a cut-off value, sum scores standardized variables, weighted sum scores;
- refined Methods: Regression Scores, Bartlett Scores and Anderson-Rubin Scores.

The non-refined methods are very simple and efficient alternatives for researchers. They are defined as unsophisticated cumulative schemes (Grice J. W., 2001). In the literature a widespread variety of non-refined methods occurs. However, the most common methods are reported in the previous list. The non-refined Methods have some advantages:

- across independent samples their stability is very high (Grice & Harris, 1998). In other words, their results do not are strongly dependent to used sample (DiStefano, Zhu, & Mindrila, 2009);
- these methods are very easy to be performed.

On the other hand, non-refined methods have some drawbacks:

- their scores are very correlated even if factors are orthogonal;
- if the solution is carried with oblique EFA, the relationships between factor scores may not be accurately reproduced correlations among factors.

*Especially for the last disadvantage, the analysis will be performed with refined method.*

Scores from refined methods are linear combinations, based on the observed variables, which take into account what is shared between the factor and the item (shared variance) and what is not evaluated (unique variance) (Gorsuch, 1983). The main advantage of this category is the production of factor scores which are highly correlated to a given factor, with unbiased estimation. They aim to replicate relationships among factors. In fact, when there is an orthogonal EFA solution, each factor should be correlated just with own factor score. Conversely, if the solution is oblique, the correlation among factors should be equal to ones among factor scores (Gorsuch, 1983).

Among the most common refined methods (Regression Scores, Anderson-Rubin Scores, etc.), *Bartlett Scores is chosen to compute the last step of EFA, because it maximises correlation between factor scores and corresponding factor and it minimises other correlations between factor scores and other factors.*

### 2.4.4. Cluster analysis on factors scores

Among multivariate techniques, there is Cluster Analysis (CA), which has as primary purpose grouping objects based on their characteristics (Hair, Black, Babin, & Anderson, 2014). The results should be clusters, which show high internal homogeneity (within-cluster) and high external heterogeneity (between clusters).

The cluster analysis has to be carried out to reach two goals:

- data reduction: a lot of observations which are meaningless, unless categorised in convenient groups. The Cluster Analysis can achieve the data reduction objectively through reduction of information from a whole population (or sample);
- hypothesis generation: Cluster Analysis can be applied to examine previously specified hypotheses.

In this research both objectives are followed, so this technique is preferred and used. However, Cluster Analysis has some limits, which are summarised as follows:

- Cluster Analysis is a-theoretical, non-inferential and descriptive (Hair, Black, Babin, & Anderson, 2014). In fact, there is not guarantee that solution is unique, because many other results can be carried out by varying some elements (algorithm, input, etc.). There is not statistical base which allows to draw inferences from sample to population;
- Cluster Analysis always produces some groups, even if there are not any structure in analysed data. Clusters are potentially relevant and meaningful only with right validation and strong conceptual interpretation.

### Selection of clustering variables

The selection of clustering variables is as important as objects of cluster analysis, because possible results are constrained also by chosen variables, not only by objects. For any application of cluster analysis, some rational must be used to select cluster variables. For example, a rational could be based on some theories, past researches or previous stated hypothesis. *To reach this aim, in this research only those variables which better qualifies objects and which are strongly related to objectives of Cluster Analysis are included.*

In addition to conceptual considerations, the analysis has to take into account some practical concerns. To recognise variables which are less profitable in a cluster analysis you have to study their distribution (Everitt, Landau, Leese, & Stahl, 2011): if there are multi-modal distributions (where there are more than one mode), it is more probable that cluster analysis provides meaningful results. *The variables which are not multi-modal are excluded from CA.*

The inclusion of only one or two inappropriate variables can effect dramatically the Cluster Analysis (Milligan, 1980). The removal of undifferentiated variables could optimize cluster definition.

### Requirements on data

The sample size is not related to statistical issues, but cluster analysis requires sufficient sample dimensions to represent rightly also small clusters. Representation of small groups is easier in larger samples, because there are more chances to have enough cases, instead, in small ones the minor clusters can be confused with outliers, then excluded. *Before to perform the CA, a check of the sample size has been performed.*

The Multicollinearity is an issue common also to other multivariate techniques. In the Cluster Analysis the Multicollinearity acts as an implicit weighting, but it does not appear to observer. *In this research factor score will be used as input for CA and this approach is a way to avoid the Multicollinearity* (Hair, Black, Babin, & Anderson, 2014).

### Detecting outliers

The Cluster Analysis is sensitive to irrelevant variables, but also to outliers, which are objects very different from others. The adopted methodology to discover them is composed by the three analyses:

- univariate detection: through the Standardisation (Equation 3), objects with absolute standardised value higher than 2,5 are potential outliers (Hair, Black, Babin, & Anderson, 2014), then they are excluded from cluster analysis;

$$z_i = \frac{X_i - \bar{X}}{\sigma^2}$$

Equation 3 – Standardisation.

- bivariate detection: through graphical approaches, scatter plots are drawn to screen data in outlier research;
- multivariate detection: to take into account simultaneously several variables, the Mahalanobis' distance $D^2$ supplies a multivariate assessment of each object. The Mahalanobis' distance $D^2$ computes distance of each observation from the mean centre of all objects in a multidimensional space (Equation 4). Then, the ratio between $D^2$ measure and degree of freedom (number of variables) has statistical properties, because its distribution is approximately equal to *t*-value one. The outlier recognition is completed with the analysis of this ratio: values higher then 2,5 can be related to potential outliers.

$$D_{Mahalnobis,i} = \sqrt[2]{(\vec{x_i} - \vec{x})^T \cdot C^{-1} \cdot (\vec{x_i} - \vec{x})}$$

Equation 4 – $D^2$ di Mahalanobis.

Where:

- $\vec{x_i}$ is vector of *i*-object, with *n*-dimension, like *n* included variables;
- $\vec{x}$ is *n*-dimension arithmetic mean vector of all objects;
- *C* is the sample covariance matrix.

Each technique has advantages and drawbacks and there is no one which can be applied automatically, without researcher's analysis of potential outliers. *For this reason, this methodology applies all approaches in synergy and the objects excluded from Cluster Analysis are only cases that are detected as outliers at least in two methods.*

### Clustering algorithms

There are two decisions in the Cluster Analysis process which have substantial implications on results and their interpretation: the selection of procedure to form clusters and the decision of cluster number. They are, respectively, topic of this paragraph and of next one.

Among clustering procedures, there are two groups: hierarchical or Non-hierarchical methods. There is no general rule between the two alternatives, because both have some advantages and disadvantages (Hair, Black, Babin, & Anderson, 2014).

The Hierarchical methods was developed before than others, so they are more popular (Milligan, 1980). Their main strong points are the following ones:

- simplicity: with the treelike structures, just one analysis allows to evaluate any possible clustering solutions;
- measures of similarity: there is an extensive development of algorithms, caused by widespread use of this methods;
- speed: in an expedient manner these methods generate all possible solutions, from one cluster to all separate clusters.

On the other hand, the Hierarchical Methods have some drawbacks:

- they are very sensitive to outliers;
- to exclude effects of outliers, these methods have to be repeated several times;
- they are not recommended for large samples with high variable numbers. Over 400 cases these methods require a lot capacity of storage. Then with huge sample they could be employed on a random sub-sample to explore potential cluster solutions.

The most important algorithms for Hierarchical Methods are: Single-Linkage (or Nearest-Neighbor Method), Complete-Linkage (or Farthest-Neighbor or Diameter Method), Average Linkage, Centroid Method, Ward’s Method. Instead, the Non-Hierarchical Methods are less sensitive to outliers than previous ones and they can analyse very large dataset, because they not require huge storage capacity. Their disadvantages are the following:

- a stronger need to validate the obtained cluster structure. These methods need to seed points, so it is possible to obtain very different solutions from each set of seed points. For this reason, with Non-Hierarchical Methods interpretation and validation phases are crucial,

- they need a cluster number as input, so they are not efficient when the analysis has to test several cluster solutions.

The clustering algorithms that have already been proposed are several (Gree, 1978). The most common ones are Sequential, Parallel and Optimization.

In addition to these traditional methods, two other methods can be mentioned (Amir & Shehroz, 2016): the Artificial Neural Networks (ANN) and the density-based methods. The second one works properly when data show very high level of noise and they can handle clusters of different shapes and sizes. On the other hand, they are not suggested when there are various densities and high-dimensional database (Tan, Steinbach, & Kumar, 2006). The ANN are very recent approach of cluster analysis, so they do not ensure well-established comparison and they are profitable with very large dataset (Big Data), because its training requires a lot of cases.

*For the sample dimension, the Non-Hierarchical methods are chosen (Table 26). The used algorithm has been Optimization algorithm, which allows reassignments from one cluster to another one. The Euclidean Distance has been used as measures among objects.*

Table 26: **Comparison among different cluster methods.**

| Methods | Advantages | Disadvantages |
|---|---|---|
| Hierarchical | Simplicity and an overall vision of all solutions | Sensitivity to outliers and not recommended for large sample |
| Non-Hierarchical | Not requiring high storage capacity, recommended for large sample and robust towards outliers | Validation is strongly necessary and cluster number is needed as input |
| Artificial Neural Network | Management of huge database (Big Data) | Few comparisons are available and for high quality of training very large size of database are required |

| | | |
|---|---|---|
| Density-based | Not affected by noise and possibility to handle very different cluster shapes and sizes | Loss of efficiency from various densities and high-dimensional dataset |

**Determination of cluster number**

To determine right cluster number, there is not a standard procedure (Hartigan, 1985) (Boch, 1985). Perhaps the cluster number is the most critical issue in the Cluster Analysis (Dubes, 1987).

With reduction of cluster number, there is a natural growth of heterogeneity intra-cluster. Since there is not a general stopping rule, Cluster Analysis requires to look at trend of selected parameters across different solutions with different cluster number. When a relevant increase occurs, the analysis stops to the previous cluster solution. Some indicators about heterogeneity are the following:

- Percentage Changes in Heterogeneity;
- Measure of Variance Change;
- Statistical Measure of Heterogeneity Change.

*The Percentage Changes in Heterogeneity will be used and as heterogeneity measure is chosen the distance between each object and its cluster centre*. However, also different solutions are evaluated, but the others have lower sense and harder interpretation, so they are excluded.

**Cluster Interpretation and Validation**

The interpretation is a challenging activity for the researcher, because it entails a recap of all information, after an accurate cluster examination. In this activity, some new knowledge and usefulness from the new clusters have to stood out. At end of this phase, each cluster is labelled accurately, according to their description.

The validation is a stability measure of the cluster solution. There are several approaches to ensure practical significance and validity, but single method does not exist. The most common is the cross-validation, when a random sub-sample is selected and a new Cluster Analysis is performed. Generally a Cluster Analysis produces the following results, in function of its stability (Hair, Black, Babin, & Anderson, 2014):

- very stable solutions, less than 10 percent of observations allocated to a different cluster;
- stable solutions, between 10 and 20 percent;
- mediocre solutions, between 20 and 30 percent.

### 2.4.5. Profile building

The last step of the analysis path is the developing of cluster description with all other information not still included in the analysis. In this way, the analysis provides profiles based on the previous clusters, but enriched by other variables, which are not included in the cluster analysis and neither in the Exploratory Factor Analysis (EFA), for instance the socio-economic information about respondents. In this phase, all information that can deep more cluster characterisation will be used to improve and to verify the previous interpretation.

As anticipated, the variables used in this phase are from three fields:

- socio-economics, like age, income, size of household, etc.;
- information about the most important trip (used mode of transport, travelled distance, travel time, etc.);
- attitudes and preferences not included in EFA or Cluster Analysis (CA).

Since the number of attitudes and preferences in the web questionnaire is very huge, it is necessary to employ some indices to summarise information from the variables in the same semantic area. The variables will be aggregated according to their subset emerged by EFA. Indeed, the variables with all requirements verified, but excluded from EFA to reach a simpler factor structure will be employed to compute new indices, as non-refined factor scores. In addition, the factors omitted from CA to obtain clear cluster solution will be used to enrich the profiles.

Finally, on all variables an ANOVA is performed to assess statistical differences among clusters. If the Levene's test evaluate differences among their variances ($p > 0.05$), the F-Ratio test is replaced by Brown-Forsythe test. Where the ANOVA cannot be performed a Chi Square Test is carried out.

From the results of ANOVA, the effect size could suggest which variables (then questions) are more efficient, and, thus, how design shorter (but still completed) web-questionnaire.

# Chapter 3

# Results

This chapter reports the results of the different steps of the research:

- *database building*, where the results of the setup of the data are reported;
- *sample description*, where the sample is characterised;
- *descriptive analysis*, that presents attitudes and preferences of the respondents;
- *exploratory factor analysis,* that reports the latent constructs found out;
- *cluster analysis,* where clusters are described;
- *profile building,* that analyse the profile of the clusters.

## 3.1. Setup of Database

The web-questionnaire "Come Ci Muoviamo" is very rich of information, but data are not immediately usable to perform the analysis. In addition, they are neither in the same servers. Indeed, during the survey administration, the first server crashed for too simultaneous respondents. For this reason, "Come Ci Muoviamo" was moved in a new and more powerful server, with a new version of Limesurvey.

The initial format of the data is not suitable as input for the analysis. Moreover, the answers have to be analysed, because in some answers the respondents apply the web-questionnaire with high degree of superficiality and negligence. Furthermore, also for answers ready to be analysed, an appropriate organisation of the database is needed.

From LimeSurvey data are organised in csv format. The file from Part A of web-questionnaire contains 855 columns and 15,956 rows, after the merge of outputs from the two servers. The Part B, which is loaded only on the most powerful server, is composed by 252 columns and 2,261 rows.

Each column is a variable which represent some information from "*Come Ci Muoviamo*". The great number of rows is due to huge quantity of incomplete answers (Figure 31 and Figure 32).

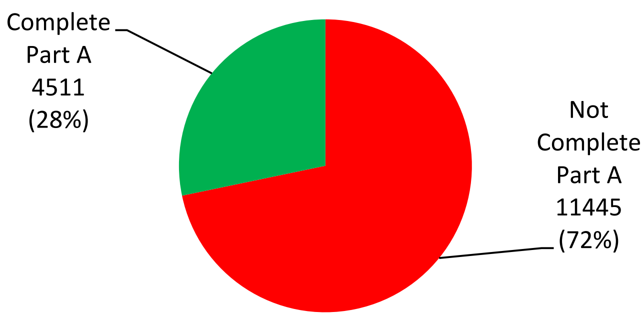


Figure 31 – Proportion of complete answers on total contacts.

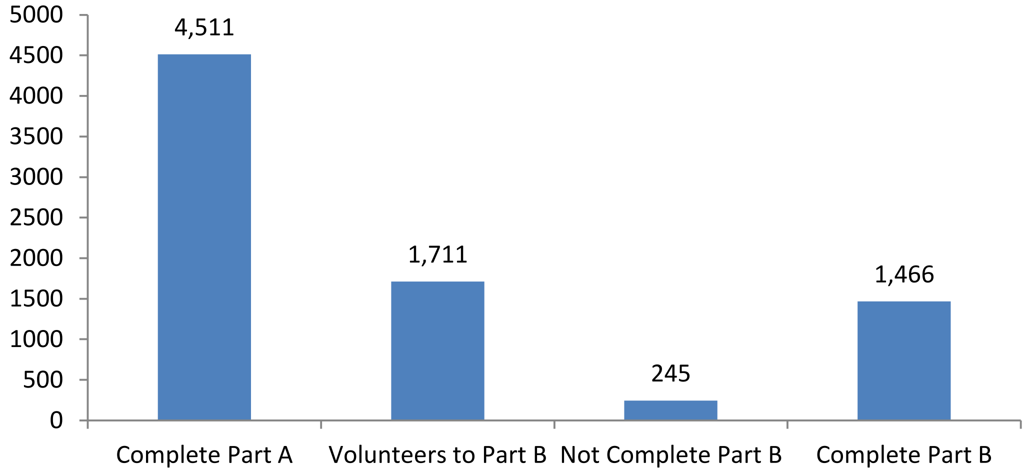


Figure 32 – Complete answers to Part B of web-questionnaire.

To start the descriptive analysis of answers, the incomplete answers (when respondents stop the questionnaire in the first pages) are excluded from DB, so the rows decrease to 4,511 for Part A and 1,466 for Part B. After this process, there is not any columns partially empty in Part A. In Part B, the empty rows are from people who chose to answer just to Part A and not to Part B or they not complete Part B.

In this section, these topics will be described in the following order:

- *data encoding*: where the database (DB) is described and its organisation is explained;
- *cleaning of answers*: where some errors done by respondents and some wrong interpretations are discussed. Their treatments are reported and explained;
- *Sustainability and Ignorance Indices*: before to start with analysis, some indices are computed to have more profitable input,
- *Variable set*: at the end of this phase is defined the set of variable on which analysis will be performed.

### Data Encoding

The codification of the answers from Part A and Part B makes easier next analysis and it is the first approach to answers. It allows to come to light some outliers, to discover mistakes in compilation, etc. The codification is mainly focused to three operations:

- check of homogeneity in each column: presence of any different format among rows, etc.;
- codification: change format from text to integer (example in Table 27).

Table 27: **Codification of categorical/ordinal text variable.**

| Text of question | Kind of variable | Format | Codification |
|---|---|---|---|
| What is your professional status? | Categorical | Integer | 1 = Unemployed<br>2 = NEET<br>3 = Retired<br>4 = Student<br>5 = Housewife<br>6 = Worker<br>7 = Employed<br>8 = Manager<br>9 = Teacher<br>10 = Free-lance<br>11 = Other |

The information presented in Table 28 are evaluated for each variable from the web-questionnaire.

Table 28: **Fields of codification legend.**

| Field | Description |
|---|---|
| Question IDs | Progressive number (1 to 914). |
| Question Codes in LimeSurvey | The code in LimeSurvey of each question. |
| Question Codes in codified database | For each question the code in clean and codified database. |
| Question Text | A short text which recall the question. |
| Variable Type | If the answer is a categorical, ordinal, interval o ratio variable. |
| Variable Format | If the answer is a string, integer or float number, data or dichotomy format. |
| Question Code | The (eventual) rules applied to the answers. |
| Measure Unit | Eventual |

### Cleaning of Answers

After the union and the codification, the next step is to improve the quality of the database. This objective is reached with four activities:

- the research of outliers;
- the exclusion of answers with very short time of compilation;
- the check of answers where "other" option is filled;
- the detection of errors in web-questionnaire compilation.

After this phase, the database goes from 4,511 rows to 4,070 for part A and from 1,466 to 1,297 for part B. The 443 answers (≈10%) of part A and 169 (≈12%) ones of part B are deleted because they are outliers or have extreme characteristics which could compromise the following analyses.

*Outlier research*

Fortunately, "*Come Ci Muoviamo*" is built with few open questions, where respondents write directly the answer. To prevent some errors, several rules were set, like hinge on answers (e.g. only integer number in year box) or automatically check on format (e.g. in the email address). For these reasons, there are low possibilities to collect wrong answers or abnormal values. In addition, the majority of questions is closed, with pre-defined options (e.g. Likert Scale, option list, etc.). However, some open questions are present (birth year, cost of travel, travelled distance, horse power of own car, etc.), so they have to be checked.

For instance, the travelled distance for the most important trip during the week is asked to respondents. This field of the database contains very various values, as shown in Figure 33. Probably among them, there are some outliers (highlighted in red) caused by wrong interpretation, typing errors, carelessness, etc.

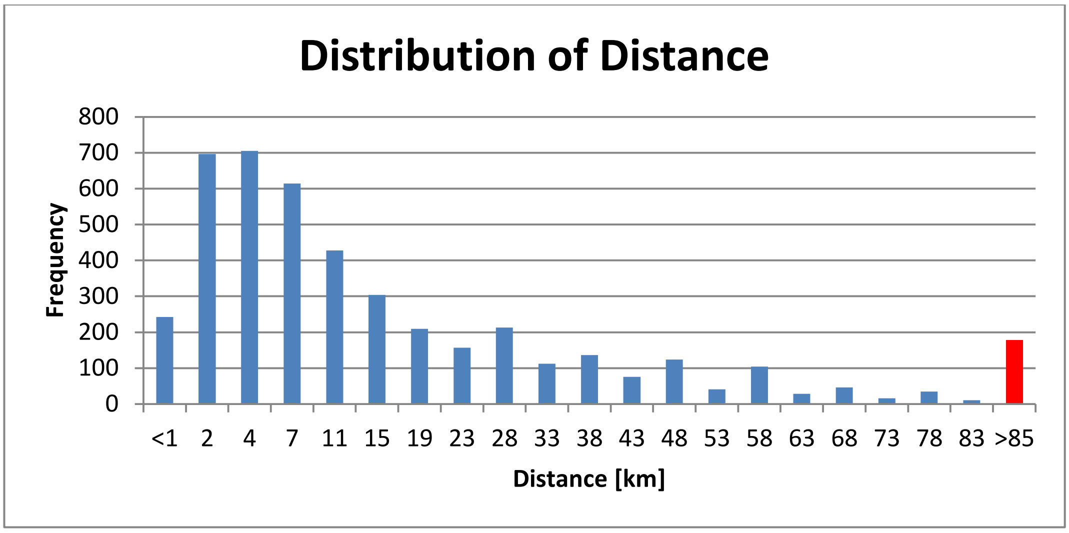


Figure 33 – Distance distribution.

These data are strictly correlated to trip purpose (school/work versus other ones, like return to house for offsite students) and to used mode of transport (by car, by train, by foot, etc.), so they are evaluated for each case, before to be excluded.

The trip purpose "Other" are excluded from analyses, because very different for frequency, distance, time, modes and cost.

For example, the outlier research among values of travelled distance by foot is reported. The starting data are represented in Figure 34. There are two series of information: the *perceived distance* is stated by respondents, while *distance from map* is calculated from coordinates of origins and destination. The second one is used to compare the extreme values found from direct answers.

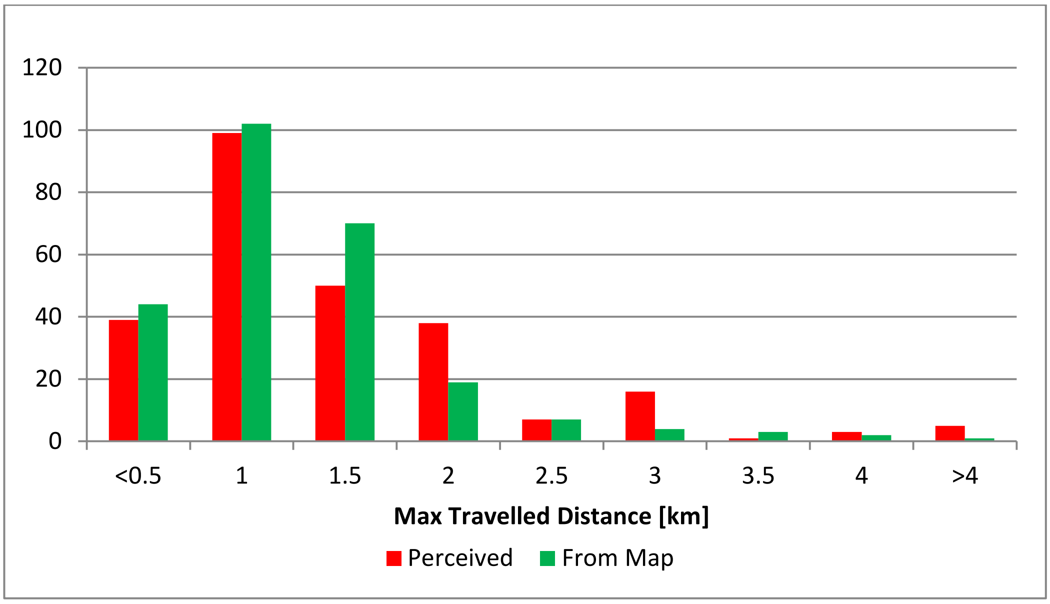


Figure 34 – Travelled distance by Foot.

In Figure 35, the Cullen and Frey graph evaluated for the foot distance distribution is depicted. It can be observed that the best fitting distribution are Log-Normal and Gamma.

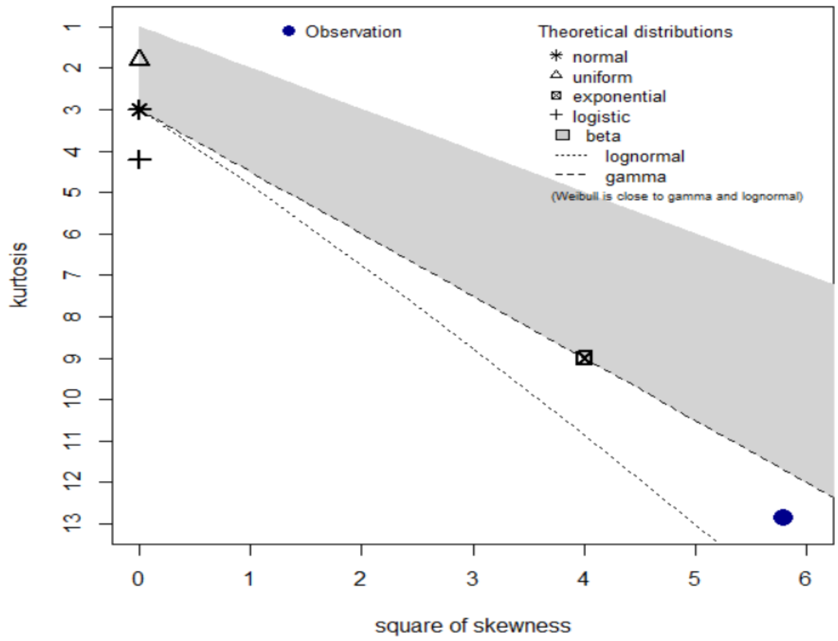


Figure 35 – Cullen and Frey graph, applied to stated travelled distance by foot.

Then, for both distributions some fit indices are calculated (Table 29). Cramer-Von Mises and Anderson-Darling statistics suggest to use Gamma distribution.

Table 29: **Fit indices for distributions.**

| Index | Gamma Distribution | Log-Normal Distribution |
|---|---|---|
| Kolmogorov-Smirnov | 0.14 | 0.14 |
| Cramer-Von Mises | 0.80 | 0.53 |
| Anderson-Darling | 4.97 | 2.76 |

In Table 30, the thresholds for both distributions are evaluated. They are very close. According to the fit indices, the threshold of Gamma distribution is chosen: 95.2% at 3.300 km.

Table 30: **Calculation of thresholds.**

| Distance [km] | Gamma Distribution | Log-Normal Distribution |
|---|---|---|
| 3.000 | 93.2% | 93.8% |
| 3.150 | 94.3% | 94.7% |
| 3.200 | 94.6% | 95.0% |
| 3.250 | 94.9% | 95.2% |
| **3.300** | **95.2%** | 95.4% |
| 3.400 | 95.8% | 95.9% |
| 3.500 | 96.3% | 96.3% |

Data over the thresholds are carefully evaluated as candidate outliers. If there is any doubt that they are outliers, they will be excluded from analyses.

*Too fast answers*

Before to perform the analyses, the diligence of respondents is evaluated. Indeed, since the web-questionnaire is quite long, it is possible that some questions (especially ones with Likert scale) are answered without the proper care.

These answers could be considered as outliers and they have not to be taken into account for the next steps.

To reach this objectives, the answers with Likert scale are scanned. For this aim, the variables and the indices which are used are:

- total time spent for "*Come Ci Muoviamo*";
- time spent for web-pages with Likert scale;
- average and mode of all answers with Likert scale in the same web-page;
- percentage of mode frequency about all answers with Likert scale in the same web-page;
- missing values, where not answering is allowed.

When two or more indices have extreme values, the answers were excluded.

*"Other" option*

Some respondents filled the "Other" option with an answer already shown in the list of choices related to other answers. The main questions with this phenomenon are about:

- trip purpose;
- used mode of transport;
- educational level;
- professional status;
- specialisation/job sector.

For those questions, a check of all other options is done and where there is correspondence with another option the answer is changed, as shown in Table 31 and Table 32. This operation requires a lot of time, but it allows to not exclude these answers.

Table 31: **Example of corrections for Other option.**

| Question text | Answer option | Other answers [*Italian*] | Correction |
| --- | --- | --- | --- |
| What mode of transport do you use for each trip purpose? | 1. chain of more modes of transport;<br>2. private car, as driver;<br>3. private car, as passenger;<br>4. train;<br>5. urban public transport;<br>6. suburban bus;<br>7. high speed train;<br>8. car sharing;<br>9. bike;<br>10. bike sharing;<br>11. by foot;<br>12. other, specify _____ | *Treno SFM*<br>*SFM*<br>*Treno extraurbano* | 4 - Train |
| | | *Automobile,*<br>*auto,*<br>*macchina* | 2 - Car |
| | | *Bus Sadem* | 6 – Suburban Bus |
| | | *Metro, Tram* | 5 – Urban Public Transport |

Table 32: **Example of corrections for Other option.**

| Question text | Answer option | Other answers [*Italian*] | Correction |
| --- | --- | --- | --- |
| Specialisation / Job sector | 1. primary sector (agriculture, fishing, livestock, etc.)<br>2. manufacture;<br>3. construction industry;<br>4. healthcare;<br>5. education;<br>6. public sector<br>7. services<br>8. trade<br>9. transport<br>10. tourism<br>11. Information & Technology<br>12. other, specify _____ | *Insegnante*<br>*Professore* | 5 - Education |
| | | *Metalmeccanica*<br>*Industria Meccanica*<br>*Industria Automotive*<br>*Motori* | 2 - manufacture |
| | | *Medicina* | 4 – Healthcare |

*Errors*

In some open questions respondents do not respect the requests and they compile fields making some mistakes.

For instance, in the first server, the year of birth is asked through an open field, where all numbers are allowed and without automatic check. The format of the year is requested as "*yyyy*", with four figures. Some people answered only with the last two.

Another example is the question about horse power of own car. Some respondents confuse horse power with engine size. Then there are answers with 1.300 horse power, which is clearly impossible.

Finally, some people was not able to properly provide rightly their coordinates using map in the question about origin and destination of their most important trip. As consequence, some geographical distance is huge, not realistic and in strong inconsistency with stated travelled distances.

### Sustainability indices

To describe how much respondents' mobility habits are environmental-friendly, three indices are calculated from information about trips along the whole week:

1. *SustIndexMode_Week*: a sustainable index about modes of transport over the week, computed with Equation 5;
2. *SustIndex_MostImpoTrip*: a sustainable index about modes of transport only in the most important trip, computed with Equation 6
3. *SustIndexDist_MostImpoTrip*: a sustainable index about modes of transport over the week, computed with Equation 7.

$$SustIndexMode\_Week = \sum w_m \cdot f_m$$

Equation 5

$$SustIndexMode\_MostImpoTrip = \sum w_m \cdot f_m$$

Equation 6

$$SustIndexDist\_MostImpoTrip = \sum w_m \cdot f_m \cdot d_m$$

Equation 7

Where:

- $m$ is the mode of transport;
- $f_m$ is the frequency for the $m$ mode of transport;
- $w_m$ is the environmental weight for the m mode of transport (Table 32);
- $d_m$ is the distance travelled by $m$ mode of transport.

The environmental weights are related to a gross estimation of $CO_2$ emissions, generated by each mode of transport (Gaborieau, 2016). The Table 33 explains how they are calculated (European Environment Agency, 2014).

Table 33: **Values of the environmental weights.**

| **Modes of transport $m$** | **Gross estimation of $CO_2$ emissions $[CO_2/p \cdot km]$** | **Weights $w_m$** |
|---|---|---|
| *Car* | *104* | 1.0 |
| *Public Transport* | *35* | 0.3 |
| *Bicycle/Walk* | *0* | 0.0 |

### Ignorance indices

With aim to investigate the knowledge about each mode of transport the questions in Table 34 are included in "*Come Ci Muoviamo*":

Table 34: **Question to investigate knowledge of alternatives.**

| **Question code** | **Investigated mode of transport** | **Question text** |
|---|---|---|
| q18_1 | Urban Public Transport | How much PT tickets costs in regional capital? |
| q18_3 | Train | What is the percentage of regional train on time in the last month? |
| q18_4 | Bike Sharing | How much costs Seasonal Tickets to bike sharing in Torino? |
| q18_5 | Car Sharing | What is the cost for each minute for car sharing in Torino? |
| q18_6 | Private Car | What is the price for one litre of gasoline? |

For each question is know the actual answer and it is matched with the respondents' perception to obtain a new variable, which is an index for each respondent about her/his knowledge about the mode of transport Table 35.

Table 35: **New indices about knowledge of transport modes.**

| Actual value | Operations | New variables |
|---|---|---|
| 1.50 € | q18_1 - actual value | Ignorance_PT |
| 90 % | Actual value – q18_3 | Ignorance_Train |
| 25 € | q18_4 - actual value | Ignorance_BikeSharing |
| 0.23 €/minute | q18_5 - actual value | Ignorance_CarSharing |
| 1.544 €/litre in 2017<br>1.568 €/litre in 2018 | q18_6 - actual value | Ignorance_PrivateCar |

The new variables are normalised with the Equation 8, before to be used in the analyses.

$$v_i = \frac{V_i - \mu}{\sigma}$$

Equation 8

Where:

- $v_i$ is the normalised value of new variables for the answer $i$;
- $V_i$ is the value of new variables for the answer $i$;
- $\mu$ is the average of the new variable;
- $\sigma$ is the standard deviation of the new variable.

### Variable set

At end of database building, the set of variables which will be included in the analysis is defined. The total variable number is 243: 161 variables from Part A and 82 from Part B. In Appendix 1, there are one table for each section from Part A and Part B, in this way variable code, name, short description, format, type and (eventual) unit of measure are presented.

## 3.2. Sample Description

The contacts to Part A of survey are 16,098 (update to 28th April 2018), while complete answers to Part A are 4,511 and to Part B 1,446. Indeed, Figure 36 shows a lot of respondents stopping after introduction or later few questions. Only the 28% of them complete the Part A.

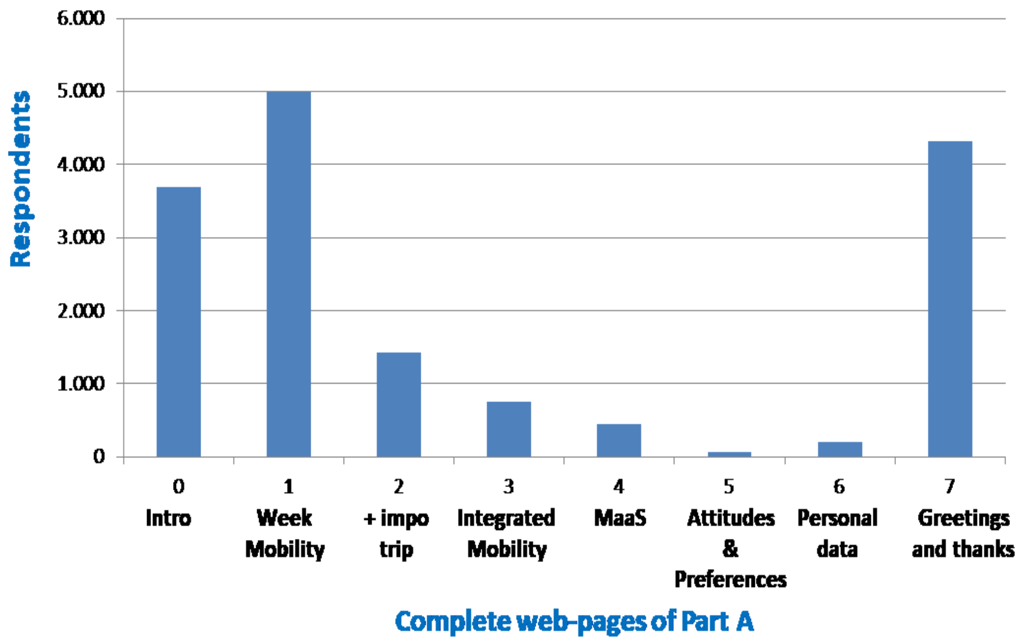


Figure 36 – How many respondents complete Part A.

In detail:

- the 54% of respondents stops after four questions (introduction and Week Mobility);
- the 17% leaves the web-questionnaire after the first four questions, but before the last page;
- the 1% starts but does not finish the last pages;
- the 28% complete the web-questionnaire “Come Ci Muoviamo”.

The progression of total completed answers is shown in Figure 37.

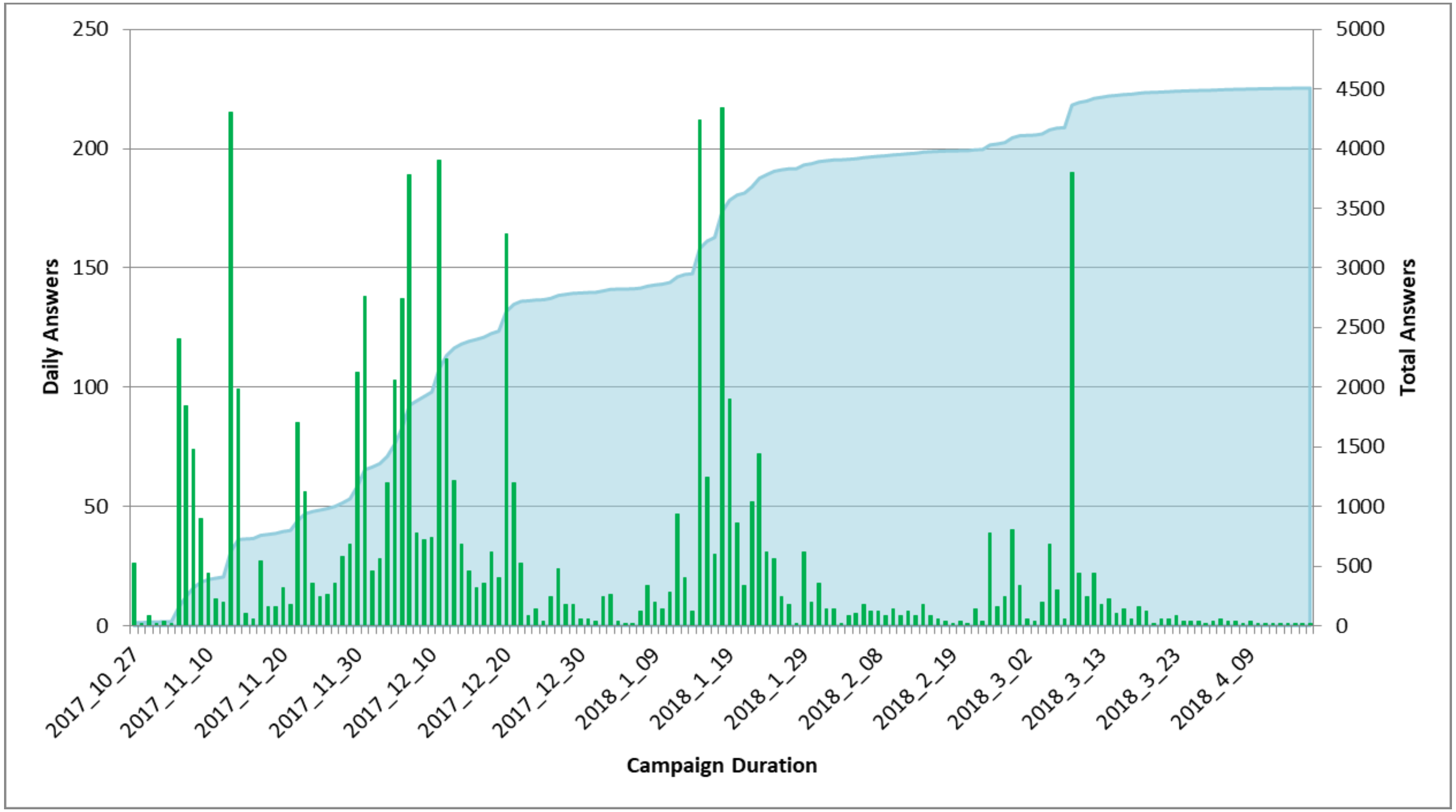


Figure 37 – Total Completed Answers along survey campaign.

In the next paragraphs, a respondents' description is provided and the sample is matched with the population of the study area. The descriptive analysis starts from social, economic and demographic characteristics and it continues with use and ownership of transport modes. The last section is focused on sample representativeness of the population: this thought leads to split sample in two groups: adults and students.

### 3.2.1. Social, economic and demographic features

The features about respondents which are analysed in this paragraph are the following:

- respondents' origins;
- gender;
- age;
- income and educational level;
- size of household;
- work force and unemployment rate;
- university students.

#### Respondents' origins

Over the Piedmont, which is the Study Area, the answers to web-questionnaire "*Come Ci Muoviamo*" cover the 0.09% of population. The collected data are not homogeneous over the entire Study Area, as explained with percentages in Table 36. In Torino the survey gathered answers five times more than in country side or Other Major Towns. There are 413 answers (about 8%) from people who have trip destination in the study area or who made some mistakes in reported their origins.

Table 36: **Respondents' trip origins and population in Study Area.**

| Sectors | Inhabitants [/1000] | Respondents | % of Piedmont Population |
|---|---|---|---|
| Torino | 872 | 2,168 | 0.25 % |
| Suburbs | 554 | 671 | 0.12 % |
| Other Major Towns | 541 | 235 | 0.04 % |
| Countryside | 2,396 | 1,024 | 0.04 % |
| Outside Study Area | / | 413 | / |
| **Piedmont** | **4,364** | **4,511** | **0.09 %** |

Regard to respondents' trip origins, the composition of sample is reported in Table 37 and also represented in Figure 38 and in Figure 39. In Table 44, the differences for each sector between Piedmont and the sample are reported in the last column. This analysis verifies the previous observations:

- more answers are collected in Torino than in other sectors;
- Suburbs and Other Major Towns are close to Piedmont population;
- in Countryside the survey did not gathered enough answers.

Table 37: **Respondents' origins in Study Area.**

| Sectors | Inhabitants [/1000] | % of Piedmont | Respondents | % of Sample | Delta [%] |
|---|---|---|---|---|---|
| Torino | 872 | 20% | 2,168 | 48% | **+28%** |
| Suburbs | 554 | 13% | 671 | 15% | +2% |
| Other Major Towns | 541 | 12% | 235 | 5% | -7% |
| Countryside | 2,396 | 55% | 1,024 | 23% | **-32%** |
| Outside Study Area | / | / | 413 | 8% | |
| **Piedmont** | **4,364** | **100%** | **4,511** | **100%** | |

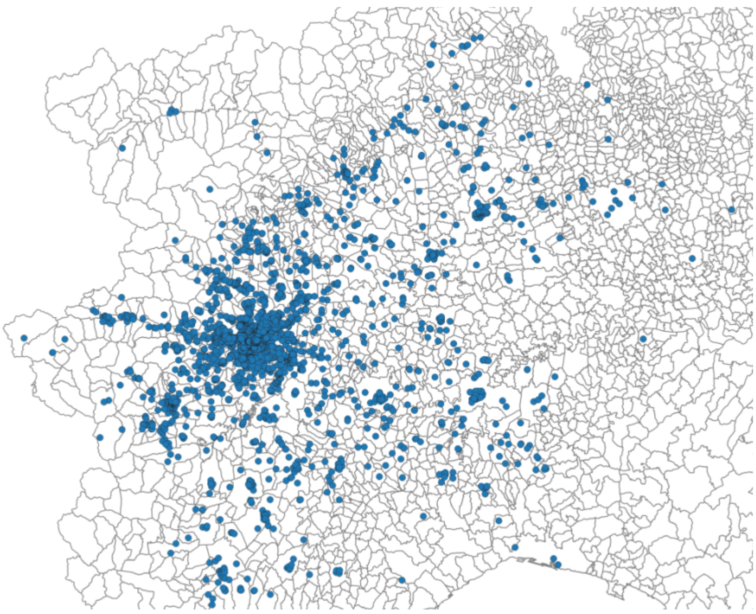

Figure 38 – Respondents' trip origins.

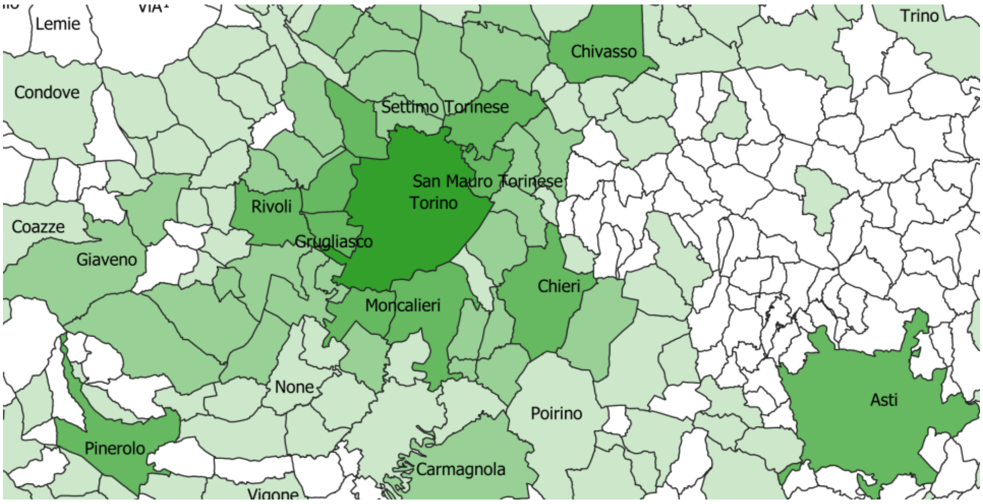


Figure 39 – Respondents' Density.

A reduction of Study Area has been considered to analyse only the area of *Città Metropolitana di Torino* (green area in Figure 40) is evaluated.

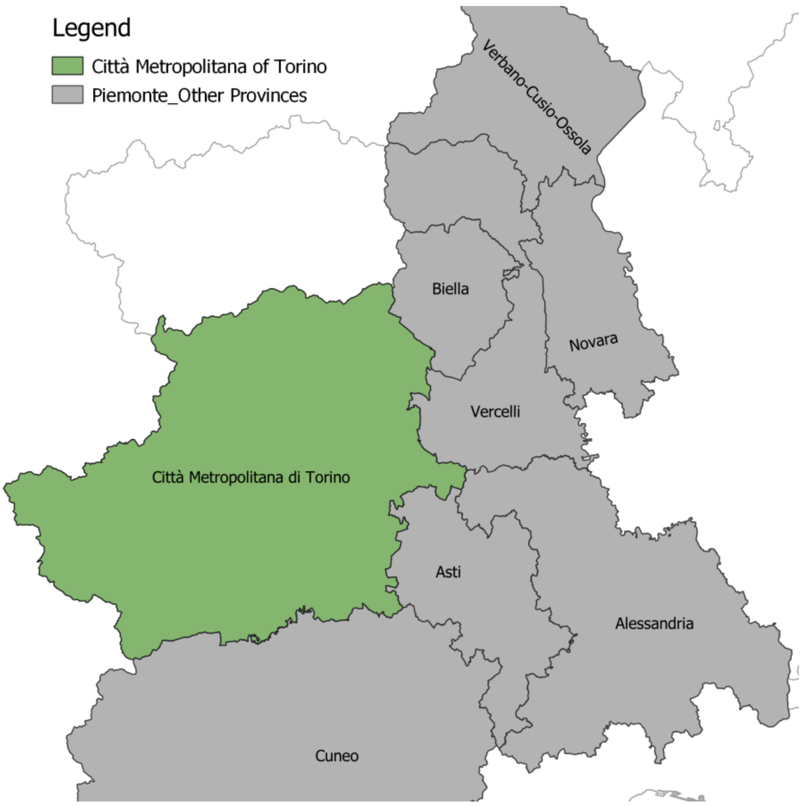


Figure 40 – *Città Metropolitana di Torino* and Piedmont provinces.

As reported in Table 38, this reduction requires the exclusion of one thousands of respondents (about 25%). In addition, these new boundaries do not resolve the differences among sectors, because strong dissimilarities still remain between inhabitants and the sample. For instance, in Torino the sample is equal to 61%, while it is the 39% of the Piedmont region.

Table 38: **Respondents' origins in Metropolitan City of Torino.**

| Sectors | Inhabitants [/1000] | % of Piedmont | Respondents | % of Sample | Delta [%] |
|---|---|---|---|---|---|
| Torino | 872 | 39% | 2,168 | 61% | **+23%** |
| Suburbs | 554 | 25% | 671 | 19% | **-6%** |
| Other Major Towns | 35 | 2% | 50 | 1% | +0% |
| Countryside | 786 | 35% | 645 | 18% | **-17%** |
| **Piedmont** | **2,248** | **100%** | **3,534** | **100%** | |

### Gender

The sample is made by 2.277 females and 2.140 males; 49 people did not answer and 8 stated "others", as shown in Figure 41.

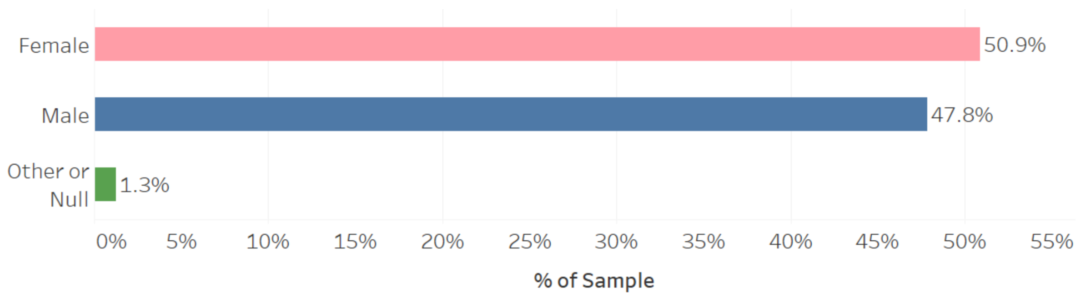


Figure 41 – Gender composition of sample.

In the sample there is a female majority (50.9 %) as in the population of Piedmont (51.8 %). The gender distribution on the different sectors of Study Area is described in Table 39, excluding answers about "Other or Null". In the Countryside and in the Suburbs, the sample has a male majority, while in the population there is female majority. Although in population women's presence in Countryside and in Suburbs is lower than average on whole Study Area, in Piedmont sectors record a male minority.

Table 39: **Comparison of Gender Distribution.**

| Sectors | Piedmont | | Sample | | Female Delta [%] |
|---|---|---|---|---|---|
| | % of Female | % of Male | % of Female | % of Male | |
| Torino | 52.7% | 47.3% | 52.2% | 47.8% | -0.50% |
| Suburbs | 51.7% | 48.3% | 49.5% | 50.5% | -2.20% |
| Other Major Towns | 52.9% | 47.1% | 54.5% | 45.5% | 1.60% |
| Countryside | 51.2% | 48.8% | 49.1% | 50.9% | -2.10% |
| **Piedmont** | **51.8%** | **48.2%** | **51.1%** | **48.9%** | **-0.70%** |

### Age

The age distributions of both sample and population are represented in Figure 42, respectively in blue and in red. There is a large component of young people of 20-30 years, from 2% to 7% in the sample versus an average of 0.9% in the population. This composition is very far from age distribution of population in the study area. Again, the sample is over-represented by people who are 40-60 years old: 2% on average versus 1.5% in the population of Study Area. Finally, answers from elders and youngest are very scarce.

As anticipated in the methodology, the cause of this sample composition is that there is a huge component of university students. For this reason, in Figure 43 a sub-sample without students is analysed. There is percentage roughly equal for years from 20 to 45, from 45 to 60 and more than 60 years. These results are due to survey administration, which is focused on university students and workers.

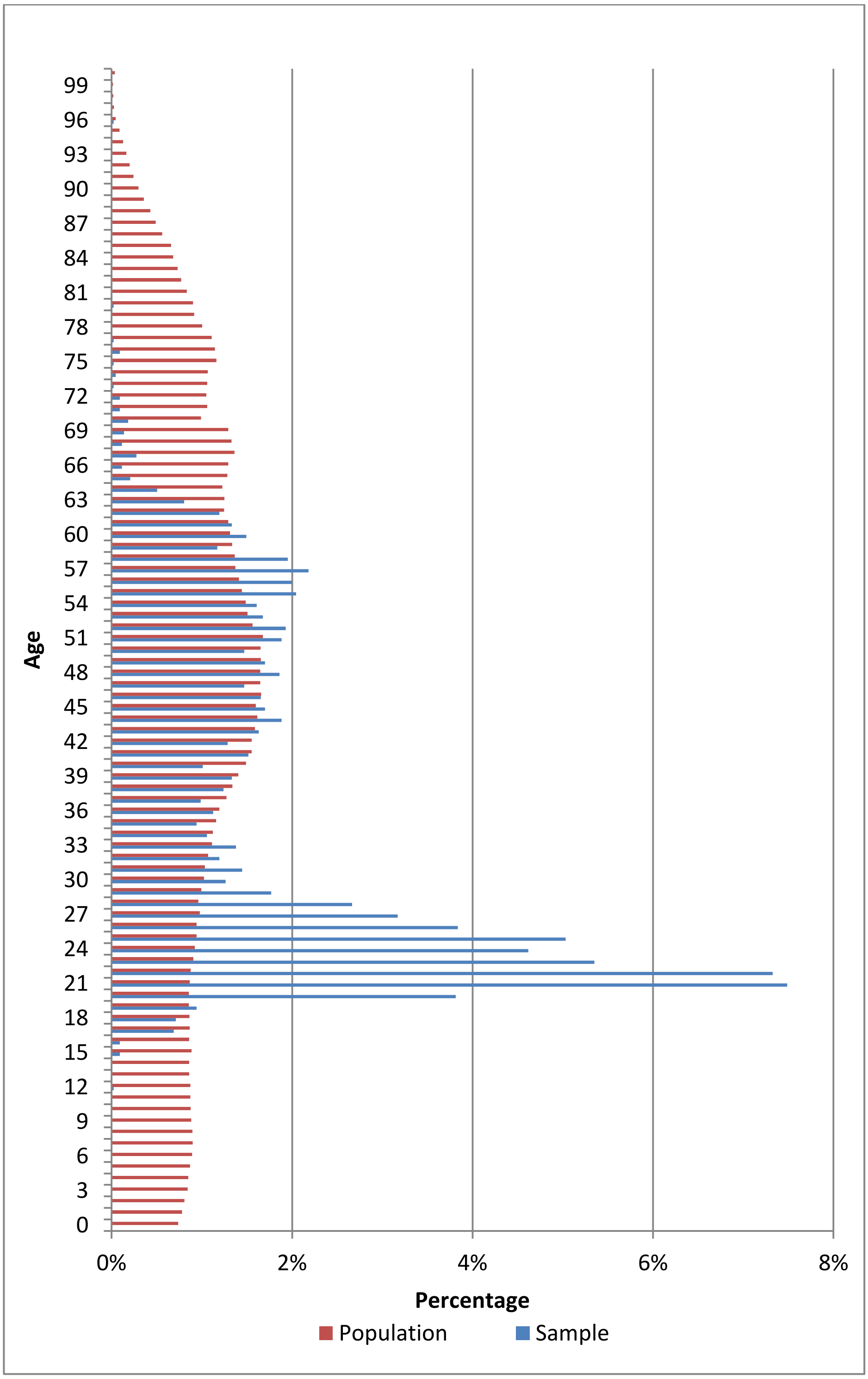


Figure 42 – Age distribution.

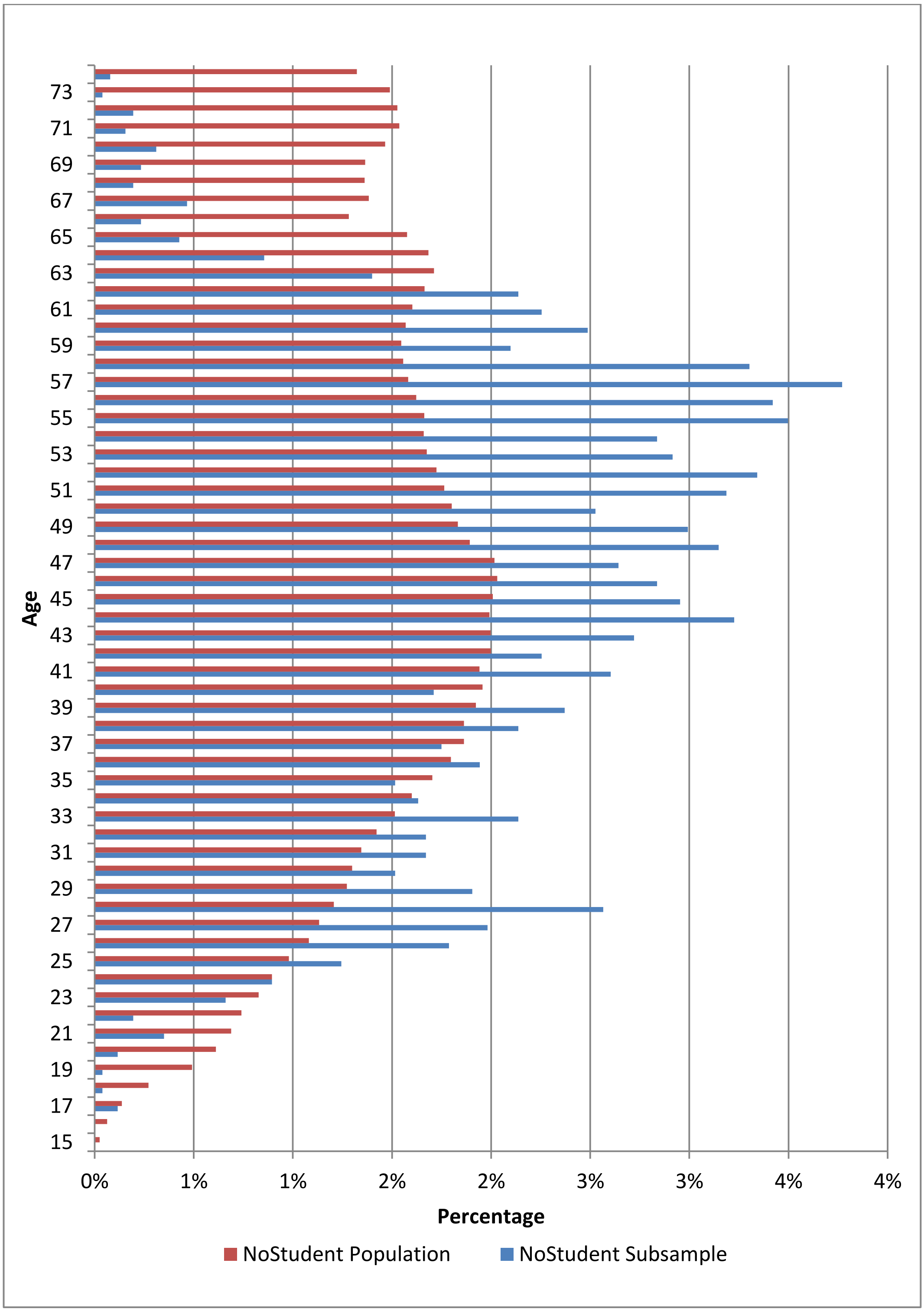


Figure 43 – Age Distribution for Work Force and Workers' Subsample.

In Table 40, the age distribution of the sample is depicted for the different areas and compared with region.

Table 40: **Age distribution (Percentage Across).**

| | | Age Classes [years] | | | | |
|---|---|---|---|---|---|---|
| **Sectors** | **Population/ Sample** | **Under 18** | **18-25** | **26-40** | **41-60** | **Over 60** |
| Torino | Population | 16.1% | 4.3% | 19.2% | 29.0% | 31.4% |
| | Sample | 0.2% | 35.0% | 26.0% | 33.6% | 5.3% |
| Suburbs | Population | 18.1% | 4.6% | 18.4% | 30.1% | 28.8% |
| | Sample | 3.1% | 35.2% | 22.1% | 32.8% | 6.9% |
| Other Major Towns | Population | 16.6% | 4.5% | 17.8% | 29.9% | 31.1% |
| | Sample | 0.0% | 26.6% | 30.5% | 37.3% | 5.6% |
| Countryside | Population | 17.4% | 4.4% | 18.2% | 29.9% | 30.0% |
| | Sample | 0.9% | 36.1% | 22.8% | 35.3% | 5.0% |
| **Piedmont** | **Population** | **17.1%** | **4.4%** | **18.4%** | **29.8%** | **30.3%** |
| | **Sample** | **0.8%** | **34.8%** | **24.9%** | **34.1%** | **5.5%** |

As know from Figure 43, there are very few answers from the youngest (0.8% vs 17.2%) and a lot of respondents is in the interval between 18 and 25 years old (4.4% vs 34.8%). Finally, the presence of elderly is low (5.5% vs 30.3%).

Age distribution of population without students is published by ISTAT just at Piedmont level, not to municipality one. For this reason, the Table 41 does not show analysis on areas of Piedmont region.

Table 41: **Age distribution of Population and Respondents without students.**

| | Age Classes [years] | | | | |
|---|---|---|---|---|---|
| | **Under 18** | **18-25** | **26-40** | **41-60** | **Over 60** |
| **Sample** | 0.1% | 3.4% | 28.5% | 58.6% | 9.4% |
| **Population** | 0.2% | 5.5% | 23.0% | 35.9% | 35.4% |
| **Sample-Population** | -0.1% | -2.1% | +5.5% | +22.7% | -26.0% |

As already shown from graph in Figure 43, the sub-sample without students is over-represented between 26 and 60 years, opposite for the others.

### Income

A lot of people did not fill out the question related to question (n° 236, 5.3% of total answers) or replied not "honestly", because there is a peak on the maximum income (n° 652, 14,6% of totals), as shown from Figure 44.

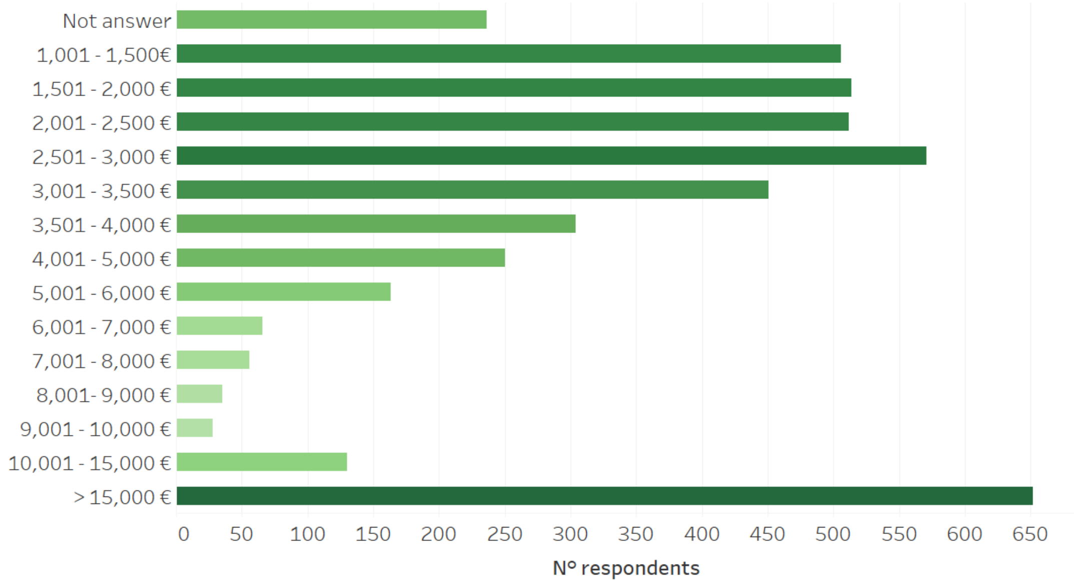


Figure 44 – Month income distribution on sample.

Excluding the HH income more than 10.000 €, the average values for each sector of study area are reported in Table 42.

Table 42: **Income levels comparison.**

| **Sectors** | **Income per HH[€/1000]** Piedmont | **Income per HH[€/1000]** Sample | **Sample vs Study Area [€/1000]** |
|---|---|---|---|
| Torino | 34.8 | 36.2 | +1.4 |
| Suburbs | 36.4 | 36.4 | ≈0.0 |
| Other Major Towns | 34.9 | 37.0 | +2.1 |
| Countryside | 32.5 | 34.6 | +2.1 |
| **Piedmont** | **33.8** | **35.9** | **+2.1** |

As depicted in Table 42, the sample has an average income greater than that of Piedmont population, except Suburbs, where they are equal.

### Educational Level

According to the description of study area, the Educational Level is divided in four classes:

- Primary School or lower Education Level;
- Secondary School;
- High School;
- Degree or other studies after High School.

Respondents' levels of education are described in Table 43 and in Table 44 there is the comparison with population of the study area.

Table 43: **Educational Levels in the sample.**

| Sectors | Primary School or lower | Secondary School | High School | Graduates or more |
|---|---|---|---|---|
| Torino | 1 | 47 | 949 | 1,146 |
| Suburbs | | 63 | 339 | 252 |
| Other Major Towns | | 2 | 104 | 120 |
| Countryside | | 29 | 530 | 445 |
| **Sample** | 1 | 141 | 1,922 | 1,963 |

Table 44: **Comparison on Educational Level between Sample and Study Area.**

| Sectors | Population/ Sample | Primary School or lower | Secondary School | High School | Graduates or more |
|---|---|---|---|---|---|
| Torino | Population | 24% | 30% | 31% | 16% |
| | Sample | 0% | 2% | 44% | 54% |
| Suburbs | Population | 26% | 31% | 29% | 9% |
| | Sample | | 10% | 52% | 39% |
| Other Major Towns | Population | 25% | 28% | 30% | 12% |
| | Sample | | 1% | 46% | 53% |
| Countryside | Population | 29% | 31% | 27% | 8% |
| | Sample | | 3% | 53% | 44% |
| **Piedmont** | **Population** | 27% | 30% | 28% | 10% |
| | **Sample** | 0% | 4% | 48% | 49% |

As observed from previous table, the sample is not balanced as regards the different educational levels. Comparing with the population of Piedmont, the graduates are almost five times than in the study area (49% vs 10%). Also people with high school level are over-represented in the sample (+20%). On the contrary, in the sample there is just one respondent with primary school and only the 4% with the secondary school.

### Size of household

The distribution of Household size in the sample is shown in Figure 45.

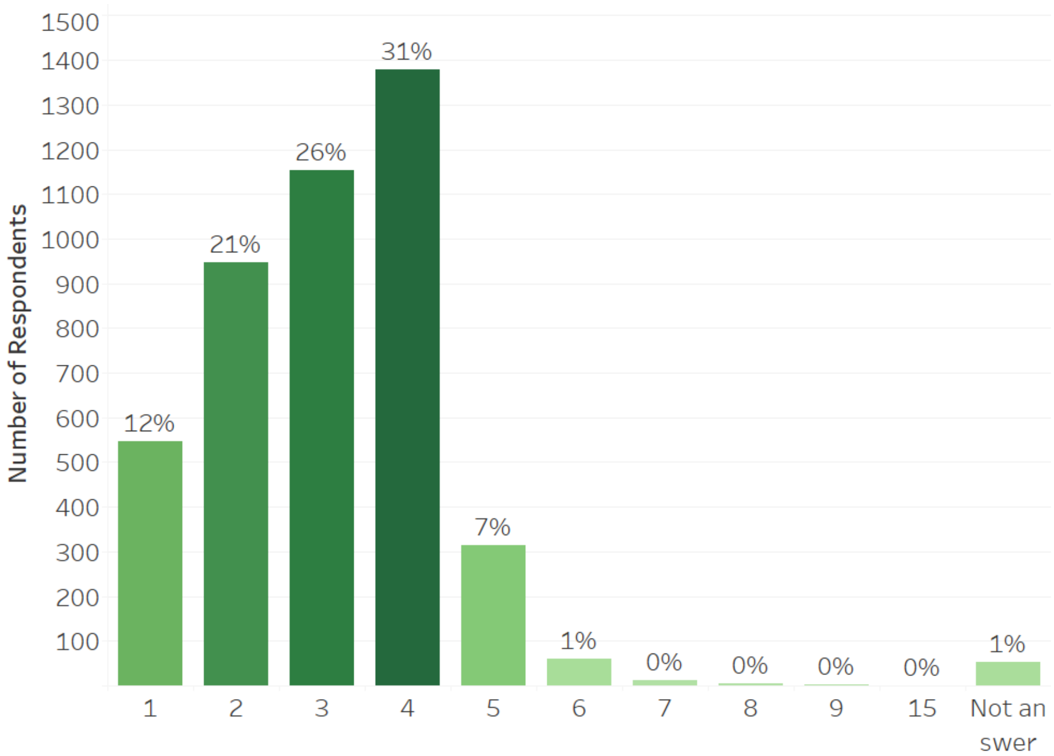


Figure 45 – Distribution in the sample of Household Size.

The most common size of the household is four components with 31%. The 66% of households has more than two members. The analysis in each sector has reported in Table 45 and the comparison with the population in Piedmont is described in Table 46.

Table 45: **Household Size of the sample for each sectors of study area.**

| Sectors | 1 member | 2 members | 3 members | 4 members | More than 4 members |
|---|---|---|---|---|---|
| Torino | 325 | 487 | 515 | 632 | 188 |
| | 15% | 23% | 24% | 29% | 9% |
| Suburbs | 58 | 121 | 185 | 233 | 58 |
| | 9% | 18% | 28% | 36% | 9% |
| Other Major Towns | 29 | 51 | 63 | 76 | 14 |
| | 12% | 22% | 27% | 33% | 6% |
| Countryside | 87 | 208 | 287 | 320 | 109 |
| | 9% | 21% | 28% | 32% | 11% |
| **Piedmont** | **499** | **867** | **1,050** | **1,261** | **369** |
| | **12%** | **21%** | **26%** | **31%** | **9%** |

Table 46: **Comparison on Household Size between Sample and Study Area.**

| Sectors | Population/ Sample | 1 member | 2 members | 3 members | 4 members | More than 4 members |
|---|---|---|---|---|---|---|
| Torino | Population | 40% | 30% | 17% | 10% | 3% |
| | Sample | 15% | 23% | 24% | 29% | 9% |
| Suburbs | Population | 28% | 33% | 22% | 15% | 3% |
| | Sample | 9% | 18% | 28% | 36% | 9% |
| Other Major Towns | Population | 36% | 31% | 19% | 11% | 4% |
| | Sample | 12% | 22% | 27% | 33% | 6% |
| Countryside | Population | 33% | 30% | 20% | 13% | 4% |
| | Sample | 9% | 21% | 28% | 32% | 11% |
| **Piedmont** | **Population** | **34%** | **30%** | **19%** | **13%** | **4%** |
| | **Sample** | **12%** | **21%** | **26%** | **31%** | **9%** |

The sample is made primarily by large household. Indeed, household with 4 members is higher (+18%) than in the people of the study area.

### Work force and Unemployment rate

The respondents' occupation is briefly described in the Figure 46, where NEET means "Not (engage) in Education, Employment and Training".

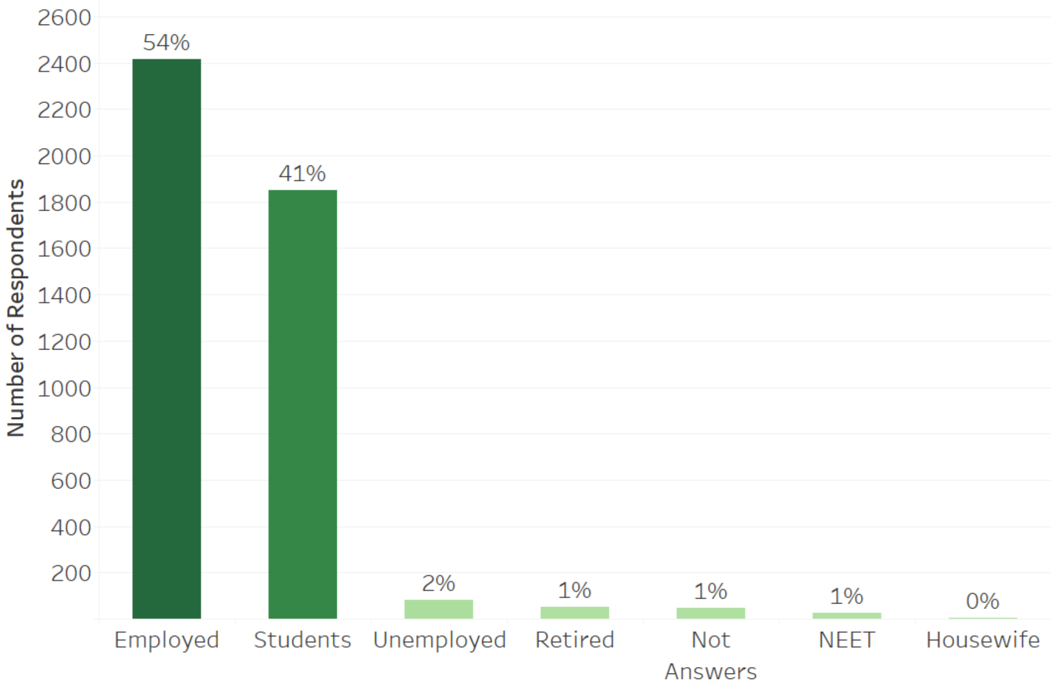


Figure 46 – Respondents' Occupation

In Table 47 the comparison with professional status of Piedmont population is shown. As stated in previous paragraphs, the students are over-represented in the sample (+36%). On the other hand, the retired people are almost absent (just 1%, -24% versus population).

The employed people are the 54% of the sample, equal to 2.411 respondents. This sub-sample is the 0.13% of all work force in Piedmont, higher as regards all population (0.09%, to see paragraph 3.2.1).

Table 47: **Comparison on professional status between sample and study area.**

| Status | Sample | Population | Sample vs Population |
|---|---|---|---|
| Employed | 54% | 41% | +13% |
| Students | 41% | 5% | +36% |
| Unemployed | 2% | 4% | -2% |
| Retired | 1% | 25% | -24% |
| NEET | 1% | 4% | -3% |
| Housewife | 0% | 7% | -7% |

The representativeness of sample on work force people is studied in Figure 47 and in Table 48. As you can see, from 50 to 65 years old, the sample has too many respondents respect to the real population; instead from 15 to 50 years old the sample needs more workers' answers, except for range between 27 and 30 years.

Table 48: **Age distribution of Work Force and Sub-Sample of Workers.**

| | Age Classes [years] | | | | |
|---|---|---|---|---|---|
| | **Under 18** | **18-25** | **26-40** | **41-60** | **Over 60** |
| **Sample** | 0.1% | 2.1% | 28.5% | 61.5% | 7.8% |
| **Population** | 0.1% | 6.9% | 36.9% | 51.5% | 4.6% |
| **Delta** | ≈0% | -4.9% | -8.4% | +10.0% | +3.2% |

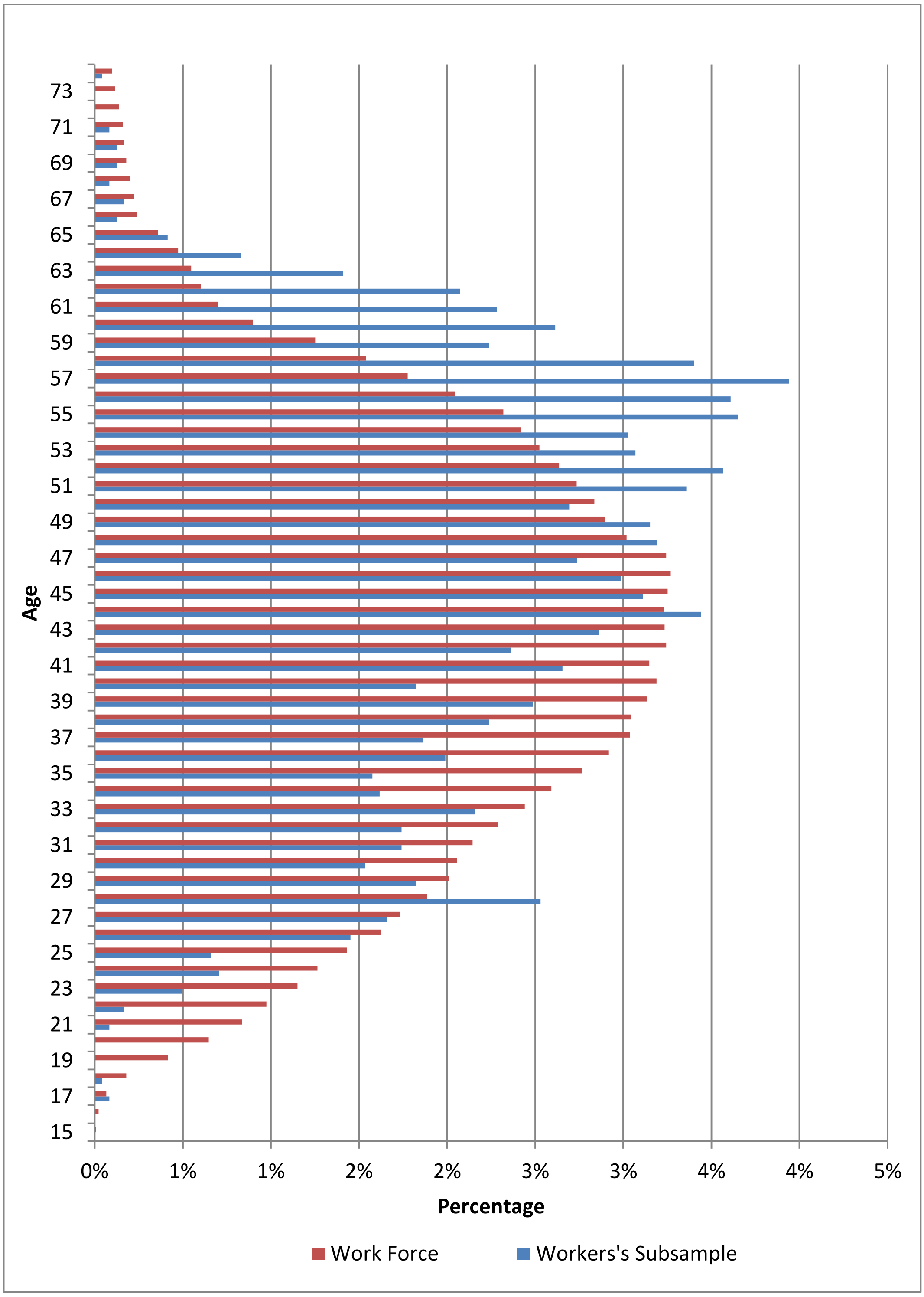


Figure 47 – Age distribution of only workers.

### University students

As anticipated, the sample includes a lot of university students, as reported in Table 49.

Table 49: **University Student in the sample end in the Study Area.**

| | University Students | | |
|---|---|---|---|
| **Sectors** | **In sample** | **In Piedmont [/1000]** | **% about all Univ. students** |
| Torino | 915 | 23 | 4.0% |
| Suburbs | 286 | 14 | 2.0% |
| Other Major Towns | 74 | 13 | 0.6% |
| Countryside | 423 | 45 | 0.9% |
| **Piedmont** | **1,698** | **94** | **1.8%** |

The sample has a good coverage on Torino (4%). This is a sub-sample which could be representative of actual university students' population and its size is important.

### 3.2.2. Use and ownership of Transport Modes

The modes of transport are studied through the aggregation explained in the Table 14 in the paragraph 2.2.9. In the sample, the most used modes of transport are the public transports: urban and suburban buses, trains and intermodal chain with PT, as shown in Figure 48.

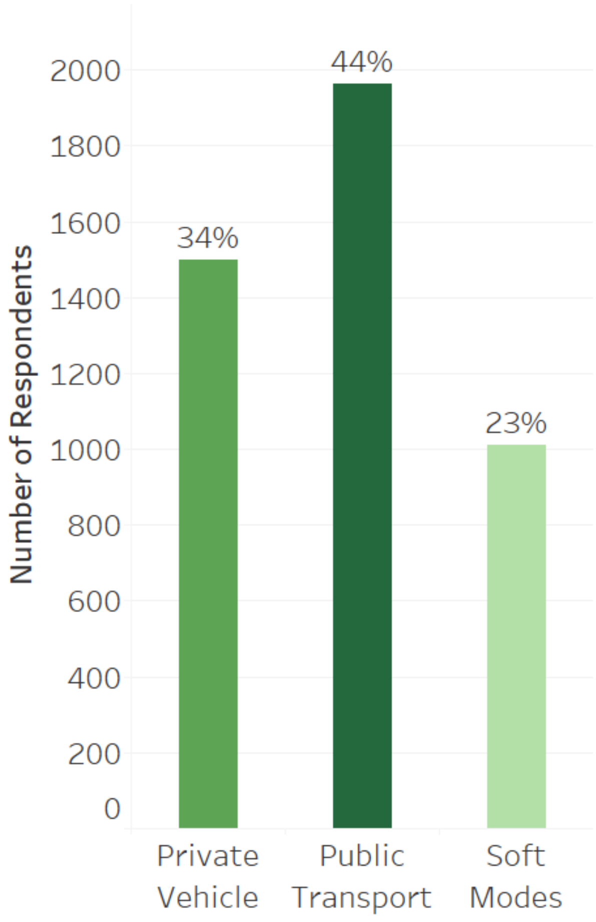


Figure 48 – Most used mode of transport in the sample.

The differences among the sectors are highlighted in Figure 49. As in the population (paragraph 2.2.9), in Torino and in Other Major Town Private Vehicle is less used than in rural area while soft modes are more utilised.

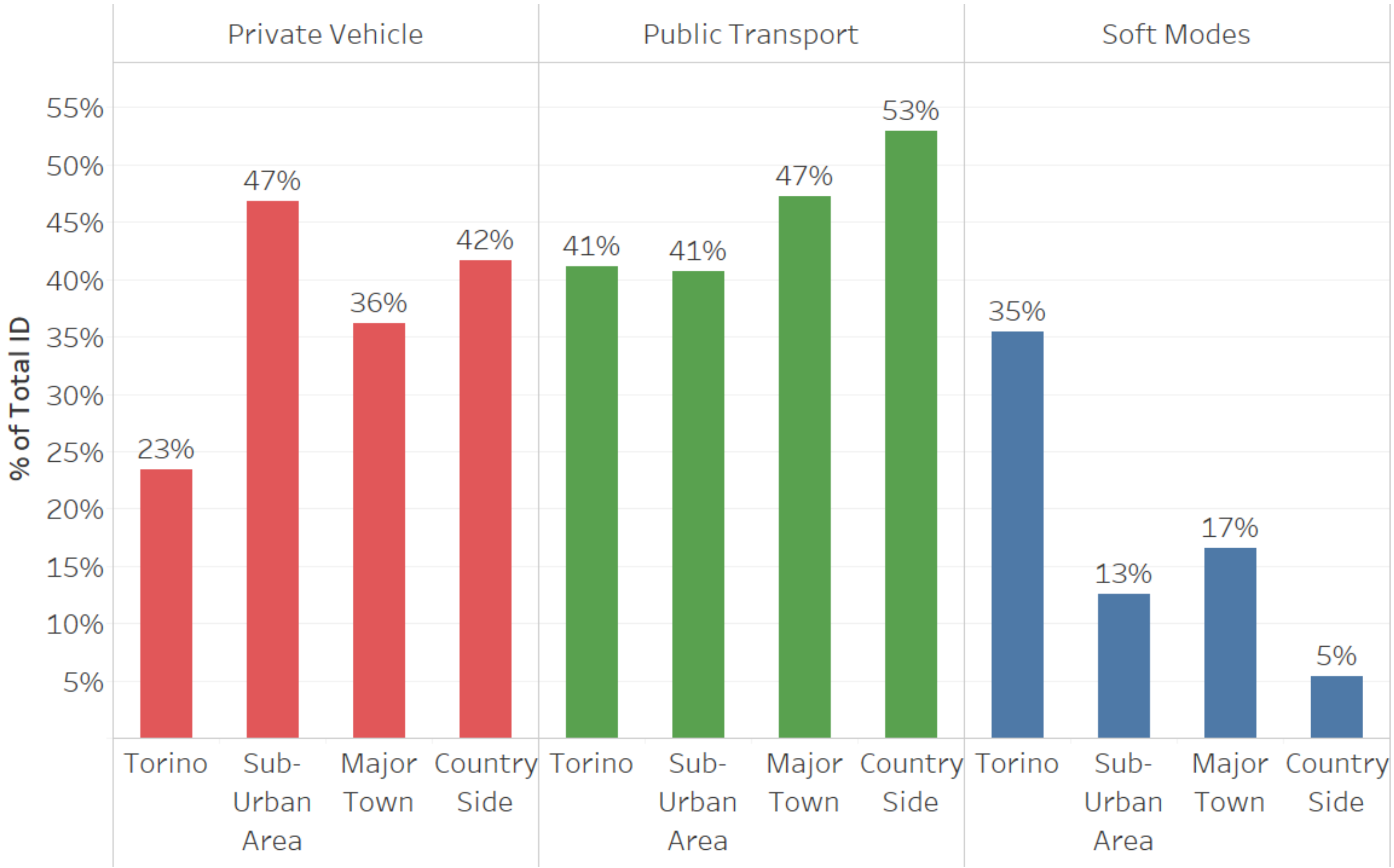


Figure 49 – Distribution of used modes of transport.

From Table 50 to Table 53, the values are classified by mode of transport, gender and sectors of the study area. For each of them the comparison with population in the Piedmont region is shown.

Table 50: **Female Students' used modes of transport.**

| **Sectors** | **Private Vehicle** | **Public Transport** | **Soft Modes** | **Private Vehicle** | **Public Transport** | **Soft Modes** |
|---|---|---|---|---|---|---|
| | **In the Sample** | | | **Sample – Study area** | | |
| Torino | 9% | 45% | 46% | -17% | 9% | 8% |
| Suburbs | 34% | 50% | 16% | -11% | 21% | -10% |
| Other Major Towns | 30% | 60% | 9% | -15% | 38% | -24% |
| Countryside | 25% | 68% | 7% | -21% | 34% | -14% |
| **Piedmont** | **17%** | **52%** | **31%** | **-25%** | **20%** | **5%** |

In the sample Soft Modes are less used than in the global population. The reason is due to university students have cover a higher distance than students of primary, secondary and high schools.

Table 51: **Male Students' used modes of transport.**

| **Sectors** | **Private Vehicle** | **Public Transport** | **Soft Modes** | **Private Vehicle** | **Public Transport** | **Soft Modes** |
|---|---|---|---|---|---|---|
| | **In the Sample** | | | **Sample – Study area** | | |
| Torino | 7% | 55% | 38% | -21% | 22% | -1% |
| Suburbs | 29% | 58% | 14% | -17% | 32% | -14% |
| Other Major Towns | 19% | 65% | 16% | -26% | 45% | -19% |
| Countryside | 31% | 64% | 5% | -15% | 32% | -17% |
| **Piedmont** | **18%** | **59%** | **24%** | **-25%** | **29%** | **-4%** |

In the sample, on private vehicle use females and males are equal. The females prefer more soft modes (+7%) than males.

Table 52: **Used modes of transport for Female Not-Students.**

| Sectors | Private Vehicle | Public Transport | Soft Modes | Private Vehicle | Public Transport | Soft Modes |
|---|---|---|---|---|---|---|
| | In the Sample | | | Sample – Study area | | |
| Torino | 39% | 28% | 33% | -8% | -7% | 15% |
| Suburbs | 64% | 24% | 12% | -10% | 9% | 1% |
| Other Major Towns | 42% | 37% | 21% | -23% | 28% | -5% |
| Countryside | 54% | 41% | 5% | -23% | 36% | -12% |
| **Piedmont** | **47%** | **31%** | **22%** | **-22%** | **18%** | **4%** |

From Table 52, the main difference with female students is more relevant use of private vehicles. The gap between sample and population has inferior magnitude than with female students in each sectors of study area.

Table 53: **Used modes of transport for Male Not-Students.**

| Sectors | Private Vehicle | Public Transport | Soft Modes | Private Vehicle | Public Transport | Soft Modes |
|---|---|---|---|---|---|---|
| | In the Sample | | | Sample – Study area | | |
| Torino | 31% | 41% | 29% | -35% | 22% | 15% |
| Suburbs | 54% | 37% | 9% | -29% | 29% | 1% |
| Other Major Towns | 40% | 44% | 16% | -35% | 37% | -2% |
| Countryside | 50% | 46% | 5% | -30% | 42% | -9% |
| **Piedmont** | **40%** | **42%** | **19%** | **-37%** | **34%** | **5%** |

On the other hand, for male the dissimilarity between sample and population increases respect with to male students, especially for private vehicle (-25% in Table 51 vs -37% in Table 53). This dissimilarity between student and adult suggests that males prefer car to other alternatives: just they can, they change towards car.

The web-questionnaire was answered more by who travel by public transport and who work in Torino. This result increases the gap between population and sample, notably for males.

In the sample, the total number of owned cars is 7,233 and the car average value per capita is equal to 0.63. This value is very similar to one of population (0.68). Among sectors of study area there are some differences, as shown in Table 54.

Table 54: **Owned cars per capita in the sample and population.**

| | Owned cars per capita | | |
|---|---|---|---|
| **Sectors** | **In the sample** | **In the population** | **Difference** |
| Torino | 0.57 | 0.65 | -0.08 |
| Suburbs | 0.67 | 0.65 | 0.02 |
| Other Major Towns | 0.67 | 0.67 | 0.00 |
| Countryside | 0.73 | 0.68 | 0.05 |
| **Piedmont** | **0.63** | **0.68** | **-0.05** |

Not considering Torino, the other sectors are very comparable with the population. In Torino, the sample differs from the population. However, both in sample and in population, in Torino, there is the lowest density of car ownership, while the highest is recorded in countryside.

### 3.2.3. Sample Representativeness

From analyses of the previous paragraphs, the sample is not representative of the population, because all variables describe important differences between sample and population. In addition, the sample convenience one, but biased due to the voluntary choice to participate to the survey. For these reasons any inferential statistics from sample to population is not possible. However, this was not purpose of the thesis because the objective is the understanding of individual cognitive mechanism, which lead the decision-making about the modes of transport. Thus, the expected results are not inferential statistic about the population, but the research of new psycho-social profiles, based on different attitudes, which explain the individual choice of transport mean.

For example, in the sample the gender balance is not consistent respect to the population for some sectors of study area (Suburbs and Countryside). In addition, age distribution shows very important differences with population and the income per household is higher than that of the population (+2,100 €, +6,2%). Notable deviations are also observed in the educational level, where the sample has large values of graduates. Furthermore, the analysis of household size explains that in the sample there are larger households than in the population. Last the used mode of transport confirms the analyses from other variables: the sample does not accurately represent the population.

This inconsistency between population and sample is due to the survey administration: it did reach very well some targets (workers in Torino from any sectors of study area and university students), but it failed towards other people, like retired people, unemployed, workers in countryside, housewife, etc.

The hypothesis to use some subsamples is rejected because not solving the dissimilarities with the population. For instance, in paragraph 3.2.1, a spatial subsample is studied: the reduction from whole Piedmont area to one of *Città Metropolitana di Torino* does not provide a subsample which properly represents the population from the spatial point of view.

Other subsamples are considered: excluding students or only workers, but also in these cases the population are not precisely described. Only sub-sample of university students properly covers this target of the population.

However, all data are important: their analysis could carry out very profitable results, because they are a mine of information. Indeed, a so large sample on attitudes about transport is very rare, even unique in academic context.

In the next analyses, the sample will be divided in two subsample according to this description:

- only Students: named *Stud_Q1*, with 1482 respondents for part A and *Stud_Q1+Q2* with 455 for part B;
- all other respondents: *Adult_Q1,* with 2587 answers for part A and *Adult_Q1+Q2* with 839 for part B.

In this way, all the answers are utilised and the most relevant subsamples are taken into account.

In this section and in the next one a global overview of the sample is given, without taking into account the two subsamples (Students and Adults). During the profile construction (section 3.6) the analysis where students and adults are separately evaluated is reported.

## 3.3. Descriptive Analysis

In this paragraph a general description of the results is provided, so that the profiles from the market segmentation based on attitudes can be compared with the average of all respondents.

All information is split in two sections:

- the first one presents the mobility patterns, general and those related to the most important trip;
- the second one focuses on attitudes and preferences reported by respondents.

### 3.3.1. Mobility Patterns

The mobility patterns are described through the trip purposes over the week, the most important purpose, the modes of transport used over the week and the features of the most important trip.

**Trip Purposes over the week**

The variable named *PurposeMostImpo* investigates options for which reasons people travel along the week and which is the frequency. The work and school trips have the highest frequency during the week: approximately they occur five times per week or more. Errands and leisure purposes have an average frequency (1-3 times per week).

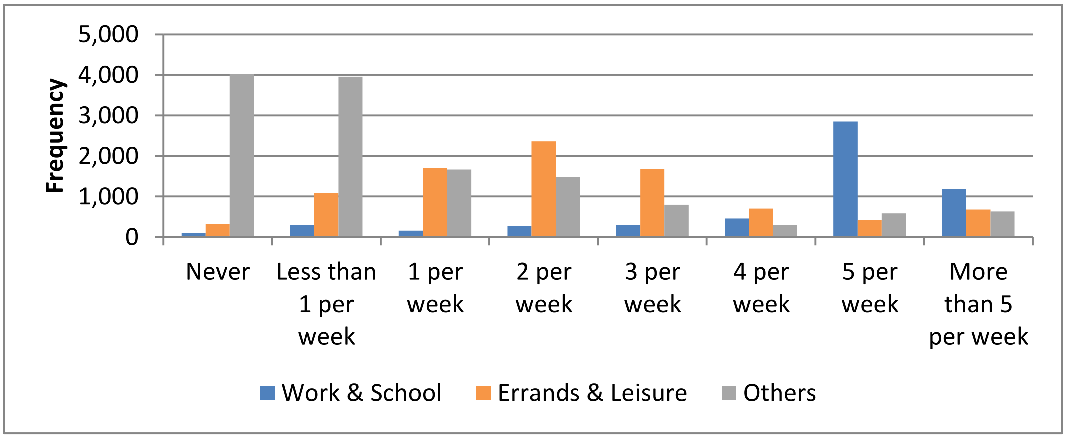


Figure 50 – Trips per purpose during a week.

For the 86% of respondents, the most important trip is also the most frequent one. Work and school are the two most important purposes (Figure 51).

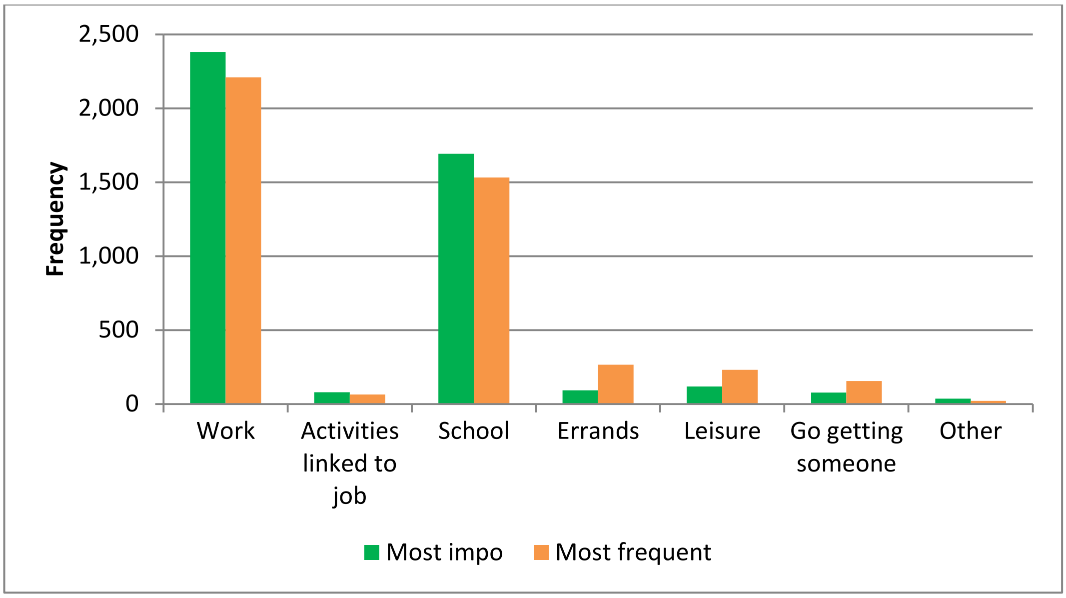


Figure 51 – Purpose of the most important and the most frequent trip.

However, the most important trip does not reach the majority of the week trips (Table 55).

Table 55: **The most important trip frequency over the week.**

| Most important trip purposes | N° answers | Mean percentage of most important trip frequency over the week |
|---|---|---|
| Work | 2380 | 44% |
| Activities linked to job | 80 | 27% |
| School | 1692 | 46% |
| Errands | 93 | 36% |
| Leisure | 118 | 38% |
| Go getting someone | 76 | 34% |
| Other | 35 | 24% |
| **Total** | **4.474** | **44%** |

### Modes of transport used

In Figure 52 the frequency of transport modes used during the week for two categories of trip purpose are reported. People prefer to choice PT (tram, urban bus, train, etc.) or a multimodal chain more for work or school than for errands, leisure or getting someone. The reason could be the flexibility and comfort needs, that nowadays PT does not adequately provide.

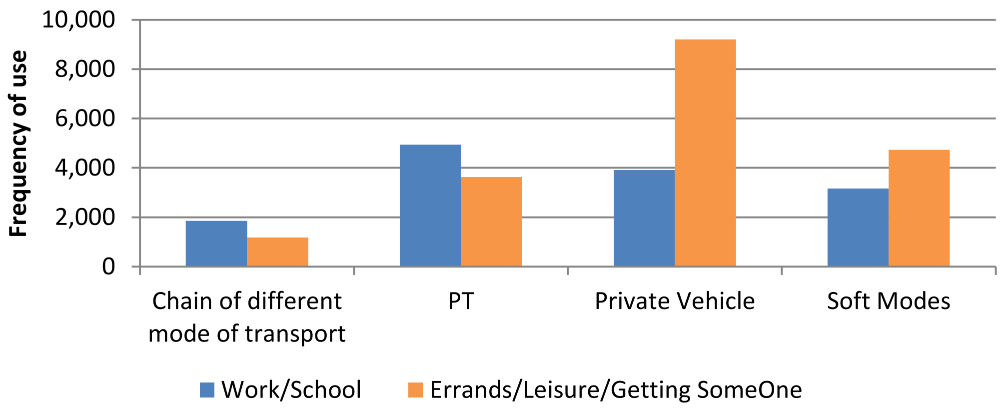


Figure 52 – Modal share for trip purpose.

The regional train is mainly chosen for work, activities related to job or school: they are the 75% of the train trips (Figure 53). Conversely, the use of car is higher for trips which require elevated level of comfort and flexibility, confirming what observed above.

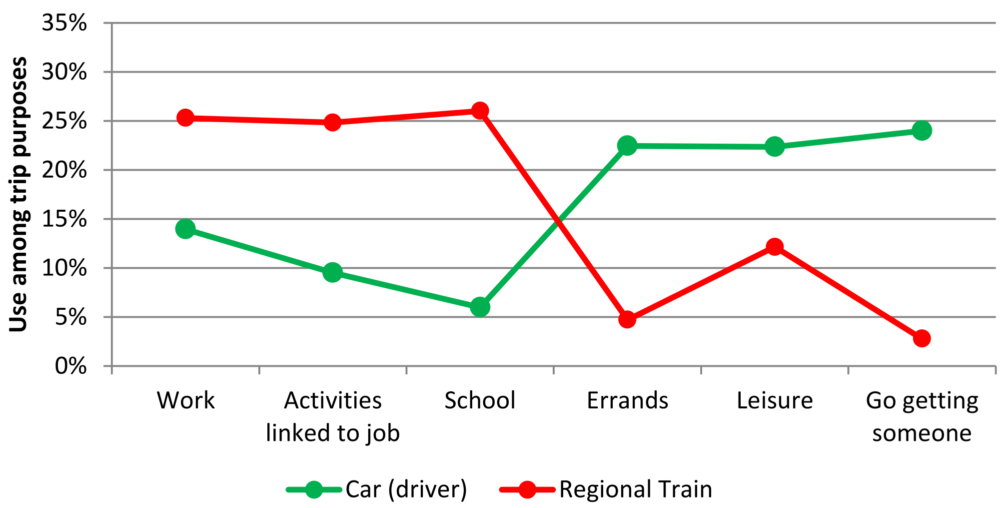


Figure 53 – Car as driver use versus regional train among trip purposes.

As observed in Table 55, the number of work or school trips is less than 50% of week trips. Then the PT improvement to increase their attractiveness for other trip purposes is fundamental to change travellers' habits and, consequently, to reduce mobility impacts.

The most important trip is described through: transport modes used in the most important trip, declared travelled distance, perceived travel time, average speed, trip monthly cost and parking (availability and cost). The transport modes used in the most important trip are presented in Figure 54. As anticipated in paragraph 3.2.2, the sample has a large component of PT users (train, bus, metro, etc.). Indeed, the first transport mode is the multimodal chain: the 51% of means in these chains are PT, followed by foot (27%); only 17% use the car (driver and passenger).

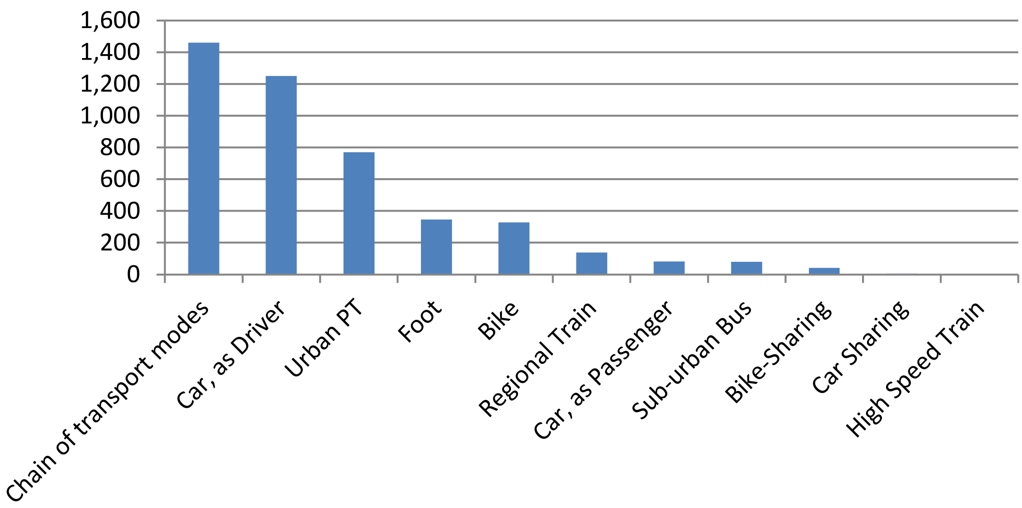


Figure 54 – Used mode of transport.

Potential modal shift is investigated on Likert scale from 1 to 6 (from "Not important" to "absolutely important"). Table 56 reports respondents who sometimes change their transport modes. The multimodal chain and train show similar values: people could leave them if punctuality, higher speed or flexibility are requested or in case of strikes. Urban and suburban public transport are very similar, but for them being on time is less important. Car driver could renounce to their private vehicles only for saving money or reducing environmental impacts. Instead for car passengers only the unavailability of a ride could change their choice. Finally, the soft modes are influenced only from weather conditions, except for the bike sharing, where the bike availability plays an important role.

Table 56: **Reasons to change mode of transport.**

| I change my habitual Mode of Transport… | My habitual Mode of Transport: Multimodal chain | Car, Driver | Car, Passenger | Train | Urban PT | Sub Urban PT | Bike | Bike Sharing | Foot |
|---|---|---|---|---|---|---|---|---|---|
| … when I have an important appointment and I must be on time | **2.8** | 1.8 | 2.1 | **3.6** | 3.0 | 2.6 | 1.6 | 2.4 | 3.0 |
| … to reduce my environment impacts | 2.2 | **3.2** | 2.3 | 1.6 | 2.4 | 1.8 | 1.3 | 1.5 | 1.8 |
| … to save money | 2.5 | **3.1** | 2.4 | 2.6 | 2.2 | 2.6 | 1.3 | 1.5 | 1.6 |
| … to be faster | **3.4** | 2.2 | 1.9 | **3.4** | **4.1** | **4.1** | 2.1 | 2.6 | **3.9** |
| … for adverse weather condition | 2.4 | 2.9 | 2.4 | 2.5 | 2.9 | 1.8 | **5.2** | **4.9** | **3.7** |
| … for my personal preference | 2.5 | 2.7 | 2.6 | 2.1 | 2.7 | 2.4 | 2.5 | 2.0 | 3.1 |
| … for its unavailability [strike, vehicles not available, etc.] | **3.7** | 3.1 | **4.4** | **4.0** | **4.3** | **3.9** | 2.5 | **4.1** | 1.9 |
| … to have more flexibility for participation to successive appointments (dinners, etc.) | **3.1** | 2.1 | 2.7 | **4.1** | **3.6** | **4.1** | 3.0 | 2.7 | 3.1 |

The respondents were asked to declare their perceived travel time and the distance which they think to travel. In Figure 56 and Figure 55 the distributions of distances and travel time of the whole sample are reported.

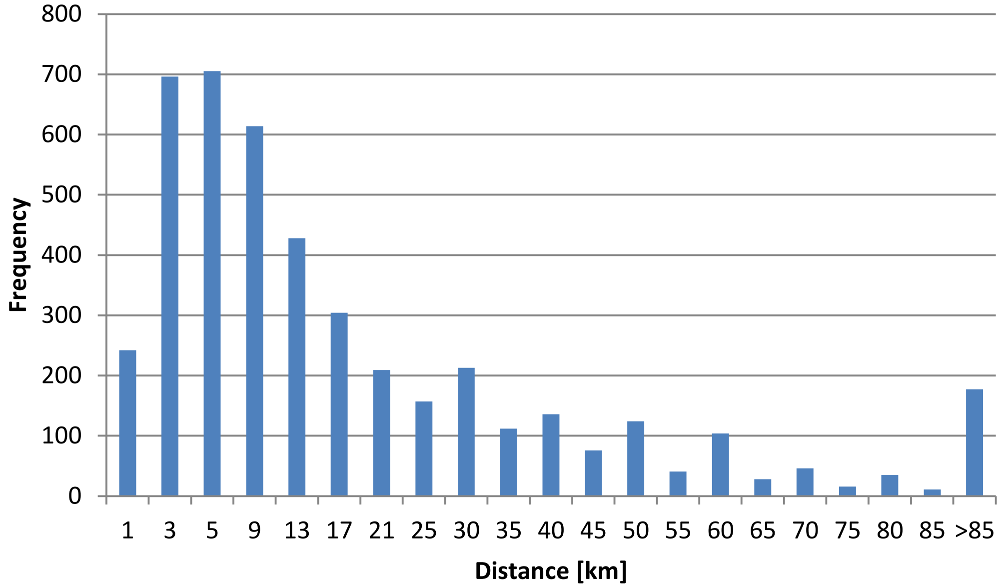


Figure 55 – The distribution of declared distance.

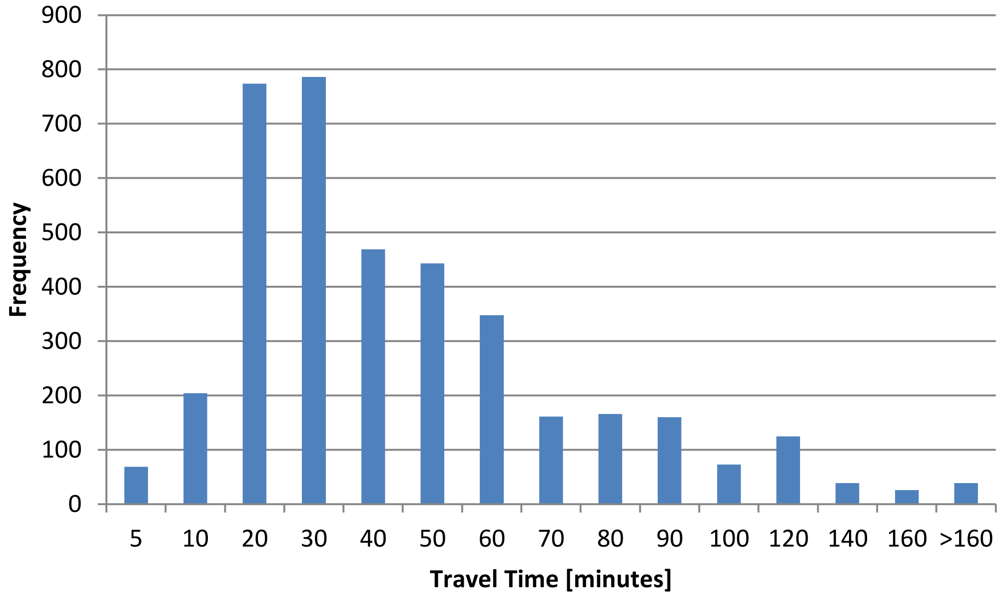


Figure 56 – The distribution of perceived travel time.

The analysis for each mode of transport reveals that people sometime misperceive some attributes of their trip (Table 57). The average speed by foot is so high, that travelling by foot is faster than by bike. The speed by bus is very low, the lowest speed of all modes of transport, while the car is the third fastest mode, after high-speed and regional trains.

The monthly cost of the most important trip is much different among the transport modes. The differences between the minimum and maximum is around 282 €, as reported in Table 57. The most expensive mode of transport is the high-speed train, followed by car sharing and car (as driver). The soft modes are very cheap, but their convenience is less evident looking at cost/km. The regional and high speed train have the cheapest cost/km after the soft modes.

Table 57: **Distances and Travel Time for each modes of transport.**

| **Code** | **Mode of transport** | **Travel Time [minutes]** | **Distance [km]** | **Average Speed [km/h]** | **Monthly Cost [€]** |
|---|---|---|---|---|---|
| 1 | Chain of transport modes | 70 | 32 | 28 | 69.74 |
| 2 | Car, as Driver | 36 | 24 | 40 | 92.10 |
| 3 | Car, as Passenger | 31 | 22 | 43 | 38.65 |
| 4 | Regional Train | 65 | 62 | 57 | 71.61 |
| 5 | Urban PT | 38 | 6 | 10 | 36.33 |
| 6 | Sub-urban Bus | 73 | 32 | 27 | 61.60 |
| 7 | Car Sharing | 21 | 5 | 15 | 82.00 |
| 8 | High Speed or Intercity Train | 128 | 217 | 101 | 286.67 |
| 9 | Bike | 21 | 4 | 12 | 4.16 |
| 10 | Bike-Sharing | 20 | 4 | 12 | 3.84 |
| 11 | Foot | 22 | 6 | 16 | 3.84 |
| | **All respondents** | **46** | **22** | **29** | **59.46** |

In Table 58, the frequency of the activities done during the trip are reported. The answers are given on a Likert scale, from 1 (“never”) to 6 (“always”).

Table 58: **Activities during the most important trip.**

| Activities | On car | On Board PT | By Soft modes |
|---|---|---|---|
| Surfing Social Network | 1.4 | 3.3 | / |
| Listening Music | 4.9 | 3.4 | 3.1 |
| Relaxing | 3.0 | 2.9 | 3.5 |
| Thinking | 4.2 | 4.3 | 4.5 |
| Admiring landscape | 3.0 | 3.6 | 4.0 |
| Calling | 2.1 | 2.5 | 2.5 |
| Talking with friends | 2.3 | 2.7 | 2.3 |
| Talking with strangers | / | 1.7 | / |
| Working | / | 2.3 | / |
| Reading | / | 3.1 | / |
| Watching movies | / | 1.3 | / |
| Chatting message | / | 3.5 | / |

The most common activity in a car is “listening music”, followed by “thinking”. On board of PT, there are several activities recording high frequency: “thinking”, “admiring landscape”, “chatting message”, “listening music” and “surfing social network”. Finally, during a trip by soft modes the most frequent activities are “thinking”, “admiring landscape” and “relaxing”. These results confirm that:

- PT allows more social activities; social network and smartphone are preferred to personal contacts with other passengers;
- soft modes, allows relaxing;
- car, does not favour relax and communication.

The last important features of the most important trip are the characteristic of parking, its availability and cost, described on a Likert scale (from 1 “very low” to 6 “very high”). The answers vary among transport modes, as shown in Table 59. Car drivers are characterised by very high availability and low cost of parking.

Table 59: **Parking unavailability and cost.**

| | | Near origin | | Near destination | |
|---|---|---|---|---|---|
| **Code** | **Mode of transport** | **Unavailability** | **Cost** | **Unavailability** | **Cost** |
| 1 | Chain of transport modes | 2.8 | 1.9 | **3.8** | **3.6** |
| 2 | Car, as Driver | **1.9** | **1.6** | **2.5** | **2.0** |
| 3 | Car, as Passenger | 2.7 | 1.8 | **3.4** | 2.4 |
| 4 | Regional Train | 2.8 | 2.2 | **3.9** | **3.8** |
| 5 | Urban PT | **3.4** | 2.4 | **4.2** | **4.0** |
| 6 | Sub-urban Bus | 2.8 | 1.7 | **3.8** | 3.1 |
| 9 | Bike | 3.3 | 2.2 | **3.6** | 3.1 |
| 10 | Bike-Sharing | **3.9** | 2.8 | **4.1** | 3.3 |
| 11 | Foot | **3.7** | 3.1 | **4.0** | **3.7** |

### 3.3.2. Attitudes and preferences

The web-questionnaire has investigated attitudes and preferences about: satisfaction about used transport mode, willingness to pay, stated determinants of mode choice, ignorance indices, attitudes towards Autonomous Vehicles, perceived quality on board PT, more car use, more bike use, relationship with car.

#### Satisfaction about used transport mode

The satisfaction about the most important trip is analysed through twelve questions about speed, safety, security, cheapness, etc. As shown in Table 60, the highest overall satisfaction is related to car, while the lowest to public transport, with just an exception: the high-speed/long distance trains, which are in the fourth position. In the Table 61 the details about satisfaction of all modes are depicted.

Table 60: **Overall satisfaction.**

| Code | Mode of transport | Overall satisfaction |
|---|---|---|
| 3 | Car (passenger) | 5.0 |
| 2 | Car (driver) | 4.9 |
| 7 | Car-sharing | 4.8 |
| 8 | High-Speed/Long Distance Trains | 4.6 |
| 9 | Bike | 4.5 |
| 11 | By foot | 4.4 |
| 10 | Bike Sharing | 4.0 |
| 4 | Regional Trains | 3.8 |
| 1 | A sequence of mode of transport | 3.8 |
| 5 | Metro/Tram/Bus | 3.7 |
| 6 | Sub-urban bus | 3.7 |
| | Average | 4.2 |

Table 61 – **Satisfaction of each transport modes in the most important trip.**

| | **Your judgement on transport mode of the most important trip** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Cheap** | **Eco-friendly** | **Fast** | **Safe** | **Secure** | **Flexible** | **Reliable** | **Comfort able** | **Free-Time during travel** | **Bring something with you** | **Take/ Bring someone** | **Likeable** |
| **Chain of transport modes** | 3.6 | 4.2 | 3.0 | 3.7 | 3.3 | 3.1 | 3.1 | 3.0 | 3.1 | 3.7 | 2.5 | 3.2 |
| **Car, as Driver** | 3.6 | 3.3 | 4.6 | 3.2 | 4.7 | 5.0 | 4.6 | 4.8 | 2.8 | 5.3 | 5.0 | 4.5 |
| **Car, as Passenger** | 4.4 | 3.3 | 4.7 | 3.2 | 4.7 | 4.7 | 4.6 | 5.1 | 3.8 | 5.4 | 5.1 | 4.5 |
| **Regional Train** | 3.5 | 4.8 | 3.0 | 4.4 | 3.3 | 2.4 | 2.9 | 2.8 | 3.6 | 4.2 | 2.3 | 3.2 |
| **Urban PT** | 4.0 | 4.3 | 2.8 | 4.1 | 3.3 | 2.9 | 3.0 | 2.5 | 2.9 | 3.5 | 2.6 | 3.2 |
| **Sub-urban Bus** | 2.9 | 3.2 | 2.5 | 3.7 | 4.0 | 2.2 | 3.0 | 3.1 | 3.2 | 3.7 | 1.9 | 2.9 |
| **Car Sharing** | 3.0 | 4.0 | 4.6 | 3.4 | 4.0 | 5.2 | 4.2 | 4.8 | 2.0 | 5.4 | 4.8 | 4.8 |
| **High Speed Train** | 3.0 | 5.3 | 5.0 | 4.7 | 5.0 | 2.3 | 4.7 | 4.3 | 4.7 | 4.3 | 1.7 | 4.0 |
| **Bike** | 5.9 | 5.9 | 5.0 | 2.7 | 3.7 | 5.3 | 5.3 | 4.2 | 3.1 | 3.5 | 1.8 | 5.5 |
| **Bike-Sharing** | 5.3 | 5.9 | 4.3 | 3.1 | 3.6 | 4.7 | 3.8 | 3.3 | 2.1 | 3.3 | 1.4 | 4.9 |
| **Foot** | 5.9 | 5.8 | 3.7 | 4.0 | 3.4 | 4.7 | 5.1 | 3.9 | 3.5 | 3.6 | 2.7 | 4.8 |
| **Average** | **4.0** | **4.2** | **3.6** | **3.6** | **3.8** | **3.9** | **3.8** | **3.6** | **3.0** | **4.1** | **3.2** | **3.9** |

The environmental sustainability is the aspect which more satisfies travellers. This high score is due to the high satisfaction of the soft modes, but also to the not-strict judgement of car users. Indeed, the environmental satisfaction of car driver is slightly higher than that of recorded about Suburban PT Users.

The worst score is recorded about the free time during the trip. The PT users do not perceive as free their time on board or they do not enjoy so much it, except in the high-speed train (4.7, the highest value). Even the car passengers are more pleased about their travel time than train travellers (3.8 vs 3.6). The sharing mobility record the lowest scores: 2.0 for car sharing and 2.1 for bike sharing, much less than car driver (2.8) or cyclists using their bike (3.1). Maybe, the fares based on time spent travelling are source of stress for users.

Another relevant result is the satisfaction about safety. It is very low for soft modes (especially for bike and bike sharing). For car users it is modest, but not extremely low. In addition, there is not a big difference with PT: only 1.2, while for speed o for flexibility it is close, respectively, 2.0 and 2.5.

The strengths of car are:

- perceived speed;
- personal security;
- reliability and flexibility;
- comfortable, possibility to bring something;
- possibility to bring/take someone somewhere.

The weakness is related to the low free time on board. For drivers, the environmental sustainability is not a key-factor (in average), neither the cost, which shows almost the same level of satisfaction of train tickets.

For PT, the areas for improvements are mainly in flexibility, reliability (punctuality) and comfort on board. These elements are more required than speed increase. The low environmental impacts and safety are the strengths of PT, not the cheapness or the free time on board.

If the PT and car are complementary, the soft modes are very different. They have the maximum scores on cheapness and environmental impacts, but they are also the most favourite mode of transport, because their users love them (until 5.5 of 6.0 for bike). The problem of soft modes is the safety: their scores are very low, except for foot.

### Willingness to Pay

The monthly Willingness To Pay (WTP) for reducing Green House Gas (GHG) emissions and saving time is analysed. In Table 62, a correlation between satisfaction and willingness to pay emerges. In fact, especially among PT and car users, low values of satisfaction match with higher WTP.

Table 62: **Willingness to pay (WTP) [€/month].**

| Code | Mode of transport | Speed satisfaction | WTP to save time | Ecological satisfaction | WTP to reduce GHG emission |
|---|---|---|---|---|---|
| 1 | Chain of transport modes | 3.0 | 13.19 € | 4.2 | 9.58 € |
| 2 | Car, as Driver | 4.6 | 10.47 € | 3.3 | 13.77 € |
| 3 | Car, as Passenger | 4.7 | 9.10 € | 3.3 | 12.92 € |
| 4 | Regional Train | 3.0 | 14.97 € | 4.8 | 8.67 € |
| 5 | Urban PT | 2.8 | 5.82 € | 4.3 | 6.72 € |
| 6 | Sub-urban Bus | 2.5 | 9.50 € | 3.2 | 6.08 € |
| 7 | Car Sharing | 4.6 | 3.75 € | 4.0 | 2.00 € |
| 8 | High Speed Train | 5.0 | 53.33 € | 5.3 | 16.67 € |
| 9 | Bike | 5.0 | 2.74 € | 5.9 | / |
| 10 | Bike-Sharing | 4.3 | 2.18 € | 5.9 | / |
| 11 | Foot | 3.7 | 4.05 € | 5.8 | / |
| | Average | 3.6 | 9.67 € | 4.2 | / |

### Determinants of mode choice

A list of possible determinants of mode choice is presented to respondents asking to evaluate the importance of each factor with a Likert scale from 1 (“not important”) to 6 (“very important”). The results are reported in Table 63.

The descriptive analysis shows that cars all appreciated for their speed, reliability, security and pleasure. “I feel more free” is very correlated to flexibility and car score confirms what observed in the previous section. Awareness of environmental impacts and risk of accidents from car use emerge: indeed, from this point of view car drivers or car passengers record the lowest scores together with car sharing. Maybe people are aware of the risk about safety and environmental consequences, but they accept them and the satisfaction is not much affected.

The PT is chosen for its cheapness, environmental sustainability and safety, even though it does not get scores high like car or soft modes. The worst scores are recorded for the suburban buses.

The users of soft modes know to have alternatives, but they like very much them and the related scores are very high.

Table 63 – Determinants of mode choice.

| I chose this MoT because… | Chain of transport modes | Car, as Driver | Car, as Passenger | Regional Train | Urban PT | Sub-urban Bus | Car Sharing | High Speed Train | Bike | Bike-Sharing | Foot |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ...I have no alternatives | 3.5 | 3.6 | 2.9 | 3.3 | 3.2 | 4.1 | 1.4 | 4.7 | 1.7 | 1.9 | 2.1 |
| ...It is the cheapest | 3.7 | 3.0 | 3.3 | 4.1 | 3.9 | 3.4 | 2.8 | 2.3 | 5.4 | 4.9 | 4.8 |
| ... It is the fast | 3.6 | 5.3 | 5.0 | 3.8 | 3.1 | 2.3 | 5.0 | 4.7 | 5.4 | 4.7 | 4.4 |
| ... It is least pollutant | 3.5 | 2.2 | 2.2 | 4.1 | 3.8 | 2.8 | 2.2 | 3.3 | 5.7 | 5.0 | 5.0 |
| ... It is the safest | 3.4 | 2.5 | 2.5 | 4.3 | 3.9 | 3.4 | 1.8 | 4.3 | 2.4 | 2.4 | 3.4 |
| ... It is the most secure | 2.7 | 4.0 | 4.0 | 2.7 | 2.5 | 2.9 | 2.6 | 4.7 | 3.1 | 2.8 | 2.6 |
| ... It is the most on time | 2.8 | 5.0 | 4.5 | 2.3 | 2.3 | 2.6 | 4.6 | 4.0 | 5.2 | 4.0 | 4.4 |
| ... I like it | 3.3 | 4.4 | 4.5 | 3.3 | 3.1 | 2.9 | 4.4 | 4.0 | 5.7 | 5.0 | 5.0 |
| ... I feel more free | 3.4 | 5.3 | 4.9 | 3.1 | 3.1 | 2.7 | 4.8 | 4.3 | 5.5 | 5.0 | 4.9 |
| ... I like the contact with landscape | 2.8 | 3.0 | 3.4 | 3.1 | 2.5 | 2.7 | 3.8 | 1.7 | 4.8 | 4.7 | 4.3 |
| ... I care just to arrive at destination. | 3.0 | 2.6 | 3.2 | 3.2 | 3.2 | 3.3 | 2.6 | 3.7 | 2.1 | 2.7 | 3.1 |

### Ignorance Indices

The respondents answered to one question about each mode of transport, that allowed to calculate some indicators reported in Table 64 and explained in Table 34 in section 3.1.

Table 64: **Ignorance indices.**

| Mode of transport | Ignorance PT | Ignorance Train | Ignorance Bike Sharing | Ignorance Car Sharing | Ignorance Private Car |
|---|---|---|---|---|---|
| Chain of transport modes | -0.05 | 0.01 | 0.04 | 0.01 | 0.03 |
| Car, as Driver | 0.19 | 0.08 | 0.04 | 0.03 | -0.14 |
| Car, as Passenger | 0.27 | 0.18 | 0.34 | -0.16 | 0.62 |
| Regional Train | 0.70 | 0.01 | 0.28 | 0.21 | 0.16 |
| Urban PT | -0.16 | 0.00 | -0.06 | -0.01 | 0.15 |
| Sub-urban Bus | 0.26 | 0.06 | 0.06 | 0.13 | 0.02 |
| Car Sharing | -0.26 | 0.22 | -0.14 | -0.38 | -0.18 |
| High Speed Train | -0.26 | -0.04 | 1.34 | 1.06 | -0.32 |
| Bike | -0.22 | -0.25 | -0.29 | -0.17 | -0.17 |
| Bike-Sharing | -0.25 | -0.24 | -0.42 | -0.15 | 0.01 |
| Foot | -0.25 | -0.15 | -0.05 | -0.06 | -0.02 |

In Table 64 negative values are sign of good knowledge, because the indicators are normalised and a negative sign means an un-accuracy lower than average. Users are well-informed only about own used mode. For instance, car drivers are always positive except for the Ignorance Private Car gasoline (based on gasoline price). Users of soft modes are those more aware because they have negative sign for all modes of transport.

### Attitudes towards Autonomous Vehicles

The attitudes towards Autonomous Vehicles (AV) are investigated through the activities which travellers would like to perform on board. The answers are collected on Likert scale from 1 (“never”) to 6 (“always”) (Table 65).

Table 65: **Activities on AV.**

| Activities | Car Users | PT Users | Soft Mode Users |
|---|---|---|---|
| Working/Studying | 2.7 | 2.5 | 2.5 |
| Reading | 3.6 | 3.0 | 3.4 |
| Admiring landscape | 3.9 | 3.8 | 4.1 |
| Surfing Social Network | 2.7 | 2.7 | 2.7 |
| Listening Music | 4.7 | 4.2 | 4.5 |
| Chatting message | 3.1 | 3.1 | 3.3 |
| Calling | 3.2 | 2.8 | 3.1 |
| Relaxing | 3.8 | 3.4 | 3.7 |
| Talking | 3.3 | 3.2 | 3.7 |
| Watching video/TV series | 2.3 | 1.9 | 2.1 |
| **Average** | **3.3** | **3.1** | **3.3** |

The car users (drivers, car passengers and car sharing users) will use AV only to listen music, admiring landscape or relaxing. Their feeling towards AV is still scarce (just 3.3), but it is the maximum together with that of soft mode users. The car users are the most ready to perform activities with high concentration, like reading or watching TV series. While surfing on social network has equal preference for all groups.

The soft mode users have the same level of openness to AV of car users, but they would like to admire landscape and to talk more than car drivers.

PT users are less geared to take advantage of free time on board of AV: their average score is the lowest one (3.1). The most favourite activities are the same of the car users, but all scores are lower. Maybe, they are used to travel with high level of safety and they need more time to trust to AV.

### Perceived quality of PT services

To all respondents what are the most important PT improvements are asked, through a Likert Scale from 1 (“not important”) to 6 (“very important”) (Table 66).

Table 66: **Most required improvements of PT.**

| Activities | Car Users | PT Users | Soft Mode Users |
|---|---|---|---|
| Lower ticket price | 4.3 | 4.3 | 4.2 |
| More speed of PT services | 5.0 | 4.7 | 4.4 |
| More frequency of PT services | 5.4 | 5.2 | 5.0 |
| More punctuality | 5.3 | 5.3 | 5.0 |
| More comfort on board | 4.7 | 4.5 | 4.3 |
| Introduction of e-ticketing | 4.4 | 4.0 | 4.4 |
| More integration among different transport modes | 4.8 | 4.4 | 4.7 |
| More cleanness on board | 4.8 | 4.5 | 4.4 |
| More security on board | 4.9 | 4.4 | 4.3 |
| **Average** | **4.8** | **4.6** | **4.5** |

Car users record the highest scores (4.8), largely due to bad opinions and prejudices rather than experience. Instead, fewer requests come from soft modes, but each investigated field is considered as needed of improvements (all are major than 4.0).

The PT users are very similar to car users to ask enhancements in speed, frequency and punctuality. Concerning aspects (e-tickets, quality on board, etc.) there is divergence between car and PT users. Finally, the question recording the lowest score is about PT ticket price. Nobody deems that lower ticket price is necessary.

### Attitudes to use more car

PT and soft modes users were asked to evaluate the most important factors which could lead to use more car. The answers are gathered through a Likert Scale from 1 (“not important”) to 6 (”very important”) (Table 67).

Table 67: **Most important factors to use more car.**

| More car use if … | PT Users | Soft Mode Users |
|---|---|---|
| … there was a decrease of fuel price | **3.0** | **2.1** |
| … there was less traffic | 3.1 | 2.2 |
| … there was more safety | 3.5 | 2.6 |
| … I had own car availability | 3.2 | 2.5 |
| … there was an increase of PT Ticket price | 3.7 | 3.4 |
| … I had an Electric Car | 3.5 | 2.4 |
| … there was more park | **4.2** | **3.5** |
| … there was lower park costs | **4.2** | **3.4** |
| Anyway I would keep the current mode of transport | 3.8 | 5.1 |
| **Average** | **3.5** | **2.7** |

The PT users present a higher inclination towards car use than soft mode users (3.5 vs 2.7) confirming the previous analyses, where soft modes are more well-informed about alternatives and they like very much their mode. This trend is corroborated also by the last question: the soft modes users are more decided to maintain the current mode of transport (5.1 vs 3.8).

The fuel price is for both groups the least important factor to induce car choice, while the most significant factors is related to the parking conditions (cost and availability).

The electric car is a potential attractive element for both users; it ranks fourth for PT users and third for soft mode ones.

### Attitudes to use more bike

Car and PT users evaluated what are the most important factors that could shift them towards bike. The answers are collected through a Likert Scale from 1 (“ not important”) to 6 (“very important”) (Table 67). The inclination of car and PT users towards bike is very similar (3.4 and 3.5), but there are some dissimilarities on some specific questions.

Table 68: **Most important factors to use more bike.**

| More bike use if … | Car users | PT Users |
|---|---|---|
| … there was safer route | 3.9 | 4.1 |
| … there was more road traffic | 2.9 | 2.9 |
| … there was less car park | 3.4 | 3.4 |
| … there was an increase of PT Ticket price | 2.6 | 3.1 |
| … I needed more sport | 2.9 | 2.9 |
| … I could have a shower at destination | 3.6 | 3.5 |
| … there was more bike park | 4.1 | 4.2 |
| … there was better air quality | 3.6 | 3.7 |
| Anyway I would keep the current mode of transport | 3.6 | 3.8 |
| **Average** | **3.4** | **3.5** |

### Attitudes towards car

All respondents declared their levels of agreement about some statements referring to their relationship with car. The answers are collected through a Likert Scale from 1 (“I disagree”) to 6 (“I agree”) (Table 69).

Table 69: **Car relationship.**

| Statements | Car Users | PT Users | Soft Mode Users |
|---|---|---|---|
| I like driving | 4.6 | 4.1 | 4.1 |
| I force my-self to keep clean car | 3.5 | 3.6 | 3.3 |
| I prefer to be passenger | 2.6 | 3.3 | 3.1 |
| I like sharing car with friends | 3.4 | 3.7 | 3.9 |
| I like sharing car with unknown | 1.9 | 2.0 | 2.5 |
| I like driving along unknown road | 3.5 | 3.0 | 3.3 |
| I avoid to drive in big cities | 2.9 | 3.8 | 3.8 |
| I avoid to drive during night | 2.4 | 2.7 | 2.6 |
| I drive also after I drank a pint of beer | 2.7 | 2.2 | 2.7 |
| I often passenger of my friends in car | 2.8 | 3.6 | 3.5 |
| I usually drive less than 120 km/h in motorway | 3.2 | 3.5 | 3.4 |
| **Average** | **4.0** | **3.6** | **3.6** |

Car users show the strongest relationship with car (4.0 versus 3.6). However, all groups have a positive attitude to drive a car: all like driving.

Car users show a clear willingness to use alone the car: the lowest values are recorded for sharing the car with unknown people but also with friends; they in any case would not be passengers, but drivers. The car-pooling is very hard to promote among drivers, maybe it is easier for PT users or soft mode ones.

In addition, car users' pleasure from driving is not affected by difficulties and worries about unknown roads, by traffic or low visibility.

## 3.4. Exploratory Factor Analysis

The results of the Exploratory Factor Analysis (EFA) are articulated in three steps:

- data examination, which includes check on data of all requirements to perform an EFA and the subsequent variable selection;
- extraction and Rotation of Factors, where all decisions in each EFA step are described and the final factor structures are shown for the four subsamples;
- factor interpretation, where are retraced the reasoning leading to factor labels are given.

### 3.4.1. Data examination

The initial matrix CxV present all ratio or interval variables, so they respect the minimum requirement to be ordinal (Marradi, 1995).

The normality distribution is tested firstly with Kolmogorov-Smirnov and Shapiro-Wilk tests, but the sub-samples are too large and their distribution does not result normal (Germano, 2015). Then, kurtosis and skewness indices are computed and matched with thresholds, two for skewness and seven for kurtosis (West, Finch, & Curran, 1995). For each sub-samples in Table 70 and in Table 71 the variables with too high kurtosis and skewness are reported. The variables which are not reported in the tables or the omitted values for present variables are those respecting the thresholds.

The strictest index is the skewness, which excludes the highest number of variables. The worst case is in the subsample Adult_Q1+Q2, where 27 variables are rejected (11% of total).

Table 70: **Variables with too severe kurtosis.**

| Code | Name | Stud 1Q | Stud 1Q+2Q | Adult 1Q | Adult 1Q+2Q |
|---|---|---|---|---|---|
| 10 | SustIndexDist_MostImpoTrip | 53.1 | 10.9 | 424.3 | 361.6 |
| 12 | TravelTime | 1426.1 | | | 219.7 |
| 26 | MonthlyCost | | 7.7 | 9.9 | 11.9 |
| 27 | WtP_MoreSpeed | 15.2 | 13.4 | 33.7 | 31.2 |
| 28 | WtP_LessPollutant | 22.2 | 46.4 | 120.3 | 99.2 |
| 40 | Ignorance_PT | 12.2 | 15.5 | 12.6 | 18.5 |
| 42 | Ignorance_BikeSharing | | | 7.4 | 8.2 |
| 43 | Ignorance_CarSharing | 10.9 | 16.1 | 7.3 | 9.0 |
| 44 | Ignorance_PrivateCar | 32.1 | 43.2 | 44.3 | 60.1 |
| 53 | WatchMovies | 14.5 | 14.3 | 38.6 | 42.1 |
| 60 | TalkStranger | 8.3 | | 12.6 | 13.0 |
| 130 | TravelWithoutTickets | | | 8.0 | 8.6 |
| 132 | Recycling | | 8.6 | 16.3 | 28.3 |
| 133 | ReuseShopBag | 7.4 | 9.3 | 9.8 | 11.8 |
| 136 | EnvironOrganActivist | | | | |
| 152 | Kids | 15.6 | | | |
| 176 | AirPollution | | | | 8.4 |
| 178 | FastGate | | 9.7 | | |
| 206 | SeatBelt | | 24.7 | | 64.9 |
| 207 | SafetyHelmet | | 90.3 | | 147.6 |
| 208 | SmartphoneOnFly | | 31.1 | | 96.5 |
| 210 | SubwayStation | | 23.1 | | 35.5 |
| | **Total** | 11 | 15 | 13 | 19 |

Table 71: **Variables with too severe skewness.**

| Code | Name | Stud 1Q | Stud 1Q+2Q | Adult 1Q | Adult 1Q+2Q |
|---|---|---|---|---|---|
| 42 | Ignorance_BikeSharing | 2.5 | 2.5 | 2.6 | 8.2 |
| 43 | Ignorance_CarSharing | 3.5 | 4.0 | 3.0 | 4.5 |
| 44 | Ignorance_PrivateCar | 5.4 | 6.2 | 6.3 | 4.2 |
| 40 | Ignorance_PT | 3.4 | 3.9 | 3.4 | 9.9 |
| 202 | LockhomeDoor | | 2.6 | | -2.4 |
| 206 | SeatBelt | | -4.8 | | -2.7 |
| 207 | SafetyHelmet | | -8.8 | | 2.5 |
| 208 | SmartphoneOnFly | | -5.1 | | 2.4 |
| 210 | SubwayStation | | -4.4 | | -7.5 |
| 214 | TooTrafficBicicle | | | | -11.1 |
| 217 | TVBedroom | | | | -9.1 |
| 26 | MonthlyCost | | 2.3 | 2.6 | 2.9 |
| 49 | Work | | | 2.7 | 2.7 |
| 53 | WatchMovies | 2.6 | 2.3 | 3.1 | 7.3 |
| 53 | WatchMovies | 3.7 | 3.7 | 6.0 | 3.2 |
| 27 | WtP_MoreSpeed | 3.5 | 3.2 | 5.1 | 4.4 |
| 28 | WtP_LessPollutant | 4.0 | 5.3 | 8.7 | 4.6 |
| 128 | GiveSeatElderly | | | -2.0 | 2.4 |
| 130 | TravelWithoutTickets | | | 2.9 | 6.2 |
| 131 | NotCareWaste | 2.1 | 2.2 | 2.2 | 3.0 |
| 132 | Recycling | -2.6 | -2.9 | -4.0 | -2.1 |
| 133 | ReuseShopBag | -2.7 | -2.9 | -3.1 | 3.0 |
| 136 | EnvironOrganActivist | 2.4 | 2.3 | | |
| 152 | Kids | 3.7 | | | |
| 170 | CongestionPollution | | | | 2.3 |
| 176 | AirPollution | | -2.4 | | -5.1 |
| 178 | FastGate | | 3.0 | | -3.4 |
| 10 | SustIndexDist_MostImpoTrip | 5.7 | 2.7 | 18.6 | 16.7 |
| 12 | TravelTime | 37.4 | | | 12.5 |
| | **Total** | 15 | 21 | 16 | 27 |

For each EFA two tests are carried out: the Bartlett's Sphericity test rejects always the hypothesis of identity matrix about the correlation matrix and the Kaiser-Meyer-Olkin Measure of Sampling Adequacy is always equal or over to 0.8, then they are "meritorious" (Kaiser H. F., 1970). The values for the four subsample in the final sub-set of variables are shown in Table 72.

Table 72: **KMO measure of subsample adequacy.**

| Subsample | KMO Measure |
|---|---|
| Stud 1Q | 0.866 |
| Stud 1Q+2Q | 0.796 |
| Adult 1Q | 0.856 |
| Adult 1Q+2Q | 0.861 |

Before to perform the analysis, the balances between variables and observations and between factors and observations have been checked. In Table 73, the ratios for the final subset of variables are shown in relation to the indications from technical literature (see section 2.4.3).

Table 73: **Ratio among observations, variables and factors.**

| | Requirements | Stud 1Q | Stud 1Q+2Q | Adult 1Q | Adult 1Q+2Q |
|---|---|---|---|---|---|
| Sample size | >200 | 1,483 | 458 | 2,587 | 839 |
| Variable/Observations | <1/10 (< 0.10) | 0.02 | 0.07 | 0.01 | 0.05 |
| Factor/Observations | <1/20 (<0.05) | 0.01 | 0.02 | 0.00 | 0.01 |

Some theoretical filters are applied to define the variable set:

- all variables about trip information, like distance and used mode of transport, are excluded from the next steps;
- all personal details, like income, level of education, etc. are left out from EFA.

In this way, the Exploratory Factor Analysis is performed mainly on attitudes and preferences. The other variables will be use later on to describe travellers' profiles.

In addition to the previous selection, the variables with value less than 0.6 on diagonal of Anti-Image Matrix are rejected, because they are not profitable in an EFA.

After this selection, the variables in EFA for each subsample are:

- 101 for Stud 1Q;
- 135 for Stud 1Q+2Q;
- 114 for Adult 1Q;
- 155 for Adult 1Q+2Q.

To reach the final sub-set of variables for each subsample, an iterative process was made on the variables remained after the first selection. The objective is to improve the factor structure. This goal is completed through three actions:

- exclusion of variables with lowest communalities;
- deletion of variables strong correlated to two or more factors;
- rejection of factors which do not have *makers*, variables loading heavily just one factor.

In this way, the analysis carries out a simpler factor structure. After this process, the final subset in EFA for each subsample are composed by:

- 35 variables for Stud 1Q;
- 34 variables for Stud 1Q+2Q;
- 36 variables for Adult 1Q;
- 38 variables for Adult 1Q+2Q.

The list of variables for each subsample is reported in Table 73, Table 7675 and 76.

### 3.4.2. Extraction and Rotation of Factors

To define the number of factors in the EFA, three criteria are employed in synergy: Kaiser criterion, Scree Test and Parallel Analysis.

The analysis of Adult 1Q for the final set of variables is explained. In Figure 57 and in Table 74 the eigenvalues are reported both for EFA and for parallel analysis. Parallel Analysis and Kaiser criterion agree on the same number of factors. In Figure 58 the Scree Test suggests nine factors.

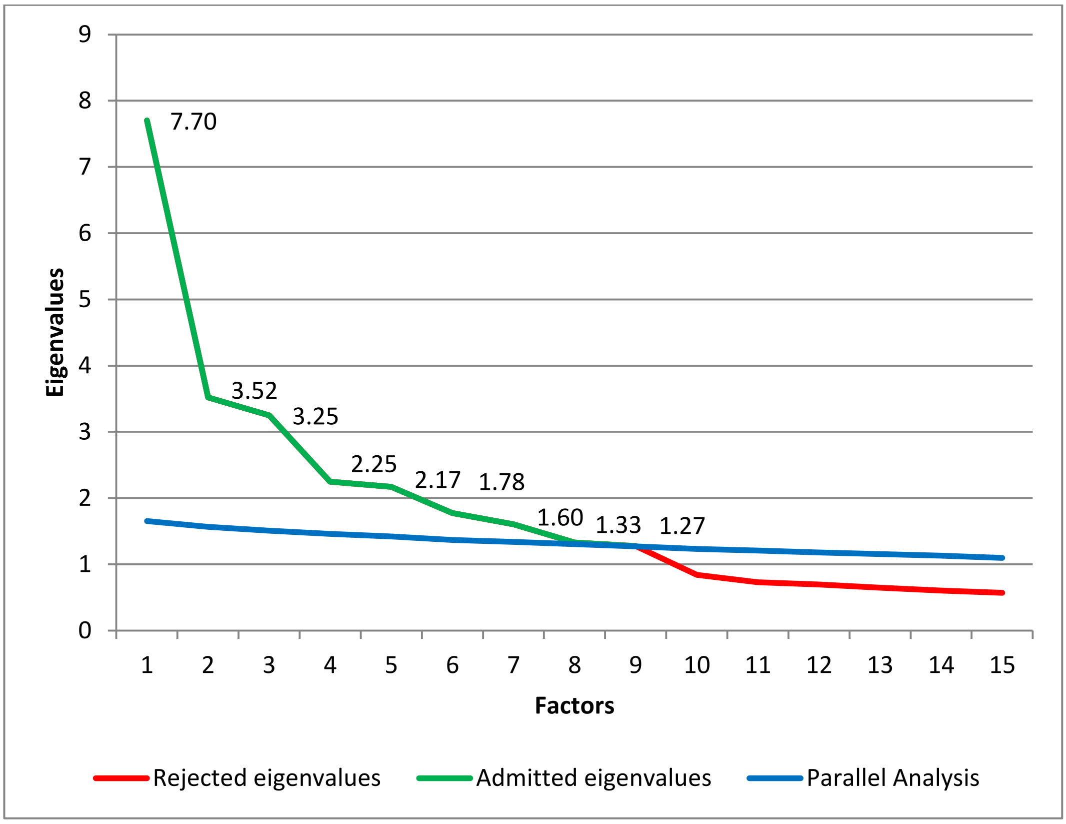


Figure 57 – Admitted Eigenvalues.

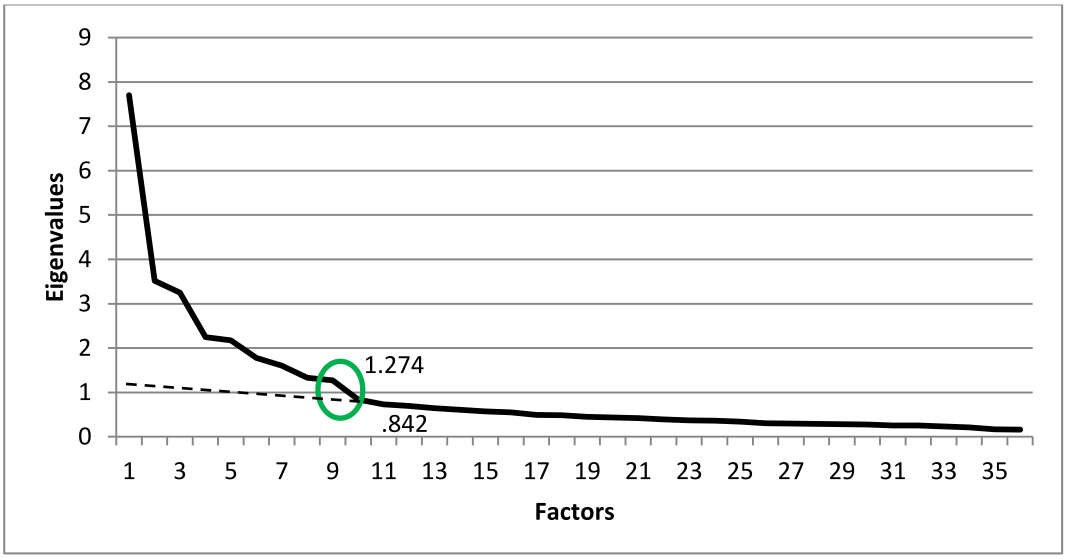


Figure 58 – All Eigenvalues for Adult Q1.

Table 74: **Eigenvalues from EFA and from Parall Analysis for Adult Q1.**

| Number | EFA | Parallel Analysis |
|---|---|---|
| 1 | 7.702 | 1.651 |
| 2 | 3.517 | 1.567 |
| 3 | 3.251 | 1.506 |
| 4 | 2.248 | 1.461 |
| 5 | 2.171 | 1.420 |
| 6 | 1.776 | 1.370 |
| 7 | 1.604 | 1.338 |
| 8 | 1.329 | 1.304 |
| 9 | 1.274 | 1.271 |
| 10 | .842 | 1.232 |
| 11 | .730 | 1.206 |
| 12 | .698 | 1.179 |
| 13 | .646 | 1.153 |
| 14 | .605 | 1.129 |
| 15 | .570 | 1.099 |

Comparable results are obtained through different extraction methods: Unweighted Least-Squares Method, Generalized Least-Squares Method, Maximum-Likelihood Method and Principal Axis Factoring. The final choice is to the last one: Principal Axis Factoring.

After the examination of the three criteria and different extraction methods, the factor numbers for each subsample with the final subset of variables are the following:

- 9 for Stud 1Q;
- 10 for Stud 1Q+2Q;
- 9 for Adult 1Q;
- 8 for Adult 1Q+2Q.

For the Factor Rotation, among the several factor rotation methods, the Direct Oblimin is chosen, as explained in section 2.4.3. It is a *nonorthogonal* method, so correlations about factors are allowed; however, the results show low values of relationship among them (≤0.3). For each subsample the simplest possible structure is reached, following the criteria listed below:

- *overdetermination*: each factor has to be defined by a sub-set of variables (at least two);
- *makers:* variables which have high loads to a single factor and low to others.

The factor structures for each sub sample are reported in the tables. As reported in Table 25 in section 2.4.3, almost all the variables have correlation very high, so they are between good and excellent according to Comrey and Lee (Comrey & Lee, A first course in factor analysis, 1992).

Table 75: **Rotated factor loadings for Adult Q1.**

| Number | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 20 | SatisfComfort | **.83** | -.20 | .05 | .00 | .01 | -.28 | -.14 | .09 | -.05 |
| 23 | SatisfBringSomeone | **.59** | -.59 | -.02 | .15 | .03 | -.23 | -.17 | .04 | -.07 |
| 24 | SatisfOverall | **.75** | .28 | .07 | .00 | .01 | -.30 | -.01 | .00 | -.04 |
| 36 | UseWhyLike | **.69** | .40 | .07 | -.01 | .01 | -.30 | .01 | -.01 | -.02 |
| 35 | UseTheMostOnTime | **.79** | -.02 | .05 | .08 | -.02 | -.28 | -.34 | .08 | -.09 |
| 19 | SatisfRegularity | **.79** | .06 | .08 | -.02 | -.03 | -.24 | -.17 | .15 | -.04 |
| 37 | UseWhyIFeelFree | **.78** | .04 | .04 | .05 | .04 | -.26 | -.24 | .04 | -.07 |
| 22 | SatisfCarryObjects | **.59** | -.48 | .03 | .12 | .07 | -.23 | -.07 | .06 | -.08 |
| 18 | SatisfFlexibility | **.74** | -.11 | .06 | .01 | .02 | -.22 | -.29 | .15 | -.07 |
| 31 | UseTheFast | **.74** | -.01 | .04 | .05 | .02 | -.26 | -.23 | .07 | -.08 |
| 15 | SatisfSpeed | **.72** | -.08 | .04 | .01 | .01 | -.21 | -.19 | .10 | -.07 |
| 14 | SatisfEcology | .00 | **.77** | -.02 | -.12 | -.06 | .04 | .25 | -.07 | .06 |
| 32 | UseTheLeastPollutant | .00 | **.72** | .07 | -.04 | -.04 | .10 | .35 | .02 | -.03 |
| 9 | SustIndexMode_MostImpoTrip | .40 | **-.57** | -.02 | .16 | .02 | -.26 | -.31 | .00 | -.03 |
| 13 | SatisfCheapness | .20 | **.63** | .05 | -.15 | -.05 | -.03 | .06 | .01 | .03 |
| 142 | LikeReachingUnknownDestination | .03 | .01 | **.91** | -.03 | .14 | -.23 | .00 | .19 | -.21 |
| 140 | LikeDiscoveringNewPlaces | .03 | .04 | **.81** | .04 | .11 | -.18 | .01 | .16 | -.22 |
| 141 | LikeDaringTravel | .04 | .03 | **.76** | -.07 | .16 | -.22 | -.02 | .27 | -.19 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 78 | PT_MoreClean | .01 | -.09 | -.01 | **.87** | .00 | -.04 | -.03 | -.10 | -.06 |
| 79 | PT_MoreSecurity | .05 | -.11 | -.05 | **.77** | .00 | -.03 | -.07 | -.14 | -.06 |
| 75 | PT_MoreConfort | -.02 | -.08 | .00 | **.67** | .00 | -.02 | .00 | -.11 | -.07 |
| 69 | AV_Chatting | .07 | -.03 | .16 | -.04 | **.90** | -.05 | -.02 | .20 | -.09 |
| 68 | AV_PhoneCall | .10 | -.06 | .17 | .05 | **.63** | -.11 | -.08 | .15 | -.14 |
| 63 | AV_SocialNetwork | .03 | -.04 | .10 | -.02 | **.65** | -.05 | .06 | .15 | .00 |
| 105 | LikeDriving | .19 | -.09 | .22 | .11 | .11 | **-.76** | .00 | .05 | -.02 |
| 107 | ToBePassenger | -.17 | .05 | -.07 | .00 | .01 | **.63** | .12 | -.01 | -.06 |
| 110 | DrivingUnkownRoad | .18 | .01 | .34 | -.02 | .06 | **-.59** | .00 | .17 | -.14 |
| 58 | Chatting | -.49 | .02 | .02 | -.07 | .41 | .19 | **.62** | -.03 | .03 |
| 51 | SocialNetwork | -.47 | .03 | .01 | -.07 | .39 | .16 | **.60** | -.03 | .05 |
| 33 | UseTheSafest | -.11 | .29 | -.01 | .01 | -.06 | .08 | **.68** | -.07 | .04 |
| 50 | Read | -.49 | .15 | .00 | -.09 | .05 | .20 | **.60** | -.06 | .00 |
| 16 | SatisfSafety | -.02 | .18 | -.01 | -.07 | -.06 | .01 | **.59** | -.02 | .05 |
| 101 | CarPooling_Driver | .12 | -.05 | .21 | -.12 | .18 | -.27 | -.07 | **.83** | -.13 |
| 100 | CarPooling_Pax | .02 | .03 | .23 | -.13 | .18 | .10 | .02 | **.80** | -.15 |
| 123 | GiveOutItems | .05 | -.04 | .15 | .12 | .03 | .02 | -.05 | .04 | **-.76** |
| 124 | LendItems | .04 | .00 | .21 | .00 | .08 | -.02 | .00 | .19 | **-.73** |

Table 76: **Rotated factor loadings for Stud Q1.**

| Number | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 36 | UseWhyLike | **.89** | .08 | -.42 | -.27 | .06 | -.14 | .08 | .23 | .05 |
| 24 | SatisfOverall | **.87** | .09 | -.42 | -.25 | .08 | -.18 | .11 | .23 | -.06 |
| 35 | UseTheMostOnTime | **.80** | .12 | -.61 | -.01 | .13 | .00 | .08 | .15 | -.23 |
| 37 | UseWhyIFeelFree | **.82** | .10 | -.52 | -.09 | .08 | -.07 | .08 | .19 | -.04 |
| 20 | SatisfComfort | **.79** | .10 | -.43 | .08 | .11 | -.15 | .09 | .24 | -.17 |
| 19 | SatisfRegularity | **.73** | .11 | -.52 | -.18 | .09 | -.10 | .13 | .19 | -.32 |
| 15 | SatisfSpeed | **.74** | .09 | -.42 | -.02 | .11 | -.05 | .11 | .16 | -.30 |
| 18 | SatisfFlexibility | **.76** | .12 | -.57 | -.08 | .11 | -.10 | .14 | .12 | -.27 |
| 31 | UseTheFast | **.73** | .12 | -.42 | -.02 | .13 | .00 | .06 | .19 | -.15 |
| 17 | SatisfSecurity | **.51** | .05 | -.29 | .20 | .08 | -.24 | .10 | .50 | -.24 |
| 34 | UseTheMostSecure | **.56** | .03 | -.34 | .22 | .06 | .00 | .02 | .47 | -.09 |
| 142 | LikeReachingUnknownDestination | .07 | **.87** | -.04 | -.01 | .12 | .01 | .26 | .01 | .12 |
| 141 | LikeDaringTravel | .10 | **.84** | -.08 | -.05 | .12 | .02 | .29 | .01 | .12 |
| 140 | LikeDiscoveringNewPlaces | .07 | **.79** | -.04 | .00 | .08 | .09 | .22 | .01 | .11 |
| 51 | SocialNetwork | -.48 | -.06 | **.87** | .14 | -.14 | .08 | -.09 | .10 | -.01 |
| 58 | Chatting | -.51 | -.07 | **.86** | .16 | -.14 | .06 | -.08 | .10 | -.02 |
| 49 | Work | -.38 | -.03 | **.54** | .17 | -.09 | -.01 | -.07 | .05 | .41 |
| 50 | Read | -.40 | -.01 | **.60** | .10 | -.11 | -.04 | -.03 | .11 | .35 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | SatisfCheapness | .28 | .06 | -.33 | **-.72** | .02 | -.11 | .11 | .08 | -.23 |
| 14 | SatisfEcology | .16 | -.02 | -.11 | **-.75** | .04 | -.20 | -.01 | .16 | .04 |
| 32 | UseTheLeastPollutant | .18 | .08 | -.04 | **-.62** | -.03 | -.09 | .09 | .29 | .28 |
| 26 | MonthlyCost | -.14 | -.06 | .19 | **.59** | .08 | .10 | -.13 | -.02 | .24 |
| 105 | LikeDriving | .08 | .09 | -.07 | .03 | **.84** | .02 | .05 | .01 | -.05 |
| 107 | ToBePassenger | -.07 | -.03 | .14 | -.01 | **-.79** | .06 | .03 | .04 | .12 |
| 110 | DrivingUnkownRoad | .15 | .22 | -.13 | .04 | **.66** | -.09 | .18 | .06 | .01 |
| 78 | PT_MoreClean | -.03 | .05 | -.03 | .10 | -.02 | **.84** | -.06 | -.05 | .03 |
| 79 | PT_MoreSecurity | -.06 | .01 | .04 | .10 | -.08 | **.78** | -.07 | -.12 | .06 |
| 75 | PT_MoreConfort | -.13 | .05 | .03 | .09 | -.02 | **.66** | -.05 | -.05 | .01 |
| 100 | CarPooling_Pax | .05 | .21 | .00 | -.05 | -.07 | -.08 | **.78** | .03 | .14 |
| 101 | CarPooling_Driver | .08 | .21 | -.10 | .00 | .36 | -.06 | **.69** | .00 | .03 |
| 109 | ShareCarUnknown | .08 | .26 | -.10 | -.09 | -.01 | -.06 | **.60** | .01 | .10 |
| 33 | UseTheSafest | .00 | .00 | .24 | -.20 | -.06 | -.01 | -.02 | **.71** | .20 |
| 16 | SatisfSafety | .09 | -.03 | .17 | -.16 | .03 | -.13 | -.02 | **.67** | -.05 |
| 124 | LendItems | -.03 | .28 | -.07 | -.02 | -.06 | .04 | .35 | -.05 | **.38** |
| 123 | GiveOutItems | -.04 | .27 | -.04 | .07 | -.05 | .10 | .28 | -.01 | **.39** |

Table 77: **Rotated factor loadings for Adult Q1+Q2.**

| Number | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|---|
| 36 | UseWhyLike | **.67** | .06 | -.47 | -.10 | -.08 | .00 | -.25 | .03 |
| 24 | SatisfOverall | **.73** | .05 | -.38 | -.11 | -.07 | .02 | -.28 | .01 |
| 20 | SatisfComfort | **.82** | .01 | .15 | -.06 | -.05 | .10 | -.37 | .05 |
| 35 | UseTheMostOnTime | **.79** | .02 | .00 | -.08 | .03 | .12 | -.53 | .03 |
| 23 | SatisfBringSomeone | **.61** | -.02 | .54 | .04 | .16 | .00 | -.25 | -.07 |
| 19 | SatisfRegularity | **.76** | .00 | -.11 | -.10 | -.05 | .20 | -.45 | .07 |
| 37 | UseWhyIFeelFree | **.77** | .02 | -.05 | -.02 | -.04 | .06 | -.41 | -.02 |
| 18 | SatisfFlexibility | **.74** | -.03 | .07 | -.07 | .00 | .14 | -.49 | .02 |
| 31 | UseTheFast | **.74** | -.03 | -.01 | .01 | .01 | .08 | -.44 | .01 |
| 22 | SatisfCarryObjects | **.57** | .02 | .42 | -.03 | .14 | .01 | -.15 | -.06 |
| 15 | SatisfSpeed | **.68** | .00 | .04 | -.01 | -.04 | .10 | -.40 | .02 |
| 231 | InterestNewGadgets | .00 | **.79** | -.02 | -.19 | .05 | .13 | .00 | -.04 |
| 232 | InterestNewTech | .01 | **.77** | -.05 | -.15 | .05 | .11 | -.01 | -.03 |
| 234 | AppHelpMe | .03 | **.76** | -.02 | .03 | .02 | .05 | .16 | -.02 |
| 236 | DownloadApp | .03 | **.70** | .07 | -.02 | .03 | .06 | .04 | .02 |
| 235 | AppsAreFun | .04 | **.69** | .02 | .01 | .06 | .04 | .08 | -.04 |
| 243 | AppsForTrips | -.03 | **.61** | .02 | .02 | .00 | .13 | .15 | .05 |
| 239 | SmartphoneUpdate | -.02 | **.62** | .05 | .00 | .09 | .01 | .09 | -.04 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 32 | UseTheLeastPollutant | -.05 | -.05 | **-.81** | -.12 | -.08 | .07 | .15 | .18 |
| 14 | SatisfEcology | -.05 | .00 | **-.77** | -.02 | -.12 | -.07 | .07 | .04 |
| 9 | SustIndexMode_MostImpoTrip | .41 | .06 | **.59** | .02 | .17 | -.03 | -.29 | -.07 |
| 13 | SatisfCheapness | .14 | .02 | **-.65** | -.09 | -.16 | .03 | -.15 | .06 |
| 30 | UseTheCheapest | .07 | -.04 | **-.60** | -.05 | -.04 | .03 | .12 | .12 |
| 142 | LikeReachingUnknownDestination | .00 | .05 | -.02 | **-.88** | -.06 | .22 | .00 | .15 |
| 141 | LikeDaringTravel | .05 | .06 | -.05 | **-.78** | -.09 | .31 | -.05 | .19 |
| 140 | LikeDiscoveringNewPlaces | .06 | .00 | -.06 | **-.76** | .01 | .20 | -.03 | .14 |
| 143 | TryAlternatives | .02 | .06 | -.08 | **-.66** | -.08 | .26 | -.08 | .28 |
| 78 | PT_MoreClean | -.01 | .04 | .05 | .04 | **.86** | -.12 | .01 | -.13 |
| 79 | PT_MoreSecurity | .06 | .07 | .13 | .06 | **.74** | -.15 | -.04 | -.13 |
| 75 | PT_MoreConfort | -.06 | .05 | .06 | .04 | **.69** | -.13 | .02 | -.11 |
| 100 | CarPooling_Pax | .01 | .05 | -.01 | -.24 | -.12 | **.84** | .01 | .19 |
| 101 | CarPooling_Driver | .15 | .14 | .08 | -.23 | -.13 | **.77** | -.10 | .19 |
| 109 | ShareCarUnknown | .05 | .07 | -.08 | -.25 | -.15 | **.62** | -.01 | .24 |
| 58 | Chatting | -.41 | .13 | -.06 | .07 | -.03 | -.03 | **.84** | -.06 |
| 51 | SocialNetwork | -.39 | .19 | -.09 | .04 | -.02 | .00 | **.83** | -.05 |
| 50 | Read | -.49 | -.03 | -.19 | .02 | -.03 | -.08 | **.64** | .01 |
| 138 | SupportEnvOrganisation | .04 | -.01 | -.08 | -.17 | -.11 | .18 | -.07 | **.75** |
| 136 | EnvironOrganActivist | -.03 | -.01 | -.08 | -.20 | -.14 | .24 | -.01 | **.75** |

Table 78: **Rotated factor loadings for Stud Q1+Q2.**

| Number | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 36 | UseWhyLike | **.84** | .14 | -.04 | -.03 | .38 | -.09 | .04 | -.08 | .09 | .04 |
| 24 | SatisfOverall | **.82** | .12 | -.01 | -.05 | .34 | -.08 | .03 | -.11 | .05 | .09 |
| 35 | UseTheMostOnTime | **.82** | .08 | -.07 | -.12 | .07 | -.12 | -.05 | .04 | .10 | .00 |
| 37 | UseWhyIFeelFree | **.81** | .14 | -.04 | -.05 | .22 | -.11 | .01 | -.04 | .07 | .01 |
| 18 | SatisfFlexibility | **.79** | .13 | -.07 | -.07 | .06 | -.04 | -.01 | -.04 | .08 | .11 |
| 20 | SatisfComfort | **.76** | .15 | .12 | -.14 | .05 | -.02 | .01 | -.12 | .06 | .09 |
| 15 | SatisfSpeed | **.76** | -.01 | -.01 | -.06 | .04 | .01 | .01 | .02 | .04 | .08 |
| 58 | Chatting | **-.59** | -.12 | .06 | .11 | -.08 | .53 | .03 | .07 | -.08 | .02 |
| 19 | SatisfRegularity | **.75** | .04 | -.02 | -.04 | .16 | -.03 | -.03 | -.08 | .00 | .07 |
| 31 | UseTheFast | **.75** | .08 | -.04 | -.10 | .14 | -.01 | -.01 | .03 | .09 | .01 |
| 142 | LikeReachingUnknownDestination | .10 | **.86** | -.05 | -.21 | .02 | .05 | -.09 | -.01 | .20 | .27 |
| 141 | LikeDaringTravel | .07 | **.85** | -.04 | -.18 | .08 | .00 | -.12 | -.04 | .26 | .33 |
| 140 | LikeDiscoveringNewPlaces | .08 | **.83** | .04 | -.16 | .06 | .04 | -.12 | .03 | .16 | .25 |
| 204 | AntiTheftAlarm | -.01 | -.03 | **.84** | -.06 | -.11 | .01 | -.12 | .10 | -.09 | -.15 |
| 205 | VideoSurveillance | -.03 | -.01 | **.77** | -.14 | -.11 | .05 | -.15 | .20 | -.03 | -.13 |
| 107 | ToBePassenger | -.03 | -.09 | -.08 | **.81** | .11 | .02 | .12 | .08 | .02 | -.02 |
| 105 | LikeDriving | .05 | .17 | .14 | **-.79** | -.10 | .02 | -.13 | .00 | -.09 | .12 |
| 110 | DrivingUnkownRoad | .18 | .31 | .03 | **-.63** | .02 | .03 | -.10 | -.09 | .06 | .27 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | UseTheLeastPollutant | .13 | .11 | -.15 | .10 | **.90** | -.07 | -.04 | -.07 | .15 | .06 |
| 30 | UseTheCheapest | .13 | .04 | -.05 | .03 | **.66** | .02 | .01 | -.01 | .06 | -.02 |
| 14 | SatisfEcology | .14 | .04 | -.10 | .12 | **.63** | -.15 | .00 | -.22 | -.06 | -.01 |
| 51 | SocialNetwork | -.56 | -.11 | .10 | .09 | -.05 | **.58** | -.02 | .08 | -.09 | -.03 |
| 63 | AV_SocialNetwork | .06 | .10 | .07 | -.07 | -.10 | **.71** | -.20 | .07 | .01 | .05 |
| 69 | AV_Chatting | .06 | .05 | .00 | -.03 | -.02 | **.68** | -.11 | .12 | .04 | .10 |
| 231 | InterestNewGadgets | -.03 | .13 | .16 | -.13 | -.02 | .15 | **-.99** | .15 | -.01 | .06 |
| 232 | InterestNewTech | .00 | .10 | .12 | -.12 | .03 | .13 | **-.85** | .07 | .07 | .02 |
| 78 | PT_MoreClean | .01 | -.01 | .15 | .00 | -.06 | .03 | -.06 | **.83** | .09 | -.05 |
| 79 | PT_MoreSecurity | .03 | -.04 | .22 | .09 | -.05 | .11 | -.07 | **.74** | .08 | -.04 |
| 75 | PT_MoreConfort | -.13 | .03 | .03 | .05 | -.13 | .10 | -.12 | **.65** | -.03 | -.06 |
| 138 | SupportEnvOrganisation | .08 | .18 | -.02 | .05 | .08 | -.01 | -.09 | .03 | **.87** | .13 |
| 136 | EnvironOrganActivist | .02 | .19 | -.10 | .01 | .02 | .01 | .02 | .05 | **.67** | .19 |
| 101 | CarPooling_Driver | .03 | .21 | .00 | -.42 | -.11 | .05 | -.10 | -.02 | .10 | **.73** |
| 100 | CarPooling_Pax | .06 | .25 | -.18 | -.02 | .01 | .06 | -.01 | -.08 | .18 | **.79** |
| 109 | ShareCarUnknown | .07 | .30 | -.16 | .01 | .08 | .03 | -.02 | -.04 | .19 | **.58** |

To reach a simple factor structure (Thurstone, 1947), the extracted factors will be rotated in the factor multidimensional space. The rotation allows to define a simple structure:

- each factor is defined by a sub-set of variables, which have high loadings relative to the residual measured variables (high with-in factor loading variability);
- each variable loads with very large value only a sub-set of factors (low factor complexity).

Among the infinite alternative orientations of factors, the final factor rotation reaches the simplest factor structure.

### 3.4.3. Interpretation Factors

Finally, the factor structure is evaluated and factors interpreted. The factor assessment is carried out taking into account two complementary aspects:

- statistical quality, through three indices: explained variance, parsimony about factor number, efficiency;
- meaning and relevance of factors, closed in the interpretation of each factor.

In Figure 59 the variance explained from EFA for each iteration in all subsamples is shown. The gradual reduction of variables (see 3.4.2) allows to increase the percentage of explained variance. The last iteration does not always show the maximum of explained variance, because also other statistical parameters are analysed in the EFA improvement and the final subset is their comprehensive optimisation. They are the Parsimony (Equation 1) and the Efficiency (Equation 2), which are reported in Table 79, for each subsample. The values of Efficiency are equal or higher than threshold (≈2.0).

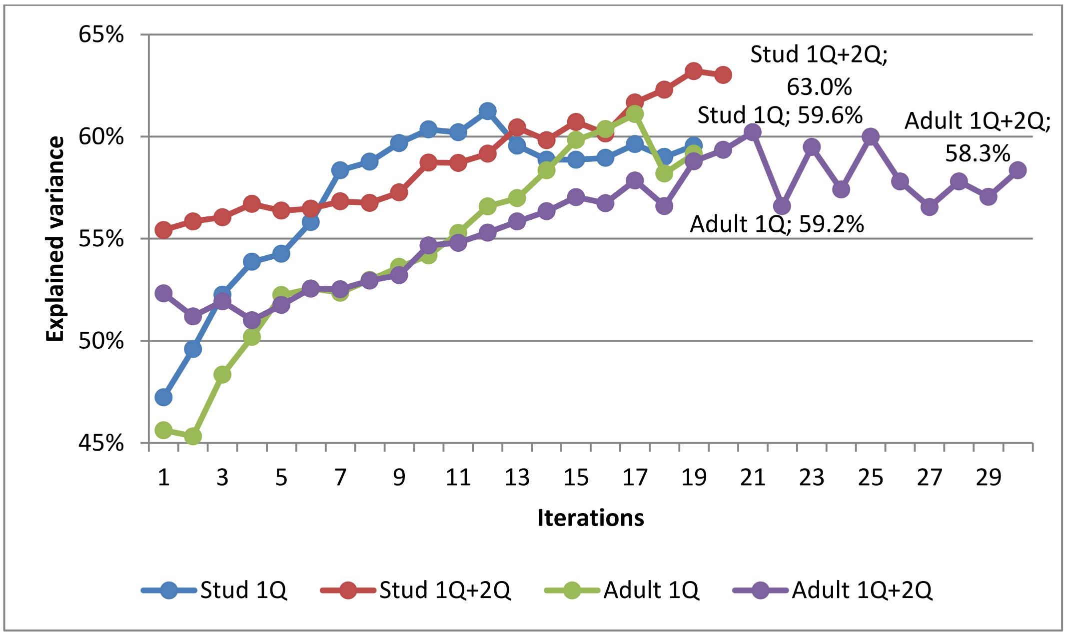


Figure 59 – Explained variance.

Table 79: **Parsimony and efficiency for the final subset of variables.**

| Subsample | Parsimony | Efficiency | Explained Variance |
|---|---|---|---|
| Adult 1Q | 27 | 2.0 | 59.2% |
| Adult 1Q+2Q | 30 | 2.8 | 58.3% |
| Stud 1Q | 26 | 2.3 | 59.6% |
| Stud 1Q+2Q | 24 | 2.0 | 63.0% |

Another index of the good quality of factor structure is that all variables are *makers*: they show very high correlation with one factor and low ones with other factors. Then, the factor interpretation is based on the *makers*, as reported in next tables. Some factors are labelled with the same name because they are defined by identical makers. For this reason, they are explained only one time. The values of Cronbach's Alpha verify the internal consistency of each factor, as shown in the tables form 80 to 83.

Table 80: **Factor interpretation for Adult 1Q.**

| Variable Numbers | Variable Names | Loads | Cronbach's Alpha | Factors |
|---|---|---|---|---|
| 20 | SatisfComfort | **.83** | .923 | 1st factor: Mode Pleasure |
| 23 | SatisfBringSomeone | **.59** | | |
| 24 | SatisfOverall | **.75** | | |
| 36 | UseWhyLike | **.69** | | |
| 35 | UseTheMostOnTime | **.79** | | |
| 19 | SatisfRegularity | **.79** | | |
| 37 | UseWhyIFeelFree | **.78** | | |
| 22 | SatisfCarryObjects | **.59** | | |
| 18 | SatisfFlexibility | **.74** | | |
| 31 | UseTheFast | **.74** | | |
| 15 | SatisfSpeed | **.72** | | |
| 14 | SatisfEcology | **.77** | .750 | 2nd factor: Eco&Cheap Travel |
| 32 | UseTheLeastPollutant | **.72** | | |
| 9 | SustIndexMode MostImpoTrip | **-.57** | | |
| 13 | SatisfCheapness | **.63** | | |
| 142 | LikeReaching UnknownDestination | **.91** | .862 | 3rd factor: Travel Pleasure |
| 140 | LikeDiscoveringNewPlaces | **.81** | | |
| 141 | LikeDaringTravel | **.76** | | |
| 78 | PT_MoreClean | **.87** | .813 | 4th factor: Improvement of onboard quality |
| 79 | PT_MoreSecurity | **.77** | | |
| 75 | PT_MoreConfort | **.67** | | |
| 69 | AV_Chatting | **.90** | .778 | 5th factor: Activities on A.V. |
| 68 | AV_PhoneCall | **.63** | | |
| 63 | AV_SocialNetwork | **.65** | | |
| 105 | LikeDriving | **-.76** | .689 | 6th factor: Driving aversion |
| 107 | ToBePassenger | **.63** | | |
| 110 | DrivingUnkownRoad | **-.59** | | |
| 58 | Chatting | **.62** | .774 | 7th factor: Self-Absorbed Activity and Feeling Safe |
| 51 | SocialNetwork | **.60** | | |
| 33 | UseTheSafest | **.68** | | |
| 50 | Read | **.60** | | |
| 16 | SatisfSafety | **.59** | | |
| 101 | CarPooling_Driver | **.83** | .777 | 8th factor: Willingness to Carpool |
| 100 | CarPooling_Pax | **.80** | | |
| 123 | GiveOutItems | **-.76** | .706 | 9th factor: Aware Consumerism |
| 124 | LendItems | **-.73** | | |

Table 81: **Factor interpretation for Stud 1Q.**

| Variable Numbers | Variable Names | Loads | Cronbach's Alpha | Factors |
|---|---|---|---|---|
| 36 | UseWhyLike | **.89** | | |
| 24 | SatisfOverall | **.87** | | |
| 35 | UseTheMostOnTime | **.80** | | |
| 37 | UseWhyIFeelFree | **.82** | | |
| 20 | SatisfComfort | **.79** | | |
| 19 | SatisfRegularity | **.73** | .933 | 1st factor: Mode Pleasure |
| 15 | SatisfSpeed | **.74** | | |
| 18 | SatisfFlexibility | **.76** | | |
| 31 | UseTheFast | **.73** | | |
| 17 | SatisfSecurity | **.51** | | |
| 34 | UseTheMostSecure | **.56** | | |
| 142 | LikeReaching UnknownDestination | **.87** | | |
| 141 | LikeDaringTravel | **.84** | .873 | 2nd factor: Travel Pleasure |
| 140 | LikeDiscoveringNewPlaces | **.79** | | |
| 51 | SocialNetwork | **.87** | | |
| 58 | Chatting | **.86** | .813 | 3rd factor: Self-Absorbed Activity |
| 49 | Work | **.54** | | |
| 50 | Read | **.60** | | |
| 13 | SatisfCheapness | **-.72** | | |
| 14 | SatisfEcology | **-.75** | .765 | 4th factor: Eco&Cheap Travel |
| 32 | UseTheLeastPollutant | **-.62** | | |
| 26 | MonthlyCost | **.59** | | |
| 105 | LikeDriving | **.84** | | |
| 107 | ToBePassenger | **-.79** | .766 | 5th factor: Driving aversion |
| 110 | DrivingUnkownRoad | **.66** | | |
| 78 | PT_MoreClean | **.84** | | |
| 79 | PT_MoreSecurity | **.78** | .797 | 6th factor: Improvement of onboard quality |
| 75 | PT_MoreConfort | **.66** | | |
| 100 | CarPooling_Pax | **.78** | | |
| 101 | CarPooling_Driver | **.69** | .748 | 7th factor: Willingness to Carpool |
| 109 | ShareCarUnknown | **.60** | | |
| 33 | UseTheSafest | **.71** | .674 | 8th factor: Feeling Safe |
| 16 | SatisfSafety | **.67** | | |
| 124 | LendItems | **.38** | .740 | 9th factor: Aware Consumerism |
| 123 | GiveOutItems | **.39** | | |

Table 82: **Factor interpretation for Adult 1Q+2Q.**

| Variable Numbers | Variable Names | Loads | Cronbach's Alpha | Factors |
|---|---|---|---|---|
| 36 | UseWhyLike | **.67** | .918 | 1st factor: Mode Pleasure |
| 24 | SatisfOverall | **.73** | | |
| 20 | SatisfComfort | **.82** | | |
| 35 | UseTheMostOnTime | **.79** | | |
| 23 | SatisfBringSomeone | **.61** | | |
| 19 | SatisfRegularity | **.76** | | |
| 37 | UseWhyIFeelFree | **.77** | | |
| 18 | SatisfFlexibility | **.74** | | |
| 31 | UseTheFast | **.74** | | |
| 22 | SatisfCarryObjects | **.57** | | |
| 15 | SatisfSpeed | **.68** | | |
| 231 | InterestNewGadgets | **.79** | .872 | 2nd factor: Interest for Tech Innovation and App Addiction |
| 232 | InterestNewTech | **.77** | | |
| 234 | AppHelpMe | **.76** | | |
| 236 | DownloadApp | **.70** | | |
| 235 | AppsAreFun | **.69** | | |
| 243 | AppsForTrips | **.61** | | |
| 239 | SmartphoneUpdate | **.62** | | |
| 32 | UseTheLeastPollutant | **-.81** | .800 | 3rd factor: Eco&Cheap Travel |
| 14 | SatisfEcology | **-.77** | | |
| 9 | SustIndexMode_MostImpoTrip | **.59** | | |
| 13 | SatisfCheapness | **-.65** | | |
| 30 | UseTheCheapest | **-.60** | | |
| 142 | LikeReachingUnknownDestination | **-.88** | .851 | 4th factor: Travel Pleasure |
| 141 | LikeDaringTravel | **-.78** | | |
| 140 | LikeDiscoveringNewPlaces | **-.76** | | |
| 143 | TryAlternatives | **-.66** | | |
| 78 | PT_MoreClean | **.86** | .805 | 5th factor: Improvement of onboard quality |
| 79 | PT_MoreSecurity | **.74** | | |
| 75 | PT_MoreConfort | **.69** | | |
| 100 | CarPooling_Pax | **.84** | .630 | 6th factor: Willingness to Carpool |
| 101 | CarPooling_Driver | **.77** | | |
| 109 | ShareCarUnknown | **.62** | | |
| 58 | Chatting | **.84** | .818 | 7th factor: Self-Absorbed Activities |
| 51 | SocialNetwork | **.83** | | |
| 50 | Read | **.64** | | |
| 138 | SupportEnvOrganisation | **.75** | .715 | 8th factor: Activism pro-Environ |
| 136 | EnvironOrganActivist | **.75** | | |

Table 83: **Factor interpretation for Stud 1Q+2Q.**

| Variable Numbers | Variable Names | Loads | Cronbach's Alpha | Factors |
|---|---|---|---|---|
| 36 | UseWhyLike | **.67** | .874 | 1st factor: Mode Pleasure |
| 24 | SatisfOverall | **.73** | | |
| 35 | UseTheMostOnTime | **.82** | | |
| 37 | UseWhyIFeelFree | **.79** | | |
| 18 | SatisfFlexibility | **.61** | | |
| 20 | SatisfComfort | **.76** | | |
| 15 | SatisfSpeed | **.77** | | |
| 58 | Chatting | **.74** | | |
| 19 | SatisfRegularity | **.74** | | |
| 31 | UseTheFast | **.68** | | |
| 142 | LikeReachingUnknownDestination | **.86** | .800 | 2nd factor: Travel Pleasure |
| 141 | LikeDaringTravel | **.85** | | |
| 140 | LikeDiscoveringNewPlaces | **.83** | | |
| 204 | AntiTheftAlarm | **.84** | .785 | 3rd factor: Worry for personal security |
| 205 | VideoSurveillance | **.77** | | |
| 107 | ToBePassenger | **.81** | .778 | 4th factor: Driving aversion |
| 105 | LikeDriving | **-.79** | | |
| 110 | DrivingUnkownRoad | **-.63** | | |
| 32 | UseTheLeastPollutant | **.90** | .765 | 5th factor: Eco-Friendly Travel |
| 30 | UseTheCheapest | **.66** | | |
| 14 | SatisfEcology | **.63** | | |
| 51 | SocialNetwork | **.58** | .630 | 6th factor: Social Network Addiction |
| 63 | AV_SocialNetwork | **.71** | | |
| 69 | AV_Chatting | **.68** | | |
| 231 | InterestNewGadgets | **-.99** | .914 | 7th factor: Interest for Tech Innovation |
| 232 | InterestNewTech | **-.85** | | |
| 78 | PT_MoreClean | **.83** | .775 | 8th factor: Improvement of onboard quality |
| 79 | PT_MoreSecurity | **.74** | | |
| 75 | PT_MoreConfort | **.65** | | |
| 138 | SupportEnvOrganisation | **.87** | .731 | 9th factor: Activism pro-Environ |
| 136 | EnvironOrganActivist | **.67** | | |
| 101 | CarPooling_Driver | **.73** | .718 | 10th factor: Willingess to Carpool |
| 100 | CarPooling_Pax | **.79** | | |
| 109 | ShareCarUnknown | **.58** | | |

The first factor is the same in all subsamples: this result shows the strength of the factor. It is composed by ten or more different variables and their correlation is very high. This factor is labelled "*Mode Pleasure*", because all variables are related to satisfaction about mode features, like speed, reliability, comfort, flexibility and punctuality. The result agree with "*Mode Performance*" and "*Mode Pleasure*" factors of a previous study carried out in Alessandria in 2011 (Pronello & Camusso, 2011).

The second factor, according to the explained variance, is the "*Travel Pleasure*". It is defined by attitudes towards travelling and it measures respondents' availability about adventurous journeys and trips to unknown destinations. Again, also this factor is a confirmation of previous work (Pronello & Camusso, 2011) and it proves the research robustness. To highlight the high level of agreement between the two results the same name is maintained.

Another is the "*Eco&Cheap Travel*", that is always between the second and fifth position in the samples. It is composed by satisfaction and reason of choice about two themes on used transport mode: the environmental sustainability and the cheapness.

The factor named "*Improvement of on board quality*" is emerged in all samples. Its variables are focus on board quality of PT: cleanness, security and comfort.

The variables about car driving, as "*LikeDriving*", compose the factor "*Driving aversion*". Among them, there is also the variable "*ToBePassenger*" which is included with opposite sign. This factor represents the opposite of car driving pleasure.

The factor "*Self-Absorbed Activity*" is made up from the following activities: surfing on social network, reading and chatting message. It shows the attitudes of people during the trip to leave your-self out of the external environment.

The "*Feeling Safe*" is a factor defined only by variables describing the safety of the used transport mode. It represents the safety perceived by respondents.

The "*Willingness to Carpool*" is explained by three variables concerning carpooling. It investigates the attitudes to offer or receive a ride by car, also with unknown people.

Three variables related to activities in Autonomous Vehicles (AV) compose the factor "*Activities on A.V.*". Chatting, calling by phone and surfing on social network are included. This factor represents the feeling and attitude towards AV.

The last factor of Adult 1Q and Student 1Q is composed by two variables concerning the re-use of things: giving out items and lending them; it is named *Aware Consumerism*.

Including the variables of Part B of "Come Ci Muoviamo", new factors emerge: "*Worry for personal security*", "*Interest for Tech Innovation*", "*App Addiction*" and "*Activism pro-Environ*".

"*Interest for Tech Innovation*" is defined by two variables measuring the interest towards technology and new tech products. They are proxy variables of the respondents' passion to technology, the attitudes to try and learn to use new devices.

The sensibility towards environment is described by the factor "*Activism pro-Environ*". It is composed by two variables, which take into account two behaviours towards pro-environmental organisation with different levels of difficulty. The first concerns the economic funding, while the second the direct support through participation to some activities.

"*App Addiction*" is made up of five variables about app use and smartphone ownership. They are considered indices of use, even addiction, of apps. This factor is emerged only in Adult Q1+Q2.

"*Worry for personal security*" is a factor carried out only from student subsample. Two variables describe it: they are referred to the need to install an anti-theft alarm and a video surveillance system and show the perceived (un)security of students.

As just described, there are several common factors among subsamples. This suggests that elements which influence the behaviour of students and adults are very similar for both categories of users.

Furthermore, the Likert scale questions from Part B do not add many new factors: the only ones that emerge are the personal security and interest to new technologies. From Part A, the weakest factor which are substituted are those based on questions from GEB.

There are some factors much correlated to the used mode of transport, like driving aversion, and others linked to general attitudes, like interest to new technologies or travel pleasure. This aspect will be useful for the cluster analysis.

On these factor structures the factor scores are computed using the Bartlett method. In some cases, the signs of factor scores are switched. For example, in subsample Adult Q1+Q2, the 7$^{th}$ factor, *Interest for Tech Innovation*, has only negative correlations with variables, so to its factor scores are changed the sign: from negative to positive. In this way interpretation and label agree with statistics. The factor scores with opposite sign are list below:

- in Adult 1Q, 9$^{th}$ factor *Aware Consumerism*;
- in Stud 1Q, 4$^{th}$ and 5$^{th}$ factors *Eco&Cheap Travel* and *Driving aversion*;
- in Adult 1Q+2Q, 3$^{th}$ and 4$^{th}$ factors *Eco&Cheap Travel* and *Travel Pleasure*;
- in Stud 1Q+2Q, 7$^{th}$ factor I*nterest for Tech Innovation*.

# 3.5. Cluster Analysis

A Cluster Analysis (CA) is carried out on the base of previous factor scores. As already argued in paragraph 2.5.5, the most common CA methods belong to hierarchical ones or K-means ones, classified according to their algorithm. In both methods, the number of clusters is not defined a priori. Through the dendogram, the hierarchical one allows a complete overview of all cases performing just one analysis. On the other hand, to manage a lot of observations is not suitable with the hierarchical method. Then, for the sample size of this research, the methodology adopts the K-means method; the following results are obtained:

- *data preparation*, where all preliminary treatment on factor scores are explained;
- *determination and validation of clusters*, where the methodology to build cluster is applied;
- *cluster interpretation*, where clusters are described with all available information to define new profiles.

## 3.5.1. Data Preparation

Before to perform the CA on factor scores, there are some preliminary activities and checks to carry out: the variable selection and the detection of outliers.

### Variable selection

Firstly, all factor scores computed in EFA are employed in the cluster analysis, but from a graphical analysis some are not profitable (Figure 63 and Figure 64).

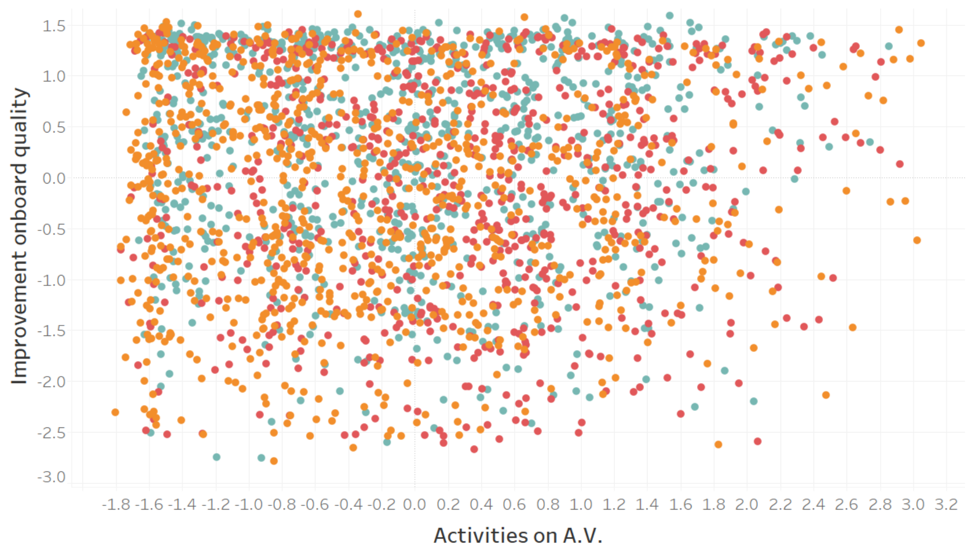


Figure 60 – Lack of clear cluster structure.

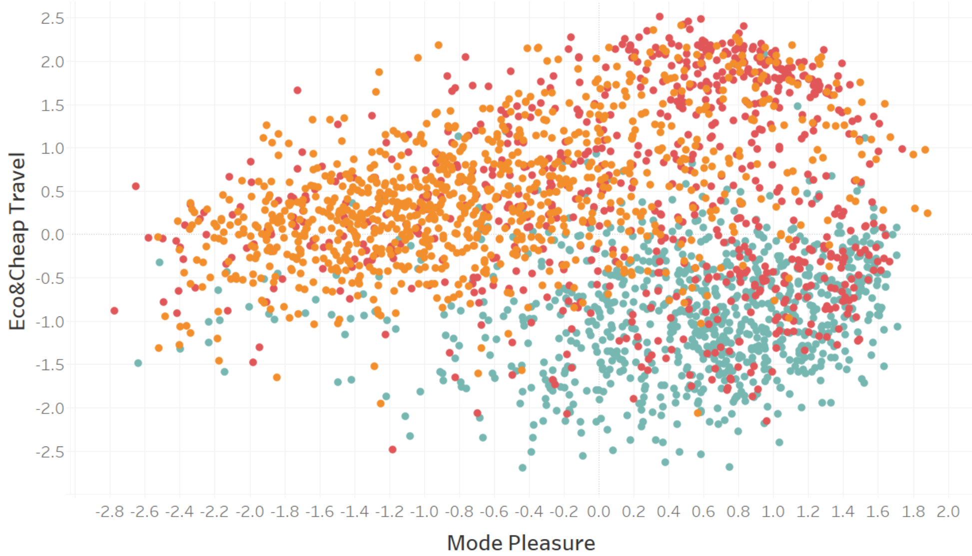


Figure 61 – Presence of clear cluster structure.

In addition to the previous scatter plots, the efficiency of the cluster analysis is evaluated, through the Euclidean distances between each observations and their cluster centre. A cluster analysis made on all factors provides a higher standard deviation on Euclidean distances than the same cluster analysis carried out on a factor sub-set; then, this kind of analysis describes worse observations with all factors.

As reported in Figure 62, numerous cluster analysis are performed on two different subset of variables. The graph in Figure 62 shows the standard deviation of the Euclidean distance between observations and their cluster centre, for different number of clusters (from 2 to 8). The red line represents the analysis with all factors for subsample Adult Q1, while the green one displays the same analysis with only five selected ones.

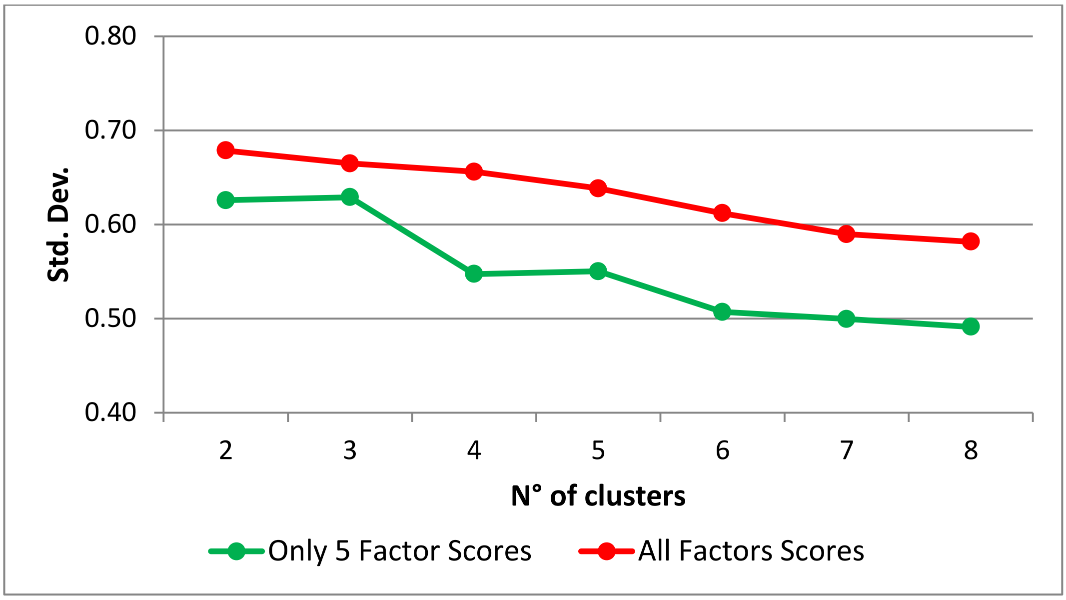


Figure 62 – Analysis from 2 to 8 clusters on different variable numbers.

As shown in Figure 65, all analyses carried out with few (five) clusters have a lower standard deviation. This suggests that to include certain factors is not convenient. To go in depth in more the factor scores, their distribution is analysed. Two examples from subsample Adult 1Q are described in Figure 66 and Figure 67.

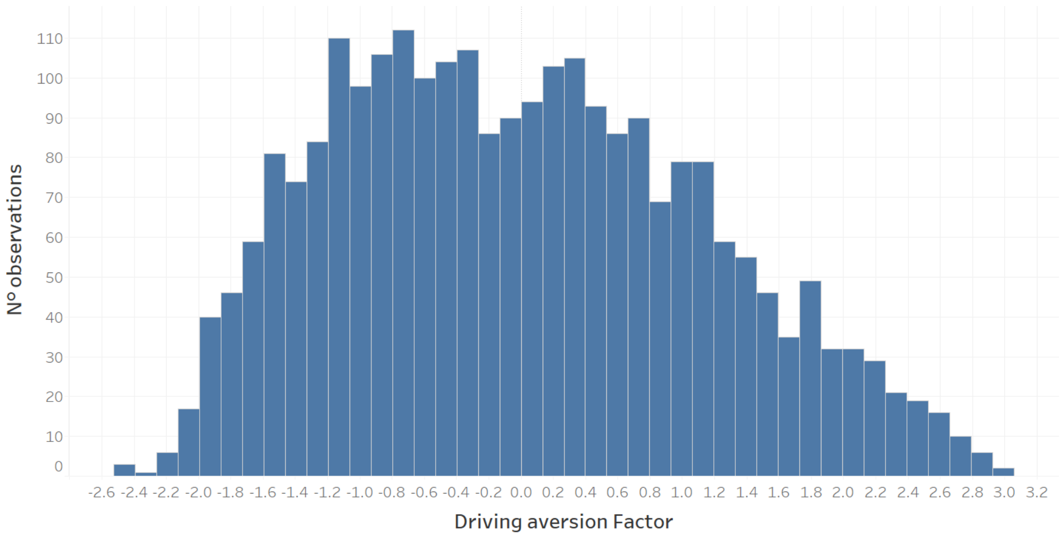


Figure 63 – One Modal distribution of 6th factor score for Adult 1Q.

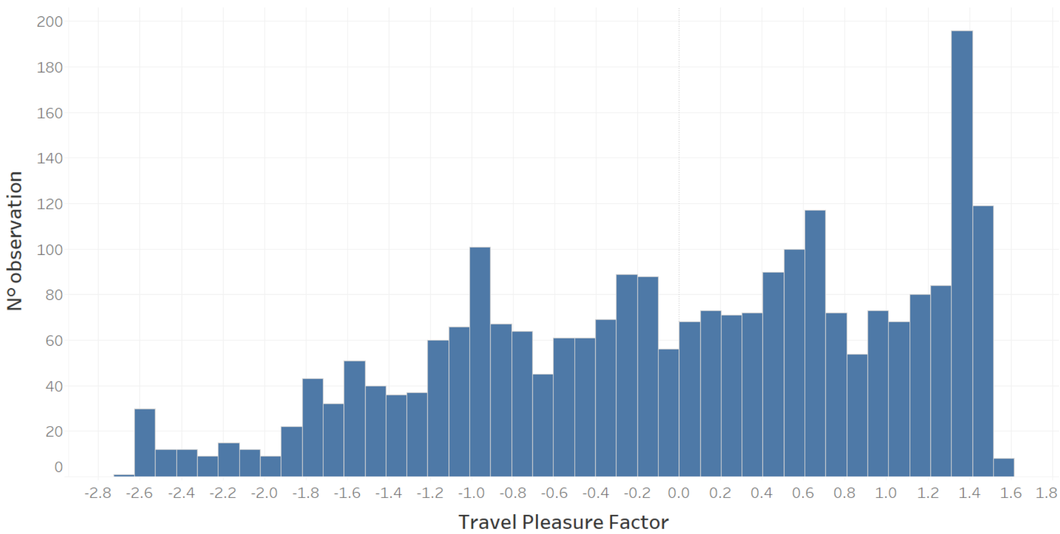


Figure 64 – Multi-Modal distribution of 3th factor score for Adult 1Q

It can be noticed that some factor scores have not a modal distribution. On the contrary, other factor scores show plainly more than one peak in their distribution. This confirms that some factor distributions are less profitable in a cluster analysis than others (Everitt, Landau, Leese, & Stahl, 2011).

The three evaluations (Scatter Plot, Cluster Analysis Efficiency and Factor Distribution) are carried out for each subsample. In this way the variable in red in Table 77 are potentially excluded from cluster analysis, while the others are kept.

Table 84: **Factors included and excluded from Cluster Analysis.**

| | Adult Q1 | Stud Q1 | Adult Q1+Q2 | Stud Q1+Q2 |
|---|---|---|---|---|
| 1 | Mode Pleasure | Mode Pleasure | Mode Pleasure | Mode Pleasure |
| 2 | Eco&Cheap Travel | Travel Pleasure | Interest for Tech Innovation and App Addiction | Travel Pleasure |
| 3 | Travel Pleasure | Self-Absorbed Activities | Eco&Cheap Travel | Worry for personal security |
| 4 | Improvement of onboard quality | Eco&Cheap Travel | Travel Pleasure | Driving aversion (no cluster) |
| 5 | Activities on A.V. (no cluster) | Driving aversion (no cluster) | Improvement of onboard quality | Eco-Friendly Travel |
| 6 | Driving aversion | Improvement of onboard quality | Willingness to Carpool (no cluster) | Social Network Addiction |
| 7 | Self-Absorbed Activity and Feeling Safe | Willingness to Carpool (no cluster) | Self-Absorbed Activities | Interest for Tech Innovation |
| 8 | Willingness to Carpool (no cluster) | Feeling safe | Activism pro-Environ | Improvement of onboard quality |
| 9 | Aware Consumerism | Aware Consumerism | | Activism pro-Environ |
| 10 | | | | Willingness to Carpool (no cluster) |

From literature review, the variables which are strongly related to the mode of transport are not very suitable for a market segmentation (Pronello & Camusso, 2011). Then the red factors in Table 77 are highly correlated to the used mode of transport. For this reason, their exclusion from cluster analysis is accepted. Their information is not lost, but they will be used to the describe profile of each cluster.

The main requirement for the cluster analysis is the subsample size, because the variables are factor scores which eliminates the risk of multicollinearity. Indeed, all factor scores have average equal to zero and standard deviation to one.

The four subsamples include large number of respondents, also the smallest one is greater than one hundred persons. As shown in Table 78, also the clusters have enough quantitative consistency. The determination of the number of cluster is explained in section 3.5.4.

Table 85: **Subsample and their Cluster sizes.**

| | Adult 1Q | Stud 1Q | Adult 1Q+2Q | Stud 1Q+2Q |
|---|---|---|---|---|
| **All** | 2,533 | 1,447 | 817 | 441 |
| **Cluster n°1** | 886 | 245 | 249 | 86 |
| **Cluster n°2** | 620 | 276 | 128 | 103 |
| **Cluster n°3** | 601 | 305 | 263 | 97 |
| **Cluster n°4** | 426 | 324 | 177 | 113 |
| **Cluster n°5** | / | 297 | / | 42 |

The assumptions to perform a CA ( (Hair, Black, Babin, & Anderson, 2014)) are respected: the sample is large enough (more than 100 cases).

### Detection of outliers

The research of outliers in the factor scores is carried out through three approach: mono-dimensional analysis, graphical analysis with scatter plot and multi-dimensional analysis, with the Mahalanobis distance (Equation 4).

Each approach produces a list of outlier candidates. If two or all analysis converge to an observation, that datum is excluded from cluster analysis. The outliers detected for each subsample are reported in Table 86.

Table 86: **Outliers from factor scores.**

| | | Adult 1Q | Stud 1Q | Adult 1Q+2Q | Stud 1Q+2Q |
|---|---|---|---|---|---|
| | **Subsample Size from EFA** | 2,587 | 1,482 | 839 | 455 |
| **Candidate outliers** | **From mono-dimensional analysis** | 300 | 179 | 99 | 45 |
| | **From Scatter Plot** | 36 | 29 | 11 | 5 |
| | **From Mahalanobis Distance** | 18 | 6 | 11 | 9 |
| | **Excluded observations** | 54<br>2.1% | 35<br>2.4% | 22<br>2.6% | 14<br>3.1% |
| | **New Subsample Size for Cluster Analysis** | 2,533 | 1,447 | 817 | 441 |

### 3.5.2. Determination and validation of Clusters

As explained in section 2.4.4, the K-means is applied more times to test some solutions with different cluster numbers. The evaluated cases are from two to eight clusters. To choose how many clusters to use, it is looked for the minimum among percentage changes of heterogeneity measure. The heterogeneity is analysed through the multi-variate Euclidean distance between observations and their centre.

The multi-variate Euclidean distance is studied through its standard deviation. In Figure 68, an example reveal cluster analyses are depicted for Adult Q1 subsample. For each case, the standard deviation of the Euclidean distance between observation and centre is reported on the left vertical axis, while on the right axis the increase of standard deviation is reported.

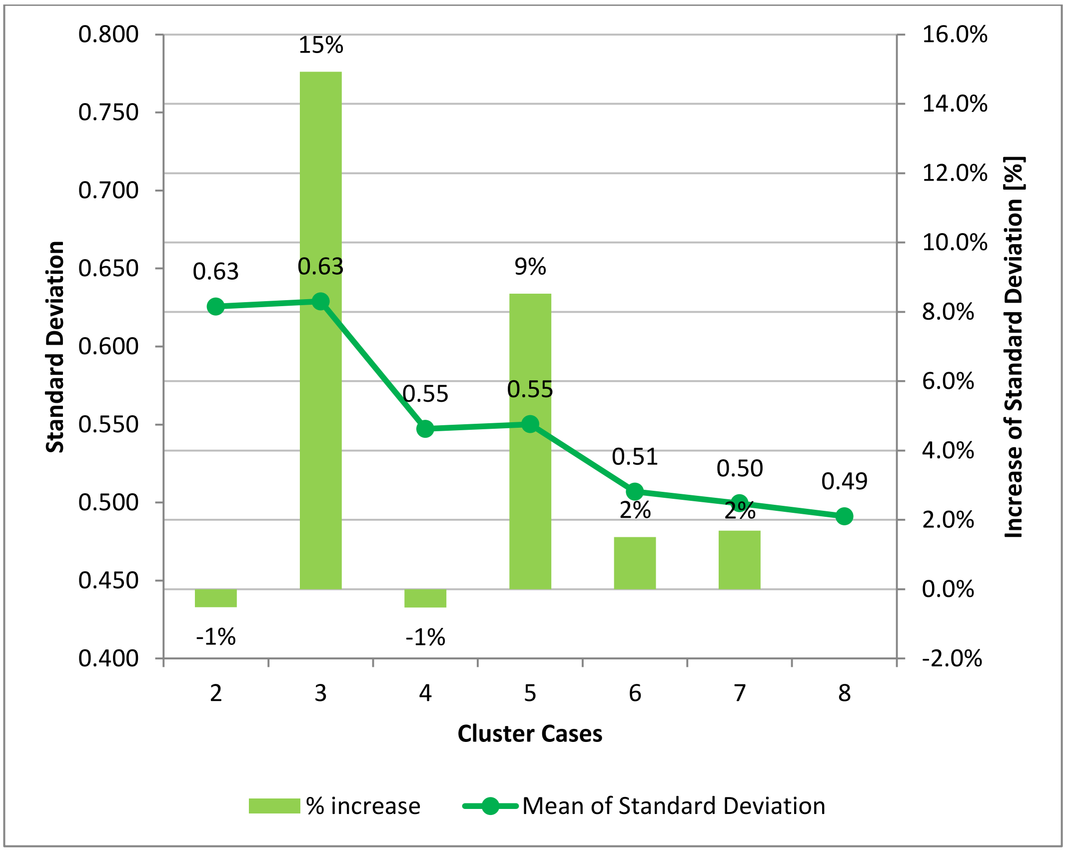


Figure 65 – Comparison of Standard Deviation of Euclidean distance among different cluster analyses.

When the number of clusters decreases, a growth of standard deviation is recorded, except in two cases: with four and two clusters. The last one is less meaningful than the first, so it is examined in depth the case with four clusters.

The same methodology is applied for the other subsamples and the following numbers of clusters are defined:

- Adult 1Q, 4 clusters;
- Stud 1Q, 5 clusters;
- Adult 1Q+2Q, 4 clusters;
- Stud 1Q+2Q, 5 clusters.

The size of each cluster is reported in Table 87.

Table 87: **Cluster size.**

| | Subsample | | | |
|---|---|---|---|---|
| **Cluster number** | **Adult 1Q** | **Stud 1Q** | **Adult 1Q+2Q** | **Stud 1Q+2Q** |
| 1 | 886 | 245 | 263 | 86 |
| 2 | 620 | 276 | 128 | 103 |
| 3 | 601 | 305 | 249 | 97 |
| 4 | 426 | 324 | 177 | 113 |
| 5 | / | 297 | / | 42 |

The cluster stability is analysed with a cross validation. From the four subsamples, some new groups are generated with a random selection. The sizes of these new test groups are listed below:

- 1000 respondents for Adult 1Q, about 40% of total;
- 750 respondents for Stud 1Q, about 50% of total;
- 350 respondents for Adult 1Q+2Q, about 43% of total;
- 197 respondents for Stud 1Q+2Q, about 45% of total.

The most stable cluster analysis is on Adult Q1+Q2, with just 9% of observation in different groups (Hair, Black, Babin, & Anderson, 2014). The other tests provide results between 13% and 21%, which are considered stable. The details of each subsample are reported in the next tables.

Table 88: **Cross Validation for Adult Q1.**

| **From first Cluster Analysis** | **From second cluster analysis** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **Total** |
| **1** | **314** | 2 | 41 | 15 | 372 |
| **2** | 12 | 34 | 28 | **165** | 239 |
| **3** | 14 | 17 | **183** | 24 | 238 |
| **4** | 2 | **133** | 10 | 6 | 151 |
| **Total** | 342 | 186 | 262 | 210 | **1000** |
| **Case assigned to same clusters** | 92% | 72% | 70% | 79% | 80% |

Table 89: **Cross Validation for Stud Q1.**

| **From first Cluster Analysis** | **From second cluster analysis** | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **Total** |
| **1** | 2 | | | **120** | | 122 |
| **2** | **119** | 1 | 32 | | 1 | 153 |
| **3** | 17 | | 21 | 1 | **116** | 155 |
| **4** | 5 | **151** | | 2 | 7 | 165 |
| **5** | | 1 | **144** | 2 | 8 | 155 |
| **Total** | 143 | 153 | 197 | 125 | 132 | **750** |
| **Case assigned to same clusters** | 83% | 99% | 73% | 96% | 88% | 87% |

Table 90: **Cross Validation for Adult Q1+Q2.**

| **From first Cluster Analysis** | **From second cluster analysis** | | | | |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **Total** |
| **1** | 6 | 3 | | **89** | 98 |
| **2** | 1 | **54** | 3 | | 58 |
| **3** | 6 | 1 | **108** | | 115 |
| **4** | **67** | 3 | 7 | 2 | 79 |
| **Total** | 80 | 61 | 118 | 91 | **350** |
| **Case assigned to same clusters** | 84% | 89% | 92% | 98% | 91% |

Table 91: **Cross Validation for Stud Q1+Q2.**

| **From first Cluster Analysis** | **From second cluster analysis** | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **Total** |
| **1** | **23** | 1 | | | 10 | 34 |
| **2** | 9 | | | 1 | **36** | 46 |
| **3** | | | 1 | **42** | 3 | 46 |
| **4** | 3 | | **40** | 6 | 1 | 50 |
| **5** | 1 | **15** | 3 | 2 | | 21 |
| **Total** | 36 | 16 | 44 | 51 | 50 | **197** |
| **Case assigned to same clusters** | 64% | 94% | 91% | 82% | 72% | 79% |

## 3.6. Profiles identification

After the definition and validation of clusters, the interpretation is made. All data about each subsample are available in appendix 2. Moreover, in this paragraph the clusters will be enriched with new information to complete their description.

Each main source which will be employed in this phase composes one of the next paragraph, as reported in following list:

- *interpretation based on cluster variables*;
- *interpretation based on preferences and attitudes exclude from Exploratory Factor Analysis (EFA) or Cluster Analysis (CA)*, summarised by some indices;
- *interpretation based on mobility patterns*, the most important trip, (e.g. used mode of transport, travelled distance, travel time, etc.) and week mobility (frequency of trips, purposes, etc);
- *interpretation based on socio-demographic and economic information*, like age, income, level of education, size of household, number of own car, etc.

Only the description through cluster variables will be reported for each subsample. Since the cluster profiles from Adult Q1 are not different from Adult Q1+Q2 (idem for Stud Q1 and Stud Q1+Q2), Adult Q1+Q2 and Stud Q1+Q2 are reported for variables included only in part B.

### 3.6.1. Interpretation based on cluster variables

The results from cluster analysis in subsample Adult Q1 are shown in Table 92, where the extreme values are highlighted to foster cluster interpretation.

Table 92: **Mean values on Cluster variables from subsample Adult Q1.**

| Cluster | Factor 1<br>Mode Pleasure | Factor 2<br>Eco&Cheap Travel | Factor 3<br>Travel Pleasure | Factor 7<br>Self Absorbed Activity and Feeling Safe | Factor 9<br>Aware Consumerism |
|---|---|---|---|---|---|
| **1** | .56 | **-.94** | .15 | -.61 | .43 |
| **2** | **-1.04** | .22 | .26 | **1.06** | .46 |
| **3** | -0.13 | .09 | **-.82** | .13 | **-1.38** |
| **4** | .54 | **1.52** | .45 | -.62 | .37 |

The values in Table 92 are displayed in the next figures, highlighting the main differences among clusters.

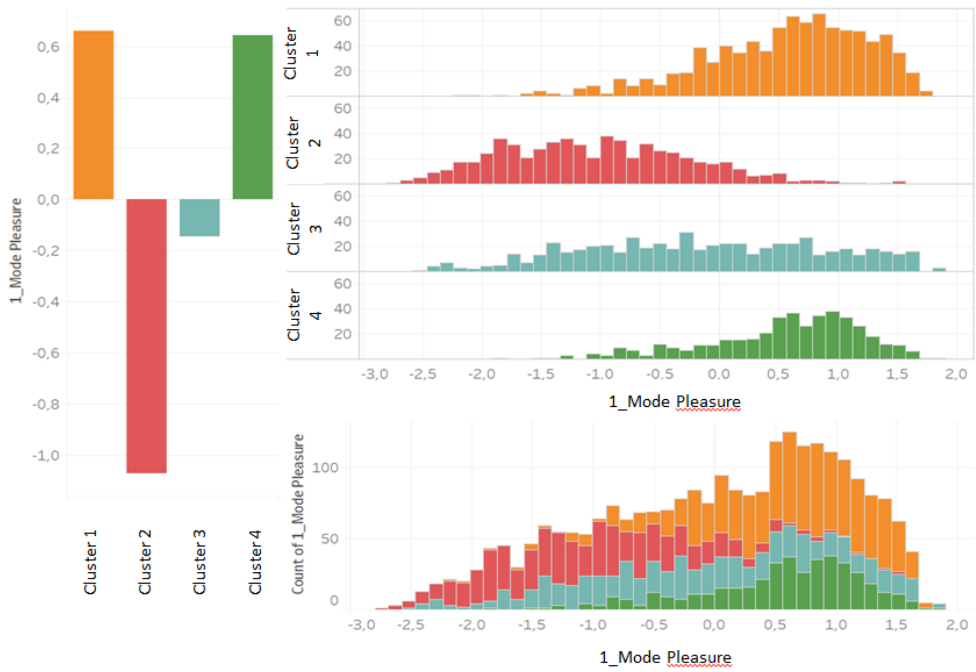


Figure 66 – Clusters on factor score *Mode Pleasure*.

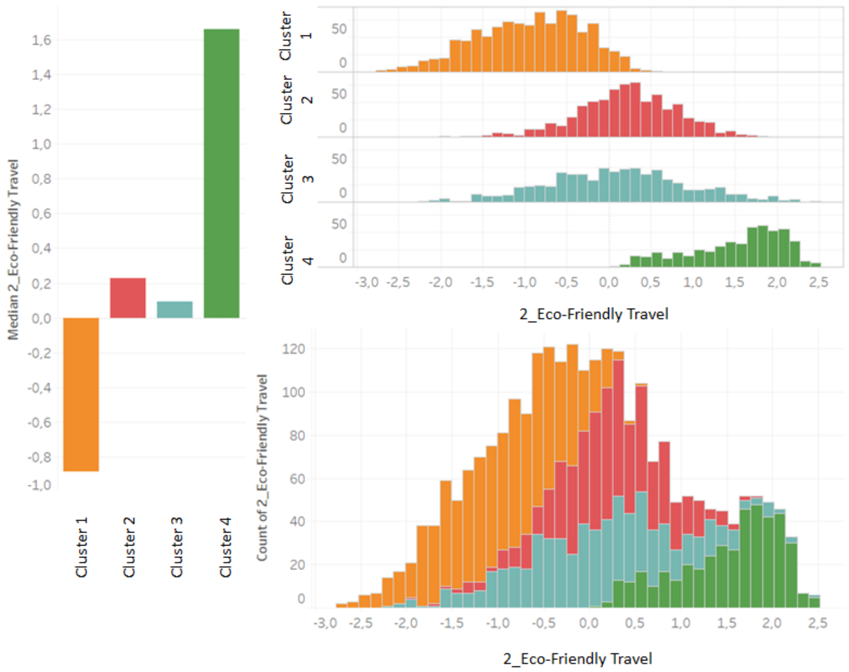


Figure 67 - Clusters on factor score *Eco&Cheap Travel*.

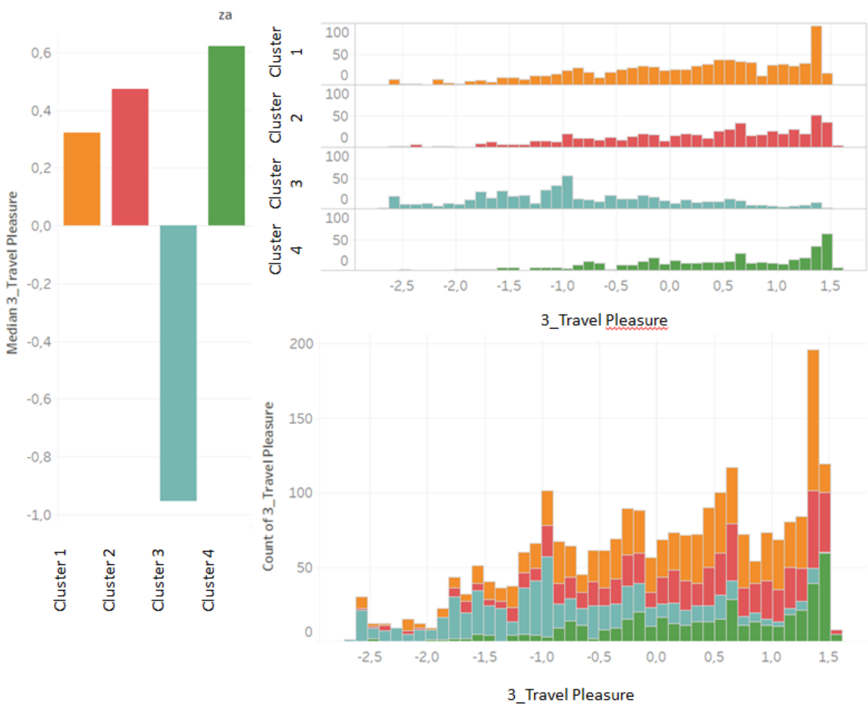


Figure 68 - Clusters on factor score *Travel Pleasure*.

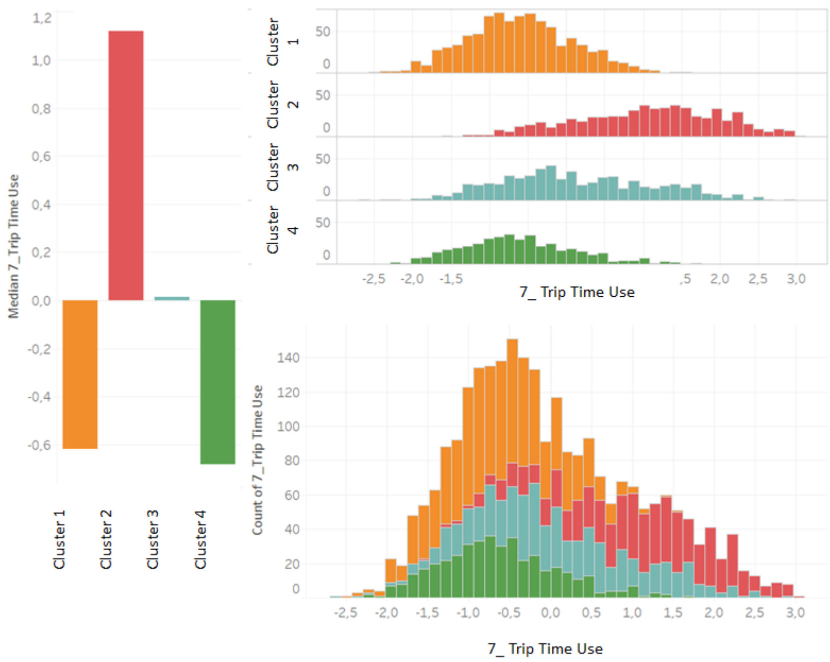


Figure 69 - Clusters on factor score *Self Absorbed Activity and Feeling Safe*.

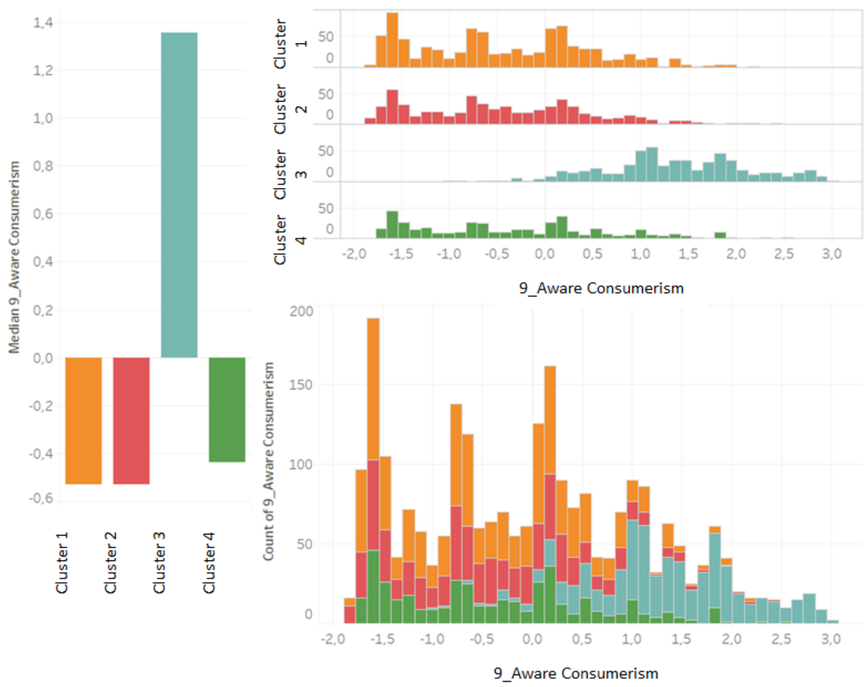


Figure 70 - Clusters on factor score *Aware Consumerism*.

The cluster n°1 is very extreme on factor Eco&Cheap Travel with -0.94 that is the minimum value among all clusters. People belonging to the first cluster are not satisfied of environmental sustainability and cheapness of their mode of transport. Furthermore, they have not time for activities (read, social networks, etc.) during the trip and they feel less safe from accidents than other clusters. Nevertheless, they are very attached to own mode of transport (highest value equal to 0.56). These information lead to state that they prefer using largely private vehicles. In addition, they are roughly in the average as regards Travel Pleasure and Aware Consumerism. For these characteristics the cluster n°1 is named *Car Addicts*.

The cluster n°2 presents two exceptional values: the lowest for Mode Pleasure and the highest for Self Absorbed Activity and Feeling Safe. People included in this cluster are very dissatisfied of their mode of transport, but they perceive it safer than the alternatives and it allows to them to have abundant free time during the travel. In addition, they judge their used mode of transport quite cheap and sustainable. This information induces to think that they mainly use Public Transport. Likely Car Addicts, they have not extreme values on Travel Pleasure and on Aware Consumerism. This description allows to label the cluster n°2 as *Malcontent Time Addicts*. This name has been decided according to previous results in Piedmont area (Pronello & Camusso, 2011), where there is a cluster with very comparable characteristics.

The cluster n°3 shows very uncommon values on two factors: the Travel Pleasure and the Aware Consumerism. For people in the cluster n°3 travelling is not interesting. They are happy to stay at home and they travel just to fit their needs. In addition, according to information from the factor Aware Consumerism, it seems that they prefer comfort. For this reason, they do not like with circular economy: they like to purchase new devices and they do not believe to lend or give away second hand things. These characteristics are clearly observable only in this cluster. About the used mode of transport, it is not possible to forecast a preference. It is probable that they utilize the most comfortable one from their point of view, in each situation, not related to habits or a priori preferences. To represent search of personal comfort, cluster n°3 is called *Timeservers*. This cluster is very similar what found in literature and, thus, the same name is chosen (Pronello & Camusso, 2011).

The cluster n°4 shows the highest value regarding Eco&Cheap Travel and it is very different from other clusters on this aspect. These people are also very satisfied of used mode of transport because factor Mode Pleasure is the second highest. However, they do not have free time during the trip. These characteristics allow to suppose that they regularly use the soft modes. In addition, they have the highest value on Travel Pleasure. The Aware Consumerism is not so significant. According to this analysis, they are classified as *Eco-Friendly Travel Pleasure Addicts*. Also for the last cluster there are a lot of common aspects with cluster of Travel Pleasure Addicts, found in Alessandria (Pronello & Camusso, 2011). In addition to the previous result, from this analysis it is possible to specify also the characteristics related to the sustainability, so that the adjective "Eco-Friendly" is added.

The results from cluster analysis in subsample Stud Q1 are reported in Table 81, where the extreme values are highlighted to foster cluster interpretation.

Table 93: **Mean values on Cluster variables from subsample Stud Q1.**

| | **Factor 1** | **Factor 2** | **Factor 3** | **Factor 4** | **Factor 8** | **Factor 9** |
|---|---|---|---|---|---|---|
| **Cluster** | **Mode Pleasure** | **Travel Pleasure** | **Being socially self-absorbed** | **Eco-Friendly Travel** | **Feeling safe** | **Aware Consumerism** |
| **1** | **1.05** | .17 | **-.98** | **-1.30** | -.03 | -.65 |
| **2** | -.08 | .16 | **.73** | .11 | **1.23** | .24 |
| **3** | -.71 | **-.85** | .61 | .08 | -.36 | **-.86** |
| **4** | .76 | .26 | **-1.00** | **1.28** | -.13 | -.01 |
| **5** | **-.93** | **.31** | .57 | -.47 | **-.62** | **1.10** |

The values in Table 93 are displayed in the next graphs, which highlight the main differences among clusters.

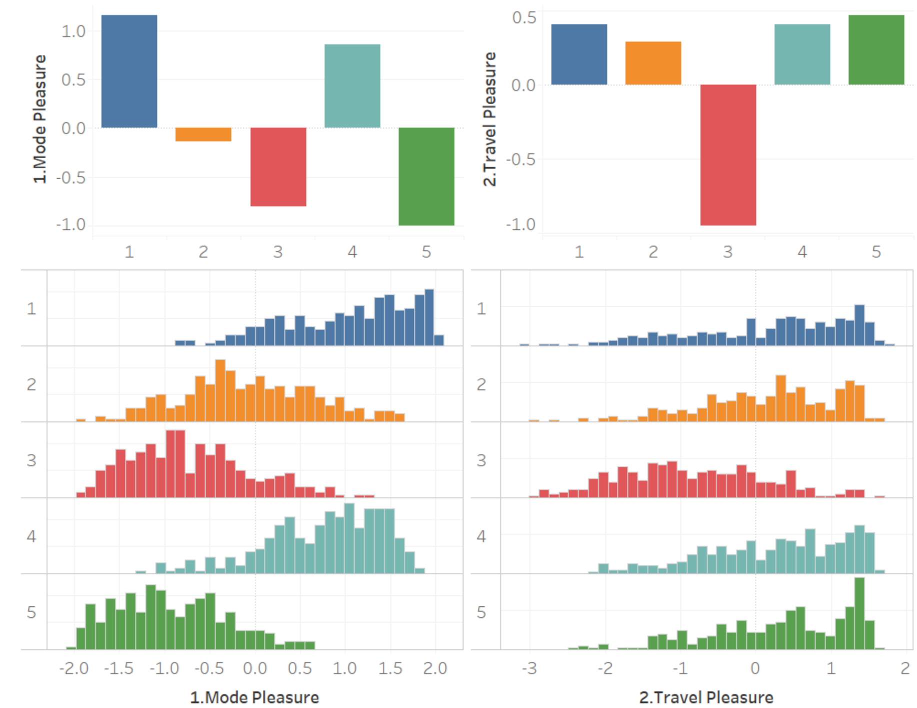


Figure 71 – Clusters on factor score *Mode Pleasure* and *Travel Pleasure*.

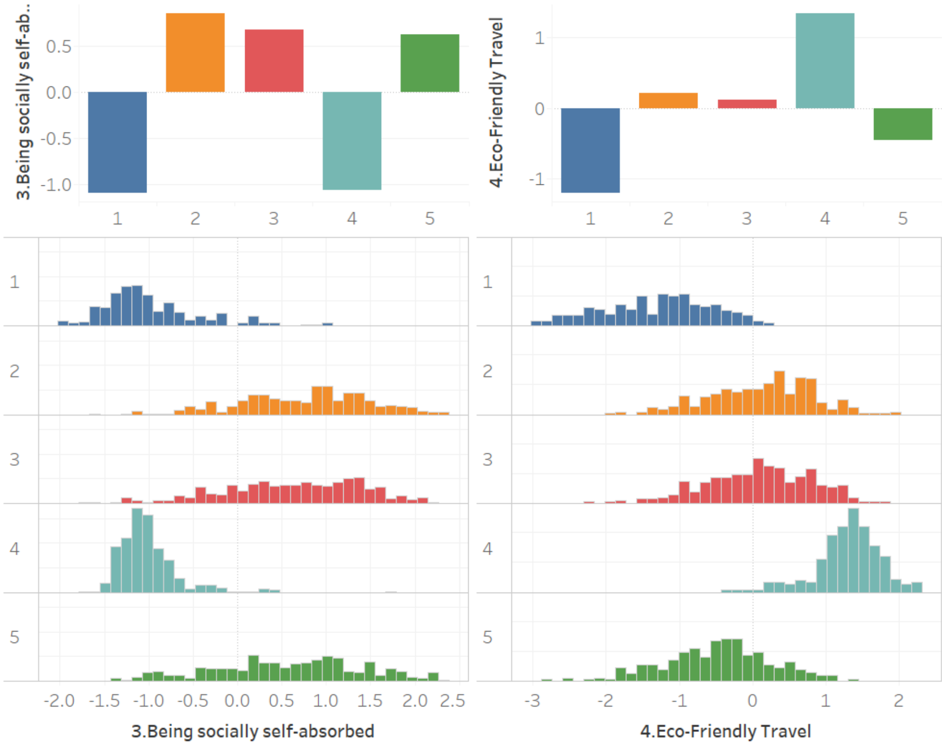


Figure 72 - Clusters on factor score *Being socially self-absorbed* and *Eco-Friendly Travel*.

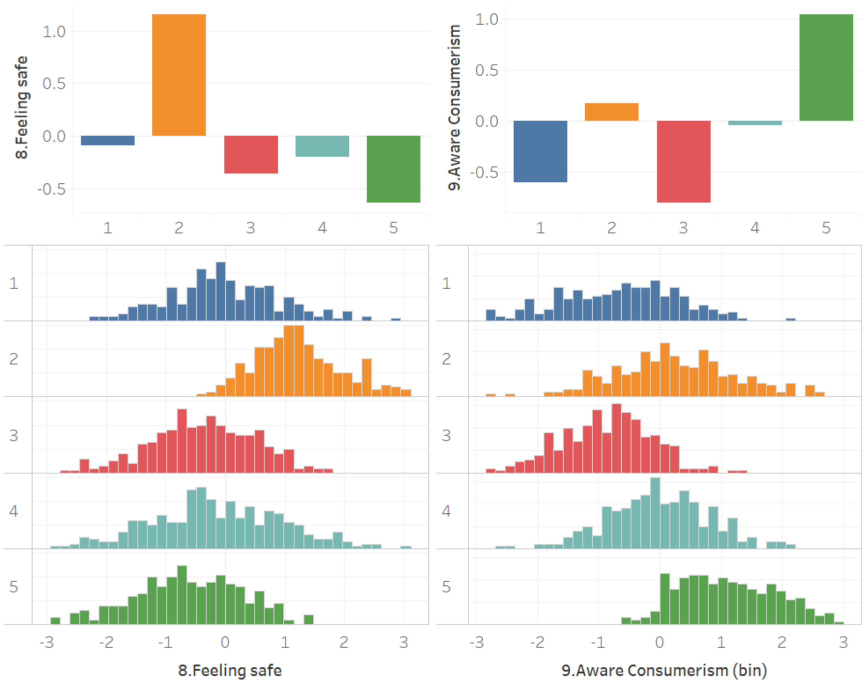


Figure 73 - Clusters on factor score *Feeling safe* and *Aware Consumerism*.

The cluster n°1 is extreme on factors Mode Pleasure, Being Socially self-absorbed and Eco&Cheap Travel with, respectively, 1.05, -.98 and -1.30. Respondents of this cluster are the most satisfied about their mode of transport, while they are the most dissatisfied about the cheapness and the sustainability of their trips. In addition, they have not free time during the travel showing the lowest value among all clusters. This information could lead to believe that they usually use private vehicle. The other variables characterising the cluster show average values or not so significant. Likely for subsample Adult Q1, this cluster can be labelled as in literature (Pronello & Camusso, 2011): *Car Addicts*.

The cluster n°2 has two high values: 0.73 on Being socially self-absorbed and 1.23 on Feeling Safe. Then people in this cluster have a lot of free time during the travel and they perceive to be safe from accidents. They are also satisfied for the sustainability of their trip (the second cluster with +0.11). For these reasons it possible to state that they mainly use firstly the Public Transport (PT). They are not very dissatisfied about their used mode of transport (-0.08) and they do not like so much travelling (0.16). They also play attention to their purchases, according to their awareness about consumerism impacts. This cluster is emerged only among students, thus, according to the above characteristics, it is named: *Millennial PT Supporters*.

The cluster n°3 has two lowest factor scores: Travel Pleasure and Aware Consumerism (-0.85 and -0.86). Considering the first factor, people travel only to fulfil their tasks and needs, so they do not try to go farer. Considering the second factor, they do not search/supply second hand items, but they prefer always new devices. This cluster is very similar to one formed by adults, but the students record lower score on Mode Pleasure. The cause could be that the choice of transport mode for students is constrained towards PT, not according to their personal comfort, but to other constraints and lack of alternatives (no car availability etc.). For the same reason, they do not perceive the safety of PT or its sustainability, like *Millennial PT Users*. The cluster n°3 is close to *Millennial PT Users* in the Being socially self-absorbed. This factor is highly correlated to social network use during travel and this activity is made from all students, also who do not choose freely the PT. According to this analysis and to previous results in Alessandria (Pronello & Camusso, 2011), this cluster is labelled with the same name: *Timeservers*.

The cluster n°4 is characterized by the lowest value on Being socially self-absorbed (-1.00) and the highest value on Eco-Friendly Travel (+1.28). Then, they have not free time during the travel and they are very satisfied of their mode of transport concerning sustainability. In addition, they like their mode of transport, because they reach 0.76 score in Mode Pleasure (2° rank). Furthermore, they are also enthusiastic travellers (again 2° position), but they do not feel themselves safe during their trips. Aware Consumerism shows average values. All information conduct to believe that these respondents are soft mode users. For the strong similarities with adults and previous results in literature (Pronello & Camusso, 2011), they are called *Eco-Friendly Travel Pleasure Addicts*.

The cluster n°5 is an extreme group: it has two highest values and two lowest ones on six cluster variables. This cluster presents very low Mode Pleasure score (-0.93): the respondents are really dissatisfied about their mode of transport. In addition, they do not perceive being safe during their travel. On the contrary, they have the highest attitudes to travel (+0.31 in Travel Pleasure) and the highest scores in Aware Consumerism (+1.10). They do not think that their mode of transport is sustainable, but they benefit from free time during the trip. For their similarity with adults, this group is classified as *Malcontent Time Addicts*.

The results from cluster analysis in subsample Adult Q1+Q2 are reported in Table 94, where the extreme values are highlighted to foster cluster interpretation.

Table 94: **Mean values on Cluster variables from Adult Q1+Q2.**

| Cluster | Factor 1<br>Mode Pleasure | Factor 2<br>Interest for Tech Innovation and App Addiction | Factor 3<br>Eco-Friendly Travel | Factor 4<br>Travel Pleasure | Factor 8<br>Activism Proenviron |
|---|---|---|---|---|---|
| **3** | **.79** | .09 | **-.90** | -.09 | -.43 |
| **2** | -.07 | **.14** | .12 | **.46** | **2.07** |
| **1** | **-1.10** | **-.10** | .04 | **-.47** | -.45 |
| **4** | .40 | **-.11** | **1.21** | **.48** | -.32 |

The cluster n°3 is similar to Car Addicts of Adult Q1: the highest value of Mode Pleasure and the lowest in Eco-Friendly Travel. In addition, they show a high attitude towards technology (0.09 in Interest for Tech Innovation and App Addiction) and a low value in Activism Pro-Environment (-0.43). For this reason, they are called with same name of the Adult Q1: *Car Addicts*.

As the cluster n°3, also the other clusters are very similar to the previous one from Adult Q1, so they are labelled with the same names:

- cluster n°2: *Malcontent Time Addicts*;
- cluster n°1: *Timeservers*;
- cluster n°4: *Eco-Friendly Travel Pleasure Addicts*.

The Malcontent Time Addicts show a very high Interest for Tech Innovation and App Addiction, instead the Timeservers and Eco-Friendly Travel Pleasure Addicts record the lowest values.

The Activism Pro-Environment is similar for all groups, except for Malcontent Time Addicts, where there is a huge difference from other clusters.

The results from cluster analysis in subsample Stud Q1+Q2 are reported in Table 95, where the extreme values are highlighted to foster cluster interpretation.

Table 95: **Mean values on Cluster variables from Stud Q1+Q2.**

| Cluster | Factor 1 Mode Pleasure | Factor 2 Travel Pleasure | Factor 3 Fear for own belongings | Factor 5 Eco&Cheap Travel | Factor 7 Interest for Tech Innovation | Factor 9 Activism Proenviron |
|---|---|---|---|---|---|---|
| **1** | **1.08** | .14 | .75 | **-.43** | **.37** | **-.41** |
| **5** | **-.85** | -.06 | **1.06** | -.24 | -.10 | -.34 |
| **4** | .64 | **.47** | -.65 | **1.15** | **-.26** | -.11 |
| **3** | -.68 | **-.50** | **-.87** | **-.43** | -.04 | -.35 |
| **2** | .14 | **.48** | -.46 | -.19 | .18 | **2.30** |

Likely to Adult Q1+Q2, in Stud Q1+Q2 there is the same structure of Stud Q1, but two new variables appear: Fear for own belongings and Activism Pro-Environment.

Since there are a lot of similarities, the labelling adopts the same names:

- cluster n°1: *Car Addicts*;
- cluster n°2: *Millennial PT Supporters*;
- cluster n°3: *Timeservers*;
- cluster n°4: *Eco-Friendly Travel Pleasure Addicts*;
- cluster n°5: *Malcontent Time Addicts*.

The Malcontent Time Addicts show a very high Fear for own belongings, followed by Car Addicts. The other three groups present negative value for this factor. As it happens in Adult Q1+Q2, one group has an exceptional value in Activism Pro-Environment: in this analysis such cluster is the Millennial PT Supporters.

### 3.6.2. Interpretation based on preferences and attitudes excluded from EFA or CA

To evaluate clusters according to the variables excluded from EFA some indices are used, as explained in section 2.4.5.

### Index computation

Before to describe the clusters using these new variables, the calculation of the indices about attitudes and preferences is explained. The final factor subset for each subsample is not composed by all the variables having all the requirements to be input in EFA, because to reach a simple structure some eliminations are needed. However, in the factor structure of the first EFA there are the relationships among variables. This information is used to build some indices allowing to quickly describe the clusters. These indices are calculated in two steps how non-refined factor scores:

- the algebraic sum of all answers, taking account the sing of the correlation with the factor;
- the total is divided by the number of variables included in the factor.

The indices are 30 calculated from 135 different variables about attitudes and preferences both from Part A and Part B of “Come Ci Muoviamo”. From Part A, the indices are described in Table 96 and from Part B in Table 97; in bold there are only variable with reverse semantic Likert scale.

Table 96: **Indices from Part A.**

| Code | Variable Name | Index | Code | Variable Name | Index |
|---|---|---|---|---|---|
| 45 | Parking_Origin_Availabilty | I.1 Easy Parking | 104 | SmartCardTicket | I.8 Social Rule Compliance |
| 46 | Parking_Origin_Cost | | 115 | DriveSlower120 | |
| 47 | Parking_Destin_Availabilty | | 116 | Heating | |
| 48 | Parking_Destin_Cost | | 117 | LaundryFull | |
| 71 | PT_LowerPrice | I.2 PT Service Increase | 128 | GiveSeatElderly | |
| 72 | PT_MoreSpeed | | **130** | **TravelWithoutTickets** | |
| 73 | PT_MoreFreq | | 39 | JustArrive | I.9 Fatalistic |
| 74 | PT_OnTime | | 29 | NoAlternative | |
| 75 | PT_MoreConfort | I.3 PT Quality Improvement | 126 | CharityToHomeless | I.10 Charity |
| 78 | PT_MoreClean | | 127 | CharityToOrganisations | |
| 79 | PT_MoreSecurity | | 123 | GiveOutItems | |
| 81 | MoreCar_Fuelprice | I.4 Will Use More Car | 135 | ChatProEnvironment | I.11 Pro Envinron |
| 82 | MoreCar_Lesstraffic | | 136 | EnvironOrganActivist | |
| 83 | MoreCar_MoreSafety | | 137 | ProEnvBehaviour | |
| 84 | MoreCar_CarAvailability | | 138 | SupportEnvOrganisation | |
| 85 | MoreCar_HigherTicketsPrice | | 139 | NoOGMproducts | |
| 86 | MoreCar_ElectricCar | | 56 | SeeLandscape | I.12 Landscape |
| 87 | MoreCar_MorePark | | 38 | UseWhyILikeLandscape | |
| 88 | MoreCar_LowerParkCosts | | 54 | Relax | |
| 89 | MoreCar_KeepActualMode | | 55 | Thinking | |
| 90 | ProBikeIf_SafetyRoute | I.5 Will Use More Soft Modes | 124 | LendItems | I.13 Awarness Consumerism |
| 91 | ProBikeIf_MoreRoadTraffic | | 121 | OldItems | |
| 92 | ProBikeIf_LessCarPark | | 122 | SecondHand | |
| 93 | ProBikeIf_MorePTTicketPrice | | 132 | Recycling | I.14 Re-Cycle |
| 94 | ProBikeIf_NeedSport | | 133 | ReuseShopBag | |
| 95 | ProBikeIf_CanHaveShower | | 33 | UseTheSafest | I.15 Perceived Safety |
| 96 | ProBikeIf_MoreBikePark | | 16 | SatisfSafety | |
| 97 | ProBikeIf_BetterAirQuality | | **102** | **PaperTicket** | I.16 ProE-Ticket |
| 98 | ProBikeIf_KeepActualMode | | 104 | SmartCardTicket | |
| 99 | JoinGAS | I.6 Car Pooling | 76 | PT_More e-ticket | |
| 100 | CarPooling_Pax | | 77 | PT_MoreIntegration | |
| 101 | CarPooling_Driver | | 120 | BioProducts | I.17 CarefulDiet |
| 244 | MobilityPackages | | 125 | EatLessMeat | |
| 109 | ShareCarUnknown | | 61 | AV_Work | I.18 AVActivities |
| **105** | **LikeDriving** | I.7 Car Aversion | 62 | AV_Read | |
| **106** | **CleanCar** | | 63 | AV_SocialNetwork | |
| 107 | ToBePassenger | | 65 | AV_WatchMovies | |
| 108 | ShareCarFriends | | 66 | AV_Relax | |
| **110** | **DrivingUnkownRoad** | | | | |
| 111 | NoDriveBigCity | | | | |
| 112 | NoDriveNight | | | | |
| 114 | UsuallyPassenger | | | | |

Table 97: **Indices from Part B.**

| Code | Variable Name | Index | Code | Variable Name | Index |
|---|---|---|---|---|---|
| 204 | AntiTheftAlarm | I.19 Comfort | 170 | CongestionPollution | I.25 Awareness of Env problem |
| 205 | VideoSurveillance | | 176 | AirPollution | |
| 219 | AirConditionHouse | | 179 | AvoidQueue | I.26 Speed research |
| 221 | AllInclusiveHoliday | | 180 | NotWaitPizza | |
| 217 | TVBedroom | | 185 | ReduceTimeDelivery | |
| 203 | EnsuranceNewCar | | 216 | NoBusSeat | I.27 Stress on PT |
| 177 | Telepass | | 220 | CrowdedPT | |
| 234 | AppHelpMe | I.20 App Addiction | 222 | StressInPT | |
| 235 | AppsAreFun | | 227 | AnnoyChangePT | |
| 236 | DownloadApp | | 233 | GPS | I.28 GPS Feeling |
| 239 | SmartphoneUpdate | | 241 | **TravelWithoutGPS** | |
| 240 | VoiceCommands | | 242 | **GPSmakesLazy** | |
| 243 | AppsForTrips | | 230 | Trust in future | I.29 Tech Innovation |
| 129 | CriminalRecords | I.21 Security | 231 | InterestNewGadgets | |
| 197 | WorryWalkAlone | | 232 | InterestNewTech | |
| 198 | FearPickpocketing | | 237 | BuyAV | |
| 199 | CrimeNews | | 17 | SatisfSecurity | I.30 Security On Board |
| 200 | TrainNight | | 22 | SatisfCarryObjects | |
| 201 | TheftIncrease | | 34 | UseTheMostSecure | |
| 188 | BestFare | I.22 Cost sensibility | | | |
| 189 | SalePurchase | | | | |
| 190 | HolidayBooking | | | | |
| 191 | TollRoad | | | | |
| 192 | GasolinePrice | | | | |
| 194 | TechPurchase | | | | |
| 182 | AspireQueue | | | | |
| 165 | LegStroll | I.23 Alternative Routes | | | |
| 167 | LegChangeMoT | | | | |
| 168 | LegNewPath | | | | |
| 169 | PleasurePath | | | | |
| 171 | EnvAwareness | I.24 Awareness Mobility Impacts | | | |
| 172 | CO2Reduction | | | | |
| 173 | PoliticsPressMe | | | | |
| 174 | FamilyPressMe | | | | |
| 175 | NoisePollution | | | | |
| 113 | **Drive&Drink** | | | | |

The majority of indices in Table 96 and Table 97 refer to other field, not being related only to transport. Their aim is trying to describe a general attitude towards other themes, for instance speed research, security or technology. In this way the research tests if the respondents are coherence in travel behaviour compared to other activities.

### Indices on clusters

After the index definition, clusters are described thanks to them. In the Table 98 and Table 99 there are the average values of all indices for each cluster, while in “Appendix 3 – Attitudes and preferences of new profiles”, also standard deviation is reported.

Table 98: **Cluster on indices from Part A.**

| | | Adult Q1 | | | | Student Q1 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Millennial PT Supporters** |
| I.1 | Easy Parking | 4.9 | 3.9 | 4.3 | 3.9 | 4.7 | 3.7 | 3.7 | 3.6 | 3.7 |
| I.2 | PT Service Increase | 5.1 | 5.0 | 4.9 | 4.9 | 5.0 | 5.2 | 4.8 | 4.6 | 4.6 |
| I.3 | PT Quality Improvement | 4.8 | 4.6 | 4.5 | 4.5 | 4.6 | 4.6 | 4.4 | 4.2 | 4.1 |
| I.4 | Will Use More Car | 3.4 | 3.3 | 3.2 | 3.0 | 3.8 | 3.9 | 3.8 | 3.1 | 3.6 |
| I.5 | Will Use More Soft Modes | 3.3 | 3.3 | 3.1 | 3.4 | 3.3 | 3.5 | 3.3 | 3.5 | 3.6 |
| 80 | Willingness More Use PT | 4.1 | 5.5 | 4.0 | 3.5 | 4.3 | 5.2 | 4.7 | 3.5 | 5.2 |
| I.6 | Car Pooling | 2.6 | 2.6 | 2.1 | 2.9 | 2.7 | 2.9 | 2.5 | 3.1 | 2.9 |
| I.7 | Car Aversion | 3.1 | 3.6 | 3.3 | 3.4 | 3.0 | 3.4 | 3.4 | 3.4 | 3.4 |
| I.8 | Social Rule Compliance | 4.9 | 5.0 | 4.6 | 4.9 | 4.5 | 4.8 | 4.5 | 4.6 | 4.8 |
| I.9 | Fatalistic | 2.9 | 2.8 | 2.8 | 1.9 | 4.0 | 3.4 | 3.3 | 4.4 | 3.5 |
| I.10 | Charity | 4.0 | 3.9 | 2.8 | 3.9 | 3.1 | 3.4 | 2.4 | 2.9 | 3.1 |
| I.11 | Pro Envinron | 3.1 | 3.1 | 2.6 | 3.4 | 2.5 | 2.7 | 2.1 | 2.7 | 2.7 |
| I.12 | Landscape | 3.3 | 3.4 | 3.3 | 4.4 | 3.7 | 3.4 | 3.2 | 4.3 | 3.7 |
| I.13 | Awarness Consumerism | 3.4 | 3.5 | 2.2 | 3.6 | 3.1 | 3.7 | 2.7 | 3.4 | 3.3 |
| I.14 | Re-Cycle | 5.8 | 5.8 | 5.5 | 5.8 | 5.5 | 5.7 | 5.3 | 5.6 | 5.6 |
| I.15 | Perceived Safety | 2.9 | 4.4 | 3.8 | 3.2 | 2.9 | 3.0 | 3.3 | 3.3 | 4.8 |
| I.16 | ProE-Ticket | 4.5 | 4.4 | 4.0 | 4.5 | 4.3 | 4.1 | 3.9 | 4.4 | 4.1 |
| I.17 | CarefulDiet | 3.5 | 3.6 | 3.3 | 3.7 | 3.4 | 3.6 | 3.3 | 3.6 | 3.6 |
| I.18 | AVActivities | 3.0 | 2.6 | 2.4 | 2.8 | 3.4 | 2.9 | 2.7 | 2.9 | 3.0 |

All indices show differences that are statistically significant.

The first index, *Easy Parking*, refers to the perceived availability and cost of parking at origin and destination of the most important trip. There is a big difference between Car Addicts and Malcontent Time Addicts. Also Eco-Friendly Travel Pleasure Addicts show a low value, while Timeservers are in the average. Students are similar to adults and Millennial PT Supporters are similar to Malcontent Time Addicts.

The two indices *PT Service Increase* and *PT Quality Improvement* show the same trends: the lowest value for Timeservers and from Eco-Friendly Travel Pleasure. Instead the maximum values refer to of Car Addicts: they are more demanding towards PT. However, both indices are greater than middle score, so respondents agree to ask PT improvement: of services (frequency, speeds, etc.) and of quality (comfort, cleanness, etc.). In students there is only one difference: the Malcontent Time Addicts are more exigent than adult ones, while the Millennial PT Supporters record the lowest scores of all clusters, both student and adult.

The attitudes to use more car, soft modes and PT are investigated. The results show that the mode of transport with more potential use is the PT. Indeed, it has the highest score in each subsample, for all clusters. Maybe there is a not negligible social desirability for PT, which leads to overestimate attitude to use PT. On the other hand, the same phenomenon could cause the low willingness to choose car. Instead, the low value about soft modes is an important alert: they are not the favourite transport mode for all profiles, except for Eco-Friendly Travel Pleasure Addicts. Among clusters, generally each individual prefers the mode of transport to better fit his(her) attitudes: for instance, Car addicts are the most suitable to use car. The Timeservers have not a favourite choice, generally they show low values; soft modes record the lowest score. The students show on average higher scores than adults, but they show similar trends. In both samples, have cluster Malcontent Time Addicts records high scores on willingness to use PT: behind their current dissatisfaction, there is strong intention to choose PT.

The *Car Pooling Index* described the inclination to car pool: it records very low success (roughly less than 3.0), a little more among students or Eco-Friendly Travel Pleasure Addicts. The Timeservers are the less available to car pool. The car-pooling hardly could be a sustainable solution: it is more attractive for soft modes and PT users than for car drivers, so it induces a modal shift from sustainable transport to car.

The *Car Aversion Index* measures how much the relationship with own car is important. If car is more than an instrument (like status symbol) and car use is settled in her/his habits, the score is low; Car Addicts record the lowest values. Again, among students this index is higher than for the adults.

The *Social Rule Compliance Index* is made up of some attitudes on respect of norms about human relationships or environment, like leaving own seat to elderly or using washing machine only with full laundry. This index aims not to measure moral or ethical level of respondents, but their awareness about consequences of their actions and behaviours on other people and on the environment. Some differences among clusters come to light: who plays more attention to the rules are the Malcontent Time Addicts. Instead, the Timeservers seem to be those who less respect these rules. Among students, lower values are recorded, but both the Millennial PT Supporter and Malcontent Time Addicts show very high scores.

The *Fatalistic Index* is a measure of assessment performed before the mode choice. It takes into account the perception of alternatives and the importance of the transport mode selection. If the index shows high values, low time is devoted to the transport mode decision. In this index the lowest value comes from Eco-Friendly Travel Pleasure Addicts, while the students show higher values. Maybe the young people have less possibilities to choose transport modes (less frequent car availability, minor budget to travel, etc.).

The *Charity Index* is composed by three variables about helping homeless. These variables show that Timeservers are not interested to social aspects: they have exceptionally low values, while other clusters are more or less equal. The students are less charitable than adults, but still students Timeservers record the lowest value.

The *Index Pro-Environ* aims to estimate how much people care about environmental problems. The most attentive to this them are Eco-Friendly Travel Pleasure Addicts. Students get lower scores than adults. This result can be explained analysing the behaviours through the variables: the students are willing to support pro-environment organisations, through economic contribution, and to actively participate. Maybe the first is too hard because students have not enough budget and the second is uncommon for university students because it is too time-consuming.

The *Index Landscape* is made up by four variables and aims to describe the attention to the external context and the environment of travellers. This parameter is high on Eco-Friendly Travel Pleasure Addicts and on average is higher for students.

The *Awareness Consumerism* is defined by the variables forming the GEB (Kaiser & Wilson, Assessing People's General Ecological Behavior: A Cross-Cultural Measure, 2000), and it confirms the relationships among variables. It measures the attitudes to re-use items and objects through purchase/sell of second hand things. Timeservers both students and adults register very low values in this index. Also in the *Re-Cycle Index*, about garbage management, Timeservers record the lowest scores. As for Social Rule Compliance, they do not think about consequences of their actions and they do not believe that their behaviour can help to improve the situation. About garbage management, again, students are less sustainable than adults.

The *Perceived Safety Index* refers to satisfaction and awareness about safety of respondents' current mode of transport. Car Addicts perceive lower security than Malcontent Time Addicts and especially than Millennial PT Supporters.

The *Pro-E-Ticket Index* aims to summarise attitudes towards more digital and integrated tickets. There is an overall positive approach, but Timeservers are not so interested to it, while the most attracted by e-ticket are Car Addicts and Eco-Friendly Travel Pleasure Addicts. Instead, Malcontent Time Addicts as well as Millennial PT Supporters are less interested. Then, the digitalisation is not required by current users, they are maybe accustomed, but it could be an attractive factor to promote modal shift from car to PT.

The *Careful Diet Index* verifies if people think about environmental consequences of their diet. The highest scores come from Eco-Friendly Travel Pleasure Addicts and Malcontent Time Addicts.

The *AV Activities Index* tries to measure attitudes towards new Autonomous Vehicles (AV vehicles). The Car Users and the students are the most confident towards AV vehicles.

In Table 99, the indices which does not show statistically significant differences are highlighted in red and bold.

Table 99: **Cluster on indices from Part B.**

| Code | Variable Name | Adult Q1 Car Addicts | Adult Q1 Malcontent Time Addicts | Adult Q1 Timeservers | Adult Q1 Eco-Friendly Travel Pleasure Addicts | Student Q1 Car Addicts | Student Q1 Malcontent Time Addicts | Student Q1 Timeservers | Student Q1 Eco-Friendly Travel Pleasure Addicts | Student Q1 Millennial PT Supporters |
|---|---|---|---|---|---|---|---|---|---|---|
| I.19 | Comfort | 3.1 | 2.7 | 3.0 | 2.6 | 3.4 | 3.4 | 2.4 | 2.3 | 2.5 |
| I.27 | Stress on PT | 3.8 | 3.4 | 3.7 | 3.1 | 3.9 | 3.9 | 3.2 | 3.7 | 3.5 |
| I.21 | Security | 3.7 | 3.2 | 3.7 | 3.3 | 3.9 | 4.0 | 3.1 | 3.3 | 3.3 |
| I.30 | Security On Board | 4.8 | 3.6 | 2.9 | 3.6 | 4.5 | 3.0 | 3.7 | 3.2 | 3.6 |
| I.22 | Cost sensibility | **4.1** | **3.9** | **4.0** | **4.0** | 4.2 | 4.3 | 4.0 | 4.1 | 4.1 |
| I.26 | Speed research | 3.1 | 3.0 | 2.8 | 2.8 | 3.1 | 3.1 | 2.7 | 2.7 | 2.8 |
| I.23 | Alternative Routes | 2.0 | 2.4 | 2.3 | 2.3 | 2.2 | 2.4 | 2.4 | 2.4 | 2.7 |
| I.24 | Awareness Mobility Impacts | 3.9 | 4.7 | 4.1 | 4.4 | 4.0 | 3.9 | 4.4 | 4.1 | 4.8 |
| I.25 | Awareness of Env problem | 5.5 | 5.7 | 5.5 | 5.7 | 5.4 | 5.3 | 5.6 | 5.5 | 5.7 |
| I.20 | App Addiction | 3.5 | 3.5 | 3.2 | 3.2 | 4.0 | 3.7 | 3.3 | 3.5 | 3.5 |
| I.28 | GPS Feeling | **3.3** | **3.1** | **3.3** | **3.0** | 3.8 | 3.9 | 3.2 | 3.7 | 3.4 |
| I.29 | Tech Innovation | **3.7** | **3.8** | **3.6** | **3.6** | 4.1 | 3.6 | 3.4 | 3.7 | 3.9 |

The values of indices which do not show statistically significant differences are highlighted in red.

The *Comfort Index* is composed by seven variables describing search of comfort, like choice of All Inclusive holidays, the installation of air conditioning at home, etc. The Timeservers and Car Addicts show the highest scores, while Eco-Friendly Travel Pleasure Addicts the lowest ones. There are not significant differences between adults and students.

The *Stress On PT Index* is composed by variables about crowd on PT and its consequences. It is correlated to research of comfort, but it is also based on current experience or prejudice about PT. The Timeservers and Car Addicts show the highest scores, like in Comfort Index, but in this case also Malcontent Time Addicts are different from Eco-Friendly Travel Pleasure Addicts, which record the lowest values.

The *Security Index* is a proxy variable of worries on personal security. The Car Addicts and the Timeservers are clusters with highest values on this index, while Malcontent Time Addicts and Eco-Friendly Travel Pleasure Addicts record the lowest values. This index is correlated to the car-pooling one: some clusters does not trust to unknown people, avoiding any contacts with them.

The *Security On Board Index* refers to the satisfaction about security of the current mode of transport. The highest value comes from the Car Addicts, who are satisfied being able to bring own objects and nobody can steal them. Also in student subsample this cluster shows high value but student average is lower than that of adults.

The *Cost Sensibility Index* show how much respondents are sensitive to the prices and costs. The clusters in Adult 1Q does not show statically significant differences: all respondents pay the same attention to money. Then, costs are not irrelevant, because the index is always greater than 3.5, but prices play an important role in all clusters. For students there are a few statistically significant differences: the Malcontent Time Addicts are the most sensitive to the cost.

The *Speed Research Index* is made up of variables related to action to save time in different field: delivery after on-line shopping, waiting of pizza cooking, etc.. The respondents who are less patient and slow are Car Addicts and Malcontent Time Addicts. Students do not differ from adults for this index.

The *Alternative Routes Index* provides information about respondents' frequency to plan some legs for various reasons, like going for a stroll, trying new alternative path, etc. In general, during the most important trip, people avoid legs (scores less than 3.0). The students have more propensity to include some legs than adults. In each subsample, the stiffest and most regular cluster is Car Addicts.

The indices *Awareness Mobility Impacts* and *Consciousness of Environmental Problem* show similar trends. The first index refers to the knowledge of respondents about impacts of their travel behaviour and their engagement to change it. The second index refers to the ability to recognise the problem of air pollution. Although everyone knows and admit that air quality is very bad, the availability and willingness to reduce emissions are less strong (averages of 5.6 versus 4.3). Within the subsamples, the Car Addicts show the lowest scores.

The last three index are about technology:

- *App Addiction* measures the use of apps through smartphone in the daily life;
- *GPS Feeling* is devoted to investigate dependence from GPS during the travels;
- *Tech Innovation* is focused on respondents' interest to technology progress.

The last two indices are not statistically significant for Adult 1Q subsample. However, students and adults in Car Addicts have better feeling to technology than Timeservers and Eco-Friendly Travel Pleasure Addicts.

### 3.6.3. Interpretation based on mobility patterns

The data about mobility are organised in two sets: data about the most important trip and data about mobility during the representative week. They are reported in Table 100 and

able 101 with average values, but more details are shown in appendix 4 (standard deviation, results from ANOVA across clusters, etc.). Except for

Ignorance Car Sharing, all variables show statistical differences between clusters both of Adult Q1 and Stud Q1.

In Table 100, all features show statistically significant differences, except for car sharing index.

Table 100: **Features of the most important trip in Adult Q1 and Stud Q1.**

| | | **Adult Q1** | | | | **Student Q1** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Millennial PT Supporters** |
| 6 | Distance | 23.5 | 26.1 | 23.3 | 11.4 | 31.3 | 21.5 | 17.8 | 9.5 | 36.4 |
| 12 | TravelTime | 37.4 | 57.1 | 42.5 | 28.4 | 50.8 | 53.0 | 48.8 | 22.0 | 75.0 |
| 25 | Desired Reduction | 17.3 | 24.4 | 19.1 | 8.9 | 16.1 | 35.6 | 19.2 | 8.3 | 20.3 |
| 26 | MonthlyCost | 93.5 | 57.0 | 62.3 | 13.1 | 68.9 | 46.4 | 36.2 | 6.0 | 69.8 |
| 27 | WtP More Speed | 9.8 | 12.5 | 9.9 | 3.3 | 9.6 | 11.5 | 6.1 | 1.8 | 7.2 |
| 28 | WtP Less Pollutant | 13.6 | 8.3 | 8.1 | 13.0 | 12.0 | 9.1 | 5.9 | 5.3 | 7.0 |
| 245 | CarUse TripImpo | 4.4 | 0.1 | 1.7 | 0.7 | 3.0 | 0.1 | 0.2 | 0.3 | 0.2 |
| 246 | PTUse TripImpo | 0.7 | 4.9 | 2.9 | 1.1 | 1.9 | 5.0 | 4.7 | 1.3 | 4.9 |
| 247 | Soft Modes Use Trip Impo | 0.1 | 0.1 | 0.5 | 3.3 | 0.1 | 0.2 | 0.3 | 3.7 | 0.1 |
| 42 | Ignorance Bike Sharing | 21.9 | 17.4 | 25.5 | 9.7 | 31.3 | 24.6 | 28.0 | 7.1 | 20.9 |
| 43 | Ignorance Car Sharing | 3.0 | 3.0 | 3.5 | 2.2 | 2.9 | 3.1 | 2.1 | 1.7 | 2.3 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 40 | Ignorance PT | 0.3 | 0.1 | 0.2 | 0.0 | 0.4 | 0.3 | 0.2 | 0.1 | 0.2 |
| 41 | Ignorance Train | -35.7 | -34.2 | -35.3 | -30.6 | -34.4 | -40.0 | -33.6 | -28.9 | -29.9 |

The Car Addicts record the second longest distance of the most important trip. Their perceived travel time is not so high, because their average speed is high. However, they aspire to reduce their duration of 17 minutes (46% of travel time). This cluster spends a huge amount of money to travel, both as a global value (93.5 €) and as a cost per km (4.0 €/km). The Car Addicts show the highest willingness to pay to reduce pollutant emissions, but not for saving time. They largely use car for their most important trip and they show very high level of ignorance of the alternatives, as shown from the ignorance indices.

The Malcontent Time Addicts travel for the longest distances (26 km) and they spend a lot of time for their most important trip (57 minutes). They would like to decrease their travel time, (highest absolute value of 24 minutes), but taking into account the total duration, such reduction is comparable to that of other clusters (43%). The monthly cost is high, but, in relation to the distance travelled, is the second cheapest (2.2 €/km). Opposite to Car Addicts, they have a stronger willingness to pay to save time than to reduce pollutant emissions. They use mainly Public Transport and their knowledge about alternatives is quite complete.

The Timeservers do not record extreme values of travelled distance, trip duration or monthly cost. In addition, they have very low willingness to pay both to save time and to reduce pollutant emissions. They have not a favourite mode of transport: car and PT are almost equal, but they do not chose soft modes. From ignorance indices emerge their inexperience about bike sharing and car sharing.

The Eco-Friendly Travel Pleasure Addicts show several exceptional values: the shortest covered distance, the shortest travel time and the lowest monthly cost. All these features are explained by the frequently use of soft modes for the most important trip. In addition, they have the deepest knowledge about alternatives.

In

able 101, all features show statistically significant differences.

able 101: **Features about week mobility from Adult Q1 and Stud Q1.**

| | | Adult Q1 | | | | Stud Q1 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Millennial PT Supporters** |
| 5 | TripPerWeek | 14.2 | 13.1 | 12.8 | 13.8 | 13.1 | 11.9 | 11.3 | 12.8 | 13.0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 248 | CarUse Week | 7.0 | 3.4 | 4.3 | 3.3 | 6.2 | 2.7 | 2.6 | 1.7 | 3.8 |
| 249 | PTUse Week | 1.1 | 3.1 | 2.2 | 1.4 | 0.9 | 2.3 | 2.4 | 1.7 | 2.6 |
| 250 | Soft Modes Use Week | 1.0 | 1.6 | 1.3 | 4.0 | 0.9 | 1.6 | 1.2 | 4.1 | 1.4 |
| / | % use of favourite MoT | 81% | 61% | 71% | 67% | 72% | 62% | 64% | 72% | 59% |
| / | % of frequency of most impo trip over week mobility | 40% | 44% | 45% | 41% | 41% | 49% | 50% | 45% | 46% |
| 9 | Sust Index Mode Most Impo Trip | 4.6 | 1.2 | 2.4 | 0.9 | 3.5 | 1.2 | 1.2 | 0.5 | 1.0 |
| 8 | Sust Index Mode Week | 12.1 | 6.7 | 8.1 | 5.0 | 10.4 | 5.7 | 5.5 | 3.1 | 7.2 |

The highest total number of trips along the week refers to Car Addicts, while the lowest to Timeservers. The modal share along the whole week is different for each cluster:

- the Car Addicts increase their dependence from car;
- Malcontent Time Addicts and Timeservers use more car for other trips along the week;
- Eco-Friendly Travel Pleasure Addicts continue to use more soft modes.

In other way, quota covered by the most important trip along the week is roughly equal for all clusters (40-45%), but the percentage of use for the favourite transport mode over the week is very different (from 61% to 81%).

The Sustainable index for the most important trip shows a large difference among clusters (nearly 1:5), but if it is calculated for all the week, the generalised increase of car use reduces this gap to approximately 1:2.

The last information about mobility is the trip purpose (Table 102). For all the student, the trip purpose is to go to university. The difference among adults are statistically significant, checked with Chi Quadro test.

Table 102: **Trip Purpose for Adult Q1.**

| Trip Purposes | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| | | | | **Addicts** |
| Work | 84.8% | 95.7% | 90.9% | 88.5% |
| Plesure | 5.9% | 2.9% | 4.5% | 4.5% |
| Errand | 3.8% | 1.0% | 3.2% | 5.6% |
| Bring/Take someone | 5.5% | 0.5% | 1.5% | 1.4% |

As it can be observed in Table 102, the purpose of the most important trip for the Malcontent Time Addicts is quite 100% for work. Instead, the Car Addicts present a wide variety of purposes.

### 3.6.4. Interpretation based on socio-demographic and economic information

The socio-demographic and economic information which are analysed are: gender, age, education level, household income, household size, kids' presence, number of owned cars, own seasonal tickets, the occupation, trip origin.

All the above features are evaluated separately for Adult Q1 and for Stud Q1. The differences among clusters are tested using Chi Square Test resulting statistically significant, except those on income level.

#### Adult Q1

Before to start the description of socio-demographic and economic information, the sizes of each cluster is recalled in Figure 51. The largest cluster is the first one, *Car Addicts*, formed by 886 persons, equal to the 35% of total sample. The smallest cluster is the number 4, *Eco-Friendly Travel Pleasure Addicts*, with 426 respondents (17%).

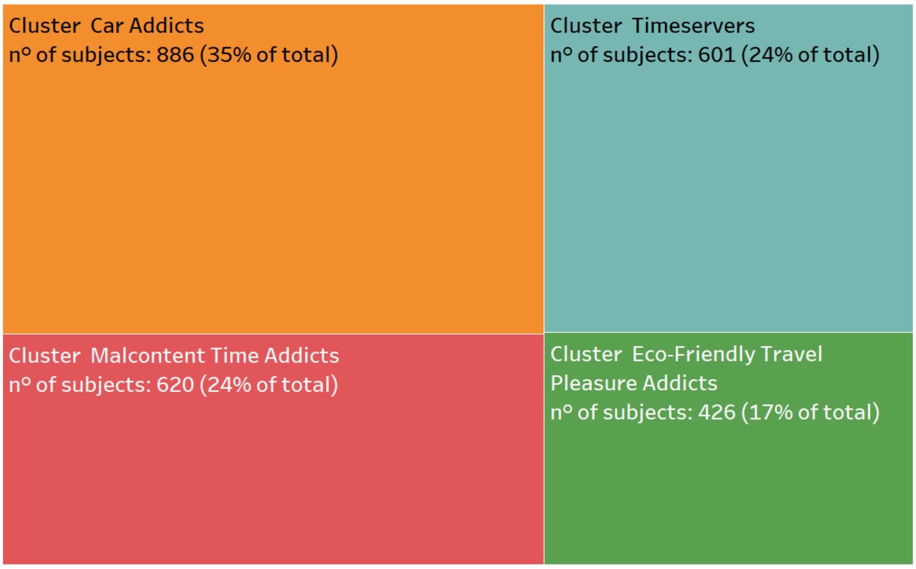


Figure 74 – Size of clusters.

The analysis of subsample Adult Q1 through social, economic and demographic characteristics starts from gender distribution (Table 103 and Figure 75).

Table 103: **Gender for Adult Q1.**

| Gender | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|
| Female | 50.9% | 42.5% | **56.4%** | **54.8%** |
| Male | 49.1% | **57.5%** | 43.7% | 45.2% |


Figure 75 – Gender composition of each cluster.

In Table 103 and Figure 75, the analysis of gender composition of the clusters shows relevant differences in all clusters, except for Car Addicts. The women are the majority in Timeservers and Eco-Friendly Travel Pleasure Addicts.

Then, the analysis of age distribution shows that Eco-Friendly Travel Pleasure Addicts and Malcontent Time Addicts are younger (<40 years) than the others (Table 104). This result confirms what found in the previous study in Alessandria (Pronello & Camusso, 2011).

Table 104: **Age distribution for Adult Q1.**

| Age classes | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|
| **Under 18 Years** | | | 0.7% | 0.5% |
| **18-25 Years** | 7.5% | 6.0% | 5.5% | 4.2% |
| **26-40 Years** | 26.4% | 33.1% | 28.8% | 36.9% |
| **41-60 Years** | 57.8% | 52.4% | 51.8% | 49.8% |
| **Over 60 years** | 7.6% | 6.9% | 12.0% | 8.2% |

As anticipated the income level distribution does not provides statistically significant differences among clusters (Table 105 and Figure 76).

Table 105: **Income level distribution for Adult Q1.**

| Income classes | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|
| < 1.000€ | 3% | 4% | 4% | 4% |
| 1.001-2.000 € | 20% | 23% | 22% | 25% |
| 2.001-3.000 € | 25% | 25% | 25% | 23% |
| 3.001-4.000 € | 20% | 17% | 19% | 17% |
| 4.001-5.000 € | 7% | 5% | 4% | 5% |
| > 5.000 € | 7% | 5% | 6% | 8% |
| Null or Not Significant | 19% | 21% | 20% | 18% |

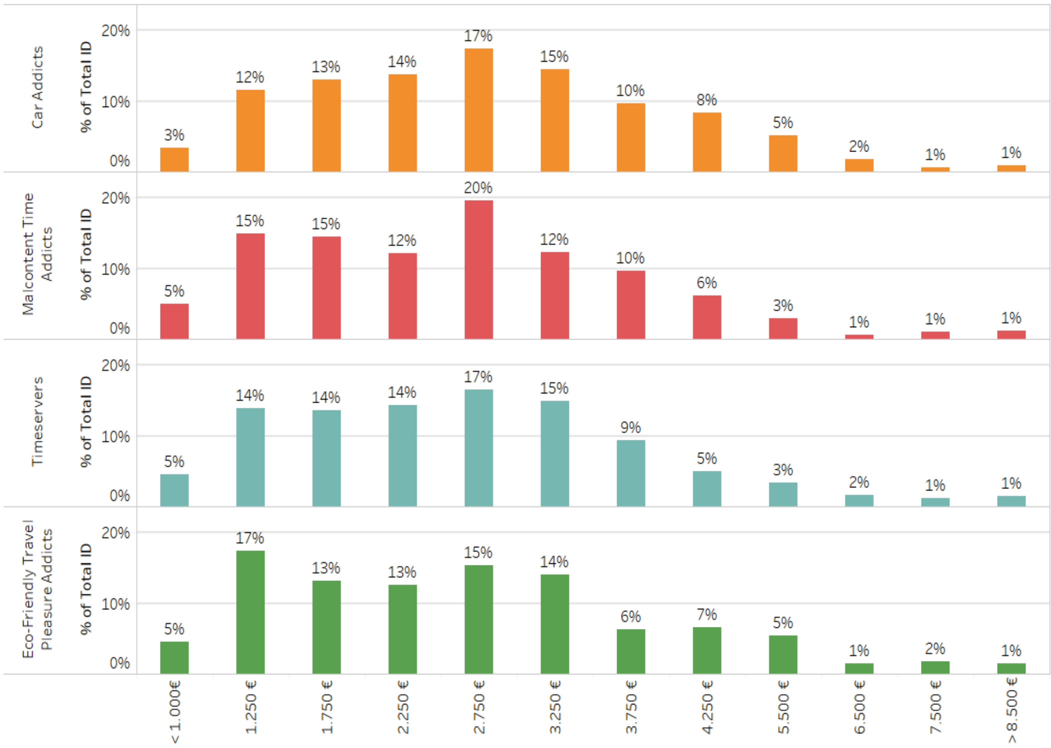


Figure 76 – Income level distribution among clusters.

From educational level a statistically significant differences emerges (Table 106): Eco-Friendly Travel Pleasure Addicts record the highest share of University degree and PhD (73%), followed by Malcontent Time Addicts (64%), Car Addicts (59%) and Timeservers (53%).

Table 106: **Educational level distribution for Adult Q1.**

| **Level of education** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** |
|---|---|---|---|---|
| Primary School or less | 0.8% | 1.5% | 1.3% | 0.2% |
| Secondary School | 2.6% | 3.1% | 4.8% | 1.4% |
| High School | 37.5% | 31.1% | 40.1% | 25.1% |
| University degree | 53.1% | 54.7% | 45.9% | 60.8% |
| PhD | 6.1% | 9.7% | 7.8% | 12.4% |

In Figure 54, the level of education of respondents in each cluster is depicted. As anticipated, the *Timeservers* presents the lowest educational level, while the *Eco-Friendly Travel Pleasure Addicts* the highest one. The other two clusters are very comparable. The educational level is important because it has proven to have a determinant role in mode choice (Kuhnimhof, Chlond, & Von Der Ruhren, 2006).


Figure 77 – Level of education among cluster subjects.

The Car Addicts are the cluster with highest percentage of large households with children.

Table 107: **Household (HH) size for Adult Q1.**

| Size of HH | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|
| 1 | 14% | 19% | 18% | 23% |
| 2 | 24% | 30% | 33% | 30% |
| 3 | 27% | 24% | 27% | 20% |
| 4 | 29% | 22% | 17% | 21% |
| >4 | 6% | 6% | 4% | 7% |

Table 108: **Kid number in household (HH) for Adult Q1.**

| Kid number of HH | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|
| 0 | 37% | 47% | 50% | 52% |
| 1 | 27% | 25% | 28% | 20% |
| 2 | 31% | 22% | 18% | 22% |
| >2 | 6% | 6% | 4% | 6% |

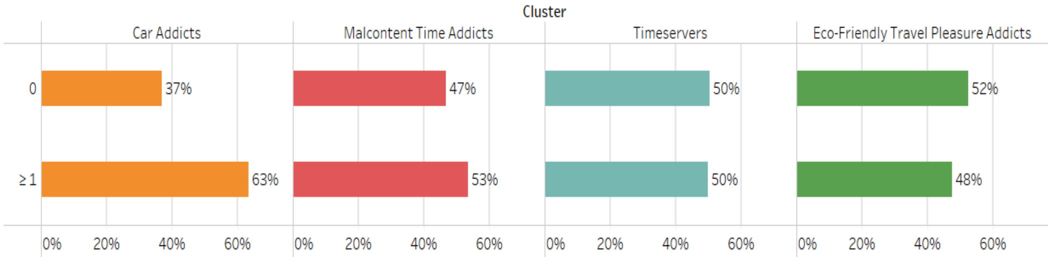


Figure 78 – Presence of kids in the household.

As shown in Figure 78, in three clusters there is not a great difference in terms of children number. The lower importance of household size for mode choice is consistent with previous studies based on attitudes (Pronello & Camusso, 2011) (Anable, 2005).

The number of owned cars is reported in Table 109. The Car Addicts have the highest number of cars (69% have at least two cars in the household).

Table 109: **Own car number in household (HH) for Adult Q1.**

| Own car number in HH | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|
| 0 | 2% | 9% | 8% | 12% |
| 1 | 29% | 46% | 44% | 50% |
| 2 | 53% | 37% | 37% | 32% |
| 3 | 13% | 6% | 9% | 5% |
| >3 | 3% | 2% | 3% | 1% |

The distribution in subsample Adult Q1 about the seasonal passes is reported in Table 110, where the 68 % of Car Addicts does not own a seasonal pass for any transport mode. Malcontent Time Addicts represent the cluster with highest number of seasonal passes (89% own at least one). They are also the most multi-modal travellers: one out of three own more than one seasonal passes.

Table 110: **Seasonal tickets distribution for Adult Q1.**

| **Seasonal Tickets** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** |
|---|---|---|---|---|
| No Seasonal Tickets | 68% | 11% | 43% | 54% |
| 1 | 24% | 56% | 39% | 33% |
| 2 | 5% | 22% | 11% | 10% |
| More than 2 | 2% | 11% | 6% | 3% |

The occupation of adults are described in the Table 111.

Table 111: **Occupation of Adult Q1.**

| **Sectors of Study Area** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** |
|---|---|---|---|---|
| Worker | 1.6% | 1.4% | 2.0% | 1.4% |
| Employee | 72.5% | 82.8% | 75.2% | 71.4% |
| Teacher/Prof | 7.8% | 6.1% | 6.9% | 8.9% |
| Manager | 3.9% | 2.2% | 2.7% | 3.0% |
| Freelance | 8.8% | 4.5% | 8.0% | 10.5% |
| Homemaker | 0.4% | 0.2% | 0.2% | |
| Retired | 1.6% | 1.1% | 3.3% | 1.6% |
| Unemployed & NeeT | 3.5% | 1.8% | 1.8% | 3.2% |
| Total | 100% | 100% | 100% | 100% |

The highest share of workers is present in Timeservers, while the employees are more numerous in Malcontent Time Addicts; instead, managers belong to Car Addicts. Teacher (or professor) and freelance are more relevant in Eco-Friendly Travel Pleasure Addicts. The retired people are generally included in Timeservers, while Unemployed and NeeT (Not engaged in Education, Employment and Training) are roughly split in equal measure between Car Addicts and Timeservers.

The trip origins for Adult Q1 are reported in Table 112. The 77% of Eco-Friendly Travel Pleasure Addicts comes from Torino. Also a large component of Malcontent Time Addicts and Timeservers come from Torino (50% and 48%). Instead Car Addicts are more balanced and they come in majority from Countryside and Suburban areas.

Table 112: **Trip origins for Adult Q1.**

| Sectors of Study Area | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|
| Sub-Urban Area | 21% | 15% | 15% | 8% |
| Torino | 37% | 50% | 48% | 77% |
| Major Town | 7% | 7% | 7% | 7% |
| Countryside | 33% | 28% | 29% | 9% |

### Stud Q1

The genders distribution of students is described in Table 113. The analysis of subsample Stud Q1 show that only the Malcontent Time Addicts record a male majority.

Table 113: **Gender for Stud Q1.**

| Gender | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts | Millennials PT Supporters |
|---|---|---|---|---|---|
| Female | **54.9%** | 41.8% | **52.1%** | **63.5%** | **55.8%** |
| Male | 45.1% | **58.3%** | 47.9% | 36.5% | 44.2% |

Then, the age distribution is very condensed in few years (Table 114) because the 95% of subsample ranges from 18 to 30 years old.

Table 114: **Age distribution for Stud Q1.**

| Age classes | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts | Millennials PT Supporters |
|---|---|---|---|---|---|
| **Under 19 Years** | 8.6% | 1.7% | 2.3% | 2.2% | 2.6% |
| **19-21 Years** | 25.7% | 32.7% | 36.1% | 29.0% | 33.8% |
| **22-24 Years** | 39.2% | 43.8% | 43.6% | 34.9% | 40.4% |
| **25-27 Years** | 19.6% | 16.8% | 16.4% | 25.3% | 19.6% |
| **Over 27 years** | 6.9% | 5.1% | 1.6% | 8.6% | 3.6% |
| **Total** | 100% | 100% | 100% | 100% | 100% |

As anticipated, the income level distribution does not provides statistically significant differences among clusters (Table 105).

Table 115: **Income level distribution for Stud Q1.**

| Income classes | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts | Millennials PT Supporters |
|---|---|---|---|---|---|
| < 1.000€ | 0% | 0% | 0% | 0% | 0% |
| 1.001-2.000 € | 22% | 24% | 26% | 22% | 22% |
| 2.001-3.000 € | 27% | 28% | 25% | 21% | 23% |
| 3.001-4.000 € | 11% | 14% | 17% | 17% | 17% |
| 4.001-5.000 € | 6% | 5% | 5% | 8% | 7% |
| > 5.000 € | 14% | 9% | 9% | 8% | 12% |
| Null or Not Significant | 20% | 20% | 19% | 24% | 18% |

For students, the educational level analysis has not been (obviously) performed. The size and number of kids in households (where students live) are higher than ones of Adults Q1(Table 116 and Table 117).

Table 116: **Household (HH) size for Stud Q1.**

| Size of HH | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts | Millennials PT Supporters |
|---|---|---|---|---|---|
| 1 | 2% | 2% | 1% | 4% | 1% |
| 2 | 11% | 11% | 9% | 10% | 9% |
| 3 | 39% | 24% | 29% | 19% | 30% |
| 4 | 37% | 52% | 48% | 49% | 46% |
| >4 | 12% | 12% | 14% | 18% | 14% |

Table 117: **Kid number in household (HH) for Stud Q1.**

| Kid number of HH | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts | Millennials PT Supporters |
|---|---|---|---|---|---|
| 0 | 6% | 9% | 6% | 12% | 8% |
| 1 | 41% | 27% | 29% | 19% | 29% |
| 2 | 43% | 51% | 53% | 51% | 48% |
| >2 | 10% | 13% | 13% | 19% | 16% |

The number of owned cars is reported in Table 118. The Car Addicts record the highest number of cars (90% have at least two cars in the household).

Table 118: **Own car number in household (HH) for Stud Q1.**

| Own car number in HH | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts | Millennials PT Supporters |
|---|---|---|---|---|---|
| 0 | 2% | 4% | 4% | 7% | 3% |
| 1 | 8% | 14% | 22% | 20% | 21% |
| 2 | 41% | 47% | 50% | 49% | 51% |
| 3 | 40% | 29% | 19% | 20% | 20% |
| >3 | 9% | 5% | 5% | 5% | 5% |

The profession of this subsample is obvious: they are all students, mainly at university level.

The trip origins for Stud Q1 are reported in Table 119. The 85% of Eco-Friendly Travel Pleasure Addicts come from Torino (confirmation of Adult Q1).

Table 119: **Trip origins for Stud Q1.**

| **Sectors of Study Area** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Millennials PT Supporters** |
|---|---|---|---|---|---|
| Sub-Urban Area | 31% | 15% | 16% | 8% | 14% |
| Torino | 16% | 28% | 54% | 85% | 53% |
| Major Town | 6% | 7% | 5% | 3% | 6% |
| Countryside | 46% | 49% | 25% | 5% | 26% |

# Chapter 4

# Discussion

In this chapter a critical analysis of the results is proposed. The analysis starts from a check of the hypotheses of the methodological approach and it ends with some thoughts which lead to the final conclusion in the next chapter. More in detail, in the next sections the five profiles emerged from EFA and CA are discussed.

The results described in the previous chapter confirms the hypothesis on which the methodology is based: it is fundamental investigating the most important trip, while it is not important its purpose.

Indeed, except for Malcontent Time Addicts, the other clusters show that there is not any difference in modal choice between the week mobility and the most important trip. Deeper analysis is necessary to explain the behaviour of Malcontent Time Addicts: the main cause is due to the limited PT supply that reduces the possibility to use it. Then, the choice of transport mode can be affected not by the trip purpose, but by some external factors.

To confirm this analysis, it can be observed that the most used transport mode along the week is that chosen for the most important trip, with a frequency of use between 61%-81% respect all other transport means. In addition, the most important trip weights less than 50% of the trips over the week.

For instance, for Malcontent Time Addicts and Eco-Friendly Travel Pleasure Addicts, who are the less car users than other clusters, Table 120 reports the used mode of transport in function of the trip purpose: the trip purpose not affect the modal choice.

Table 120: **Trip Purpose and mode of transport.**

| Trip Purpose | Car users | PT users | Soft Mode users | Total |
|---|---|---|---|---|
| Work | 77 (7%) | 559 (53%) | 288 (28%) | **924 (88%)** |
| Activities linked to job | 4 (0%) | 13 (1%) | 8 (1%) | **25 (2%)** |
| School | | 15 (1%) | 6 (1%) | **21 (2%)** |
| Errands | 6 (1%) | 8 (1%) | 16 (2%) | **30 (3%)** |
| Leisure | 3 (0%) | 18 (2%) | 16 (2%) | **37 (4%)** |
| Go getting someone | 3 (0%) | 3 (0%) | 3 (0%) | **9 (1%)** |
| **Total** | **93 (9%)** | **616 (59%)** | **337 (32%)** | **1046 (100%)** |

This hypothesis was already confirmed in 2011 in the restricted area of Alessandria (Pronello & Camusso, 2011). Despite several years have passed from that study, the area of the current research is much larger and this sample is not well-stratified, the results confirm that trip purpose does not affect the transport choice.

Before to start detailed analysis of results of each cluster, a global view on some results, which are transversal to all the profiles, is proposed.

The most evident aspect is related to the role of habits. The Theory of Planned Behaviour (TPB) states that the most important determinant to predict individual behaviour is the intention to carry out that behaviour, so called “behavioural intention” (Ajzen, From intentions to actions: A theory of planned behavior, 1985). Then, the intention is defined by attitudes, perceived behavioural control and subjective norms.

Even if the TPB fits very well the prediction of behaviour in some fields, as physical activities (Hagger, Chatzisarantis, & Biddle, 2002), other researches show that the TPB hypothesises a too strong behavioural control. Other factors could reduce its impact on the observed behaviour; for instance, the habit plays a role which reduces the strength of behavioural control. The TPB predicts more accurately behaviour of people with weak habits than other with strong ones (Chatzisarantis & Hagger, 2007). This last work is closer the results of this research: habit seems playing an important role to choose mode of transport for the most important trip. In addition, also an extensive ignorance about alternatives (see values on ignorance indices) and a scarce awareness of the effect of own mobility on environment are the most important hinges to reach a modal shift towards more sustainable transport modes.

All variables related to money, like income and attitudes towards cost sensitivity, do not show statistically significant differences. This agrees with results from the previous study in Alessandria, where income was not a relevant indicator for the modal choice.

## 4.1. Car Addicts

The respondents belonging to this cluster use the car, mainly as drivers. The Cluster Analysis (CA) finds out that they like this transport mode; they are very satisfied about punctuality, flexibility and speed (Figure 79). They choice car because they feel themselves more free and owning car is believed the most comfortable way to move (Figure 80). These results agree with previous works, where attitudes towards flexibility and comfort can play a relevant role in the modal choices (Johansson & Heldt, 2006).

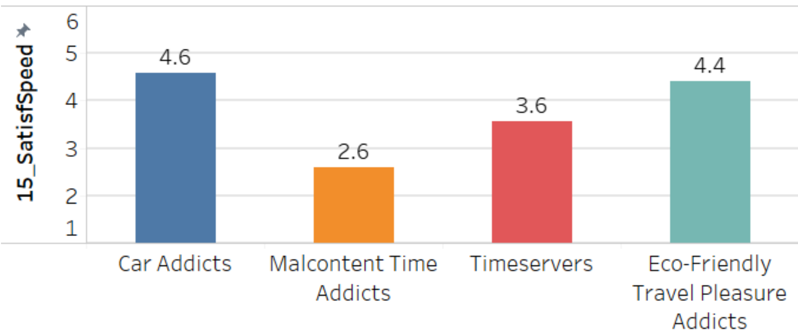


Figure 79 – Satisfaction about Speed.

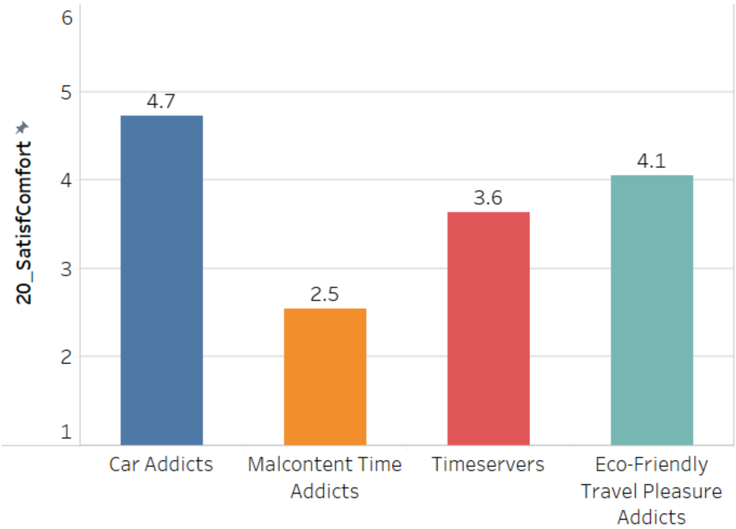


Figure 80 – Satisfaction about comfort.

The attention of Car Addicts towards speed and comfort is proved by the two indices *Comfort* (I.19) and *Speed Research* (I.26), where they obtain the highest values (Figure 81). Considering that these indices are related to other themes, this result confirms that travel behaviour of Car Addicts is coherent with their general attitudes towards research speed and comfort.

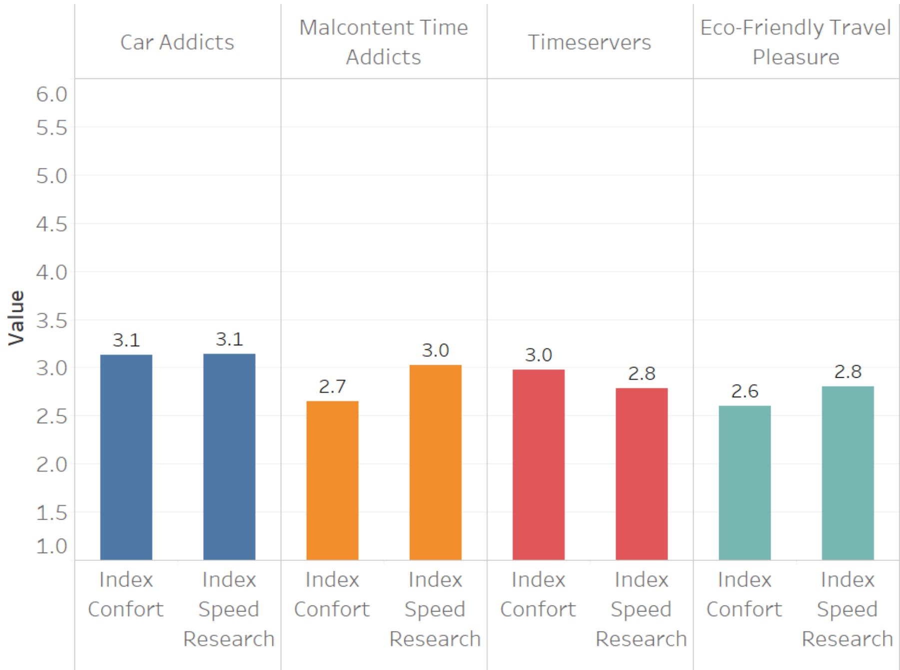


Figure 81 – Scores on indices about security.

In addition, Car Addicts believe car as the most secure mode of transport. This statement is confirmed by scores (Figure 82) on their satisfaction about security (*SatisfSecurity*) and also by importance given to security when choosing the mode (*UseTheMostSecure*).

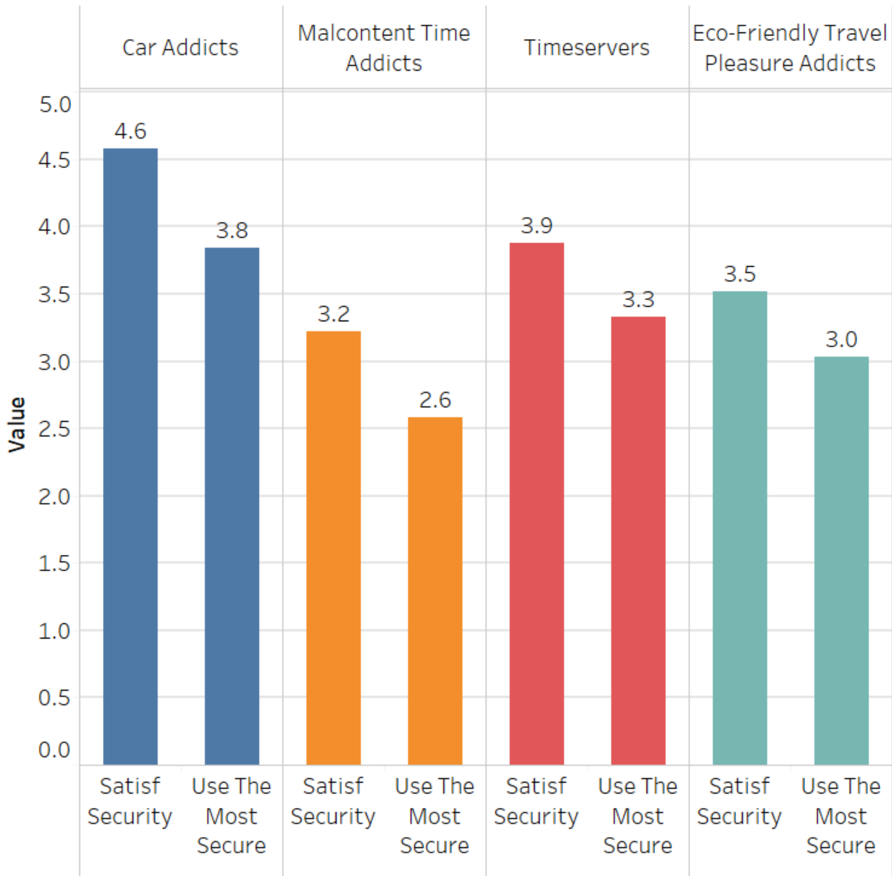


Figure 82 – Satisfaction of Security and its importance on modal choice.

Likewise to comfort and speed, also for personal security there is a positive relationship between general attitudes about personal security and modal choice. The index *Security* collects answers on different field not only related to transport, for instance about current theft trend and information about crime-news. In this index, the Car Addicts show the highest values together Timeservers (Figure 83).


Figure 83 – Security Index and believing of theft are increasing.

The personal security is deeply correlated with the worries about own things and objects. This relationship is found out as latent construct in EFA and it is described inside the index *SecurityOnBoard*. It takes into account the satisfaction about personal security and the trust to bring with themselves some objects. From this point of view there is a big difference from other clusters (Figure 84).

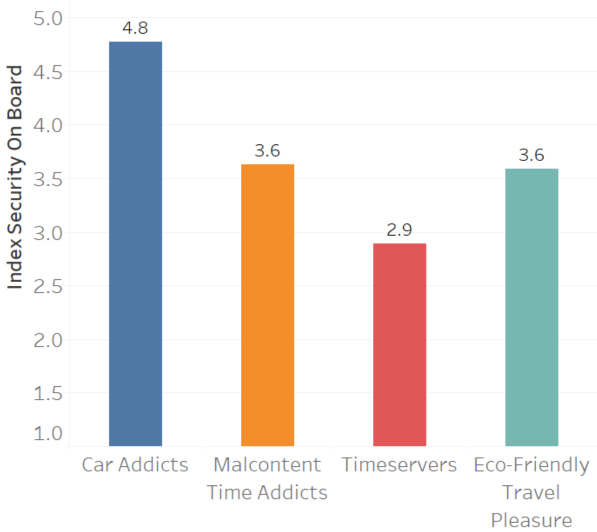


Figure 84 – Index about Security on Board.

This attention to own things could lead to think that Car Addicts are attached to material objects but they record an average score on Aware Consumerism (lend and donate own items) as well as on Charity Index (code I.10). Then, their research and worry about personal security is not arguably related to egoism and attachment to own belongings, but more probably is due to a strong and persistent perceived un-security for themselves and, as consequence, on their items.

Car Addicts record also the lowest score on car aversion (Figure 85), then they are the most attached to car, nearly to "lovers": they take care of own car, they do not like to be a passenger, but they prefer to be drivers and they are not afraid to drive in adverse conditions (during night, along unknown road, in traffic, etc.). Most likely they are target of car manufacture advertising, which promotes their products like status symbol and desire object, not just a utilitarian tool.

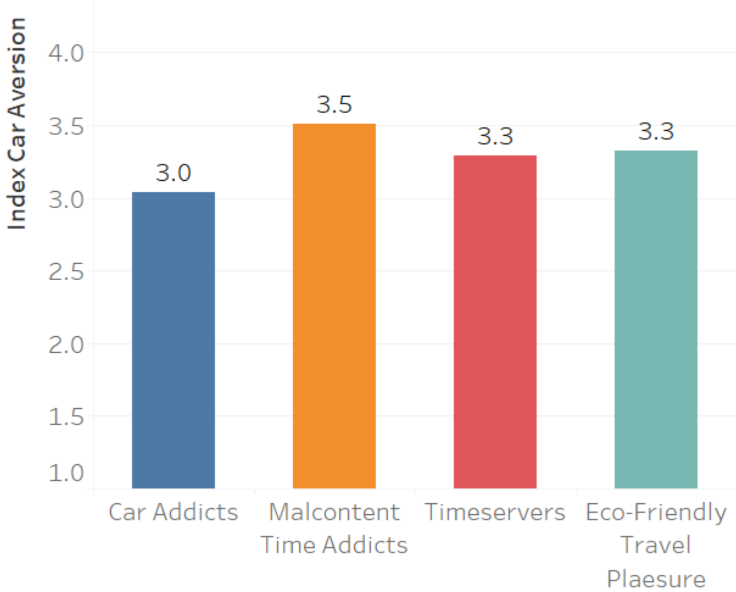


Figure 85 – Car aversion among clusters.

The strong importance of both personal security and car affection influence negatively the propensity towards car-pooling: the Car Addicts are very low inclined to this way to travel and they actually used it very rarely (Figure 86).

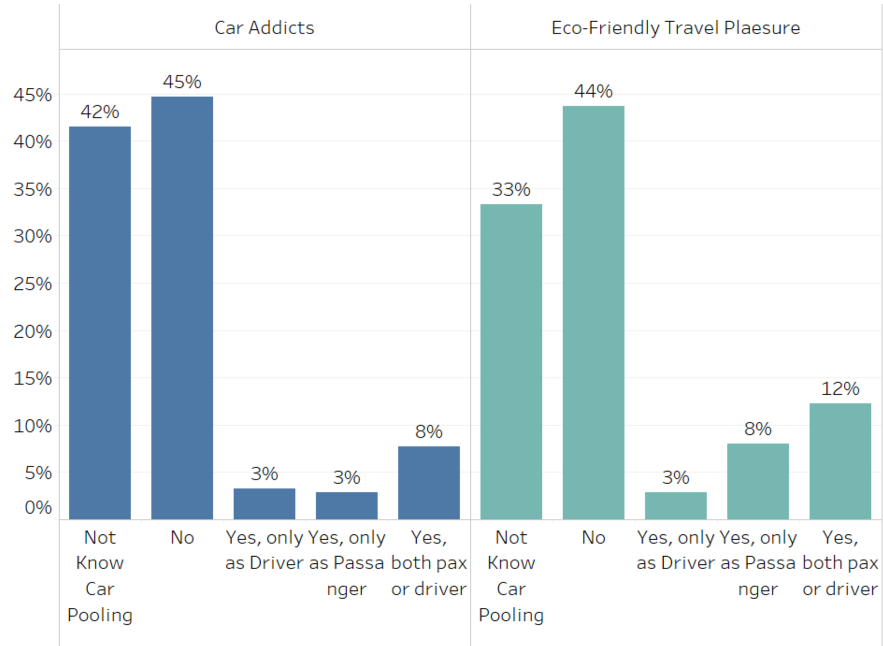


Figure 86 – Have you done car-pooling?

The comparison with the Eco-Friendly Travel Pleasure Addicts shows that a lot of Car Addicts (42%) even do not know car-pooling, neither (45%) have experimented it before the web-questionnaire. Instead, the Eco-Friendly Travel Pleasure Addicts show higher percentage of whom have done car-pooling before (+9%) and less respondents do not know car-pooling (-9%). The inclination to car pool in future trips (Figure 87) confirms that Car Addicts have a minor attitudes than Eco-Friendly Travel Pleasure Addicts .

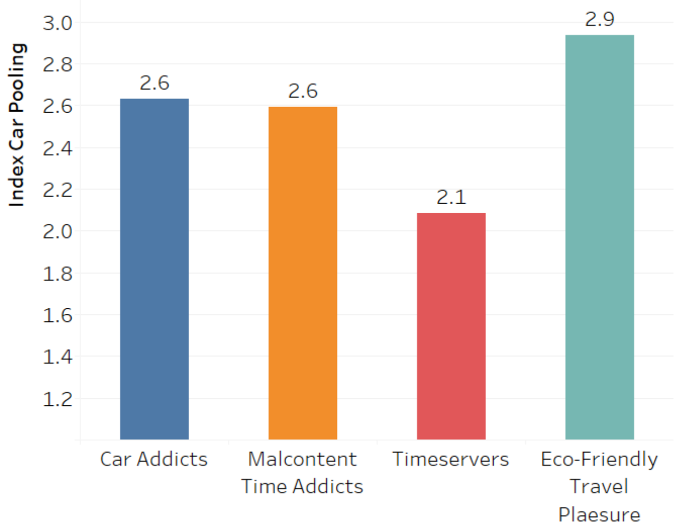


Figure 87 – Index Car-Pooling

Furthermore, Car Addicts show a not-bad level of travel pleasure respect to other clusters (factor 3, Travel Pleasure), so we can argue that they like go out from home and explore new places, but there is an unique hinge: travelling by car. Their very high inclination to use more car (index I.4, Will Use More Car) as regards other transport modes is not a surprise after this analysis.

To conclude, the shift of Car Addicts from own private vehicle towards more sustainable transport modes will be very hard to achieve. To face this challenging goal, a deeper analysis of their decision-making about mode of transport is necessary. Car Addicts use mainly car (Figure 88), roughly the 93%.

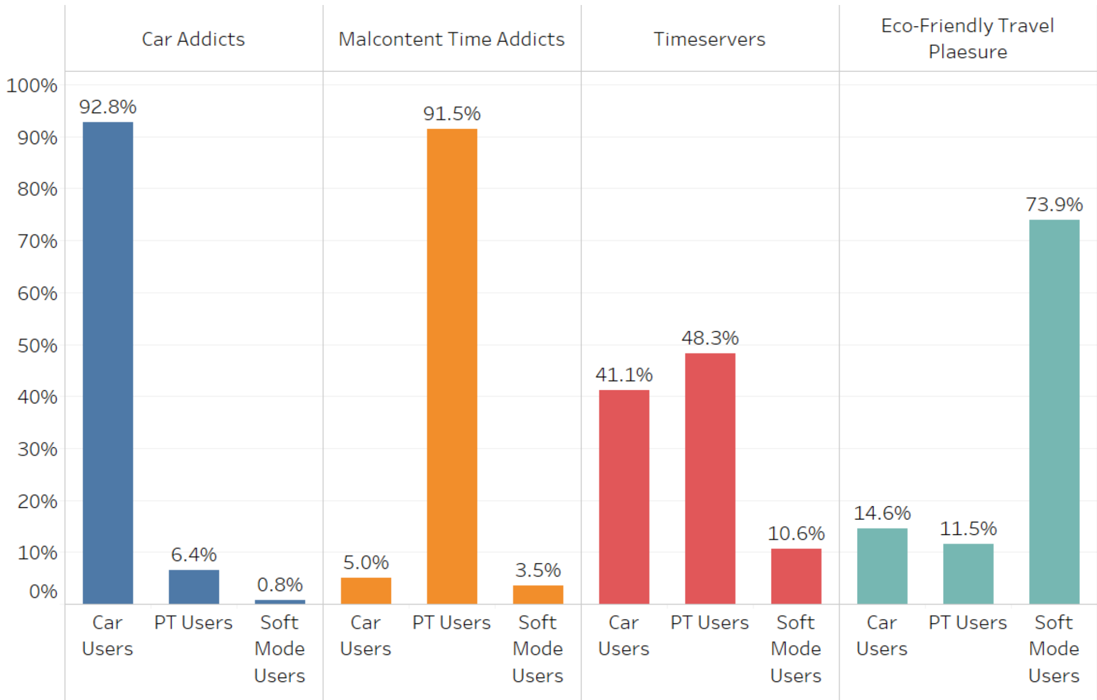


Figure 88 – Used transport modes in each clusters.

The other 7% shows a gap between attitudes to car and observed travel behaviour. Probably there are external elements which weaken the relationship attitude-behaviour (Ajzen & Cote, Attitudes and the prediction of the behaviour, 2008). One reason can be the un-availability or cost of parking, as shown by the index Easy Parking in Figure 89: the car users (of all clusters) have the easiest access to parking.

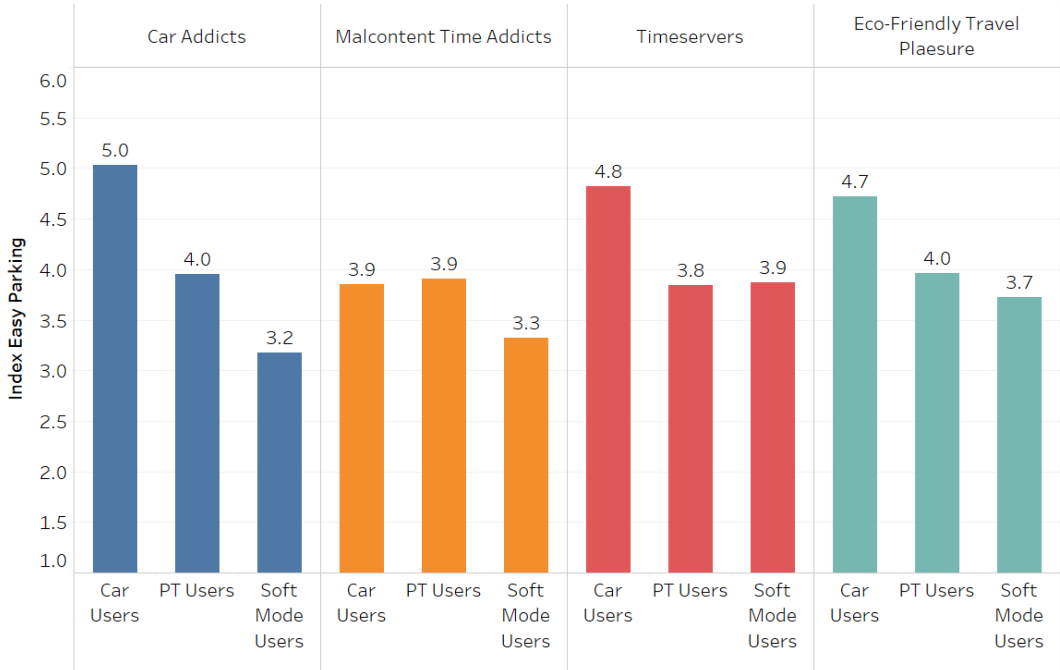


Figure 89 – Parking availability for used mode of transport.

Also the car (un-)availability in the household or the absence of alternatives (*NoAlternative*, code 29) can explain the choice of transport mode which is different from other respondents in the same cluster (Table 121). The Car Addicts who do not travel by car have the lowest car number in household; then, probably, if they had an extra car, they would drive instead to choose PT or soft modes. Furthermore, Car Addicts who generally use PT show the highest level of no-alternative among PT users.

Table 121: **Car un-availability and perceived alternatives.**

| Profiles | Used Mode of Transport | Available Car in household | No Alternative |
|---|---|---|---|
| Car Addicts | Car users | **1.9** | **3.6** |
| | PT users | 1.7 | **3.6** |
| | Soft Mode users | 1.3 | 3 |
| Malcontent Time Addicts | Car users | 1.5 | **3.7** |
| | PT users | 1.4 | 3.1 |
| | Soft Mode users | 1.6 | 2.8 |
| Timeservers | Car users | **1.8** | **3.4** |
| | PT users | 1.4 | 2.9 |
| | Soft Mode users | 1.4 | 2.6 |
| Eco-Friendly Travel Pleasure Addicts | Car users | 1.5 | **3.2** |
| | PT users | 1.4 | 2.9 |
| | Soft Mode users | 1.3 | 1.7 |

As observed in Table 121, the Car Addicts perceive less than other profiles some alternatives to car use. Indeed, this perception is due to a deep ignorance of the other transport modes (to see Ignorance Indices, codes 40-43) and to a strong and negative prejudice about PT (indices I.2, I.3 and I.27). Both elements make hard changing transport mode for Car Addicts.

Policy makers and PT operators have to face a hard task to pull out from car those people. To this end, the profile description of can give some useful information. For instance, Car Addicts currently spend a lot of money, much more than other profiles (Figure 90).

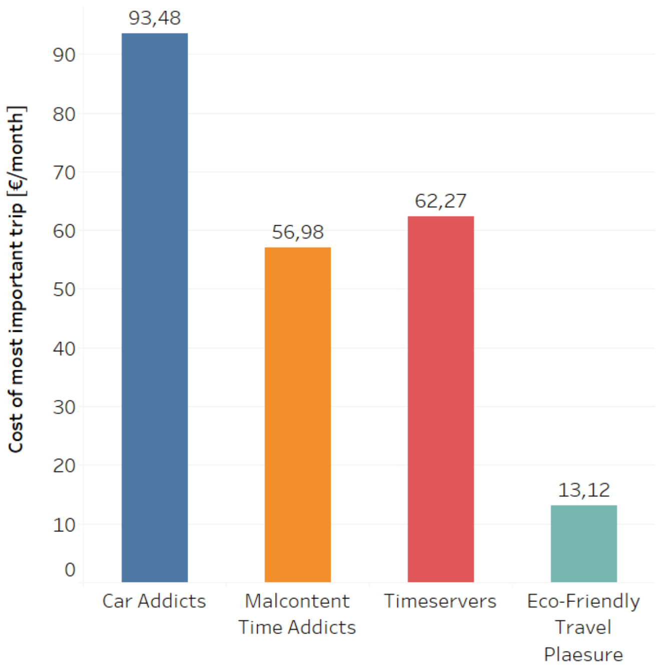


Figure 90 – Month Cost of the most important trip.

For transport companies they are precious potential customers: taking account objective parameters, like travelled distance or duration, Car Drivers are the most similar to Malcontent Time Addicts and their costs are nearly double (4.0 €/km versus 2.2 €/km). However, the mobility providers have to improve their transport services and to present them to Car Addicts as alternatives similar to car. The comfort and flexibility are key factors where PT have to improve, as already pointe out by previous researches (Steg, 2005).

In addition, Car Addicts do not perceive properly the safety level of car. From Figure 91 it can be observed that the level of satisfaction is close to the middle of scale (3.5). The distance from the safest mode (PT) is just 1.2, while it is larger for other themes, like security, flexibility, punctuality and comfort (Table 122). In other way, Car Addicts detect very well PT flaws and they do not perceive those related to car.

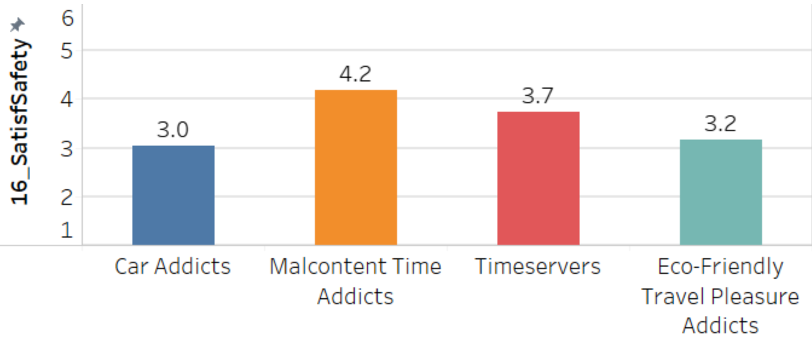


Figure 91 - Satisfaction about safety.

Table 122: **Satisfaction between Car Users and Malcontent Time Addicts.**

| | **Code** | **Satisfaction about** | **Car Addicts** | **Malcontent Time Addicts** | **Differences** |
|---|---|---|---|---|---|
| Pro-PT | 13 | SatisfCheapness | 3.3 | 3.8 | -0.5 |
| | 14 | SatisfEcology | 3.0 | 4.5 | -1.5 |
| | 16 | SatisfSafety | 3.0 | 4.2 | -1.2 |
| | 21 | SatisfFreeTime | 2.8 | 3.3 | -0.5 |
| Pro-Car | 17 | SatisfSecurity | 4.6 | 3.2 | 1.4 |
| | 18 | SatisfFlexibility | 5.1 | 2.6 | 2.4 |
| | 19 | SatisfRegularity | 4.5 | 2.7 | 1.8 |
| | 20 | SatisfComfort | 4.7 | 2.5 | 2.2 |
| | 24 | SatisfOverall | 4.2 | 3.0 | 1.2 |

As can be deduced from indices Awareness of Environmental Problem (I-25), Pro-Environment (I.11) and Re-Cycle (I-14), in Table 98 and in Table 99, the Car Addicts are more aware than Timeservers about environmental problems, that society have to face. To assert this sensitivity to environment, they show the highest willingness to pay to reduce the pollution caused by the most important trip (+50% of Timeservers or Malcontent Time Addicts, to see Table 100). Then, the promotion of more sustainable modes of transport can start from this negative aspect of travelling by car. After having removed external factors, the general positive attitudes towards environment can produce a change in travel behaviour, but now the gap still persists. This situation was found also in Alessandria (Pronello & Camusso, 2011), with cluster called paying ecologist.

Moreover, the current activity of Car Addicts during the trip is only listening music or radio (Table 123).

Table 123: **Frequency of activities during the most important trip.**

| Code | Satisfaction about | Car Addicts | Malcontent Time Addicts | Timeservers | Eco-Friendly Travel Pleasure Addicts |
|---|---|---|---|---|---|
| 49 | Work | 1.0 | 2.2 | 1.6 | 1.0 |
| 50 | Read | 1.0 | 3.7 | 1.9 | 1.0 |
| 51 | Social Network | 1.2 | 3.2 | 1.9 | 1.0 |
| 52 | Listen Music | **5.0** | 3.0 | 3.3 | 2.6 |
| 53 | Watch Movies | 1.0 | 1.3 | 1.1 | 1.0 |
| 54 | Relax | 2.9 | 2.9 | 2.8 | 3.5 |
| 55 | Thinking | **4.2** | 4.2 | 4.0 | 4.7 |
| 56 | See Landscape | 3.0 | 3.4 | 3.0 | 4.1 |
| 57 | Phone Call | 2.4 | 2.7 | 2.2 | 2.2 |
| 58 | Chatting | 1.3 | 3.4 | 2.0 | 1.1 |
| 59 | Talk Friend | 2.2 | 2.5 | 2.2 | 1.9 |
| 60 | Talk Stranger | 1.0 | 1.7 | 1.3 | 1.0 |

In the social network age, this is not more enough: the car drivers would like to stay connected. Indeed, the first cause of road accidents is the lack of attention when driving (Istituto Nazionale of Statistica (ISTAT), 2018). The promotion of PT has to stress the free time on board, that opens to new entertainment during the trip for the first time to Car Addicts.

The last point concerns technology. The Car Addicts are interested to the innovation and tech-devices and they are very passionate of apps. Some measures like the ticket on-line and integrated among several modes of transport are very appreciated by Car Addicts (top values in ProE-ticket Index, code I.16, in Table 98). These actions combined to information and services through apps can make comfortable and attractive the PT services.

This passion for technological innovations makes Car Addicts more interested to autonomous vehicles (AV), as shown by the highest values among clusters on AV Activities Index (code I.18), in Table 98. From Car Addicts' point of view, AVs could become an alternative to own car, because they are presented as a new sustainable way to travel. This aspect could make less priority the modal shift towards PT or soft modes. In addition, AVs allow passengers to enjoy free time during trips, without compromises on flexibility, personal security or comfort. Indeed, AV will probably offer transport services without timetable, contacts with unknown people and physical effort, like required by PT or soft modes. From this point of view, the AV could be in the future a competitor of PT and soft modes. For instance, the transport planning will have to take into account AV services to complete supply of mobility services in uncovered areas or during some day/night periods when PT cannot be efficient.

## 4.2. Malcontent Time Addicts

The Malcontent Time Addicts reveal two fundamental characteristics: the intense dissatisfaction about the mode of transport which they currently use and a high level of free time and safety during the most important trip (Table 92). They show also a medium-high score on Travel Pleasure and Eco&Cheap Travel factors. This profile mainly use public transport; indeed, Malcontent Time Addicts who use PT are the 91.5% (Figure 88). Moreover, almost 60% of all PT users in the subsample Adult 1Q are included in Malcontent Time Addicts cluster (Figure 92). The remaining 8.5% of Malcontent Time Addicts is composed by 31 respondents who use car and 22 people who travel by soft modes.

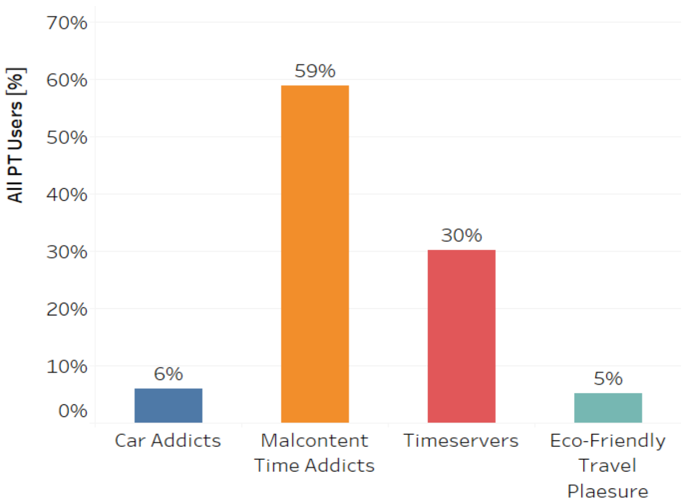


Figure 92 – PT Users distribution among clusters.

Among who chooses car, the cause of the gap between attitudes favourable to PT and observed behaviour cannot be due to easiness to park: as shown in Figure 89 their index Easy Parking is roughly equal to other groups which do not use the car. In addition, they do not have a high number of available cars in the household (to see Table 121). Nevertheless, they state that they have not alternatives to car (Figure 93): the variable *NoAlternative* (code 29) is higher than the average value of their cluster (3.5 or 4.0 versus an average value of 3.1).

Then, there are almost 50% of this group who lives in very small towns in the Torino hinterland and in the countryside (e.g. Beinasco, Cafasso, Mezzomerico, etc.), where the PT supply is very scarce; this factor could be reason of the absence of alternatives to car. Vice versa, for the other people who live in Torino (or Other Major Town in the study area) the destination could be not connected through PT services.

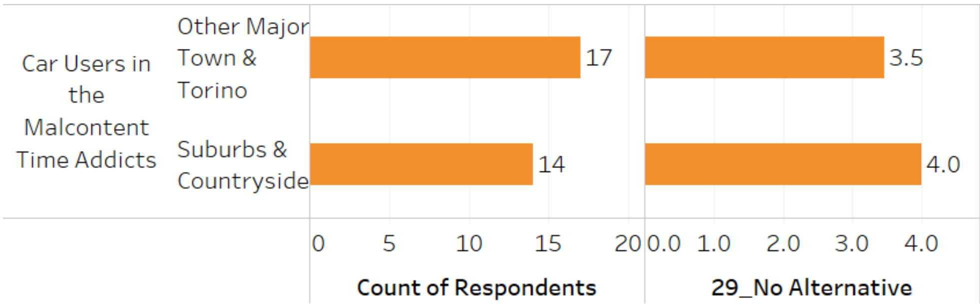


Figure 93 – Alternative for Car Users inside Malcontent Time Addicts.

The 90% of Malcontent Time Addicts, who already use their own mode, do not have any gap between general attitudes and observed behaviour; however, they are very dissatisfied about their modes of transport (to see scores on Mode Pleasure factor in Figure 94).

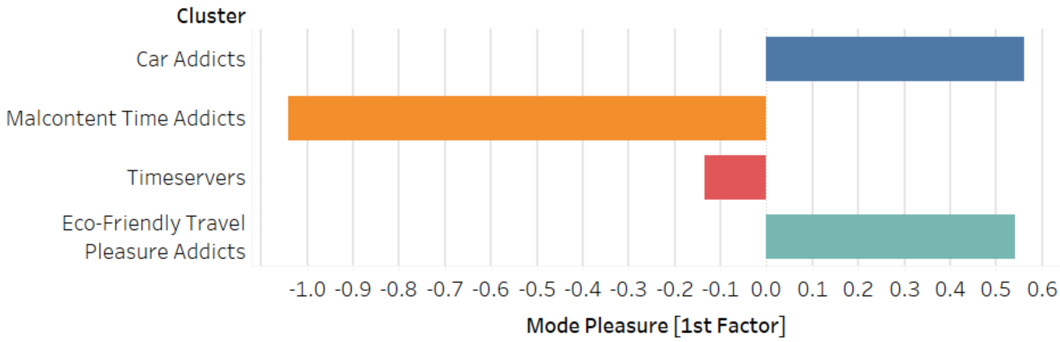


Figure 94 – Scores on Mode Pleasure.

This dissatisfaction is the characteristic making them “Malcontent”. The other feature, which distinguishes them, is the will that their mode becomes faster.

The analysis starts from data about the most important trip: nowadays the Malcontent Time Addicts travel the longest distance of all groups and their average speed is lower than Timeservers or Car Addicts: respectively 27.5 km/h versus 33.0 km/h or 37.8 km/h. Car Addicts travel +40% faster than Malcontent Time Addicts, thus their complaint is probably founded.

In addition, they criticize that their used transport mode is not flexible and reliable (Figure 95).

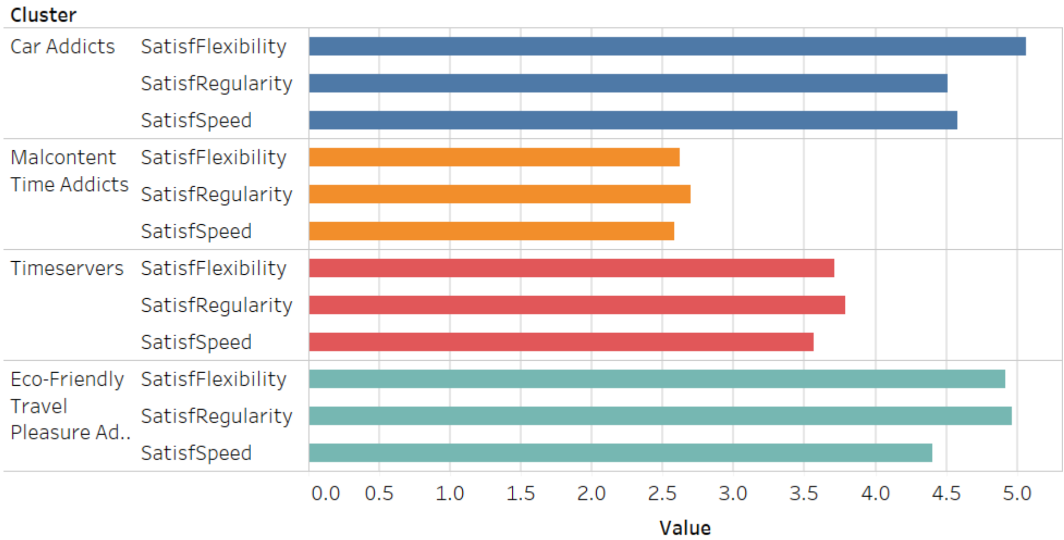


Figure 95 – Satisfaction on Flexibility, Regularity and Speed.

This low flexibility and versatility constrain PT use mainly for planned trips. Indeed, the purpose of the most important trip for Car Addicts is the work (95.7%, to see Table 102): arguably it is the unique one that ensures enough regularity to allow use of PT services. To confirm this difficulty to use PT, along the week the other trips of Car Addicts are made with a higher use of car, which is more suitable for errands and appointments (to see

able 101).

The reasons which make Malcontent Time Addicts continuous users of PT should be very strong to overcome these difficulties and disadvantages. There is not one motive to lead them to PT choice, but a set of behavioural determinants, both external and personal.

The main external factor is the car parking (un-)availability: as depicted in Figure 89 and already reported in Table 98, the *EasyParking* (code I.1) is the lowest among clusters. Thus, Malcontent Time Addicts usually spend time in location where finding parking it is difficult or too expensive.

Except Car Addicts, defining other evident external factor is arguable because the car availability, household size and kids presence are comparable or slightly greater than the other clusters, as described in Table 124, while the income is not statistically different among groups.

Table 124: **Potential external determinants in the modal choice.**

| **Determinants** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** |
|---|---|---|---|---|
| EasyParking | 4.9 | 3.9 | 4.3 | 3.9 |
| Car per Household | 1.9 | 1.5 | 1.5 | 1.4 |
| Household with at least 3 members | 61% | 51% | 49% | 47% |
| Household with at least 2 kids | 63% | 53% | 50% | 48% |
| Household with income lower than 2.000 €/month | 23% | 27% | 26% | 29% |

Also the residential location does not add any useful information to explain their modal choice, because this cluster is composed in equal measure of all sectors of the study area: Torino, Suburbs, Other Major Town and Countryside (Table 125).

Table 125: **Trip origin, percentage across.**

| **Origin of most important trip** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** | **Tot.** |
|---|---|---|---|---|---|
| Torino | 26% | **24%** | 23% | 26% | 100% |

| | | | | | |
|---|---|---|---|---|---|
| Sub-Urban Area | 47% | **23%** | 22% | 8% | 100% |
| Major Town | 35% | **25%** | 25% | 15% | 100% |
| Countryside | 43% | **25%** | 26% | 5% | 100% |

Other elements affect the choice of the transport mode and they have to be researched in the individual travel behaviour. In the Malcontent Time Addicts some attitudes emerge clearly: the sense of duty, the law respect, the attention to the social problems and awareness of environmental impacts. As shown in Table 98 and Table 99, the Malcontent Time Addicts record the highest scores in the following indices: Social Rule Compliance (I.8), Awareness of Mobility Impacts (I.24), Awareness of Environmental Problem (I.25), Re-Cycle (I.14). Moreover, they show very high values in Charity (I.10) and Aware Consumerism (I.13) while their scores on Security (I.21) and Security On Board (I.30) are the lowest, showing their social openness.

These attitudes are proof that the Malcontent Time Addicts chose the PT not for personal advantages, because they include in the decision process also the mobility impacts on the community and, as extension, on the environment. In other way, their behaviour respects norms, rules, and values, so they take into account consequences of actions and they adopt an altruistic point of view, before looking for personal advantages.

The correlation between social orientation and self-transcendent values (like justice, solidarity and equality) is usually positive (Garling, 1999) and it is confirmed by this result. Furthermore, the above indices corroborate the relationship between attention to social and environmental problems and PT choice (Vugt, Meertens, & Lange, 1995) (Nordlund & Garvill, 2003). This individual decision-making process, based on so strong values and norms, can be fully formed during the education path: the Car Addicts include less graduates and PhD than Malcontent Time Addicts (Table 106). The difference on educational levels could contribute to explain the two ways to choose the transport mode.

In addition, pro-choice of PT services for the Malcontent Time Addicts are the perceived safety (index I.15 records the maximum value among clusters), the aversion towards car (with maximum score on index I.7) and the free time on board, which allows to them to surf on social network, to talk or call someone, to read or work, even to watch TV series. Malcontent Time Addicts show the greatest willingness to use more PT if some improvement are carried out: 5.5 versus a mean inferior to 4.0 (variable code 80 in Table 98). This is a key point to improve their loyalty to PT: for instance, they can increase PT use in other trips, different from the most important one. However, without improvement of PT services, Malcontent Time Addicts can leave these modes and shift to private vehicle.

The Malcontent Time Addicts do not require primarily quality on board, but more frequency, reliability and speed of the PT services, as shown from the two indices PT Service increase (I.2) and PT Quality Improvement (I.3) in Table 98. If they do not perceive an upgrade of the supply, they will probably change mode. Furthermore, Malcontent Time Addicts do not perceive the current PT performance. For instance, they estimate a lower train punctuality than the actual one. Moreover, they state same values of other groups which do not travel by train (Ignorance Train, code 41, in Table 100). Then, they currently cannot appreciate the real value of the PT services and they are naturally inclined to search other travel options.

A reinforcement of the external factors can be another element which leads Malcontent Time Addicts to car use. Indeed, they can overcome the previous attitudes which are favourable to PT. For instance, some new determinants, like a change of work timetable or new kids' errands, can force them to leave PT to satisfy the need of more flexibility.

In addition, they record the highest willingness to pay (WTP) to reduce travel time. This WTP could get over the major cost of car use, as proved by the second highest willingness to use more car. The index Speed Research (I.26, Table 99) supports this hypothesis, because it shows that Malcontent Time Addicts have attitudes similar to Car Addicts towards the research of fast service, not only in transport field.

Finally, the Malcontent Time Addicts are the most opened to make experience of new alternative routes (indices I.23, in Table 99). Their openness to new solutions can lead to try and adopt private vehicle. The shift from initial use of PT to car could be explained by the difference in age distribution among Car Addicts and Malcontent Time Addicts. The majority (56.3%) of the Malcontent Time Addicts is under 40 years old, instead the percentage of Car Addicts in the same interval is just the 31.5%.

In the future, the Autonomous Vehicles (AV) can be more attractive for their extreme advanced technological features. Malcontent Time Addicts are passionate of technology as Car Addicts. For this reason, PT supply has to become (and appear) technologically advanced, unless the technology passion can induce Malcontent Time Addicts to try AVs and leave PT.

## 4.3. Timeservers

This clusters records extreme results on two factors: the lowest values on the Travel Pleasure (Figure 96) and on the Aware Consumerism. Thus, they are not interested to visit new places, they do not enjoy travel along new paths and they avoid the adventures and risks. The second factor adds the information that Timeservers usually do not lend or give out items.

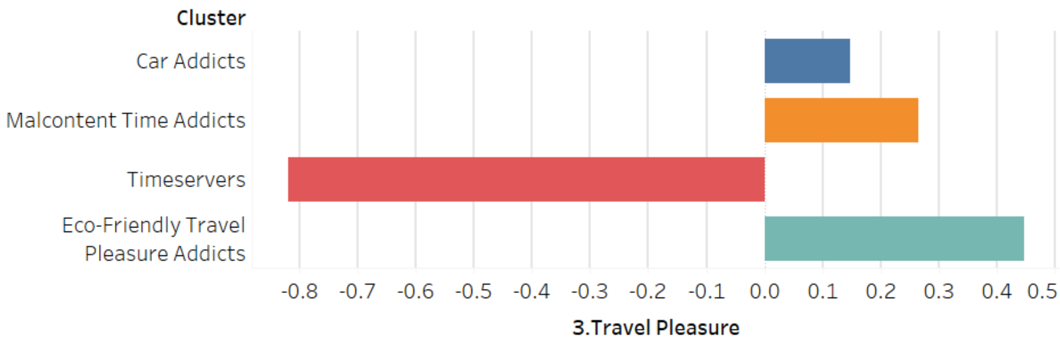


Figure 96 – Score on Travel Pleasure.

From the CA there is no indications that allows to estimate Timeservers' mode of transport, but just some information about their psycho-social profile. The analysis of the other indices adds new information and clarifies behaviour of Timeservers. The indices I.4 and I.5 (Table 98) about the willingness to use more, respectively, car and soft modes, show the lowest scores for Timeservers among all clusters. They declare a weak preference for PT: it seems that they are not interested in active role during the trip, because they enjoy the free time during the travel.

They have not a favourite transport mode (Table 100), they are nearly equally distributed between car and PT, with very low frequency on use of soft modes.

This result leads to believe that Timeservers probably do not take into account environmental impacts or they search for speed, flexibility and high level of service in the modal choice. Furthermore, their low willingness to use more all transport modes is explained thanks to the above indices and shown by the lowest number of trips during the week. This fact suggests that Timeservers prefer not travel. This profile agrees with the scores on latent construct Travel Pleasure which characterises this group. Then, it is possible say that Timeservers like go out from their home few times and they do it only for need, not for pleasure. In their opinion, the travel need is a derived demand from a major need. In the travel there is not any characteristic which can give them a pleasure. Another information to support this description is the percentage of the most important trip on the number of week trips (see Table 100) and the purpose of the most important trip (Table 102). The share of the most important trip over the week is the highest, showing that they try to travel as little as possible. The purpose of their most important trip is similar to that of Malcontent Time Addicts, but the reason is different. In this case, there is not a correlation with used transport mode, but with the willingness to reduce trips, so they move only for very relevant purposes, like work.

The index I.19 about comfort tells that Timeservers have the attitude to look for personal comfort. This could be the key-factor in the modal choice, which is still lacking. Indeed, the score on index I.26 about preference of fast service suggests that they are not looking for speed. Also the environment is not taken into account as proved by score in Table 98 and Table 99 of several indices: Pro-Environment (I.11), Re-Cycle (I.14), Awareness of Mobility Impacts (I.24) and Awareness of Environmental Problem (I.25). In addition, Timeservers show very low value on indices Social Rule Compliance (I.8) and Charity (I.10). In Table 126, their values are shown, highlighting scores of some variables included in these indices.

Table 126: **Social Rule Compliance and Charity indices among clusters.**

| **Code** | **Variable/Index** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** |
|---|---|---|---|---|---|
| 126 | Charity To Homeless | 3.2 | 3.1 | **2.5** | 3.1 |
| 123 | Give Out Items | 5.0 | 5.0 | **2.9** | 4.9 |
| I.10 | Index Charity | 4.0 | 3.9 | **2.8** | 3.9 |

| | | | | | |
|---|---|---|---|---|---|
| 117 | Laundry Full | 5.3 | 5.3 | **4.7** | 5.4 |
| 128 | Give Seat Elderly | 5.6 | 5.5 | **5.2** | 5.6 |
| I.8 | Index Social Rule Compliance | 4.8 | 5.0 | **4.6** | 4.8 |

Then, also in other fields, their behaviour does not strictly follow social norms or absolute values, on the contrary of Malcontent Time Addicts. Furthermore, they are characterised by an intense perception of un-security, as shown by indices (I.21) and (I.30). It seems that the personal un-security reduces the people willingness to have contacts with others, especially with an unknown person. This need of security is a barrier towards car-pooling; indeed, Timeservers record a low score in index (I.6).

If the Malcontent Time Addicts present an high share of graduates and PhD, the Timeservers have the most important presence of low educational levels, as reported in Table 127.

Table 127: **Low educational levels among clusters.**

| **Origin of most important trip** | **Car Addicts** | **Malcontent Time Addicts** | **Timeservers** | **Eco-Friendly Travel Pleasure Addicts** |
|---|---|---|---|---|
| Primary School or less | 0.8% | 1.5% | 1.3% | 0.2% |
| Secondary School | 2.6% | 3.1% | 4.8% | 1.4% |
| High School | 37.5% | 31.1% | 40.1% | 25.1% |
| Total | 40.9% | 35.6% | 46.3% | 26.8% |

The index CarefulDiet (I.17), together to current low frequency of soft modes use and the scarce willingness to increase their use, suggests that Timeservers avoid physical activities. It is possible to believe that among Timeservers are included few sportswomen/sportsmen.

Finally, Timeservers feel a weak interest towards technology. Their use of apps does not appear so assiduous and relevant (low value on index App Addiction I.20). The e-tickets are not attractive for Timeservers (index I.16) and they have the lowest interest towards Autonomous Vehicles (I.18).

Timeservers' profile is a confirmation of the result of the previous work in Alessandria, where a very similar profile was found (Pronello & Camusso, 2011), but also in previous works travellers' profile similar to Timeservers were found. Steg defines a group of commuters who choose the transport mode without social or affective reasons, but only for its performances (Steg, 2005). The Timeservers are very similar: they are equally distributed between car and PT and they choice them in function of their comfort.

## 4.4. Eco-Friendly Travel Pleasure addicts

The Eco-Friendly Travel Pleasure Addicts record an outstanding score in Eco&Cheap Travel and the highest ones in Travel Pleasure and in Mode Pleasure. In addition, they do not have free time during the travel, so it is possible to suppose that they choose soft modes for their most important trip.

As shown in Figure 88, the 74% of Eco-Friendly Travel Pleasure Addicts choose the soft modes. Furthermore, the 77% of soft mode users in the sample Adult Q1 are included in Eco-Friendly Travel Pleasure Addicts (Figure 97).

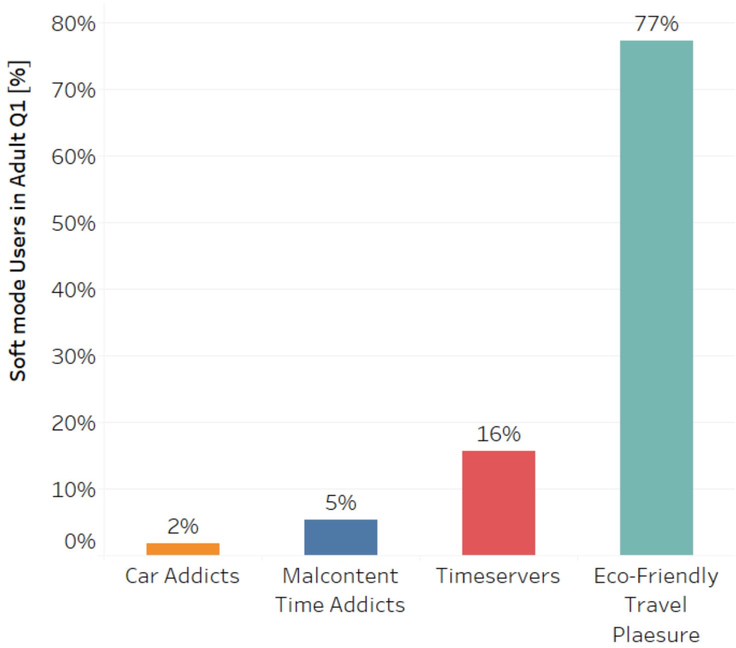


Figure 97 – Soft mode users in all subsample Adult Q1.

The 26% who do not use soft modes is composed by 49 PT users and 62 people who travel by car (Figure 88). Among car users, there are 39 respondents (more than 60%) who choose car due to external factors. For instance, 27 come to Torino from small towns, instead 5 go out from Torino to the countryside, while other travel by evening or in early morning; in such spatial and time contexts PT supply is scarce and the convenience to choose car wins whatever reasoning and attitude.

Eco-Friendly Travel Pleasure Addicts show the strongest attitude towards environment and, arguably, this attitude determines the observed travel behaviour. To support this hypothesis, all indices about environment (or correlated to this theme) record the highest values: Pro-Environment (I.11), Awareness Consumerism (I.13), Re-Cycle (I.14), CarefulDiet (I.17), Awareness of Mobility Impacts (I.24) and Awareness of Environmental Problem (I.25).

The index Landscape (I.12) confirms the high scores in the latent constructs called Travel Pleasure. The Eco-Friendly Travel Pleasure Addicts state that they are in harmony with the landscape and they find pleasure to travel, because they can relax and think. Their opinion is the opposite of the Timeservers, who travel from home only for strong needs and the travel is a task to carry out, not a pleasure.

For Eco-Friendly Travel Pleasure Addicts, the relationship between attitudes and observed behaviour can be reinforced from their very deep knowledge. The Eco-Friendly Travel Pleasure Addicts are the most accurate to answer about the prices and performances of the alternatives provided by the other transport modes. They well perceive the other alternatives, as shown by Fatalistic index (I.9), although they choose the soft modes. It seems that the role of habits is less strong in this profile.

Also in this case, the external factors can influence the modal choice: the Eco-Friendly Travel Pleasure Addicts live generally in small households, without kids and they have very low parking availability. These two conditions can support the attitudes in the determination of the behaviour. However, the modal shift can occur, notwithstanding a general pro-environment attitude. The Eco-Friendly Travel Pleasure Addicts record the highest level of personal security (indices I.21 and I.30 in Table 98) and the highest inclination towards car-pooling (index I.6).

As a consequence, the Eco-Friendly Travel Pleasure Addicts are the respondents who have more experiences about the car-pooling (Figure 98).

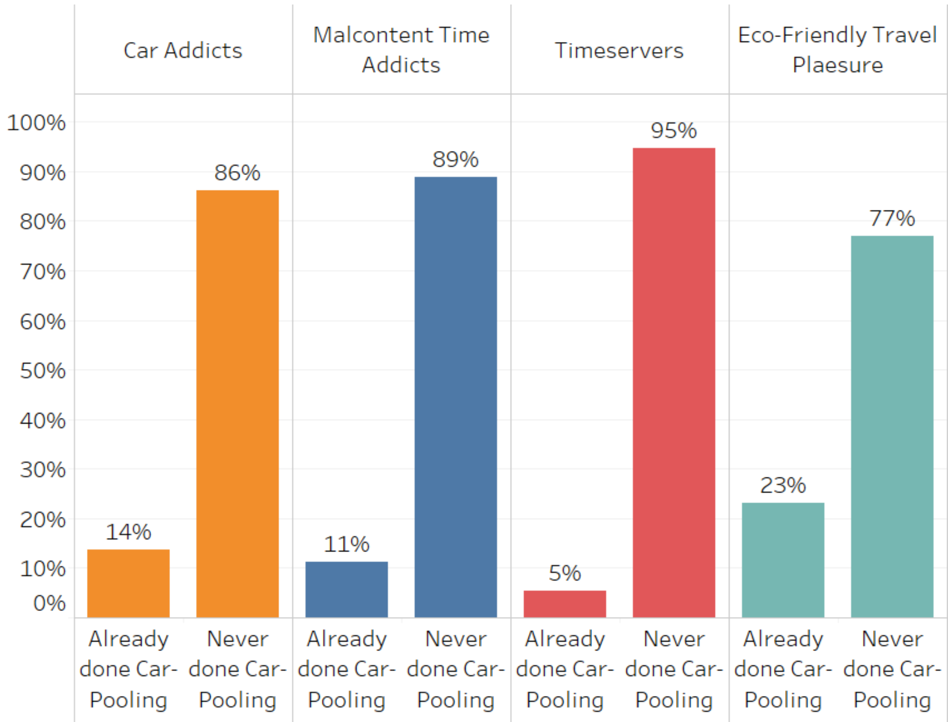


Figure 98 – Car-Pooling experience.

Furthermore, Eco-Friendly Travel Pleasure Addicts show some common characteristics with Car Addicts. For instance, they record a great number of trips per week, very similar to that of Car Addicts. In addition, they appreciate the flexibility and reliability of the current used mode of transport. Maybe, if they have to change, they will not renounce to these features, so they are more inclined to choose car. Moreover, both Car Addicts and Eco-Friendly Travel Pleasure Addicts are used to have not free time during the travel, so they do not perceive the disadvantage of driving task. Finally, Eco-Friendly Travel Pleasure Addicts are the second group most interested to Autonomous Vehicles, so, in the next future, this innovation can become the opportunity to try an alternative.

The opinion of the Eco-Friendly Travel Pleasure Addicts about the PT is the most positive, despite they have the lowest willingness to use PT services. Indeed, they ask less improvement on PT than other groups (to see indices I.2 and I.3 in

Table 98). These low scores agree with their attitudes about looking for comfort and speed (indices I.19 and I.26 in Table 99): indeed, Eco-Friendly Travel Pleasure Addicts are not looking for more comfort or faster services. To increase PT use of the Eco-Friendly Travel Pleasure Addicts, the e-ticket and the integration of tariffs among different modes of transport can be some right measures, according to their results in index ProE-tickets (I.16). Indeed, the Eco-Friendly Travel Pleasure Addicts record the strongest preference towards these improvements of PT quality.

Eco-Friendly Travel Pleasure Addicts are a profile already emerged in Alessandria (Pronello & Camusso, 2011). In this previous work, this profile showed the same strong attitude towards travel pleasure, it did a modal choice coherent with a pro-environment behaviour and it stated an intense enjoyment to be connected with landscape thanks to their transport mode.

The attitude towards comfort and speed research, which are very low in Eco-Friendly Travel Pleasure Addicts, are found also in other studies (Mokhtarian & Salomon, 2001) (Cao & Mokhtarian, 2005) (Cao, 2005). The adventure seekers, like this cluster, are defined as more flexible and they know how to adapt to new situations.

## 4.5. Students

The profiles presented in the paragraph 3.6 about students are very similar to those of adults, so they are discussed only highlighting the different features and the common points.

Generally, there are few notable differences, as shown in Table 128 and in Table 129, but a lot of characteristics show unexpected similarities. This outcome confirms that age is not necessarily a variable useful to explain the modal choice. Some attitudes, which influence travel behaviour, are cross-generation, thus they are homogenous in samples with different ages.

Table 128: **Adults versus students on indices from Part A and Part B.**

| Code | Variable Name | Adult Q1 | Student Q1 | Differences | Millennial PT Supporters |
|---|---|---|---|---|---|
| I.1 | Easy Parking | 4.3 | 3.8 | 0.5 | 3.7 |
| I.2 | PT Service Increase | 5.0 | 4.8 | 0.2 | 4.6 |
| I.3 | PT Quality Improvement | 4.6 | 4.4 | 0.2 | 4.1 |
| I.4 | Will Use More Car | 3.3 | 3.6 | -0.4 | 3.6 |
| I.5 | Will Use More Soft Modes | 3.3 | 3.5 | -0.2 | 3.6 |
| 80 | Willingness More Use PT | 4.3 | 4.6 | -0.3 | 5.2 |
| I.6 | Car Pooling | 2.5 | 2.8 | -0.3 | 2.9 |
| I.7 | Car Aversion | 3.3 | 3.3 | 0.0 | 3.4 |
| I.8 | Social Rule Compliance | 4.9 | 4.6 | 0.2 | 4.8 |
| I.9 | Fatalistic | 2.7 | 3.7 | -1.1 | 3.5 |
| I.10 | Charity | 3.7 | 3.0 | 0.7 | 3.1 |
| I.11 | Pro Envinron | 3.0 | 2.5 | 0.5 | 2.7 |
| I.12 | Landscape | 3.5 | 3.7 | -0.1 | 3.7 |
| I.13 | Awarness Consumerism | 3.2 | 3.2 | 0.0 | 3.3 |
| I.14 | Re-Cycle | 5.7 | 5.5 | 0.2 | 5.6 |
| I.15 | Perceived Safety | 3.5 | 3.5 | 0.1 | 4.8 |
| I.16 | ProE-Ticket | 4.4 | 4.2 | 0.2 | 4.1 |
| I.17 | CarefulDiet | 3.5 | 3.5 | 0.0 | 3.6 |
| I.18 | AVActivities | 2.7 | 3.0 | -0.2 | 3.0 |
| I.19 | Comfort | 2.8 | 2.8 | 0.0 | 2.5 |
| I.27 | Stress on PT | 3.5 | 3.7 | -0.2 | 3.5 |
| I.21 | Security | 3.5 | 3.5 | 0.0 | 3.3 |
| I.30 | Security On Board | 3.3 | 3.6 | -0.3 | 3.6 |
| I.22 | Cost sensibility | 3.9 | 4.1 | -0.2 | 4.1 |
| I.26 | Speed research | 2.8 | 2.9 | 0.0 | 2.8 |
| I.23 | Alternative Routes | 2.3 | 2.4 | -0.1 | 2.7 |

| | | | | | |
|---|---|---|---|---|---|
| I.24 | Awareness Mobility Impacts | 4.3 | 4.2 | 0.2 | 4.8 |
| I.25 | Awareness of Env problem | 5.6 | 5.5 | 0.2 | 5.7 |
| I.20 | App Addiction | 3.3 | 3.6 | -0.3 | 3.5 |
| I.28 | GPS Feeling | 3.1 | 3.6 | -0.5 | 3.4 |
| I.29 | Tech Innovation | 3.7 | 3.7 | -0.1 | 3.9 |

Table 129: **Adults versus students on mobility patterns.**

| **Code** | **Variable Name** | **Adult Q1** | **Student Q1** | **Differences** | **Millennial PT Supporters** |
|---|---|---|---|---|---|
| 6 | Distance | 22.1 | 22.8 | -0.7 | 21.5 |
| 12 | TravelTime | 41.9 | 49.3 | -7.4 | 53.0 |
| 25 | Desired Reduction | 18.0 | 19.8 | -1.8 | 20.3 |
| 26 | MonthlyCost | 63.6 | 43.8 | 19.8 | 46.4 |
| 27 | WtP More Speed | 9.4 | 7.0 | 2.4 | 7.2 |
| 28 | WtP Less Pollutant | 10.9 | 7.7 | 3.2 | 7.0 |
| 245 | CarUse TripImpo | 2.1 | 0.7 | 1.4 | 0.1 |
| 246 | PTUse TripImpo | 2.3 | 3.6 | -1.3 | 5.0 |
| 247 | Soft Modes Use Trip Impo | 0.7 | 1.0 | -0.3 | 0.2 |
| 42 | Ignorance Bike Sharing | 19.6 | 21.8 | -2.2 | 20.9 |
| 43 | Ignorance Car Sharing | 3.0 | 2.4 | 0.6 | 2.3 |
| 40 | Ignorance PT | 0.2 | 0.2 | 0.0 | 0.2 |
| 41 | Ignorance Train | -34.4 | -33.3 | -1.1 | -29.9 |

This sample is mainly made by university students; they generally travel by PT due to some external factors. Since the majority of the universities in Torino is located in the city centre, the index about parking describes a common difficulty to find it. This condition induces to prefer PT and soft modes. In addition, students have less availability of car than adults and perceive a stronger lack of alternatives to their current used mode (index I.9). According to this interpretation, student’s attitudes do not push them towards PT or soft modes. Furthermore, the attitudes towards environment and social problems are weaker than adults. Indeed, no one of the following indices reveal an higher value for students: Social Rule Compliance (I.8), Charity (I.10), Pro Environ (I.11), Aware Consumerims (I.13), Re-Cycle (I.14), CarefulDiet (I.17), Awareness of Mobility Impacts (I.24), Awareness of Environmental Problem (I.25).

Probably, some items in the web-questionnaire did not intercept students' attitudes, because questions are about some behaviours which still not fully involve students. Then, before to state that students are less pro-environment than adults, it will be necessary to check if such behaviour could be applied to them.

Another explanation can be that the sample of students is more representative of the population (in Torino it reaches the 4% of the whole university students), while adult one is too biased, showing a strong pro-environment behaviour as regards the general population.

Furthermore, students' attitude towards car is equal to the adults' one (Index Car Aversion, code I.7); maybe, their sensitivity to car manufacture advertising is equal to adults' one. It is also necessary to take into account that they have just obtained driving licence, so probably they are still enthusiastic of the new opportunities offered by car.

If towards environment and social problems students' attitudes are less strong than adults' ones, as regards research of comfort, (un-)security and speed they are equal. These three elements are very cross-generation. Arguably the students are very sensitive to current social debate and their attitudes are shaped from it. Then, especially for perceived personal security, there is no difference with adults, notwithstanding students' young age should push to underestimate the risks.

Instead, an attitude where students show higher scores than adults is that towards technology. The students are more passionate towards technological innovation and they are more addicted to app use and GPS assistance. In analysis of adults' profile, the technology is relevant only in the Malcontent Time Addicts and Car Addicts. This trend is coherent with students' results, which are prevalent PT users with inclination to car use.

Another strong attitude of students is towards travelling; students' Travel Pleasure is higher than in adults. In other way, they generally like travelling and discovering new places. Their daily experience is consistent with this attitude: they travel longer distances and they spend more time travelling. In addition, they are more willing to use all modes of transport.

Finally, the students show slightly major inclination to car-pooling than adults, as proved by index I.6, despite they feel same level of personal security.

Beyond the attitudes, the web-questionnaire investigated also the knowledge about all transport modes. The students have similar high level of un-accuracy of adults according to the features measured by the Ignorance Indices. These indices show that knowledge about transport between adults and student is not different.

To conclude, the solution to decrease the environmental impacts of mobility is not waiting that current young people become next adults, because they are not so different form the last ones. Several actions and measures are needed to solve this problem. However, there is a new element from the Cluster Analysis: the fifth group, named "Millennial PT Supporters". This cluster is formed by very loyal PT users. They know deficiencies of present PT supply, but they have better opinion about it, as shown from indices I.2 and I.3. In addition, they show the highest willingness to use more PT and they already use PT with high frequency. This group is similar to the other students in some attitudes, like willingness to use more car or towards the Autonomous Vehicles. Instead, they show a very strong pro-environment attitude (indices I.10, I.11, I.14, I.17, I.24 and I.25 higher than students' average). Furthermore, they show more sensibility towards social problems and respect of norms (I.10 and I.12) and look less for the comfort (I.19).

This profile is very comparable to that of Eco-Friendly Travel Pleasure Addicts, but they usually use PT Services. This characteristic is not present in the adult subsample.

# Chapter 5

# Conclusions

The most important threat for the future is the climate change and the transport sector in European Union (EU) does not improve enough to reduce its Green House Gas emissions (GHG) (European Commission, 2019). Other sectors, like agriculture, industries, residential and services have seen more important decline of their emissions from 1990 to nowadays. Indeed, today transport represents almost a quarter of all UE emissions, while in 1990 it was just 19% (European Commission, 2016). This sector is still largely dependent from fossil sources: the 94% of its energy needs was satisfied by oil in 2014 (Eurostat, 2018). In the same year, the road transport generated more than 70% of emissions.

So far, the objective to make the mobility sustainable is not reached yet. According to this scope, European Commission and national governments are committed to carry out huge investments, like building new infrastructures (e.g. TEN-T Network[7]). These actions require a lot of resources and very long time before they produce benefits, so, simultaneously, other measures are being undertaken to optimise the transport services using the current infrastructures. One of them is the promotion of the integrated mobility that connect all modes of transport allowing multimodal trips that are composed by a chain of several transport means.

Within this context, this research has two objectives: analysing the influences of attitudes in the travel behaviour and finding the most relevant obstacles of

[7] https://ec.europa.eu/transport/themes/infrastructure_en

choosing more sustainable transport modes. These two tasks are achieved through the definition of a market segmentation based on psycho-social latent constructs. Thanks to the travellers' profiles found so far, it is possible to provide some measures and suggestions to policy makers and transport operators.

The choice to delineate a users' segmentation based only on psycho-social variables is quite rare in transport sector, despite all psychosocial models are based on them (Hunecke, Haustein, Bohler, & Grischkat, 2010). The methodology starts from data collection, through the design of the survey "*Come Ci Muoviamo*". The web-questionnaire investigates simultaneously a lot of different themes, so that it allows to compare them and discovering their relationships; then, an improvement of the GEB (General Ecological Behaviour) items is proposed (Kaiser & Wilson, Assessing People's General Ecological Behavior: A Cross-Cultural Measure, 2000) (see section 2.2).

The successive administration of "*Come Ci Muoviamo*" involved more than 15.000 people in three months and the web-questionnaires collected more than 5.000 complete answers, a notable result in academic field. The analysis of the study area (see section 2.1) and the sample (see section 3.2) show that the respondents are not representative of whole population. However, the aim of the survey was not inferring the mobility pattern of all the study area, so the sample representativeness was not a requirement. Instead, the sample quality is in its size that, joined to the variety of investigated themes, allows to obtain valuable information on people behaviour.

The data analysis is composed by two steps: an Exploratory Factor Analysis to find the latent constructs and a Cluster Analysis based on the factor scores. Each step is repeated for two subsample, composed by university students and adults. From adult subsample, four cluster are defined: Car Addicts, Malcontent Time Addicts, Timeservers and Eco-Friendly Travel Pleasure Addicts. From the students, one cluster more has been found and it is called Millennials PT Supporters. Their features are described in section 3.6 and discussed in chapter 4. Finally, the clusters are evaluated through the lens of social-demographic variables to complete their understanding. The groups of travellers defined thanks to the cluster analysis is the base of the new market segmentation, which allows to understand in depth the travel behaviour and to provide some useful suggestions to policy makers and transport operators.

The first consideration crossing several profiles is the information about the travel alternatives. The role of habits can make the choice of transport mode an automatic task and travellers are not more interested to search information about alternatives (Aarts, Verplanken, & Van Knippenberg, 1998). This impact of habit was found also in a previous work in 2011 (Pronello & Camusso, 2011) in a part of the study area analysed in this research.

Car Addicts do not know the alternative to own car; it seems that habit plays a very important role in their modal choice. Thus, transport planners and transport operators should propose their service supply considering the negative aspects of travelling by car, notably the environmental impacts. The Car Addicts show a pro-environment attitude (they have the highest willingness to pay to reduce their emission), but it is not enough to push them out of car. In addition, they spend a lot of money for travelling, so the campaign of advertising pro-PT have to underline this disadvantage. Furthermore, they do not perceive properly the gap between PT and car concerning safety: it is another advantage to foster. Finally, in social network age, people feel the need to be continuously connected and Car Addicts are not different. The free time on board the PT is not taken into account in decision-making about the transport modes. The advertising campaign could be performed using the panels along roads, to be sure that the target is reached.

The Malcontent Time Addicts need different information. They do not underestimate the performance of current PT services, so results and records of PT should be made known to the users. Maybe some open day of transport operators could be effective to reduce the gap among customers and PT service providers. In addition, the negative aspects of car use (e.g. waste time for traffic, environmental impacts) have to be reminded to the Malcontent Time Addicts, highlighting the positive aspects of PT (saving of $CO_2$ emissions, etc.). This advertising could be performed on board, at bus stops or in the stations or even on tickets with some slogans.

The Timeservers fear for their personal security, so they could choose more frequently PT services but they are much influenced by feeling of un-security. The PT would become more attractive for Timeservers if more actions were undertaken, like more presence of police, staff members, CCTV. Also other measures are correlated to security and they can be effective: improvement of illumination in station or on board and cleanness of vehicles.

In addition to the specific knowledge about transport alternatives, it is necessary a more general education about impacts of transport on society and on environment. Indeed, people who choose the private vehicle are not aware of consequences of their mobility. The impact of the education on travel behaviour is confirmed in this market segmentation: the clusters showing lower frequency of car use are those with the highest level of education. For this reason, it is necessary to start a public debate about impacts of mobility, because the concept that each mode choice cause some consequences is not commonly shared.

Investments to improve current PT supply are needed according to opinions of all profiles. The Malcontent Time Addicts and Eco-Friendly Travel Pleasure Addicts require more frequency, reliability and speed, to make PT more flexible to face daily errands and appointments. In addition, the Car Addicts, who do not still experience the PT services, ask for improvements about on board quality (comfort, cleanness, etc.) with the same priority of the above requests. All profiles show the willingness to use more PT if some developments will be carried out. Indeed, there is across willingness to use more PT in the future, albeit with different level of frequency among each profiles. Unless any benefit from new investments will arrive, also Malcontent Time Addicts, who are the most loyal PT users, could shift towards cars, especially in the future with Autonomous Vehicles (AVs). Indeed, the AVs can become an alternative for their attractiveness and a competitor of the PT, reducing the pressure to a modal shift from private vehicle.

As anticipated above, the shift of the Car Addicts from car to PT is also hampered by perceived lack of comfort on board the PT vehicles. An efficient measure to overcome this problem could be equipping the PT vehicles with Wi-Fi service. Through this new technological infrastructure, the transport operators could provide new services to customers (like newspaper, TV series, etc.), so this upgrade could become an opportunity for new income (e.g. advertising). This improvement fit also another attitude, common among Car Addicts: the passion about technology. With the introduction of Wi-Fi, the PT services will appear more technological and they could become more attractive. The WiFi connection would allow travellers to maintain easier the access to social networks, increasing the perceived comfort versus the car and enriching the possible activities on board.

To reduce number of cars travelling in the cities, the car-pooling is fostered. However, the policy makers have to pay attention to the promotion of car-pooling:

it is a way of travel preferred by Eco-Friendly Travel Pleasure Addicts, who are the most sustainable travellers and their shift to car should be avoid. Instead, Car Addicts or Timeservers show less experiences of car-pooling.

Across all profiles, the external factors which influence travel behaviour are the availability and cost of car parking. Parking is the most effective external tool for the policy to push the shift from private vehicle to other modes of transport. If in the next future the AVs are able to look for parking outside the city centre, the efficacy of this measure will be lost and some PT users could decide to travel by car.

To foster the soft modes, the travellers ask more safety. The current road infrastructures are designed for cars and private vehicles. While for walking in the past years several measures are undertaken, the cycle paths are still incomplete and their use is not attractive. The analysis based on psycho-social point of view show a lot of positive consequences about travelling by soft modes. People feel more secure, are more careful to social and environmental problems and have more contact with landscape, with more attachment to city and what is around themselves. In a society where the security is the main matter of public opinion, people risk to be addicted to the virtual life on social network and, then, need more physical activities; the policy has to take into account the positive effects of soft modes promotion also in other issues.

To conclude, two profiles, Malcontent Time Addicts and Eco-Friendly Travel Pleasure Addicts, already record a sustainable travel behaviour, but the first are much dissatisfied and could shift to use car, while the second show an uncommon pro-environment attitude. On the other hand, Car Addicts and Timeservers show a positive general attitude to use more PT if it improves. Indeed, at present, PT users perceived some disadvantages and only who have a strong attitude towards environment or high awareness of own mode choice can overcome them. If the target is sustainable mobility of the majority of people, without decreasing the quality of life, some improvements are necessary. The impacts of the current mobility on the quality of life and on the environment make urgent the measures discussed above.

The results of this research are at different levels: they confirm the methodological approach and the psycho-social profiles of the previous study in Alessandria in 2011 (Pronello & Camusso, 2011), but it can be also the starting point for next activities. New attitudes can be included in the analysis to define more in depth the profiles; in the survey new items can substitute or reinforce the current ones. Furthermore, the sample has not properly covered all age intervals (e.g. elderly) and some job profiles (workers, housewife, etc.); thus, the market segmentation can be enriched of new profiles and the income (and other variables correlated to it) could show statistically difference. Notwithstanding the market segmentation is a confirmation of the previous study in Alessandria in 2011, it can be replicated in other contexts to verify its results and to discover possible new determinants of travel behaviour, analysing different social-cultural backgrounds. With a stratified sample, the weight of each profile in the population can be computed, then the efficacy of each measure estimated. Finally, the gender gap could be investigated: Timeservers and Eco-Friendly Travel Pleasure Addicts are mainly female, while Car Addicts and Malcontent Time Addicts are male.

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# Appendices

## Appendix 1 – Variables Set

Table 130: **Variables from the first section of Part A, *Mobility in the standard week*.**

| Code | Name | Description | Type |
|---|---|---|---|
| 1 | ID_Answer | Chronological count of the answers | Ratio |
| 2 | PurposeMostImpo | Purpose of the most important trip in the week | Categorical |
| 3 | FreqMostImpo | Frequency of the most important trip | Ordinal |
| 4 | PercentageMostImpo | Percentage of the most important trip over all trips of the week | Ratio |
| 5 | TripPerWeek | Number of all trips during the week | Ratio |
| 245 | CarUse_TripImpo | Use frequency of car for the most important trip | Ratio |
| 246 | PTUse_TripImpo | Use frequency of PT for the most important trip | Ratio |
| 247 | SoftModesUse_TripImpo | Use frequency of soft modes for the most important trip | Ratio |
| 248 | CarUse_Week | Use frequency of car during the week | Ratio |
| 249 | PTUse_Week | Use frequency of PT during the week | Ratio |
| 250 | SoftModesUse_Week | Use frequency of soft modes during the week | Ratio |

Table 131: **Variables from the second section of Part A,**
***Diary of most important trip.***

| Code | Name | Description | Type |
|---|---|---|---|
| 6 | Distance | Distance travelled in the most important trip | Ratio |
| 7 | GeoDistance | Distance travelled in the most important trip, calculated from coordinates of origin and destination | Categorical |
| 8 | SustIndexMode_Week | Sustainability index computed for used modes of transport during overall week mobility | Ordinal |
| 9 | SustIndexMode_MostImpoTrip | Sustainability index computed for used modes of transport in the most important trip | Ratio |
| 10 | SustIndexDist_MostImpoTrip | Sustainability index computed with from distance travelled with each mode of transport for the most important trip | Ratio |
| 11 | MoT | Used mode(s) of transport in the most important trip | Ratio |
| 12 | TravelTime | Duration of the most important trip | Ratio |
| 13 | SatisfCheapness | Satisfaction about cheapness for the most important trip | Ratio |
| 14 | SatisfEcology | Satisfaction about ecology for the most important trip | Ratio |
| 15 | SatisfSpeed | Satisfaction about speed for the most important trip | Ratio |
| 16 | SatisfSafety | Satisfaction about safety for the most important trip | Categorical |
| 17 | SatisfSecurity | Satisfaction about security for the most important trip | Ratio |
| 18 | SatisfFlexibility | Satisfaction about flexibility for the most important trip | Interval |
| 19 | SatisfRegularity | Satisfaction about punctuality for the most important trip | Interval |
| 20 | SatisfComfort | Satisfaction about comfort for the most important trip | Interval |
| 21 | SatisfFreeTime | Satisfaction about free time during the most important trip | Interval |
| 22 | SatisfCarryObjects | Satisfaction about carrying objects for the most important trip | Interval |
| 23 | SatisfBringSomeone | Satisfaction about taking/bringing someone during the most important trip | Interval |
| 24 | SatisfOverall | Overall satisfaction for the most important trip | Interval |
| 25 | DesiredReduction | Desire reduction of travelled time to be satisfied | Interval |

Table 132: **Variables from the third section of Part A, *Integrated Mobility*.**

| Code | Name | Description | Type |
|---|---|---|---|
| 26 | MonthlyCost | Total month cost for the most important trip | Ratio |
| 27 | WtP_MoreSpeed | Willingness to pay to save time for the most important trip | Ratio |
| 28 | WtP_LessPollutant | Willingness to pay to produce less pollutant for the most important trip | Ratio |
| 29 | NoAlternative | Level of agreement about the statement "I have not alternative" about transport mode used in the most important trip | Interval |
| 30 | UseTheCheapest | Importance of cheapness in the choice of the mode of tranport | Interval |
| 31 | UseTheFast | Importance of speed in the choice of the mode of tranport | Interval |
| 32 | UseTheLeastPollutan t | Importance of pollutant in the choice of the mode of tranport | Interval |
| 33 | UseTheSafest | Importance of safety in the choice of the mode of tranport | Interval |
| 34 | UseTheMostSecure | Importance of security in the choice of the mode of tranport | Interval |
| 35 | UseTheMostOnTime | Importance of punctuality in the choice of the mode of tranport | Interval |
| 36 | UseWhyLike | Importance of personale pleasure in the choice of the mode of tranport | Interval |
| 37 | UseWhyIFeelFree | Importance of freedom in the choice of the mode of tranport | Interval |
| 38 | UseWhyILikeLandsc ape | Importance of contact with landscape in the choice of the mode of tranport | Interval |
| 39 | JustArrive | Level of agreement about the statement "The only important thing is to reach the destination" about the most important trip | Interval |
| 40 | Ignorance_PT | Ignorance about price of one-way ticket on urban public transport in Torino | Ratio |
| 41 | Ignorance_Train | Ignorance about punctuality of regional train in the previous month | Ratio |
| 42 | Ignorance_BikeShari ng | Ignorance about price seasonal ticket for bike sharing in Torino | Interval |
| 43 | Ignorance_CarSharin g | Ignorance about price of car sharing in Torino | Ratio |
| 44 | Ignorance_PrivateCar | Ignorance about price of one litre of gasoline | Ratio |
| 45 | Parking_Origin_Avai labilty | Availability of car parking near to the origin | Interval |
| 46 | Parking_Origin_Cost | Cost of car parking near to the origin | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 47 | Parking_Destin_Avai labilty | Availability of car parking near to the destination | Interval |
| 48 | Parking_Destin_Cost | Cost of car parking near to the destination | Interval |
| 49 | Work | Frequency of work activities during the most importan trip | Interval |
| 50 | Read | Frequency of reading during the most importan trip | Interval |
| 51 | SocialNetwork | Frequency of social network use during the most importan trip | Interval |
| 52 | ListenMusic | Frequency of music listening during the most importan trip | Interval |
| 53 | WatchMovies | Frequency of movie wacthing during the most importan trip | Interval |
| 54 | Relax | Frequency of relax during the most importan trip | Interval |
| 55 | Thinking | Frequency of thinking during the most importan trip | Interval |
| 56 | SeeLandscape | Frequency of admire landscape during the most importan trip | Interval |
| 57 | PhoneCall | Frequency of phone calling the most importan trip | Interval |
| 58 | Chatting | Frequency of chatting during the most importan trip | Interval |
| 59 | TalkFriend | Frequency of talking with friends during the most importan trip | Interval |
| 60 | TalkStranger | Frequency of talking with strangers during the most importan trip | Interval |
| 61 | AV_Work | Frequency of work activities during the most importan trip in AV in AV | Interval |
| 62 | AV_Read | Frequency of reading during the most importan trip in AV | Interval |
| 63 | AV_SocialNetwork | Frequency of social network use during the most importan trip in AV | Interval |
| 64 | AV_ListenMusic | Frequency of music listening during the most importan trip in AV | Interval |
| 65 | AV_WatchMovies | Frequency of movie wacthing during the most importan trip in AV | Interval |
| 66 | AV_Relax | Frequency of relax during the most importan trip in AV | Interval |
| 67 | AV_Landscape | Frequency of admire landscape during the most importan trip in AV | Interval |
| 68 | AV_PhoneCall | Frequency of phone calling the most importan trip in AV | Interval |
| 69 | AV_Chatting | Frequency of chatting during the most importan trip in AV | Interval |
| 70 | AV_Talking | Frequency of talking with friends during the most importan trip in AV | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 71 | PT_LowerPrice | Importance of lower price of PT ticket | Interval |
| 72 | PT_MoreSpeed | Importance of more speed of PT | Interval |
| 73 | PT_MoreFreq | Importance of more frequency of PT | Interval |
| 74 | PT_OnTime | Importance of more punctuality of PT | Interval |
| 75 | PT_MoreConfort | Importance of more comfort of PT | Interval |
| 76 | PT_More e-ticket | Importance of more e-ticket of PT | Interval |
| 77 | PT_MoreIntegration | Importance of more integration of PT | Interval |
| 78 | PT_MoreClean | Importance of more clean of PT | Interval |
| 79 | PT_MoreSecurity | Importance of more security of PT | Interval |
| 80 | WillingnessMoreUse PT | Willingness to use more PT | Interval |
| 81 | MoreCar_Fuelprice | Level of agreement to "More car use if there was decrease of fuel price" | Interval |
| 82 | MoreCar_Lesstraffic | Level of agreement to "More car use if there was less traffic" | Interval |
| 83 | MoreCar_MoreSafety | Level of agreement to "More car use if there was more safety" | Interval |
| 84 | MoreCar_CarAvailab ility | Level of agreement to "More car use if I had own car availability" | Interval |
| 85 | MoreCar_HigherTick etsPrice | Level of agreement to "More car use if there was an increase of PT Ticket price" | Interval |
| 86 | MoreCar_ElectricCar | Level of agreement to "More car use if I had a Electric Car" | Interval |
| 87 | MoreCar_MorePark | Level of agreement to "More car use if there was more park" | Interval |
| 88 | MoreCar_LowerPark Costs | Level of agreement to "More car use if there was lower park costs" | Interval |
| 89 | MoreCar_KeepActua lMode | Level of agreement to "Anyway I would keep the current mode of transport" | Interval |
| 90 | ProBikeIf_SafetyRou te | Level of agreement to "More bike use if there was safer route" | Interval |
| 91 | ProBikeIf_MoreRoad Traffic | Level of agreement to "More bike use if there was more road traffic" | Interval |
| 92 | ProBikeIf_LessCarPa rk | Level of agreement to "More bike use if there was less car park" | Interval |
| 93 | ProBikeIf_MorePTTi cketPrice | Level of agreement to "More bike use if there was an increase of PT Ticket price" | Interval |
| 94 | ProBikeIf_NeedSport | Level of agreement to "More bike use if I needed more sport" | Interval |
| 95 | ProBikeIf_CanHaveS hower | Level of agreement to "More bike use if I could have a shower at destination" | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 96 | ProBikeIf_MoreBikePark | Level of agreement to "More bike use if there was more bike park" | Interval |
| 97 | ProBikeIf_BetterAirQuality | Level of agreement to "More bike use if there was better air quality" | Interval |
| 98 | ProBikeIf_KeepActualMode | Level of agreement to "Anyway I would keep the current mode of transport" | Interval |

Table 133: **Variables from the fourth section of Part A, "*Mobility as Service (MaaS)*".**

| Code | Name | Description | Type |
|---|---|---|---|
| 99 | JoinGAS | Willingness to join in a fair buying groups to purchase a car | Interval |
| 100 | CarPooling_Pax | Willingness to do car pooling, as driver | Interval |
| 101 | CarPooling_Driver | Willingness to do car pooling, as passenger | Interval |
| 102 | PaperTicket | Preference to paper ticket | Interval |
| 103 | SmartphoneTicket | Preference to load ticket on smartphone | Interval |
| 104 | SmartCardTicket | Preference to load ticket on smartcard | Interval |
| 244 | MobilityPackages | Willigness to use a Mobility Packages. | Interval |

Table 134: **Variables from the fifth section of Part A, "*Attitudes and preferences*".**

| Code | Name | Description | Type |
|---|---|---|---|
| 105 | LikeDriving | Level of agreement to "I like driving" | Interval |
| 106 | CleanCar | Level of agreement to "I force my self to keep clean car" | Interval |
| 107 | ToBePassenger | Level of agreement to "I prefer to be passenger | Interval |
| 108 | ShareCarFriends | Level of agreement to "I like sharing car with friends" | Interval |
| 109 | ShareCarUnknown | Level of agreement to "I like sharing car with unknown" | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 110 | DrivingUnkownRoad | Level of agreement to "I like driving along unknown road" | Interval |
| 111 | NoDriveBigCity | Level of agreement to "I avoid to drive in big cities" | Interval |
| 112 | NoDriveNight | Level of agreement to "I avoid to drive during night" | Interval |
| 113 | Drive&Drink | Level of agreement to "I drive also after I drank a pint of beer" | Interval |
| 114 | UsuallyPassenger | Level of agreement to "I often passenger of my friends in car" | Interval |
| 115 | DriveSlower120 | Level of agreement to "I usually drive less than 120 km/h in motorway" | Interval |
| 116 | Heating | Level of agreement to "I turn off the heat at night" | Interval |
| 117 | LaundryFull | Level of agreement to "I wait to have a full laundry before to use washing machine" | Interval |
| 118 | OpenWindowWinter | Level of agreement to "In winter, I open for long time the windows" | Interval |
| 119 | LaundrySoftner | Level of agreement to "I use softner for the laundry" | Interval |
| 120 | BioProducts | Level of agreement to "I look for biologic products" | Interval |
| 121 | OldItems | Level of agreement to "Sometimes I sell goods I don't use anymore" | Interval |
| 122 | SecondHand | Level of agreement to "SometimesI buy second hands goods" | Interval |
| 123 | GiveOutItems | Level of agreement to "Sometimes I offer goods I don't use anymore" | Interval |
| 124 | LendItems | Level of agreement to "Sometimes I lend goods I occasionally use" | Interval |
| 125 | EatLessMeat | Level of agreement to "I eat less meat than years ago" | Interval |
| 126 | CharityToHomeless | Level of agreement to "Sometimes I give money to panhandlers" | Interval |
| 127 | CharityToOrganisations | Level of agreement to "From time to time I give money to charity" | Interval |
| 128 | GiveSeatElderly | Level of agreement to "If an elderly or disabled person enters a crowded PT vehicle, I offer him/her my seat" | Interval |
| 129 | CriminalRecords | Level of agreement to "If I were an employer, I would not hesitate hiring a person previously convicted of crime" | Interval |
| 130 | TravelWithoutTickets | Level of agreement to "Sometimes I ride public transport without paying a fare" | Interval |
| 131 | NotCareWaste | Level of agreement to "I put dead batteries in the garbage" | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 132 | Recycling | Level of agreement to "I sort glass wastes for recycling" | Interval |
| 133 | ReuseShopBag | Level of agreement to "I re-use plastic bag from the groceries" | Interval |
| 134 | CannedDrinks | Level of agreement to "I sometimes buy beverage in cans" | Interval |
| 135 | ChatProEnvironment | Level of agreement to "I often talk with friends about problems related to the environment" | Interval |
| 136 | EnvironOrganActivist | Level of agreement to "I am a member of an environmental organization" | Interval |
| 137 | ProEnvBehaviour | Level of agreement to "In the past, I have pointed out to someone his or her un-ecological behaviour" | Interval |
| 138 | SupportEnvOrganisation | Level of agreement to "I sometimes contribute financially to environmental organizations" | Interval |
| 139 | NoOGMproducts | Level of agreement to "I boycott companies using OGM or pesticides" | Interval |
| 140 | LikeDiscoveringNewPlaces | Level of agreement to "I like travel towards new places" | Interval |

Table 135: **Variables from the seventh section of Part A, "*Personal Information*".**

| Code | Name | Description | Type |
|---|---|---|---|
| 147 | Gender | Gender of respondents | Categorical |
| 148 | Age | Age of respondents | Ratio |
| 149 | EduLevel | Education level of respondents | Categorical |
| 150 | ProfStatus | Professional status of respondents | Categorical |
| 151 | HHSize | Size of respondents' household (HH) | Ratio |
| 152 | Kids | Number of sons and daughters in HH | Ratio |
| 153 | DrivingLicence | If respondent has driving license | Categorical |
| 154 | CarNumber | Number of cars in the HH | Ratio |
| 155 | BikeSharingTicket | If respondent has bike sharing seasonal tickets | Categorical |
| 156 | PTTicket | If respondent has PT seasonal tickets | Categorical |
| 157 | SubUrbPTTicket | If respondent has PT Suburban seasonal tickets | Categorical |
| 158 | RuralPTTicket | If respondent has PT Rural seasonal tickets | Categorical |
| 159 | TrainTicket | If respondent has train seasonal tickets | Categorical |
| 160 | CarSharingTicket | If respondent has car sharing seasonal tickets | Categorical |
| 161 | Income | Income level of HH | Ordinal |

Table 136: **Variables from the first section of Part B, "*Information about most important trip*".**

| Code | Name | Description | Type |
|---|---|---|---|
| 162 | LegBringSomeone | Frequence of leg to bring/take someone | Interval |
| 163 | LegErrand | Frequence of leg for errands | Interval |
| 164 | LegSport | Frequence of leg to do sport/cultural activities | Interval |
| 165 | LegStroll | Frequence of leg for stroll | Interval |
| 166 | LegVisitSomeone | Frequence of leg to visit someone | Interval |
| 167 | LegChangeMoT | Frequence of leg to change mode of transport | Interval |
| 168 | LegNewPath | Frequence of leg to try new path | Interval |
| 169 | PleasurePath | Frequence of alternative for more pleasure from landscape | Interval |

Table 137: **Variables from the second section of Part B, "*Attitudes and preferences*".**

| Code | Name | Description | Type |
|---|---|---|---|
| 170 | CongestionPollution | Level of agreement to "Congestion worsens air pollution" | Interval |
| 171 | EnvAwareness | Level of agreement to "I take into account of environmental impact to chose my mode of transport" | Interval |
| 172 | CO2Reduction | Level of agreement to "Reduction of green house emissions is my personal responsability" | Interval |
| 173 | PoliticsPressMe | Level of agreement to "I believe that politic has to press me to reduce environmental impact of my trips" | Interval |
| 174 | FamilyPressMe | Level of agreement to "I believe that my family has to press me to reduce environmental impact of my trips" | Interval |
| 175 | NoisePollution | Level of agreement to "Noise Pollution is a huge problem for Torino" | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 176 | AirPollution | Level of agreement to "Air Pollution is a huge problem for Torino" | Interval |
| 177 | Telepass | Level of agreement to "Telepass is fundamental for my trips" | Interval |
| 178 | FastGate | Level of agreement to "When I travel by airplane, I pay more to have fast access to the gate" | Interval |
| 179 | AvoidQueue | Level of agreement to "Pay musem on-line booking to avoid queue at entrance" | Interval |
| 180 | NotWaitPizza | Level of agreement to "Booking in advance pizza from take away to not wait" | Interval |
| 181 | NotWaitCommercials | Level of agreement to "During commercials, I change TV channel" | Interval |
| 182 | AspireQueue | Level of agreement to "In the supermarket I check the other queue to see if my choice is the most fast" | Interval |
| 183 | NotWaitBuses | Level of agreement to "While I am waiting bus, I usually walk towards next stops" | Interval |
| 184 | SetMyAlarm | Level of agreement to "Set my alarm at morning playing attention to minutes" | Interval |
| 185 | ReduceTimeDelivery | Level of agreement to "For on-line shopping, I am available to spend more to reduce time delivery" | Interval |
| 186 | FastWebConnection | Level of agreement to "I have the fast web connection on my house" | Interval |
| 187 | FastFood | Level of agreement to "When I eat outside home, I prefer fast food" | Interval |
| 188 | BestFare | Level of agreement to "I change supermarket to follow the best fare" | Interval |
| 189 | SalePurchase | Level of agreement to "I buy my clothes mainly during sale" | Interval |
| 190 | HolidayBooking | Level of agreement to "I book my holiday in function of the price (very in advance or last minute)" | Interval |
| 191 | TollRoad | Level of agreement to "When I travel by car, I avoid toll road" | Interval |
| 192 | GasolinePrice | Level of agreement to "I look for gas station with the best price" | Interval |
| 193 | BookingFollowsPrice | Level of agreement to "When I book hotel, I prefer to order proposals by price" | Interval |
| 194 | TechPurchase | Level of agreement to "I wait sale to buy my new tech gadgets" | Interval |
| 195 | PlanApplianceUse | Level of agreement to "I plan appliance use on the evening or in the weekend" | Interval |
| 196 | WellKnowBrand | Level of agreement to "I look for products of well-known brand" | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 197 | WorryWalkAlone | Level of agreement to "I am worried to walk alone in night" | Interval |
| 198 | FearPickpocketing | Level of agreement to "I fear to go out with a lot of money in the pocket" | Interval |
| 199 | CrimeNews | Level of agreement to "I follow constantly crime news" | Interval |
| 200 | TrainNight | Level of agreement to "At evening, I prefer travel on the first coach near to train manager" | Interval |
| 201 | TheftIncrease | Level of agreement to "I believe that thefts are increasing in the last year" | Interval |
| 202 | LockhomeDoor | Level of agreement to "I go out without locking home door" | Interval |
| 203 | EnsuranceNewCar | Level of agreement to "I believe necessary a theft and fire insurance for a new car in the first four years" | Interval |
| 204 | AntiTheftAlarm | Level of agreement to "I believe necessary an antitheft alarm in my house" | Interval |
| 205 | VideoSurveillance | Level of agreement to "I believe necessary a videosurveillance system" | Interval |
| 206 | SeatBelt | Level of agreement to "I fasten my seat belt on car" | Interval |
| 207 | SafetyHelmet | Level of agreement to "I wear helmet in moto" | Interval |
| 208 | SmartphoneOnFly | Level of agreement to "On the flight I respect rules about use of smartphone" | Interval |
| 209 | OvertakeCar | Level of agreement to "When I drive, I overtake only with intermitted strips" | Interval |
| 210 | SubwayStation | Level of agreement to "In rail station I use only subway to cross rails" | Interval |
| 211 | Music&Running | Level of agreement to "Walking/Running while I listen music" | Interval |
| 212 | HelmetBicicle | Level of agreement to "I wear safety helmet when I bycicle" | Interval |
| 213 | DomesticAccident | Level of agreement to "I believe necessary an insurance for domestic accidents" | Interval |
| 214 | TooTrafficBicicle | Level of agreement to "I avoid too traffic road when I bycicle" | Interval |
| 215 | EnjoyWalk | Level of agreement to "I enjoy to walk a strecth" | Interval |
| 216 | NoBusSeat | Level of agreement to "I annoy to not have a seat on bus" | Interval |
| 217 | TVBedroom | Level of agreement to "I believe necessary to have TV in bedroom" | Interval |
| 218 | HolidayInTent | Level of agreement to "I love holiday in tent" | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 219 | AirConditionHouse | Level of agreement to "I believe necessary to have air condition system in house" | Interval |
| 220 | CrowdedPT | Level of agreement to "I believe too crowded PT" | Interval |
| 221 | AllInclusiveHoliday | Level of agreement to "I book all-inclusive holiday" | Interval |
| 222 | StressInPT | Level of agreement to "Travelling by PT is more stressing and longer than by car" | Interval |
| 223 | AirConditionCar | Level of agreement to "In my car, I use air condition/heating during the trip" | Interval |
| 224 | ChangePTtoSaveTime | Level of agreement to "I prefer to change Bus/Train/Metro/tram to reach faster my destination" | Interval |
| 225 | OneTicketDesire | Level of agreement to "I pay more to have one integrated ticket among several MoT and Companies" | Interval |
| 226 | LeaveEarlyMorning | Level of agreement to "I prefer to travel for more time, but to leave more late in the morning" | Interval |
| 227 | AnnoyChangePT | Level of agreement to "I annoy to change bus/metro/train/tram during the trip" | Interval |
| 228 | AnnoyDifferentTickets | Level of agreement to "I annoy to have tickets different for each modes of transport (buses, train, bike sharing, etc.)" | Interval |
| 229 | LoadTicketsOnSmartphone | Level of agreement to "I wish loading all tickets on my smartphone" | Interval |
| 230 | Trust in future | Level of agreement to "I believe that in the future robots improve our life" | Interval |
| 231 | InterestNewGadgets | Level of agreement to "I like to test new technological gadgets" | Interval |
| 232 | InterestNewTech | Level of agreement to "I am interest to new technologies" | Interval |
| 233 | GPS | Level of agreement to "I am lost without GPS" | Interval |
| 234 | AppHelpMe | Level of agreement to "Apps help me everyday" | Interval |
| 235 | AppsAreFun | Level of agreement to "Some Apps are fun to use" | Interval |
| 236 | DownloadApp | Level of agreement to "I download new app to try" | Interval |
| 237 | BuyAV | Level of agreement to "I wish to buy a new autonomous vehicle" | Interval |
| 238 | TechIsUseless | Level of agreement to "I believe that majority of technological instruments are useless" | Interval |
| 239 | SmartphoneUpdate | Level of agreement to "I enjoy to have always my smartphone update" | Interval |

| Code | Name | Description | Type |
|---|---|---|---|
| 240 | VoiceCommands | Level of agreement to "I use voice commands to my smartphone" | Interval |
| 241 | TravelWithoutGPS | Level of agreement to "I prefer travel without using GPS" | Interval |
| 242 | GPSmakesLazy | Level of agreement to "Excessive use of navigators (eg car GPS or smartphone apps) makes people lazy to keep their brains active" | Interval |
| 243 | AppsForTrips | Level of agreement to "I already use apps during my trips" | Interval |

# Appendix 2 – Factor Scores among Clusters

Table 138: **Cluster Analysis on Adult 1Q.**

| Code | Cluster | Size | Factor 1<br>Mode Pleasure | Factor 2<br>Eco&Cheap Travel | Factor 3<br>Travel Pleasure | Factor 4<br>Improvement of onboard quality | Factor 5<br>Activities on A.V. | Factor 6<br>Driving aversion | Factor 7<br>Self Absorbed Activity and Feeling Safe | Factor 8<br>Willingnes to Carpool | Factor 9<br>Aware Consu-merism |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Car Addicts** | 886 | .56 | -.94 | .15 | .18 | .07 | -.29 | -.61 | .12 | .43 |
| 2 | **Malcontent Time Addicts** | 620 | -1.04 | .22 | .26 | -.03 | .18 | .33 | 1.06 | -.07 | .46 |
| 3 | **Timeservers** | 601 | -.13 | .09 | -.82 | -.08 | -.32 | .09 | .13 | -.37 | -1.38 |
| 4 | **Eco-Friendly Travel Pleasure Addicts** | 426 | .54 | 1.52 | .45 | -.06 | -.03 | -.05 | -.62 | .30 | .37 |
| | **Total** | 2,533 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Mean Squares Between** | | 361.6 | 600.1 | 183.4 | 10.8 | 28.1 | 49.0 | 399.0 | 45.5 | 497.7 |
| | **Mean Squares Within** | | 0.6 | 0.4 | 0.9 | 1.1 | 1.1 | 1.2 | 0.7 | 1.2 | 0.8 |
| | **D.F.-S** | | 3, 2529 | 3, 2529 | 3, 2529 | 3, 2529 | 3, 2529 | 3, 2529 | 3, 2529 | 3, 2529 | 3, 2529 |
| | **F-Ratio** | | 1,365.4 | 205.7 | 9.9 | 26.0 | 39.5 | 579.8 | 39.3 | 640.5 | 568.6 |
| | **P-value** | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Table 139: **Cluster Analysis on Stud 1Q.**

| Code | Cluster | Size | **Factor 1** Mode Pleasure | **Factor 2** Travel Pleasure | **Factor 3** Self Absorbed Activities | **Factor 4** Eco&Cheap Travel | **Factor 5** Driving aversion | **Factor 6** Improvement of onboard quality | **Factor 7** Willingness to Carpool | **Factor 8** Feeling safe | **Factor 9** Aware Consu-merism |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Car Addicts** | 245 | 1.05 | .17 | -.98 | -1.30 | -.31 | .18 | .03 | -.03 | -.65 |
| 2 | **Millennial PT Supporters** | 276 | -.08 | .16 | .73 | .11 | .02 | -.22 | .03 | 1.23 | .24 |
| 3 | **Timservers** | 305 | -.71 | -.85 | .61 | .08 | .13 | -.01 | -.36 | -.36 | -.86 |
| 4 | **Eco-Friendly Travel Pleasure Addicts** | 324 | .76 | .26 | -1.00 | 1.28 | .00 | -.13 | .28 | -.13 | -.01 |
| 5 | **Malcontent Time Addicts** | 297 | -.93 | .31 | .57 | -.47 | .10 | .23 | .02 | -.62 | 1.10 |
| | **Total** | 1,447 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Mean Squares Between** | | 217.0 | 71.9 | 229.9 | 254.6 | 7.8 | 10.6 | 16.8 | 143.6 | 176.6 |
| | **Mean Squares Within** | | 0.4 | 0.9 | 0.5 | 0.5 | 1.1 | 1.1 | 1.2 | 0.8 | 0.7 |
| | **D.F.-S** | | 4, 1442 | 4, 1442 | 4, 1442 | 4, 1442 | 4, 1442 | 4, 1442 | 4, 1442 | 4, 1442 | 4, 1442 |
| | **F-Ratio** | | 491.2 | 78.3 | 498.2 | 547.1 | 6.8 | 9.5 | 14.3 | 169.3 | 243.3 |
| | **P-value** | | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Table 140: **Cluster Analysis on Adult 1Q+2Q.**

| Code | Cluster | Size | **Factor 1** Mode Pleasure | **Factor 2** Interest for Tech Innovation and App Addiction | **Factor 3** Eco&Cheap Travel | **Factor 4** Travel Pleasure | **Factor 5** Improvement of onboard quality | **Factor 6** Willingnes to Carpool | **Factor 7** Self Absorbed Activities | **Factor 8** Activism pro-Environ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Car Addicts** | 263 | .79 | .09 | -.90 | -.09 | .23 | -.13 | -.41 | -.43 |
| 2 | **Malcontent Time Addicts** | 128 | -.07 | .14 | .12 | .46 | -.30 | .51 | -.08 | 2.07 |
| 3 | **Timeservers** | 249 | -1.10 | -.10 | .04 | -.47 | .08 | -.28 | .57 | -.45 |
| 4 | **Eco-Friendly Travel Pleasure Addicts** | 177 | .40 | -.11 | 1.21 | .48 | -.14 | .07 | -.26 | -.32 |
| | **Total** | 817 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Mean Squares Between** | | 165.1 | 3.2 | 157.5 | 41.4 | 10.0 | 18.7 | 45.7 | 222.0 |
| | **Mean Squares Within** | | 0.5 | 1.1 | 0.5 | 1.0 | 1.1 | 1.1 | 1.0 | 0.5 |
| | **D.F.-S** | | 3, 813 | 3, 813 | 3, 813 | 3, 813 | 3, 813 | 3, 813 | 3, 813 | 3, 813 |
| | **F-Ratio** | | 351.8 | 2.9 | 304.2 | 43.5 | 9.3 | 17.0 | 47.7 | 452.6 |
| | **P-value** | | 0.000 | 0.000 | 0.036 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

Table 141: **Cluster Analysis on Stud 1Q+2Q.**

| Cluster | Size | Factor 1<br>Mode Pleasure | Factor 2<br>Travel Pleasure | Factor 3<br>Worry for personal security | Factor 4<br>Driving aversion | Factor 5<br>Eco&Cheap Travel | Factor 6<br>Social Network Addiction | Factor 7<br>Interest for Tech Innovation | Factor 8<br>Improvement of onboard quality | Factor 9<br>Activism pro-Environ | Factor 10<br>Willingnes to Carpool |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Car Addicts** | 86 | 1.08 | .14 | .75 | .27 | -.43 | .01 | .37 | .20 | -.41 | .02 |
| **Malcontent Time Addicts** | 103 | -.85 | -.06 | 1.06 | .02 | -.24 | .05 | -.10 | .16 | -.34 | -.11 |
| **Eco-Friendly Travel Pleasure Addicts** | 97 | .64 | .47 | -.65 | -.10 | 1.15 | -.17 | -.26 | -.30 | -.11 | .12 |
| **Timservers** | 113 | -.68 | -.50 | -.87 | -.13 | -.43 | .07 | -.04 | -.18 | -.35 | -.12 |
| **Millennial PT Supporters** | 42 | .14 | .48 | -.46 | -.04 | -.19 | -.12 | .18 | .37 | 2.30 | .37 |
| **Total** | 441 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Mean Squares Between** | | 66.9 | 15.2 | 74.907 | 2.296 | 43.269 | .998 | 5.248 | 5.909 | 65.465 | 2.498 |
| **Mean Squares Within** | | 0.5 | 0.9 | .540 | 1.175 | .769 | 1.246 | .951 | 1.156 | .408 | 1.236 |
| **D.F.-S** | | 4, 436 | 4, 436 | 4, 436 | 4, 436 | 4, 436 | 4, 436 | 4, 436 | 4, 436 | 4, 436 | 4, 437 |
| **F-Ratio** | | 146.6 | 17.0 | 138.6 | 2.0 | 56.2 | 0.8 | 5.5 | 5.1 | 160.3 | 2.0 |
| **P-value** | | 0.000 | 0.000 | 0.000 | 0.101 | 0.000 | 0.525 | 0.000 | 0.000 | 0.000 | 0.091 |

# Appendix 3 – Attitudes and preferences of new profiles

Table 142: **Attitudes and preferences scores of new profiles from Adult Q1.**

| | | Car Addicts | | Malcontent Time Addicts | | Timeservers | | Eco-friendly Travel Pleasure Addicts | |
|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** |
| 27 | WtP_MoreSpeed | 9.8 | 21.6 | 12.5 | 22.6 | 9.9 | 21.9 | 3.3 | 7.3 |
| 28 | WtP_LessPollutant | 13.6 | 26.9 | 8.3 | 14.9 | 8.1 | 15.2 | 13.0 | 34.4 |
| 25 | DesiredReduction | 17.3 | 50.5 | 24.4 | 29.2 | 19.1 | 30.1 | 8.9 | 16.3 |
| 42 | Ignorance_BikeSharing | 21.9 | 53.4 | 17.4 | 53.4 | 25.5 | 58.8 | 9.7 | 39.1 |
| **43** | **Ignorance_CarSharing** | **3.0** | **7.6** | **3.0** | **7.7** | **3.5** | **8.3** | **2.2** | **6.3** |
| 40 | Ignorance_PT | 0.3 | 0.9 | 0.1 | 0.5 | 0.2 | 0.8 | 0.0 | 0.5 |
| 41 | Ignorance_Train | -35.7 | 27.7 | -34.2 | 26.3 | -35.3 | 27.8 | -30.6 | 25.3 |
| I.1 | Easy Parking | 4.9 | 1.1 | 3.9 | 1.1 | 4.3 | 1.2 | 3.9 | 1.3 |
| I.18 | AVActivities | 3.0 | 1.0 | 2.6 | 1.0 | 2.4 | 1.0 | 2.8 | 0.9 |
| I.2 | PT Service Increase | 5.1 | 0.8 | 5.0 | 0.8 | 4.9 | 0.9 | 4.9 | 0.9 |
| I.3 | PT Quality Improvement | 4.8 | 1.1 | 4.6 | 1.1 | 4.5 | 1.1 | 4.5 | 1.1 |
| 80 | WillignessMoreUsePT | 4.1 | 1.5 | 5.5 | 0.9 | 4.0 | 1.7 | 3.5 | 1.6 |
| I.4 | Will Use More Car | 3.4 | 1.0 | 3.3 | 0.9 | 3.2 | 0.9 | 3.0 | 0.9 |
| I.5 | Will Use More Soft | 3.3 | 0.9 | 3.3 | 1.0 | 3.1 | 0.9 | 3.4 | 1.0 |
| I.6 | Car Pooling | 2.6 | 1.1 | 2.6 | 1.1 | 2.1 | 0.8 | 2.9 | 1.2 |
| I.7 | Car Aversion | 3.1 | 0.9 | 3.6 | 1.0 | 3.3 | 0.9 | 3.4 | 0.9 |
| I.8 | Social Rule Compliance | 4.9 | 0.7 | 5.0 | 0.7 | 4.6 | 0.8 | 4.9 | 0.7 |
| I.9 | Idealism | 4.1 | 1.4 | 4.2 | 1.4 | 4.2 | 1.4 | 5.1 | 1.2 |
| I.10 | Charity | 3.0 | 1.1 | 3.1 | 1.1 | 4.2 | 1.0 | 3.1 | 1.1 |
| I.11 | Pro Environ | 3.1 | 1.1 | 3.1 | 1.0 | 2.6 | 1.0 | 3.4 | 1.1 |
| I.12 | Landscape | 3.3 | 1.1 | 3.4 | 1.0 | 3.3 | 1.1 | 4.4 | 1.2 |
| I.13 | Awarness Consumerism | 3.4 | 1.2 | 3.5 | 1.2 | 2.2 | 0.9 | 3.6 | 1.3 |
| I.14 | Re-Cycle | 5.8 | 0.6 | 5.8 | 0.6 | 5.5 | 0.9 | 5.8 | 0.6 |
| I.15 | Perceived Safety | 2.9 | 1.1 | 4.4 | 1.2 | 3.8 | 1.3 | 3.2 | 1.3 |
| I.16 | ProE-Ticket | 4.5 | 1.1 | 4.4 | 1.1 | 4.0 | 1.2 | 4.5 | 1.2 |
| I.17 | CarefulDiet | 3.5 | 0.4 | 3.6 | 0.4 | 3.3 | 0.4 | 3.7 | 0.4 |

Table 143: **Attitudes and preferences, significance of differences in Adult Q1.**

| | | Levene's Test | | Welch Test | | Brown-Forsythe Test | |
|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Statistic** | **Sign.** | **Statistic** | **Sign.** | **Statistic** | **Sign.** |
| 27 | WtP_MoreSpeed | 22.610 | .000 | 51.541 | .000 | 19.969 | .000 |
| 28 | WtP_LessPollutant | 12.490 | .000 | 11.540 | .000 | 9.747 | .000 |
| 25 | DesiredReduction | 3.437 | .016 | 45.713 | .000 | 19.231 | .000 |
| 42 | Ignorance_BikeSharing | 18.490 | .000 | 11.317 | .000 | 8.944 | .000 |
| **43** | **Ignorance_CarSharing** | **7.472** | **.000** | **2.725** | **.043** | **2.395** | **.067** |
| 40 | Ignorance_PT | 51.184 | .000 | 16.986 | .000 | 15.951 | .000 |
| 41 | Ignorance_Train | 5.442 | .001 | 4.020 | .007 | 3.783 | .010 |
| I.1 | Easy Parking | 14.509 | .000 | 148.789 | .000 | 131.874 | .000 |
| I.18 | AVActivities | 3.258 | .021 | 55.439 | .000 | 55.586 | .000 |
| I.2 | PT Service Increase | 4.048 | .007 | 14.268 | .000 | 14.027 | .000 |
| I.3 | PT Quality Improvement | 1.868 | .133 | 8.037 | .000 | 7.861 | .000 |
| 80 | WillignessMoreUsePT | 219.776 | .000 | 124.991 | .000 | 127.389 | .000 |
| I.4 | Will Use More Car | .027 | .994 | 10.627 | .000 | 10.646 | .000 |
| I.5 | Will Use More Soft | 6.281 | .000 | 8.213 | .000 | 7.951 | .000 |
| I.6 | Car Pooling | 25.574 | .000 | 72.823 | .000 | 59.549 | .000 |
| I.7 | Car Aversion | 3.019 | .029 | 35.644 | .000 | 35.934 | .000 |
| I.8 | Social Rule Compliance | 6.593 | .000 | 33.571 | .000 | 35.686 | .000 |
| I.9 | Idealism | 6.982 | .000 | 63.380 | .000 | 54.750 | .000 |
| I.10 | Charity | 7.917 | .000 | 226.145 | .000 | 200.207 | .000 |
| I.11 | Pro Envinron | 3.255 | .021 | 54.984 | .000 | 51.109 | .000 |
| I.12 | Landscape | 6.370 | .000 | 93.892 | .000 | 107.415 | .000 |
| I.13 | Awarness Consumerism | 27.501 | .000 | 273.629 | .000 | 197.246 | .000 |
| I.14 | Re-Cycle | 42.276 | .000 | 17.226 | .000 | 22.790 | .000 |
| I.15 | Perceived Safety | 15.724 | .000 | 224.072 | .000 | 196.337 | .000 |
| I.16 | ProE-Ticket | 3.302 | .020 | 28.270 | .000 | 29.881 | .000 |
| I.17 | CarefulDiet | 4.037 | .007 | 129.954 | .000 | 125.572 | .000 |

Table 144: **Attitudes and preferences scores of new profiles from Stud Q1.**

| | | Car Addicts | | PT Supporters | | Timservers | | Eco-Friendly Travel Pleasure Addicts | | Malcontent Time Addicts | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** |
| 27 | WtP_MoreSpeed | 9.6 | 18.0 | 7.2 | 12.2 | 6.1 | 8.8 | 1.8 | 5.6 | 11.5 | 17.7 |
| 28 | WtP_LessPollutant | 12.0 | 16.9 | 7.0 | 8.9 | 5.9 | 12.0 | 5.3 | 10.7 | 9.1 | 14.4 |
| 25 | DesiredReduction | 16.1 | 24.6 | 20.3 | 21.9 | 19.2 | 39.3 | 8.3 | 41.9 | 35.6 | 68.6 |
| 42 | Ignorance_BikeSharing | 31.3 | 58.0 | 20.9 | 52.6 | 28.0 | 58.4 | 7.1 | 32.3 | 24.6 | 53.9 |
| **43** | **Ignorance_CarSharing** | **2.9** | **7.3** | **2.3** | **6.3** | **2.1** | **5.9** | **1.7** | **5.5** | **3.1** | **7.8** |
| 40 | Ignorance_PT | 0.4 | 1.0 | 0.2 | 0.6 | 0.2 | 0.6 | 0.1 | 0.4 | 0.3 | 0.8 |
| 41 | Ignorance_Train | -34.4 | 24.7 | -29.9 | 24.1 | -33.6 | 23.9 | -28.9 | 22.8 | -40.0 | 24.8 |
| I.1 | Easy Parking | 4.7 | 1.1 | 3.7 | 1.1 | 3.7 | 1.0 | 3.6 | 1.2 | 3.7 | 1.1 |
| I.18 | AVActivities | 3.4 | 1.0 | 3.0 | 1.0 | 2.7 | 1.0 | 2.9 | 1.0 | 2.9 | 1.1 |
| I.2 | PT Service Increase | 5.0 | 0.8 | 4.6 | 0.9 | 4.8 | 0.9 | 4.6 | 1.0 | 5.2 | 0.8 |
| I.3 | PT Quality Improvement | 4.6 | 1.1 | 4.1 | 1.1 | 4.4 | 1.2 | 4.2 | 1.1 | 4.6 | 1.1 |
| 80 | WillignessMoreUsePT | 4.3 | 1.5 | 5.2 | 1.1 | 4.7 | 1.3 | 3.5 | 1.6 | 5.2 | 1.0 |
| I.4 | Will Use More Car | 3.8 | 1.1 | 3.6 | 1.1 | 3.8 | 1.1 | 3.1 | 1.2 | 3.9 | 1.1 |
| I.5 | Will Use More Soft | 3.3 | 1.2 | 3.6 | 1.2 | 3.3 | 1.2 | 3.5 | 1.1 | 3.5 | 1.4 |
| I.6 | Car Pooling | 2.7 | 1.0 | 2.9 | 1.0 | 2.5 | 0.8 | 3.1 | 1.1 | 2.9 | 1.0 |
| I.7 | Car Aversion | 3.0 | 0.9 | 3.4 | 0.9 | 3.4 | 0.9 | 3.4 | 0.8 | 3.4 | 0.9 |
| I.8 | Social Rule Compliance | 4.5 | 0.6 | 4.8 | 0.6 | 4.5 | 0.6 | 4.6 | 0.7 | 4.8 | 0.6 |
| I.9 | Idealism | 4.0 | 1.3 | 3.5 | 1.3 | 3.3 | 1.2 | 4.4 | 1.2 | 3.4 | 1.3 |
| I.10 | Charity | 3.9 | 1.1 | 3.9 | 1.1 | 4.6 | 0.8 | 4.1 | 1.0 | 3.6 | 1.0 |
| I.11 | Pro Envinron | 2.5 | 1.0 | 2.7 | 0.9 | 2.1 | 0.7 | 2.7 | 0.9 | 2.7 | 1.0 |
| I.12 | Landscape | 3.7 | 1.1 | 3.7 | 0.9 | 3.2 | 0.9 | 4.3 | 1.0 | 3.4 | 1.0 |
| I.13 | Awarness Consumerism | 3.1 | 1.2 | 3.3 | 1.1 | 2.7 | 1.0 | 3.4 | 1.1 | 3.7 | 1.1 |
| I.14 | Re-Cycle | 5.5 | 0.8 | 5.6 | 0.8 | 5.3 | 1.0 | 5.6 | 0.8 | 5.7 | 0.6 |
| I.15 | Perceived Safety | 2.9 | 0.9 | 4.8 | 0.7 | 3.3 | 1.0 | 3.3 | 1.2 | 3.0 | 1.0 |
| I.16 | ProE-Ticket | 4.3 | 1.1 | 4.1 | 1.1 | 3.9 | 1.2 | 4.4 | 1.1 | 4.1 | 1.0 |
| I.17 | CarefulDiet | 3.4 | 0.4 | 3.6 | 0.4 | 3.3 | 0.4 | 3.6 | 0.4 | 3.6 | 0.4 |

Table 145: **Attitudes and preferences, significance of differences in Stud Q1.**

| | | Levene's Test | | Welch Test | | Brown-Forsythe Test | |
|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Statistic** | **Sign.** | **Statistic** | **Sign.** | **Statistic** | **Sign.** |
| 27 | WtP_MoreSpeed | 34.993 | .000 | 22.693 | .000 | 9.083 | .000 |
| 28 | WtP_LessPollutant | 6.708 | .000 | 3.575 | .008 | 3.287 | .013 |
| 25 | DesiredReduction | 10.086 | .000 | 10.413 | .000 | 16.668 | .000 |
| 42 | Ignorance_BikeSharing | 23.235 | .000 | 15.825 | .000 | 9.801 | .000 |
| **43** | **Ignorance_CarSharing** | **5.732** | **.000** | **2.208** | **.067** | **2.206** | **.066** |
| 40 | Ignorance_PT | 26.899 | .000 | 8.068 | .000 | 8.141 | .000 |
| 41 | Ignorance_Train | 1.485 | .204 | 9.984 | .000 | 10.054 | .000 |
| I.1 | Easy Parking | 4.064 | .003 | 46.793 | .000 | 46.863 | .000 |
| I.18 | AVActivities | 1.757 | .135 | 15.629 | .000 | 14.545 | .000 |
| I.2 | PT Service Increase | 5.256 | .000 | 29.790 | .000 | 26.975 | .000 |
| I.3 | PT Quality Improvement | 105.472 | .000 | 73.158 | .000 | 57.337 | .000 |
| 80 | WillignessMoreUsePT | 3.359 | .010 | 24.883 | .000 | 28.460 | .000 |
| I.4 | Will Use More Car | 4.140 | .002 | 4.850 | .001 | 4.746 | .001 |
| I.5 | Will Use More Soft | 5.778 | .000 | 15.440 | .000 | 13.762 | .000 |
| I.6 | Car Pooling | 1.132 | .340 | 10.967 | .000 | 11.444 | .000 |
| I.7 | Car Aversion | 1.076 | .367 | 13.538 | .000 | 13.389 | .000 |
| I.8 | Social Rule Compliance | 2.028 | .088 | 48.106 | .000 | 44.264 | .000 |
| I.9 | Idealism | 6.255 | .000 | 46.051 | .000 | 36.417 | .000 |
| I.10 | Charity | 5.138 | .000 | 27.886 | .000 | 21.730 | .000 |
| I.11 | Pro Envinron | 2.196 | .067 | 58.021 | .000 | 55.608 | .000 |
| I.12 | Landscape | 15.186 | .000 | 273.477 | .000 | 178.351 | .000 |
| I.13 | Awarness Consumerism | 1.188 | .314 | 8.203 | .000 | 8.529 | .000 |
| I.14 | Re-Cycle | 1.211 | .304 | 41.675 | .000 | 39.031 | .000 |
| I.15 | Perceived Safety | 34.993 | .000 | 22.693 | .000 | 9.083 | .000 |
| I.16 | ProE-Ticket | 6.708 | .000 | 3.575 | .008 | 3.287 | .013 |
| I.17 | CarefulDiet | 10.086 | .000 | 10.413 | .000 | 16.668 | .000 |

Table 146: **Attitudes and preferences scores of new profiles from Adult Q1+Q2.**

| | | Car Addicts | | Malcontent Time Addicts | | Timeservers | | Eco-friendly Travel Pleasure Addicts | |
|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** |
| I.19 | Comfort | 3.0 | 0.9 | 2.7 | 0.9 | 3.1 | 0.9 | 2.6 | 0.9 |
| I.20 | App Addiction | 3.2 | 1.0 | 3.5 | 1.1 | 3.5 | 1.1 | 3.2 | 1.1 |
| I.21 | Security | 3.7 | 1.1 | 3.2 | 1.1 | 3.7 | 0.9 | 3.3 | 1.0 |
| **I.22** | **Cost sensibility** | **4.0** | **0.9** | **3.9** | **0.9** | **4.1** | **0.9** | **4.0** | **0.8** |
| I.23 | Alternative Routes | 2.3 | 1.0 | 2.4 | 1.1 | 2.0 | 0.9 | 2.3 | 0.9 |
| I.24 | Trust on Law | 4.1 | 0.9 | 4.7 | 0.7 | 3.9 | 0.9 | 4.4 | 0.8 |
| I.25 | Awareness of Env problem | 5.5 | 0.7 | 5.7 | 0.6 | 5.5 | 0.8 | 5.7 | 0.6 |
| I.26 | Speed research | 2.8 | 1.1 | 3.0 | 1.1 | 3.1 | 1.1 | 2.8 | 1.1 |
| I.27 | Stress on PT | 3.7 | 1.0 | 3.4 | 1.0 | 3.8 | 1.0 | 3.1 | 1.0 |
| **I.28** | **GPS Feeling** | **3.3** | **1.2** | **3.1** | **1.3** | **3.3** | **1.3** | **3.0** | **1.3** |
| **I.29** | **Tech Innovation** | **3.6** | **1.2** | **3.8** | **1.3** | **3.7** | **1.2** | **3.6** | **1.2** |
| I.30 | Security On Board | 2.9 | 0.9 | 3.6 | 1.1 | 4.8 | 0.9 | 3.6 | 1.0 |

Table 147: **Attitudes and preferences, significance of differences in Adult Q1+Q2.**

| | | Levene's Test | | Welch Test | | Brown-Forsythe Test | |
|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Statistic** | **Sign.** | **Statistic** | **Sign.** | **Statistic** | **Sign.** |
| I.19 | Comfort | .711 | .546 | 15.939 | .000 | 15.763 | .000 |
| I.20 | App Addiction | .522 | .667 | 4.752 | .003 | 4.767 | .003 |
| I.21 | Security | 1.498 | .214 | 13.272 | .000 | 13.454 | .000 |
| **I.22** | **Cost sensibility** | **.728** | **.536** | **1.397** | **.243** | **1.398** | **.242** |
| I.23 | Alternative Routes | 3.738 | .011 | 7.805 | .000 | 7.170 | .000 |
| I.24 | Trust on Law | 1.850 | .137 | 32.424 | .000 | 30.316 | .000 |
| I.25 | Awareness of Env problem | 7.423 | .000 | 8.641 | .000 | 8.313 | .000 |
| I.26 | Speed research | .311 | .818 | 5.605 | .001 | 5.550 | .001 |
| I.27 | Stress on PT | 1.185 | .314 | 19.151 | .000 | 17.868 | .000 |
| **I.28** | **GPS Feeling** | **2.018** | **.110** | **2.030** | **.109** | **2.026** | **.109** |
| **I.29** | **Tech Innovation** | **1.108** | **.345** | **1.521** | **.208** | **1.544** | **.202** |
| I.30 | Security On Board | 2.500 | .058 | 171.164 | .000 | 153.388 | .000 |

Table 148: **Attitudes and preferences scores of new profiles from Stud Q1+Q2.**

| | | Car Addicts | | PT Supporters | | Timservers | | Eco-Friendly Travel Pleasure Addicts | | Malcontent Time Addicts | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** |
| I.19 | Comfort | 3.4 | 0.7 | 3.4 | 0.7 | 2.4 | 0.7 | 2.3 | 0.6 | 2.5 | 0.7 |
| I.20 | App Addiction | 4.0 | 1.0 | 3.7 | 1.0 | 3.3 | 1.1 | 3.5 | 1.0 | 3.5 | 1.0 |
| I.21 | Security | 3.9 | 0.9 | 4.0 | 0.9 | 3.1 | 0.9 | 3.3 | 0.8 | 3.3 | 0.9 |
| I.22 | Cost sensibility | 4.2 | 0.8 | 4.3 | 0.8 | 4.0 | 0.9 | 4.1 | 0.8 | 4.1 | 0.8 |
| I.23 | Alternative Routes | 2.2 | 0.9 | 2.4 | 0.9 | 2.4 | 1.0 | 2.4 | 1.0 | 2.7 | 1.1 |
| I.24 | Trust on Law | 4.0 | 0.9 | 3.9 | 0.9 | 4.4 | 0.8 | 4.1 | 0.7 | 4.8 | 0.7 |
| I.25 | Awareness of Env problem | 5.4 | 0.8 | 5.3 | 0.8 | 5.6 | 0.6 | 5.5 | 0.7 | 5.7 | 0.5 |
| I.26 | Speed research | 3.1 | 1.0 | 3.1 | 1.0 | 2.7 | 1.0 | 2.7 | 0.9 | 2.8 | 1.0 |
| I.27 | Stress on PT | 3.9 | 1.0 | 3.9 | 1.0 | 3.2 | 0.8 | 3.7 | 1.0 | 3.5 | 0.9 |
| I.28 | GPS Feeling | 3.8 | 1.3 | 3.9 | 1.2 | 3.2 | 1.2 | 3.7 | 1.1 | 3.4 | 1.3 |
| I.29 | Tech Innovation | 4.1 | 1.2 | 3.6 | 1.2 | 3.4 | 1.1 | 3.7 | 1.2 | 3.9 | 1.1 |
| I.30 | Security On Board | 4.5 | 1.0 | 3.0 | 0.9 | 3.7 | 0.9 | 3.2 | 0.9 | 3.6 | 1.2 |

Table 149: **Attitudes and preferences, significance of differences in Stud Q1+Q2.**

| | | Levene's Test | | Welch Test | | Brown-Forsythe Test | |
|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Statistic** | **Sign.** | **Statistic** | **Sign.** | **Statistic** | **Sign.** |
| I.19 | Comfort | 1.427 | .224 | 56.871 | .000 | 56.610 | .000 |
| I.20 | App Addiction | .461 | .765 | 6.056 | .000 | 6.251 | .000 |
| I.21 | Security | .489 | .744 | 17.153 | .000 | 17.610 | .000 |
| I.22 | Cost sensibility | .064 | .992 | 2.472 | .046 | 2.486 | .043 |
| I.23 | Alternative Routes | .291 | .884 | 2.440 | .049 | 2.560 | .039 |
| I.24 | Trust on Law | 1.450 | .217 | 15.071 | .000 | 14.395 | .000 |
| I.25 | Awareness of Env problem | 3.298 | .011 | 3.899 | .005 | 3.737 | .005 |
| I.26 | Speed research | 1.459 | .214 | 4.438 | .002 | 4.423 | .002 |
| I.27 | Stress on PT | 1.722 | .144 | 8.867 | .000 | 7.768 | .000 |
| I.28 | GPS Feeling | 2.064 | .085 | 4.635 | .001 | 4.738 | .001 |
| I.29 | Tech Innovation | .184 | .947 | 4.919 | .001 | 4.814 | .001 |
| I.30 | Security On Board | 2.342 | .054 | 34.284 | .000 | 32.574 | .000 |

# Appendix 4 – Current mobility of new profiles

Table 150: **Mobility of new profiles from Adult Q1.**

| | | Car Addicts | | Malcontent Time Addicts | | Timeservers | | Eco-friendly Travel Pleasure Addicts | |
|---|---|---|---|---|---|---|---|---|---|
| **Code** | **Variable Name** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** | **Mean** | **Std Dev** |
| 6 | Distance | 31.3 | 52.1 | 21.5 | 25.2 | 17.8 | 23.7 | 9.5 | 83.7 |
| 12 | TravelTime | 50.8 | 39.6 | 53.0 | 34.8 | 48.8 | 32.5 | 22.0 | 21.3 |
| 26 | MonthlyCost | 68.9 | 54.2 | 46.4 | 42.5 | 36.2 | 33.3 | 6.0 | 15.6 |
| 245 | CarUse_TripImpo | 3.0 | 2.5 | 0.1 | 0.4 | 0.2 | 0.7 | 0.3 | 1.2 |
| 246 | PTUse_TripImpo | 1.9 | 2.4 | 5.0 | 1.4 | 4.7 | 1.6 | 1.3 | 2.2 |
| 247 | SoftModesUse_TripImpo | 0.1 | 0.7 | 0.2 | 0.7 | 0.3 | 0.9 | 3.7 | 2.5 |
| 5 | TripPerWeek | 13.1 | 5.5 | 11.9 | 4.3 | 11.3 | 4.6 | 12.8 | 4.7 |
| 248 | CarUse_Week | 6.2 | 4.7 | 2.7 | 3.1 | 2.6 | 3.3 | 1.7 | 2.7 |
| 249 | PTUse_Week | 0.9 | 1.7 | 2.3 | 3.1 | 2.4 | 3.1 | 1.7 | 2.3 |
| 250 | SoftModesUse_Week | 0.9 | 2.1 | 1.6 | 2.0 | 1.2 | 1.8 | 4.1 | 3.5 |
| / | % use of favourite MoT | 72% | 26% | 62% | 22% | 64% | 24% | 72% | 22% |
| / | % of frequency of most impo trip over week mobility | 41% | 14% | 49% | 16% | 50% | 17% | 45% | 13% |
| 9 | SustIndexMode_MostImpoTrip | 3.5 | 2.3 | 1.2 | 1.0 | 1.2 | 1.1 | 0.5 | 1.3 |
| 8 | SustIndexMode_Week | 10.4 | 5.2 | 5.7 | 3.1 | 5.5 | 3.4 | 3.1 | 3.5 |

Table 151: **Current Mobility, significance of differences in Adult Q1.**

| Code | Variable Name | Levene's Test | | Welch Test | | Brown-Forsythe Test | |
|---|---|---|---|---|---|---|---|
| | | **Statistic** | **Sign.** | **Statistic** | **Sign.** | **Statistic** | **Sign.** |
| 6 | Distance | 8.018 | .000 | 12.035 | .000 | 12.379 | .000 |
| 12 | TravelTime | 18.988 | .000 | 112.689 | .000 | 118.502 | .000 |
| 26 | MonthlyCost | 84.847 | .000 | 249.013 | .000 | 174.777 | .000 |
| 245 | CarUse_TripImpo | 348.769 | .000 | 1134.592 | .000 | 830.755 | .000 |
| 246 | PTUse_TripImpo | 276.059 | .000 | 1147.467 | .000 | 655.978 | .000 |
| 247 | SoftModesUse_TripImpo | 745.324 | .000 | 249.822 | .000 | 509.672 | .000 |
| 5 | TripPerWeek | .733 | .532 | 8.564 | .000 | 8.938 | .000 |
| 248 | CarUse_Week | 34.413 | .000 | 101.956 | .000 | 122.332 | .000 |
| 249 | PTUse_Week | 57.586 | .000 | 52.184 | .000 | 55.444 | .000 |
| 250 | SoftModesUse_Week | 103.709 | .000 | 71.924 | .000 | 112.673 | .000 |
| / | % use of favourite MoT | 14.179 | .000 | 104.438 | .000 | 99.057 | .000 |
| / | % of frequency of most impo trip over week mobility | 5.694 | .001 | 13.363 | .000 | 13.549 | .000 |
| 9 | SustIndexMode_MostImpoTrip | 24.187 | .000 | 240.771 | .000 | 266.792 | .000 |
| 8 | SustIndexMode_Week | 106.810 | .000 | 689.028 | .000 | 630.365 | .000 |

Table 152: **Mobility of new profiles from Stud Q1.**

| Code | Variable Name | Car Addicts | | PT Supporters | | Timservers | | Eco-Friendly Travel Pleasure Addicts | | Malcontent Time Addicts | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Std Dev | Mean | Std Dev | Mean | Std Dev | Mean | Std Dev | Mean | Std Dev |
| 6 | Distance | 31.3 | 52.1 | 21.5 | 25.2 | 17.8 | 23.7 | 9.5 | 83.7 | 36.4 | 37.0 |
| 12 | TravelTime | 50.8 | 39.6 | 53.0 | 34.8 | 48.8 | 32.5 | 22.0 | 21.3 | 75.0 | 47.8 |
| 26 | MonthlyCost | 68.9 | 54.2 | 46.4 | 42.5 | 36.2 | 33.3 | 6.0 | 15.6 | 69.8 | 46.1 |
| 245 | CarUse_TripImpo | 3.0 | 2.5 | 0.1 | 0.4 | 0.2 | 0.7 | 0.3 | 1.2 | 0.2 | 0.6 |
| 246 | PTUse_TripImpo | 1.9 | 2.4 | 5.0 | 1.4 | 4.7 | 1.6 | 1.3 | 2.2 | 4.9 | 1.5 |
| 247 | SoftModesUse_TripImpo | 0.1 | 0.7 | 0.2 | 0.7 | 0.3 | 0.9 | 3.7 | 2.5 | 0.1 | 0.6 |
| 5 | TripPerWeek | 13.1 | 5.5 | 11.9 | 4.3 | 11.3 | 4.6 | 12.8 | 4.7 | 13.0 | 6.1 |
| 248 | CarUse_Week | 6.2 | 4.7 | 2.7 | 3.1 | 2.6 | 3.3 | 1.7 | 2.7 | 3.8 | 4.0 |
| 249 | PTUse_Week | 0.9 | 1.7 | 2.3 | 3.1 | 2.4 | 3.1 | 1.7 | 2.3 | 2.6 | 4.1 |
| 250 | SoftModesUse_Week | 0.9 | 2.1 | 1.6 | 2.0 | 1.2 | 1.8 | 4.1 | 3.5 | 1.4 | 2.4 |
| / | % use of favourite MoT | 72% | 26% | 62% | 22% | 64% | 24% | 72% | 22% | 59% | 23% |
| / | % of frequency of most impo trip over week mobility | 41% | 14% | 49% | 16% | 50% | 17% | 45% | 13% | 46% | 19% |
| 9 | SustIndexMode_MostImpoTrip | 3.5 | 2.3 | 1.2 | 1.0 | 1.2 | 1.1 | 0.5 | 1.3 | 1.0 | 1.1 |
| 8 | SustIndexMode_Week | 10.4 | 5.2 | 5.7 | 3.1 | 5.5 | 3.4 | 3.1 | 3.5 | 7.2 | 4.3 |

Table 153: **Current Mobility, significance of differences in Stud Q1.**

| Code | Variable Name | Levene's Test Statistic | Levene's Test Sign. | Welch Test Statistic | Welch Test Sign. | Brown-Forsythe Test Statistic | Brown-Forsythe Test Sign. |
|---|---|---|---|---|---|---|---|
| 6 | Distance | 4.734 | .001 | 17.349 | .000 | 14.200 | .000 |
| 12 | TravelTime | 37.703 | .000 | 115.727 | .000 | 82.735 | .000 |
| 26 | MonthlyCost | 83.833 | .000 | 246.158 | .000 | 126.039 | .000 |
| 245 | CarUse_TripImpo | 308.540 | .000 | 81.703 | .000 | 227.259 | .000 |
| 246 | PTUse_TripImpo | 48.741 | .000 | 252.155 | .000 | 286.123 | .000 |
| 247 | SoftModesUse_TripImpo | 308.342 | .000 | 157.194 | .000 | 472.333 | .000 |
| 5 | TripPerWeek | 4.647 | .001 | 7.018 | .000 | 6.631 | .000 |
| 248 | CarUse_Week | 15.603 | .000 | 52.972 | .000 | 63.454 | .000 |
| 249 | PTUse_Week | 19.318 | .000 | 21.995 | .000 | 13.434 | .000 |
| 250 | SoftModesUse_Week | 34.015 | .000 | 50.711 | .000 | 85.439 | .000 |
| / | % use of favourite MoT | 8.874 | .000 | 12.569 | .000 | 11.495 | .000 |
| / | % of frequency of most impo trip over week mobility | 5.168 | .000 | 19.288 | .000 | 18.876 | .000 |
| 9 | SustIndexMode_MostImpoTrip | 11.853 | .000 | 101.147 | .000 | 122.574 | .000 |
| 8 | SustIndexMode_Week | 102.530 | .000 | 81.498 | .000 | 157.685 | .000 |