



## Impact and assessment of “Free” Public Transport measures: lessons from the case study of Brussels

Cathy Macharis <sup>1\*</sup>, Astrid De Witte <sup>1</sup>, Thérèse Steenberghen <sup>2</sup>  
Stefaan Van de Walle <sup>2</sup>, Pierre Lannoy <sup>3</sup>, Céline Polain <sup>3</sup>

<sup>1</sup> *Vrije universiteit Brussel  
Brussels, Belgium*

<sup>2</sup> *Katholieke Universiteit Leuven  
Leuven, Belgium, Leuven, Belgium*

<sup>3</sup> *Université Catholique de Louvain  
Louvain-la-Neuve, Belgium*

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### Abstract

The objective of the paper is to examine and to assess the effects of the introduction of a third payer system on the mobility behaviour from a multidisciplinary viewpoint. This approach allows an analysis of various effects that free public transport and, in general, price policies can entail. The concept of the “third payer system” implies that the cost of public transport is not paid by the user or provider, but partially or completely by a third party. Local authorities, other public organisations and private organisations can enter into such agreements and pay for public transport for a specific target group in a specific area. The analysis has been performed through a case study, namely the introduction of free urban public transport for students at Dutch-speaking universities and colleges in Brussels. In how far this measure contributes to a more sustainable mobility system has caused much debate. Also, not everyone is convinced that such a measure is beneficial for the society. Some people argue that there are better ways to spend the money, for instance on the quality of public transport. In order to assess whether this measure has societal benefits, a social cost-benefit analysis (SCBA) has been carried out. This analysis calculates the benefits and costs of the measure, in order to find out if the balance is positive or negative.

*Keywords:* Public transport; Mobility behaviour; Social cost-benefit analysis.

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### 1. Introduction

Public transport subsidies play an important role in the present Belgian mobility policy. The introduction of “free” bus transport in Hasselt in 1997 was an important event. Over the years, more “free” public transport initiatives were taken. Since 2000,

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\* Corresponding author: Cathy Macharis (Cathy.Macharis@vub.ac.be)

seniors (65+) and children (-12) can benefit from the third payer system on the Flemish network. Later, it was also introduced in Brussels for seniors in January 2003. From July 2004 onwards, federal employees of federal administrations and autonomous public organisations are refunded for their train and Brussels' public transport season ticket. Since March 2005, people with minimum wages have also been benefiting from this measure.

## **2. The case study of Brussels**

A "free" public transport initiative started in Brussels in the 2003-2004 academic year for students at Dutch-speaking colleges and universities. The "free" public transport ticket is only valid on the public transport modes (tram, bus and metro) operated by the Brussels Public Transport Company (STIB). The public transport lines of the STIB cover the entire Brussels Capital Region. In order to benefit from the measure students need to be younger than 25 years (except for medical students) and need to be registered for a first degree – in other words – a first registration. The Flemish Government ("Vlaamse Gemeenschapscommissie") took the initiative for the measure. The "Brusselsfonds" (Brussels fund) of the Flemish Government invested 1,2 million Euros in the project.

At the start of the 2003-2004 academic year, an administrative fee of € 10 was asked. The next academic year, this fee was raised to € 25. During the first year more than 8.000 students applied for a "free" public transport ticket. The second year 5.100 students applied for the card. The third year the administrative fee of € 25 was retained but students got refunded immediately, resulting in a higher subscription rate.

The main objective is to help students discovering Brussels by promoting their mobility. Other objectives are promoting subscriptions at Dutch-speaking institutions in Brussels, stimulating students to participate at various activities in Brussels, convincing Flemish students to come and live in Brussels and improving the city's image among students and subsequently the entire Flemish population. The measure is also intended to contribute to a sustainable mobility by improving the image of public transport, inducing habit forming and ensuring access to mobility.

## **3. Theoretical base**

Theories of mode choice are diverse. A broad distinction can be made between a rationalist approach, a psychological approach and a socio-geographical approach. An attempt to integration was made by Kaufmann. Kaufmann (2002) analyses mobility as a broad phenomenon, in which making trips depends on the fulfilment of several factors, considered as potential factors allowing understanding why a particular journey has or hasn't been undertaken. These factors constitute the individual's "motility", i.e. the travel potential of an individual. The factors included in an individual's motility can be grouped into three types: access, skills and appropriation (Figure 1).

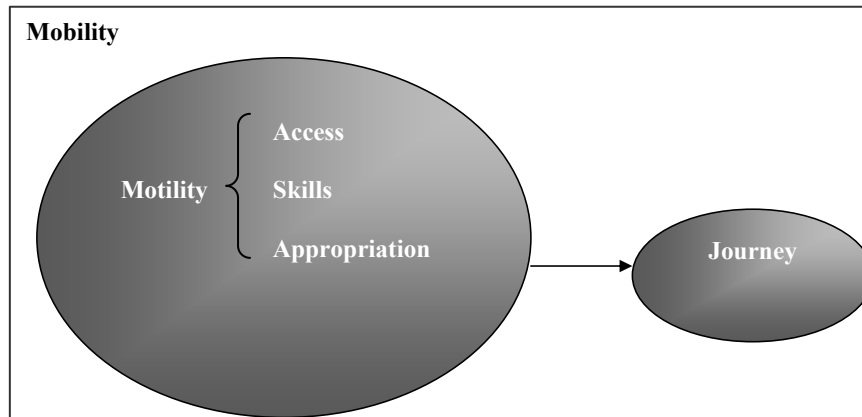


Figure 1: Mobility and motility concept (Kaufmann, 2002).

This analysis grid has the advantage not to focus on one explanatory factor of travel behaviour. In this research the analysis was focused on the factors listed in Table 1.

Table 1: Motility scheme of Kaufmann, with factors analysed in this research.

<i>Access</i>	<i>Skills</i>	<i>Appropriation</i>
Modes' availability	Knowledge of the city	City image
Residential situation		Perception public transport and car
Price	Activity patterns	Values
Supply		Habits

There is a wide range of factors that influence the demand for public transport. There is plenty of empirical evidence as to what the relevant factors are, and which of them may be more important than others, in different circumstances (Balcombe et al., 2004). The motility concept groups them into three main categories.

### 3.1 Access

Access factors are linked to the disposal of different “options”, or means of travel. Access is “conditioned” by the location and accessibility of the various origins and destination points to transportation networks (Flamm, 2004). Also, the price and schedule offered by transportation networks and the budget and time available for users are access factors. The supply of transport comprises the availability of personal travel means and of loyalties to public travel modes, as well as the quality of the travel networks.

Prices of travel modes and consequently the budget that has to be spent for travel, is difficult to assess at a theoretical level (Frenay, 1994; Flamm, 2004). The price of transport services consists of several components. Empirical research confirms that consumers are sensitive for changes in price/costs, but the extent depends on several

factors, like the purpose of the trip (Dijst & Van Wee, 2002; Balcombe et al., 2004) and the time horizon (Button, 1993). Studies also indicate that the cost of transport, assessed by individuals, is often biased: car costs are minimized compared to the price of public transport (Hine & Scott, 2000; Frenay, 1994).

### 3.2 Skills

Individuals develop skills relative to mobility and to different travel means. These skills can be physical, acquired or organizational. Acquired skills are linked to the knowledge people have developed of the various means of travel at their disposal and of the space in which mobility takes place. Skills may also result from organizational abilities developed by an individual with regard to time and space arrangements and budget management. An example is the ability to collect and use travel information.

#### 3.2.1 The Activity Space

In order to grasp time and space skills of the students we have used the activity space concept. The concept was developed in the late 1960s and aims to represent the space which contains the places frequented by an individual over a period of time. An activity space can be defined as a two-dimensional form which is constituted by the spatial distribution of those locations a traveller has personal experience with (Figure 2) (Schönfelder & Axhausen, 2002). Mental maps are defined in a broader sense and comprise also those locations of which a person has second hand experience.

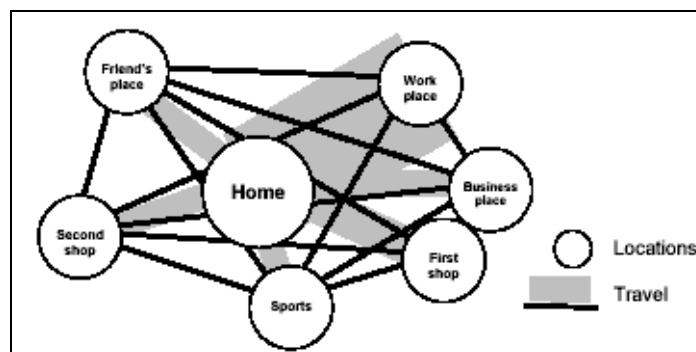


Figure 2: Representation of the activity space (Schönfelder & Axhausen, 2003).

#### 3.2.2 Mental maps

In order to grasp knowledge (skills) and appreciation (appropriation) of the city by students the concept of “mental maps” was used. This concept was developed in the 1960s by Lynch (1960) within the behaviourist movement. Behaviourism no longer considered people as objective units but as individuals who receive environmental messages and process information individually, resulting in a transformed mental image

of the spatial environment. The image of the environment consists of a transformation of distances, times, areas, a selective knowledge of points, lines and surfaces and an appreciation of connections, modes etc. (Figure 3) (Golledge & Stimson, 1997; Gould & White, 1986). A broad definition of mental maps comes from Downs and Stea (1973), who defined a mental map as the organized representation by a person of a part of his spatial environment. A history of the research in spatial cognition can be found in Mark et al. (1999) and Foreman and Gillet (1997).

Mental maps are currently embedded in the research field of spatial cognition, which studies the knowledge, experience and perception of the environment. It is a research area in the periphery of various disciplines, notably geography, urban planning, psychology and computer science.

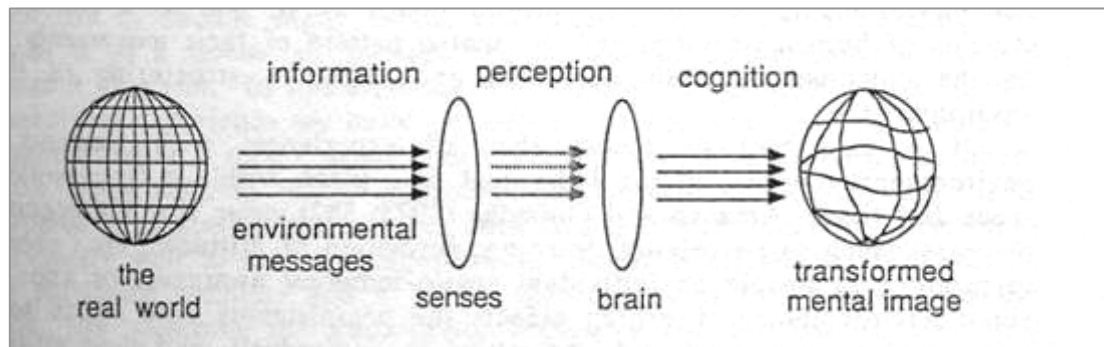


Figure 3 The formation of images (Golledge & Stimson, 1997)

The notion that people's everyday spatial behaviour is based on the world as they believe it to be is central in understanding mental maps. This implies a mutual relation between a person's mental map and his mobility behaviour. People use their mental map of an area to estimate the distance, travel time and to appreciate the different travel modes. Trip decisions are wholly or partially based on the information stored in their mental map. Conversely, the mode someone uses influences the notion of the spatial environment a person has, since people observe the environment during their trip and new elements from the environment are ordered and related to each other (Van Beynen & De Hoog, 2003; Weston & Handy, 2004).

### 3.2.3 Appropriation

Appropriation comprises the user's experiences, habits, perceptions and values linked to travel modes and space. This affects the way individuals appreciate their own access and skills to travel modes (Fujii & Kitamura, 2003; Heath & Gifford, 2002). For example, users often contrast car and public transport; car is often seen quite positively, so that a dependence on the car and a car-oriented mind seems to arise. Public transport is then more negatively assessed (Flamm, 2004; Kaufmann, 2000; Petit, 2002; Bassand & Kaufmann, 1996). The way users have experienced travel modes will lead them to appreciate a particular travel means. This is why some studies proposed to give users experiences of a real-life situation, an experience that could potentially lead to modify mode decisions (Brown et al. 2003; Fujii et al., 2001; Fujii & Kitamura, 2003; Heath & Gifford, 2002).

#### **4. Research questions**

“Free” public transport policies are expected to have an impact on different aspects of the mobility system. Besides mobility effects, this type of measure also has psycho-social, economic and spatio-temporal consequences.

Several ex-ante studies were conducted to examine the effect of the pricing measure (a.o. Ubillos & Sainz, 2004; Proost et al., 2002). Because the introduction of “free” public transport is usually combined with changes in the supply and/or with an evolution of the demand, these studies raise much debate about the real impact of the pricing measure. The problem is to assess the effect of “free” use of public transport on travel behaviour independently of other changes in the environment.

The introduction of the measure in Brussels created a situation where one group benefits from the measure and a similar group in the same area does not. The price of public transport is in fact the only difference in the transport supply between the two groups. Using this “laboratory” situation, it is analysed how this free access causes changes in the mobility behaviour of students. The general objectives of this study are thus the analysis and the assessment of the effect of the third payer system from a psycho-sociological, geographical and economical viewpoint. The assessment will be performed by means of a social cost-benefit analysis.

#### **5. Data collection & methodology**

##### *5.1 Survey*

A survey has been conducted in order to examine differences in travel behaviour before and after the introduction of “free” public transport, asking for the number of trips students make, their travel motives, travel costs, spread in time, origins and destinations, etc. The population for the representative survey consisted of students from Dutch- and French-speaking universities and colleges. 3162 surveys were collected: 1618 (51%) from students at Dutch-speaking and 1544 (49%) from students at French-speaking institutions. The number of surveys was determined proportionally to school size. The sample was selected according to the principle of the quota sample (De Pelsmacker & Van Kenhove, 2002). The survey was first tested among around fifty students of the Vrije Universiteit Brussel by means of pilot testing.

The survey also served as data collection for the construction of activity spaces. All locations regularly visited by the respondents are input for this. People were asked which locations they frequently visited. There are various techniques for measuring activity spaces, such as confidence ellipse, kernel density and minimum spanning tree (Schönfelder & Axhausen, 2002).

Each of these captures different aspects of the activity space. In this research confidence ellipses were used (Figure 4). The confidence ellipse represents the smallest possible area in which a specified proportion of all visited places is located. The size of the ellipse is an indicator for the dispersion of the locations visited.

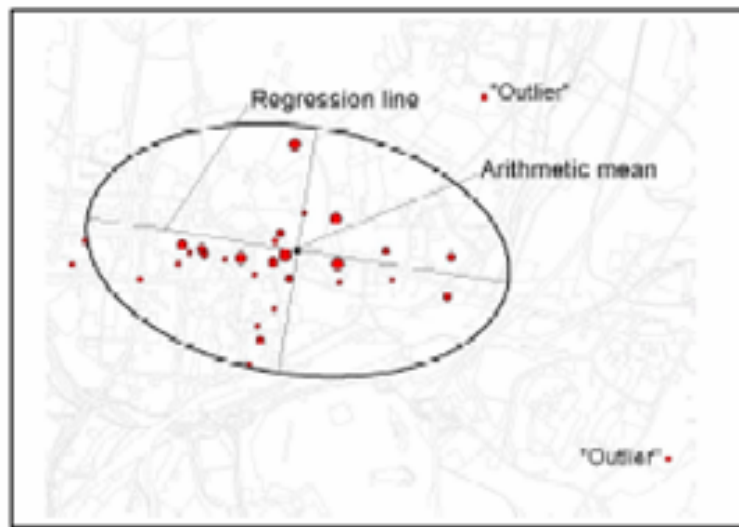


Figure 4: Confidence ellipse method to construct activity spaces.

## 5.2 Mental map interviews

### 5.2.1 Interview construction

300 students filled in a questionnaire on mental maps, additional to the survey. Students were selected at random proportionally to the school size. Different methods were tested and four questions were withheld. The questions provided more information on the students' preferences and verified some of the information on activity patterns. They provided information on the students' knowledge and perception of Brussels and the elements they consider significant in Brussels. A number of criteria have been developed to assess the quality of a mental map (Lynch, 1960; Dorling and Fairbairn, 1997). Combined, these questions provide a wide range of information on the students' knowledge and appreciation of places in Brussels.

### 5.2.2 Ranking place preferences

Students were asked to evaluate each neighbourhood on a seven-point scale, running from +3 to -3. Mental maps can be constructed from ordinal measurements using principal components analysis. This method is described in detail in Gould & White (1986). This method allows finding the overall structure in the student's responses, better than merely taking average scores and enables to detect outliers (Gould & White, 1986).

### 5.2.3 Processing of mental map information

A relational database was built containing for each student the place names listed and/or drawn. Only features that were drawn more or less on the right location were

included. A set of geocoding operations were then carried out to georeference the information. After geocoding place names on the most detailed level possible, all information was reclassified to statistical sector level. This means that each building, street or commune was assigned to the statistical sector(s) it lied within or contained. The results are mental maps on statistical sector level, indicating for each student or group of students the familiar places. For further processing the maps were converted to raster format (Figure 5).

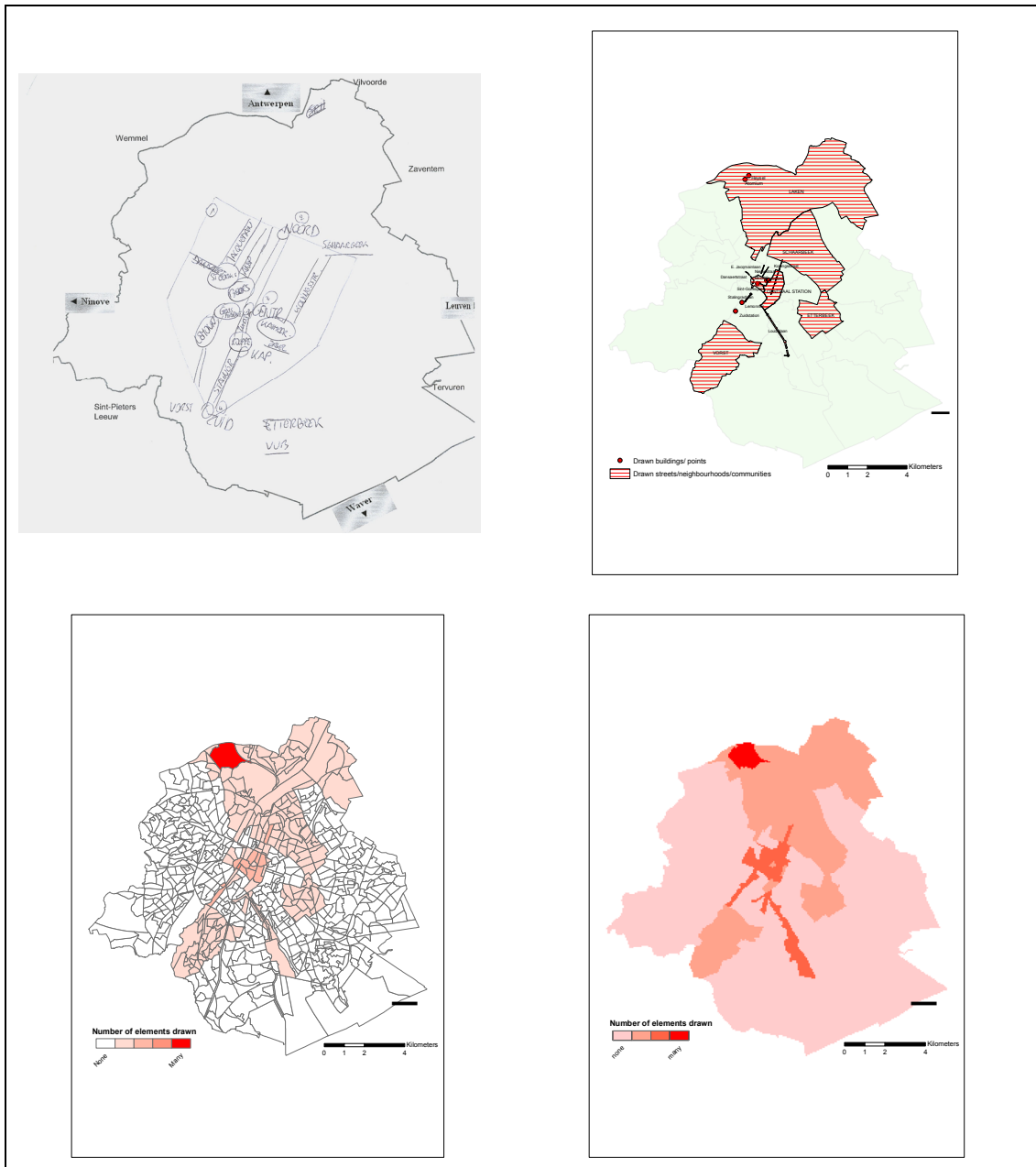


Figure 5 Processing of mental maps. Top left: example of a manually drawn mental map. Top right: geocoding of the drawn and labelled map elements. Bottom left: number of map elements drawn per neighbourhood. Bottom right: raster map of the number of map elements per neighbourhood.



#### *5.2.4 Comparing individual mental maps*

By starting with the individual mental maps and by comparing them based on their spatial characteristics, groups of similar mental maps can be formed.

Automated procedures for map comparison have been applied. The Map Comparison Kit (MCK) is a software tool for the comparison of raster maps, developed by the Research Institute for Knowledge Systems (RISK). The method used is Fuzzy Set Map Comparison, which is a combination of Kappa statistic and Fuzzy Set theory. It takes proximity relations and similarity between legend categories into account in order to obtain a nuanced view on map similarity. A detailed specification of the method is given in Hagen (2003a and 2003b).

The raster files of the individual mental maps were converted to ASCII files and automatically entered and processed in the MCK (batch mode). The processing consisted of a two-by-two comparison of all maps, resulting in a 288\*288 cells matrix for each indicator (Klocation, Khisto and Kappa) which was automatically written to a Statistica (Access) database.

#### *5.2.5 Cluster analysis*

The purpose of this step is to define groups of mental maps based on their spatial characteristics. To achieve this, the Kappa values were used. A K-means clustering technique was applied to define a set of clusters of greatest possible distinction. Best results were obtained with 7 clusters. Euclidean distances from each case to the cluster centre were used to identify representative cluster members.

#### *5.2.6 General Discriminant Analysis*

Finally, a general discriminant analysis helped to find which socio-economical and mobility variables influence a student's mental map. Discriminant analysis is used to determine which variables discriminate between two or more groups. A model is built to predict as well as possible to which group a case belongs. A stepwise model approach allows selecting those variables that discriminate most between the cluster groups. Each step, the model is evaluated and variables can be added or removed. Only main effects were taken into account, so not combinations (products) of different variables.

### *5.3 Analysis of the public transport supply*

Insight in well and less well served areas in Brussels Capital Region is needed in order to ease the interpretation of the activity patterns and mental maps. Perhaps certain places are not visited because the transport supply is insufficient. Secondly, the analysis of the transport supply is important to balance the effect of price measures versus investments in the transport supply.

Data sources readily available at the MIVB/STIB have been used, such as the Vision 2020 document, which contains information on the public transport offer. Secondly, for all public transport stops the number of passing vehicles (bus, tram, metro) per hour has

been calculated for a selected time frame (morning and late evening). The result is a map with isolines that indicates the number of passing vehicles per hour.

#### *5.4 In-depth interviews*

Hypotheses which could highlight the mode choices made by individuals were defined. The understanding of those choices would allow us to get the importance of financial type factors in the reasoning held by individuals. The interview guide has thus been built to take these hypotheses into account. A first proposed hypothesis was that of lived experiences – as potentially carrying sense and so participating in a privileged way in the mode choices made by individuals. The second hypothesis suggested that «mobility diaries» could influence mode choice. Finally socialization – as it would create mode use habits – appeared also as a factor influencing the attraction and/or the use of some means of transport.

The methodology could be defined as an inductive and comprehensive one. Inductive methodologies start from particular elements to come to generalization. The comprehensive approach (Kaufmann, 1997; Petit, 2002) focuses on the justifications used, rather than on the description of behaviour. The comprehensive approach is aimed at understanding the elements that influence logics of action followed in the everyday mobility and to understand the significance that an actor gives them.

Qualitative methods are consequently those that correspond in a more obvious way with such a comprehensive approach, as these data collecting methods allow the individuals to freely express themselves relatively to their logics of action. It becomes then possible to avoid immediate answers and to go deeper in the attitudes, representations, perceptions and feelings of a person (Hay, 2000). Since the point is rather to look for diversity of profiles, reaching a representative sample is not considered a relevant epistemological criterion. Data collecting is stopped when no new information is found with additional interviews. Qualitative interviews are carried out in a semi-structured way. This means that open questions are asked to respondents who answer freely.

A complete transcription of the interviews was implemented. With the transcriptions, we have sketched an analysis of the materials, based on the structural method. This kind of method considers the talk of the respondent as being structured in a particular and systematic way. The main goal is then to identify and to analyse sets of themes and lines of arguments followed by students (Hiernaux, 1995; Piret et al., 1996). This work has allowed us to examine whether different types of respondents – which arise from quite close lines of arguments – could be distinguished. Finally, encoding of the qualitative data has been carried out, using Nvivo software, allowing analysing the whole dataset.

#### *5.5 Social cost-benefit analysis*

The Social Cost-Benefit Analysis (SCBA) model is based on the theory of welfare economics, according to which the welfare of a society depends on the aggregate individual utility levels of all members of that society. The aim of the SCBA is to produce an evaluation in terms of a general objective, which takes into account the

interests of all actors who will be affected by the decision. Therefore it is a suitable method for evaluating government investments.

The SCBA has three main characteristics. First, it adopts the position of the society as a whole. It does not only take financial costs and benefits into account, but it also tries to capture the societal effects. Secondly, it converts all the effects into a common unit, namely the monetary unit. Thirdly, it calculates the balance of the monetarized effects. A positive balance means that the society as a whole benefits from the project. A negative balance means that the costs for the society are higher than the benefits (Immers & Stada, 2004; De Brucker et al., 1998).

The costs of the measure can be divided into direct costs and external costs. Direct costs in this project are directly related to the introduction of the “free” public transport measure. If additional public transport kilometres are made, then external costs related to congestion, pollution, accidents and noise are generated. The benefits taken into account for the SCBA, are direct benefits, indirect benefits and external benefits. Direct benefits are the positive effects the users of public transport experience as a result of the measure. Indirect benefits result from the direct benefits and are for instance effects on employment, economical growth and on the image of a city or region. These benefits are difficult to monetarize and are taken into account pro memoria (Spit et al., 2004). Finally, the measure reduces external negative effects, such as fewer private vehicle kilometres. These are external benefits.

## **6. Results of the quantitative survey**

47% of the students of Dutch-speaking institutions have requested a refund of their season ticket at Quartier Latin. 89% of these students have been regularly using it. “Free” travelling Dutch-speaking students use public transport more frequently than their paying equivalents. However, compared to French-speaking students, the frequencies are rather low. Even though French-speaking students in Brussels have to pay for their public transport use, they use it more often and frequently. Compared with the previous academic year the majority of students indicate that they use Brussels public transport more. An analysis of generation and substitution effects showed that generation effects occurred with 25% of the students, who made on average 1,7 additional trips per week. Limited substitution effects were encountered between car and public transport (66% of students with car available), between train and MIVB public transport (14%) and between walking and public transport (21%).

Differences in mobility behaviour between Dutch- and French-speaking students can be partially explained by differences in the proportion of students living outside and inside Brussels. 63% of the French-speaking students are living in Brussels compared to only 9% of the Dutch-speaking students. Dutch-speaking students tend to be more positive in their overall appreciation for public transport than French-speaking students. A possible explanation is that French-speaking students, having to pay for their trips, are more critical because they expect a certain service in return.

## **7. Spatial analysis**

### *7.1 Analysis of mental maps*

Considerable differences exist among students in the knowledge and appreciation of neighbourhoods in Brussels. Important factors that determine the composition and quality of the mental map are the location of the school, having or not a student residence in Brussels and the appreciation of the city. The language and the number of years in Brussels were not significant. There is a strong mutual relation between the mental map and mobility behaviour. Public transport stops and stations or arterial roads are important structural elements.

In general the mental map of many students at Dutch-speaking institutions is very small. It is limited to the school, the station of entrance and exit in Brussels and a few landmarks (Atomium, Grote Markt). In some cases locations related to going out (Beurs, Cimetière, Kinopolis), shopping (Louisa Avenue, Woluwe Shopping Centre, Nieuwstraat) and sports (Sportopolis, Ter Kameren Bos) are included in the mental map. However, for many students Brussels is only associated with studies and other activities are fulfilled outside Brussels.

In general the appreciation of Brussels is significantly lower among Dutch-speaking students. They only have a positive image of the centre and a few neighbourhoods (around school). The image is more positive among French-speaking students. The difference in residential situation – a smaller percentage of Dutch-speaking students lives in Brussels – only partly explains the difference. A more unattractive image (notably with regards to insecurity) seems indeed to be more conveyed among the Dutch-speaking population.

### *7.2 Analysis of activity patterns*

In general activity patterns of students are characterized by a few isolated locations. This means that the area between the attraction points is not part of the activity pattern. For going out the activity pattern is a north-south axis, with the Kinopolis complex in the north, the city centre and the VUB-campus in the south. For shopping the activity pattern is an east-west axis formed by the Westland Shopping centre (west), Naamsepoort and the Woluwe Shopping Centre. For sports the activity pattern is characterised by a spread-out locations and some concentration points (Sportopolis, ADEPS, VUB Sport, Ter Kameren bos). The location of the school is determining for the activity pattern. For each school the activity pattern is mainly shaped by the three poles Kinopolis, the city centre and the school.

The activity pattern of commuting students is strongly related to the pattern of the Flemish students: very limited and oriented towards a few isolated poles. Interesting is the difference within the Flemish group between users and non-users of the free public transport tickets, with the latter having a wider activity space.

Students benefiting from the free public transport measure visit the same set of locations but visit those 30% to 45% more frequently than their paying equivalents. These figures suggest that the effect of the introduction, if any, is an increase in the

number of trips, but to the same locations. Longitudinal analysis would be needed to confirm this observation.

### *7.3 Analysis of transport supply*

Analysis of the **public transport supply** learns that:

- Only a small proportion of the built area in the Brussels Capital Region is not within a 400m distance of a public transport stop.
- Areas in the urban periphery where important developments are happening are well less served by public transport, particularly by metro. Especially for students, the evening and night offer is limited. The night bus is assessed very positively.
- 12 of the 18 institutions for higher education have a good accessibility by public transport. The other schools are still located close to the centre (Erasmus Hogeschool), are located eccentrically but near a metro node (KUB and HONIM) or near the terminus of a metro line (HeldB, HeldV, Ephec).

## **8. Psycho-social analysis**

### *8.1 The role of price concerns*

Assessment of the costs of a car is often based on variable costs, such as fuel and sometimes insurance. For public transport, evaluation of price is based on the type of ticket used, the perceived service quality and the user's financial situation. Price is perceived in a different way according to the fact of travelling with a season ticket – perceived as expensive at the beginning but profitable if regularly used – or a travel ticket – often perceived as expensive.

The perceived quality of service also plays an important role, as this perception works as a justification of the price asked. Price of tickets is also often compared with the price of other services. The perception of prices appears to be very practical and relative. Sometimes identical criteria lead to different evaluations and judgements of prices. The way students reason about prices of means of travel depends strongly on the context in which the journey takes place. Moreover, the assessed prices do generally not include all real costs (Hine & Scott, 2000; Frenay, 1994).

As far as the transport budget is concerned, negotiations with the parents seem to result in a greater financial involvement of the students in case of possession of a car. This choice is indeed less usual, as students are often in a constrained and dependant financial situation. This particular financial situation can also contribute to exacerbate a sensitivity of students to the price factor, which plays probably a more important role in their travel decisions and behaviour than other fringes of the population (Hine & Mitchell, 2001; Jemelin, 2004). This observation results notably by referring to their

fare-dodging conduct. The way of reasoning about prices proves thus to be complex and has to do with representations, experiences and situations in which users are involved.

### 8.2 Impact of environmental values

Students were also surveyed about their environmental values in order to examine whether sensitivity to these concerns existed.

- Environmental values could not be observed as relevant in the sociological interviews. About a half of the interviewed students mentioned environmental arguments, but only few showed a real concern (by opposition to the observation of other authors: e.g. Büttner & Grübler, 1995; Sandqvist, 2002).
- An awareness seems to exist, but is maybe considered as “standing to reason”, obvious and not really appropriated so that behaviour would be adapted to these considerations. Environmental problems in Brussels are associated with health and noise problems and traffic pollution.
- The relative absence of environmental concern among respondents seems thus to justify a measure, such as the free public transport one, to be implemented if sustainable aims are to be reached.

### 8.3 Students' social experience of travelling

It is important to understand the qualitative elements or social experience (Flamm, 2004; Petit, 2002) guiding daily mobility behaviour and attitudes of students.

- Senses (smell, hearing, sight and especially touch) are often used and sometimes, perturbed when travelling. The sensitivity to the sensorial perturbations appears however to vary from student to student. Senses are often referred to when assessing the attraction towards a travel mode.
- Senses also participate in the development of sensations. Five different kinds of sensations have here been differentiated: physio-psychological, social, time, security and cleanliness sensations. The latter are often argued by the students using oppositions. Physio-psychological sensations are those of pleasure of driving *versus* displeasure of driving and being careful *versus* letting oneself go. Social dimensions often oppose travel modes as social or individual places, whereas the question of good citizenship, altruism *versus* rudeness, self-centredness using travel modes is also asked. Time considerations reveal diverse ways of considering and of using travel times. Sensations of rapidity or slowness of travel modes are mentioned. However few respondents have really calculated and compared travel times using different travel modes and those sensations vary according to the quality of (travel) times (busy *versus* having time; efficiently used *versus* annoying travel times). Security and insecurity feelings are linked to various criteria, but especially to the morality *versus* immorality of the persons frequenting the considered place. Finally, the cleanliness (clean *versus* dirty) sensation has also to do with several other senses

and sensations. All these sensations experienced when travelling contribute to direct mobility attitudes and behaviour.

- Representations of travel modes appeared actually as socially shared, as the images evoked were quite close in the interviews (Bassand & Kaufmann, 1996; Kaufmann, 2002). Car has been described as a cocoon, an extension of the house, which is owned, intimate and protected, but also as a symbol of the social status of the owner. This latter dimension has also been reported for soft travel modes, even if the significance varies. However, the use of some soft travel modes can also be associated with convictions of the user. Besides, values are also referred to when travelling. The usual ones are the independence and autonomy, the responsibility and control and finally freedom, values which can be attributed to each travel mode, following the valuation of the considered student. These representations and values are however more easily positively associated to the car. This is why we could conclude that a cultural predisposition to the use of the car seems to exist.
- The student also refers to a biographical reference frame (past and abroad experiences and socialization to mobility), as it influences the respondent's decisions and behaviour. The first mobility experiences indeed contribute to a learning and appropriation process which can turn to be determinant in future behaviour. Socialization to mobility through the family and the circle of friends also seems to lead to learn and valorise some travel attitudes. Habits can thus also be partly linked to that biographical reference frame. A perturbation in those habits because of a major biographical event (e.g. moving, and especially for the students, renting a student room) or an alternative experience (e.g. abroad experience) can also question the respondents' travel behaviour and attitudes. This reference frame appears as a kind of resource from which students get their attitudes and behaviour.

#### *8.4 Free public transport policy in Brussels and its assessment by students*

Some observations have been made with regard to the assessment of the free public transport measure

First, the "free" public transport measure is quite positively seen among students, in particular at first sight. The main negative element is group favouritism (as the measure is in fact aimed at a very specific population). The social equity the measure can provide and the improvements of traffic conditions are considered as advantages.

Second, students who are not benefiting from free season tickets look at the behavioural effects of the measure quite variously: some students are not expecting any change due to this kind of measure as their habits suit their own way of life and/or as they consider that the price of public transport is not its main drawback (the quality of service is here highlighted), whereas other expect very positive consequences, because of the attraction to public transport such a measure could create.

Another important observation was that students who benefit from the measure observe changes according to their former way of travelling within Brussels. Students who travelled previously occasionally with the Brussels' public transport network assess the measure positively and report personal behavioural changes (especially concerning the frequency of travel to the centre of Brussels). This is not the case, whereas the

opposite situation appears for students who regularly used the network and already possessed a STIB/MIVB season ticket, before the measure was introduced.

It can also be noticed that the increase in the frequentation rate of the STIB/MIVB network observed among the beneficiary students can be understood as an effect of the school season ticket (made more accessible due to the reimbursement mechanism), rather than as an effect of the free aspect. Possessing a season ticket has indeed been highlighted as a practical way of travelling because of the easiness and immediacy it provides.

Finally, several expected negative consequences have also been mentioned by the interviewed students, such as the loss of the customer status (allowing exerting one's power on the provider) and the loss of respect of users. A bad or under-use of the season ticket has also been observed. Finally, the trend to shift from soft travel modes to public transport has also been pointed out.

### 8.5 Typology of students' mobility behaviour and attitudes

In order to provide a global insight on the qualitative data, a typology of students' attitudes and behaviour concerning mobility and travel modes has been proposed (inspired by Kaufmann, 2000). The ideal types described allow grasping the diversity of profiles of students, corresponding to different kinds of rationales concerning mobility decisions and behaviour.

Two axis of analysis have been differentiated: the sensitivity to public transport supply and the student's effective modal commitment. First, students are likely to take or not the supply into account when having to travel. The student's attitudes towards travel modes can be open (taking all available travel modes into account) or closed (valorising one means of travel, in this case the car). Secondly, the student's effective modal commitment or not has more to do with behaviour, which results from a choice rationale towards some kinds of travel means (car *versus* soft modes) or not. Behaviour can be open (because it depends on the mobility context or because it does not suit the user) or closed (a choice that suits the user has been made and behaviour is guided by this choice; these students reveal then to be more committed in their choices).

Table 2: Typology of students' mobility attitudes and behaviour.

Sensitivity to public transport supply (attitudes)	Yes	No
	Effective modal commitment (behaviour)	City oriented T4 <i>Favourable to public transport and «soft» modes</i>
Yes	Plastic T3 <i>Favourable to public transport and to car</i>	Constrained public transport users T2 <i>Unfavourable to public transport; favourable to car</i>
No		



The typology allows then to link some types of students to particular concerns, experiences or assessment of the free public transport measure. The “exclusive motorists” (T1) often share a dissuasive past experience of public transport, together with family surrounding rather car-oriented. Car corresponds for them to time efficiency (time is often reported to be quite busy) and to a pleasant way of travelling. Students from this type don’t expect their personal behaviour to change if a free public transport policy is introduced, since using a car fits their current way of life and since they do not conceive other ways of travelling.

The students who feel “constrained to the use of public transport” (T2) report to appreciate travelling by public transport to the city centre, but their global attitude is still car-oriented. Experiences of public transport have thus proved to be dissuasive, or at least not convincing enough to change the car-oriented attitude of those students. The residential and familial context often explains partly why car is valorised. The social representation of the car seems here to be quite strong in the mind of this type. No association with the assessment of a free public transport policy could be found.

The more numerous type were “plastic” (T3) students. They were called “plastic” students because they have not so clear-cut attitudes towards travel means and appeared to behave according to the best alternative for the travel. These students have thus not so strongly opted for one particular means of travel. Sensitivity to practical considerations, comfort and security feelings have been observed. Positively invested travel times and sometimes displeasure to drive also characterise students from this type. A free public transport measure is variously assessed among these students but the fact that the greatest majority of beneficiary students were ranked in this type shows that benefiting from the measure widens the scope of mobility decisions and behaviour.

The last type (“city oriented” – T4) groups older students who valorise and are sensitive to the urban environment and its quality of life, and so environmental concerns are here often developed. This is why residential strategies and travel attitudes and behaviour are oriented towards city favourable options (as for mobility, public transport and soft travel modes are valorised and chosen). Car is depreciated in the urban context. The concerns of those students are more collective. They invest positively travel times. Finally, their attitude towards a free public transport policy is rather favourable.

These types are seen as attitudinal and behavioural trends, which can vary according to stages of life, spatial localisations, financial situations etc. They help to conceive the complex nature of mobility decisions and behaviour, and grasping some rationales which could be observed among this population.

Mobility behaviour and especially modal choice appear thus as being inseparable from the general social experience of the users that we have tried to give an overview on. It also shows that the price “attraction” reveals to lead to more or less important behavioural changes, according to the mobility profile of the student. Reactions to a free public transport measure is thus not homogeneous among a similar population.

## **9. Social cost-benefit analysis**

The reference scenario reflects the situation before the introduction of the “free” public transport for students. The project alternative describes the situation after the initiation of the “free” STIB subscription (academic year 2003-2004). The differences

between both alternatives represent the effects of the introduction of “free” public transport. These effects can be positive (net-benefits) or negative (net-costs) for the society. Table 3 gives an overview of the dimensions taken into account for the evaluation of the “free” public transport project.

Table 3: The SCBA Model.

<i>Costs</i>	<i>Benefits</i>
<u><b>1. Direct costs</b></u> - Government Subsidy - Operating Costs - Costs related to capacity and punctuality problems	<u><b>1. Direct benefits</b></u> Increase Consumer Surplus
	<u><b>2. Indirect benefits (Pro Memory)</b></u> - Improvement city image and attractiveness - Basic mobility access - Familiarisation of public transport
<u><b>2. External costs</b></u> - Congestion - Pollution - Accidents - Noise	<u><b>3. External benefits</b></u> - Congestion - Pollution - Accidents - Noise

### 9.1 Calculation of the costs

Since the public transport company did not provide additional supply, the marginal costs in public transport are zero. Thus the only societal cost that needs to be taken into account is the subsidy from the government. In total, the government granted a budget of 1,446,293€ to finance the “free” public transport project in the academic year 2003-2004.

### 9.2 Calculation of the benefits

The two types of benefits to be monetarized are the direct and the external benefits. The *indirect benefits* are not included into the SCBA and are taken into account pro memory. The *direct benefits* are reflected by the increase in consumer surplus as a result of the “free” public transport measure. A demand function has been constructed from the number of students applying for the ticket before and after introduction of the free public transport measure. From the demand curve the increase of consumer surplus as a result of the measure can be calculated and turns out to be 707,000 Euro.

The *external benefit* results from the mode shift from car to public transport. Using an additional telephone survey as data source, we were able to extrapolate the substitution effects mentioned in section 6. The number of substituted kilometres turned out to be 76.26 km per student per week: 47.64 km during peak hours and 28.62 km in the off-peak period. This value needs to be multiplied with the number of weeks in the academic year (40) and the number of students who made a mode shift (1048) in order to calculate the total number of reduced vehicle kilometres. A first external benefit is the likely reduction in the number of accidents. The marginal external *accident costs* for cars on urban roads in Belgium are estimated on 122.6€/1000vkm during low traffic flows and 130.2€/1000vkm during high traffic flows (INFRAS/IWW, 2004). Multiplied

with the average amount of substituted kilometres, this results in a reduction of external accident costs of 407,000€. A second external benefit is the reduction of noise. According to INFRAS/IWW (2004) the marginal external noise cost is 7.63€/1000vkm during high traffic flows and 18.49€/1000vkm during low traffic flows. Subsequently, the diminution of external noise costs is 37,500€. Another important external benefit is the reduction of atmospheric pollution (NO<sub>x</sub> emissions, CO<sub>2</sub>, lead, CO). INFRAS/IWW (2004) differentiated the marginal external pollution costs for gasoline on 9.54€/1000vkm and for diesel on 74.74€/1000vkm. Using a distribution of 52% gasoline cars and 48% diesel cars (NIS, 2005) the reduction in external air pollution costs is 131,000€ (table 8.7). Finally, there is an external benefit due to the reduced congestion. Mayeres et al. (1997) determined the marginal external congestion cost in urban areas by passenger cars on 1462.57€/1000vkm during peak hours and 4.21€/1000vkm in off-peak periods. This results in a total external congestion cost saving of 2,900,000€.

The actual external benefit of the measure is however lower. Blauwens et al. (2002) indicate that in high congested areas the space made available on the road system will attract new car users. As a result, the external benefits of the substitution are partly undermined. The question is how much of the newly available road space will be filled up with new car users. We presume that this phenomenon occurs mainly during peak hours. We found that 62% of the mode shift occurred during peak hours and 38% in the off-peak period.

We first consider a 50% reduction in external cost during peak hours. Adding up the reductions in peak and off-peak hours results in an overall actual external cost saving of 1,927,000€ for the 2003-2004 academic year.

### 9.3 Impact assessment

The welfare implications of the project become apparent when we make up the balance of the benefits and costs induced by the “free” public transport. The total costs amount to 1,446,000€ and the total benefits are 2,634,000€. The benefits exceed the costs, mainly as a result of the encouraged modal shift from car use towards public transport use which leads to a significant reduction of external costs. When we deduct the costs from the benefits, we obtain a positive welfare result for the society as a whole of 1,188,000€ for the 2003-2004 academic year (Table 4).

Table 4: Social cost-benefit analysis: synthesis.

<b>Costs</b>	<i>Subsidy</i>	- 1,446,000 €
<b>Benefits</b>	Δ Consumer surplus	+ 707,000 €
	External benefits	+ 1,927,000 €
Balance		<b>+ 1,188,000 €</b>

However, this result assumes that 50% of the space made available was filled up again. A sensitivity analysis showed that the project remains beneficial as long as no more than 86% of the space made available on the road is filled up by new car users.

Taking into account difficult to quantify indirect benefits such as improvement of the city image, induce habit forming and a more students establishing themselves in Brussels, we can conclude that the “free” public transport project is a beneficial measure for the society as a whole. It does not only increase the welfare of the benefiting students, but it also has positive welfare implications for the other society members.

## **10. Conclusions and recommendations**

Introducing free public transport is ‘hot’ in Belgium. Third payer systems in which the government or an other partner pays for the public transport trips of a target population group have been introduced widely for various reasons: reducing congestion, generating a mode shift or promoting public transport. In Brussels the circumstances are somewhat particular. The measure is limited to the students of Dutch-speaking colleges and universities, their counterparts from French-speaking institutions do not benefit from the measure. The aim of the introduction has in fact been to stimulate students to discover Brussels, participate in city life and to improve the city’s image with students and subsequently the whole Flemish population. The limitation of the beneficiary group to the Dutch-speaking group has created a laboratory situation that allows analyzing the effect of the measure.

The first year of its implementation the measure has caused an increase in public transport use, 47% of the students use the card. However, an increase in the number of public transport trips alone is not sufficient. Survey information reveals significant differences in mobility behaviour between Dutch- and French-speaking students. French-speaking students use public transport more frequently than the Dutch-speaking ones. More factors than the price of a ticket determine public transport use.

The distribution between the two student groups of commuters, students with a student residence and those living permanently in Brussels, is strongly different between the groups. Only 36% of the Flemish students live permanently or rent a room in Brussels, compared to 81% from the French-speaking students. The much higher share of commuters with the Flemish group causes a lower average knowledge of place names in Brussels. Differences in knowledge and appreciation of the city are important factors to explain differences in mobility behaviour between Dutch- and French-speaking students. Dutch-speaking students in general have a more negative image of Brussels, except for a few neighbourhoods such as the city centre (Beurs), Louisa and Etterbeek. Their activity pattern consists for each motive of a few isolated locations. The routes and attractions between these locations are virtually unknown. Often a large part of their activity pattern is situated outside Brussels and they return home as soon as lessons have finished, leading a kind of “double life” in a “double space”, which does not correspond to the same space appropriation. When the activity pattern is limited and the appreciation of the city in general negative, the objective of the measure to explore the city won’t be fulfilled. The increasing number of public transport trips consists of more trips to the same locations. Public transport is used more frequently, but this doesn’t result in a higher number of stops that are used.

The analysis of the accessibility of the Brussels Capital Region by public transport shows a good overall accessibility of most places in the region, except for a few attraction points that are difficult to access in the evening. Frequency and the evening and night supply are perceived very important by students. Psychological barriers are more important for students than physical barriers. Analysis of the students' mental maps shows that the school and the possession of a student residence have the strongest impact on the perception of the city.

The social experience of interviewed students learns that behaviours and in particular attitudes towards mobility and travel modes are underlain by qualitative factors that are not always likely to be modified. The weight given to the price factor enters in interaction with other factors (the assessment of prices is thus relative), and so according to the situation is likely or not to lead to behavioural and attitudinal change. This observation highlights thus that the students' behaviours are not homogeneous and so that some categories of students (cf. typology described) may be more likely to modify their behaviours due to a free public transport measure. An interesting observation made was that beneficiary students who were not used to travel regularly with the Brussels' public transport network before the measure had a good perception of the measure and reported to travel more regularly using public transport, even if this increase is probably a slight one. This could mean that an easier financial and practical access to public transport, by means of a season ticket, contributes to modify their behaviours, and possibly also their attitudes towards this mode. In these cases, free public transport seemed thus to open the scope of travel possibilities.

The social cost-benefit analysis shows that the "free" public transport project is a beneficial measure, not only for the students being able to travel for "free", but also for the society as a whole. The benefits generated by the project exceed the costs. There is a positive welfare result or gain for the society as a whole. This gain is mainly a result of the encouraged modal shift from car use towards public transport use which leads to a significant reduction of external accident, noise, pollution and congestion costs.

With regard to the generalisability of the results, it is expected that the measure would have a bigger impact on the group of French-speaking students. Secondly, students are a particular population segment. They often have a limited budget, implying that their price elasticity is higher. Car availability is low in this group resulting in a high share of public transport captive travellers. Another typical element for students is that part of their activity pattern is located outside Brussels.

Determinants and constraints of these social experiences have to be subtly analysed in order to properly forecast and assess the impact of measures, such as free public transport, on the evolution of the problems raised by mobility. This understanding constitutes an important scientific stake and demands a deep treatment that such an interdisciplinary work provides.

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