2012•2013
FACULTEIT BEDRIJFSECONOMISCHE WETENSCHAPPEN
master in de verkeerskunde: mobiliteitsmanagement
(Interfacultaire opleiding)

Masterproef

Comparison of travel behaviour between Flanders and Wallonia

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Masterproef voorgedragen tot het bekomen van de graad van master in de verkeerskunde , afstudeerrichting mobiliteitsmanagement

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KNOWLEDGE IN ACTION

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Master Thesis Mobility Management

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Total Words: 7857 words + 16 tables and figures

August 22, 2013

ABSTRACT

Travel behaviour is important to study in order to understand, detect and overcome road traffic problems. This paper investigates the influence various independent variables can have in predicting travel decisions, for example the number of trips a person makes a day or which mode of transport he uses to make a trip. The BELDAM and OVG surveys provide the necessary information about socio-demographic as well as travel data of households and their members in Belgium. Using SAS and the CHAID analysis it is possible to create decision trees for certain travel decisions, which show the independent variables which are most important in predicting a travel decision. Resulting Chi square values show the magnitude of the influence of the independent variables, and impact values indicate in which manner a travel decision is influenced by a specific independent variable. The final purpose of the paper is to investigate if there are differences in certain travel decisions, and more importantly the influences of their explaining variables. Therefore the results are compared between different regions namely Flanders and Wallonia, and between separate travel surveys like BELDAM and OVG. Generally the results are quite similar, but there are also some very interesting differences in the comparisons, which are highlighted throughout the paper.

INTRODUCTION

Nowadays road traffic is becoming more and more problematic in Belgian society. Congestion and traffic accidents, together with their adverse effects like environmental, economic, social and health costs for society are issues which demand improvement. For one these issues are caused by the travel behaviour of the Belgian inhabitants and the foreigners travelling through the country. Why do people travel from A to B, when, with whom, which travel mode and travel route they use,.. These are all questions one tries to investigate and to understand, and in a later stage tries to influence, in order to improve road traffic and avoid traffic problems.

Much research and many analyses have already been performed on travel behaviour and their influences, in order to understand and improve travel. Travel behaviour has many different types of determinants, like personal and household socio-demographics, activity participation, urban form,.. They all have a certain influence, not only on travel behaviour but also directly and indirectly upon each other, which makes it difficult to investigate them all at once. Lu et al. (1999) tried to show the complex relationship between socio-demographics, activity participation and travel behaviour. This relationship was transformed into a model which can investigate and measure the influences of demographic variables and variables of activity participation on travel behaviour. It can be concluded that socio-demographics can have a direct effect on travel behaviour as well as an indirect effect via activity participation. This makes it difficult to investigate the total effects of socio-demographics on travel behaviour. A second important conclusion is that people with different socio-demographic characteristics have different activity participation characteristics, and variables including age, gender, employment status and number of children are systematically important in explaining variations in activity participation. The investigation by Pas et al. (1984) on the effect of selected socio-demographic characteristics on daily activity-travel behaviour produced statistical analyses which indicate the significant influence of the role, life-cycle, and life-style characteristics of individuals and their households on personal daily activity-travel behaviour. The results also demonstrate that specific socio-demographical parts of urban travel have differential likelihoods of making particular daily activity-travel patterns.

OBJECTIVES

Different from past research, this study first of all investigates how important certain variables are in influencing somebody's travel behaviour. For instance the number of trips a person makes per day can be influenced by many different variables like age, gender, car possession, household income, diploma, day of the week, and so on. What we don't know is which variable is important in predicting a certain travel decision and which variable is not. Insight in this matter might help practitioners and policy makers to influence certain variables in order to eventually positively influence travel behaviour and their travel outcomes.

As a second interesting subject this study investigates in which way independent variables influence a certain travel behaviour, also known as target variable. Looking at the number of trips a person makes during the day, with for instance household income as an independent variable, it is interesting to investigate in which way an increase or decrease of the household income influences the number of trips per day a person makes. In Belgium a person from a household with a high income is likely to make more trips a day on average than someone with a low

income household. This indicates that in Belgium an increase in household income results in making more trips per day.

The third interesting approach of the study is to investigate if there is a difference in influence of independent variables on a certain travel decision between different ethnic or geographical areas. There have been several studies which compare the differences in travel behaviour between different areas and investigate the variables influencing travel behaviour. A study by Van Goeverden and de Boer (2013) analyses the variables influencing both home-to-school distance and modal choice in Flanders and the Netherlands. It appears that age, gender, the urbanisation degree of home and school municipality, and car ownership have a considerable influence on the home-to-school distance. Modal choice of school travel behaviour on the other hand is mostly influenced by distance, season, urbanisation degree and personal characteristics like age, income and gender. Comparing the differences in school travel behaviour between Flanders and the Netherlands, it can be said that Dutch pupils are more inclined to use the bike than Flemish pupils are. Instead of the bicycle, Flemish pupils use the car more frequently for primary education and collective transport for secondary education. Another study from Giuliano and Dargay (2004) compares the interaction of car ownership, travel and land use between the US and Great Britain. An estimated model shows that differences in travel are caused by differences in demographics between the two countries on the one hand, and lower household income and higher transport costs in Great Britain on the other. A third study from Zegras and Srinivasan (2006) analyses the differences in travel behaviour and location characteristics across three different income groups in two cities from Chile and China, two very different countries in the world. There are some surprising results in travel behaviour between the two countries, for one that all income categories in Santiago (Chile) have higher bicycle ownership rates, and household bicycle ownership increases with income while in Chengu (China) it declines. Santiago also shows higher average trip times than Chengdu, while trip distances are fairly comparable. This makes it difficult to explain Santiago's high average trip times. These three studies show that travel behaviour comparisons have already been made between cities and regions, but not between different regions within the same country. There also haven't been any studies which investigate if there are any clear influential differences in explaining variables on a certain travel decision between differing geographical areas. That's why this paper tries to investigate the influence of a number of explaining variables on certain travel decisions for Flanders and Wallonia, and makes comparisons between the two regions.

To complete this study, the results of different databases are compared to each other. Apart from comparing travel behaviour between Flanders and Wallonia, the results from the BELDAM and OVG studies are also compared. Because both studies use different survey methods it’s interesting to see if the analyses on these studies show different outcomes. Whenever possible the OVG study carried out their surveys face-to-face, while the BELDAM study executed their surveys by post or telephone, except for the cities of Ghent and Antwerp, where the face-to-face method is applied per hundred each time. Finally the analyses of two different OVG studies, more particular OVG 3 and OVG 4, are compared to each other. Because OVG 3 has been executed in the time period of 2007-2008 and OVG 4 in 2008-2013, it is interesting to see if there are influences of explaining variables on certain target values which have changed over time in Flanders.

METHOD

BELDAM Survey

Enabling an investigation on the travel behaviour of a certain area, a database with travel data is needed to examine the different variables which influence the travel behaviour of Flemish and Walloon people. Therefore two surveys are being used. The first one is the BELDAM survey, a Belgian survey on daily mobility from December 2009 until December 2010, as a sequence of the MOBEL survey in 1999. Apart from updating the situation of mobility behaviour in Belgium, the goal of the survey was to better learn and understand Belgian mobility and identify possibilities to improve sustainability. The survey also offers a lot of useful data to investigate different variables of travel behaviour:

- Household data like household income and information about their vehicle ownership
- Analysis on socioeconomic determinants of daily movements
- The spread of respondents' trips in time
- The reasons behind their trips
- Use of different travel modes
- Etc.

As a result the BELDAM survey has data of 4018 people from 1987 households in Flanders and of 8054 people from 4211 households in Wallonia.

OVG Survey

The second survey is the OVG survey. Since 1994 OVG tries to identify the travel behaviour of the Flemish people as accurate as possible. Therefore a survey was used to ask the respondents from where to where they travel, why they travel, when, with which means of transport, for how long, how far and with whom. The goal of the survey is to obtain personal and household characteristics which relate to mobility. With the personal characteristics an indication of the number of trips a person effectively makes during the day is retrieved. The household characteristics are meant for getting insight about the vehicles households own and can be used to execute their trips. Since 1994 four OVG surveys have been carried out, of which this paper uses the two most recent ones, more specifically OVG 3 (2007-2008) and OVG 4 (2008-2013).

Materials/Data/Tools

The databases used in this investigation are registered in three separate tables. The first one is the Household table, with information about the income of the households and about the vehicles they possess. The second table gives information about the individuals like their age, gender, professional status, how often they travel with a certain mode of transport, and so on. The third table gives information about the trips the individuals have made on an a priori selected day of the week. Important variables in this table are the day of the week, hour of department and arrival, distance, travel time, main goal and main mode of transport of the trip.

The decision of making a trip from A to B depends on a lot of separate travel choices, like which mode of transport to use as main mode in making the trip. A choice like this, in turn, is dependent on many different other variables. Therefore these travel choices are treated as dependent or target variables further on in the analyses. The variables influencing these target

variables are the independent variables. For instance, distance, travel time and vehicle availability are some of many independent variables influencing the travel choice of which means of transport to use when a person wants to make a trip.

In SAS several dependent variables can be created to investigate, together with a selection of independent variables which are interesting to study and might have an influence on that particular target variable. The independent variables have to be selected carefully, because not all independent variables are suitable to use as an explaining variable for certain target variables. To create data sets of target variables with their independent variables, the statistical analysis program SAS can be used. With this program new variables like total travel time of the trip and number of trips per person can be created, and used in further analysis. If there is a continuous variable which can take a lot of different values, it is best to make this variable discrete by dividing these different values into several categories in SAS, because CHAID originally works with discrete values. Although it is possible to create many categories per variable, the number of categories is limited to a maximum of six, because it is more accurate and clear. Examples of such continue variables are distance, travel time and age. For example, the variable travel distance is divided in the following six classes:

- 0 = [0 km – 20 km[
- 1 = [20 km – 40 km[
- 2 = [40 km – 60 km[
- 3 = [60 km – 80 km[
- 4 = [80 km – 100 km[
- 5 = [100 km- …[

Data sets with the appropriate independent variables have been created in SAS for the investigation of the following ten travel choices (target variables):

- Number of trips
- Trip distance
- Average trip distance per person
- Trip travel time
- Average trip travel time per person
- Main mode of transport of a trip
- Use of Public Transport as main mode of transport of the trip
- Use of the bicycle as main mode of transport of the trip
- Use of car as a driver as main mode of transport of the trip
- Use of car as a passenger as main mode of transport of the trip

To be able to compare the situation between Flanders and Wallonia, BELDAM and OVG, OVG 3 and OVG 4, it is important that for every target variable, data sets are created the same in every database.

After creating the ten data sets for every travel choice in the necessary databases, a CHAID analysis (“Chi Square Automatic Interaction Detection”) is performed. This form of analysis determines how variables best combine to explain the outcome in a given dependent or target variable. It is a helpful tool for discovering the relationships between explaining variables and choices made by respondents. Another advantage of a CHAID analysis is that it can visualize the relationship between the target variable and the related declaring variables in the form of a decision tree, which is very important in this particular investigation.

Also in the study of Pitombo et al. (2010) decision tree analysis is used to investigate variables influencing travel pattern choices. The study aimed to find relations between the socioeconomic characteristics, activity participation, land use patterns and travel behaviour in Sao Paulo. The decision tree method revealed that car ownership, household income, professional status and trip purpose, variables which are applied in our investigation too, are among the variables with the highest influence on the travel pattern choice.

Before it is possible to perform a CHAID analysis through FEATHERS, the data sets of the target variables have to be transformed into proper CHAID inputs in order to execute the analyses.

Data-Analysis

CHAID Output

The CHAID inputs of all ten of the target variables are transformed into CHAID outputs. The CHAID outputs contain a decision tree which shows which independent variables are subsequently used to predict the outcome of the target variable. Underlying figure is the CHAID output of the decision tree for the number of trips per day in Flanders.

```
diploma    0,2: 0.059, 0.458, 0.108, 0.187, 0.066, 0.123, 1989
        use_bic    0-2: 0.058, 0.427, 0.122, 0.198, 0.059, 0.136, 1283
                use_cdr      0: 0.062, 0.341, 0.146, 0.200, 0.067, 0.184, 451
                use_cdr    1-4: 0.056, 0.474, 0.108, 0.197, 0.055, 0.109, 832
        use_bic    3-4: 0.061, 0.513, 0.082, 0.166, 0.079, 0.099, 706
                weekday    0,2: 0.030, 0.587, 0.109, 0.134, 0.075, 0.065, 201
                        dri_lic      0: 0.012, 0.617, 0.090, 0.132, 0.078, 0.072, 167
                        dri_lic      1: 0.118, 0.441, 0.206, 0.147, 0.059, 0.029, 34
                weekday 1,3,6,4: 0.080, 0.486, 0.050, 0.195, 0.092, 0.097, 401
                        prof_st 0,1,4,3: 0.094, 0.463, 0.045, 0.189, 0.135, 0.074, 244
                        prof_st    2,6: 0.049, 0.512, 0.000, 0.146, 0.000, 0.293, 41
                        prof_st    5,7: 0.060, 0.526, 0.078, 0.224, 0.034, 0.078, 116
                                use_cpa    0-1: 0.113, 0.623, 0.000, 0.170, 0.019, 0.075, 53
                                use_cpa    2-4: 0.016, 0.444, 0.143, 0.270, 0.048, 0.079, 63
                weekday      5: 0.048, 0.471, 0.154, 0.115, 0.038, 0.173, 104
diploma      1: 0.058, 0.578, 0.113, 0.134, 0.047, 0.070, 344
diploma    3,4: 0.039, 0.345, 0.115, 0.178, 0.124, 0.200, 1300
        use_cdr    0-1: 0.039, 0.324, 0.114, 0.178, 0.132, 0.213, 1153
                oth_veh      0: 0.036, 0.328, 0.107, 0.177, 0.136, 0.215, 1077
                oth_veh    1-5: 0.079, 0.263, 0.224, 0.184, 0.066, 0.184, 76
                        use_bic    0-2: 0.133, 0.200, 0.311, 0.178, 0.089, 0.089, 45
                        use_bic    3-4: 0.000, 0.355, 0.097, 0.194, 0.032, 0.323, 31
        use_cdr      2: 0.034, 0.508, 0.203, 0.051, 0.102, 0.102, 59
        use_cdr    3-4: 0.045, 0.511, 0.057, 0.261, 0.034, 0.091, 88
```

FIGURE 1 Example of CHAID Output Flanders

In this example “diploma” is an important variable in predicting the number of trips a Flemish person makes per day. This means that in Flanders, which diploma you have, seems to contribute a lot in predicting the number of trips a person makes a day compared to the other variables used in the analysis. Other variables with a certain share of influence on the number of trips are bicycle use (“use_bic”), car used as a driver (“use_cdr”) and the day of the week (“weekday”). When comparing the Flemish decision tree to the Walloon one, there is quite a different outcome.

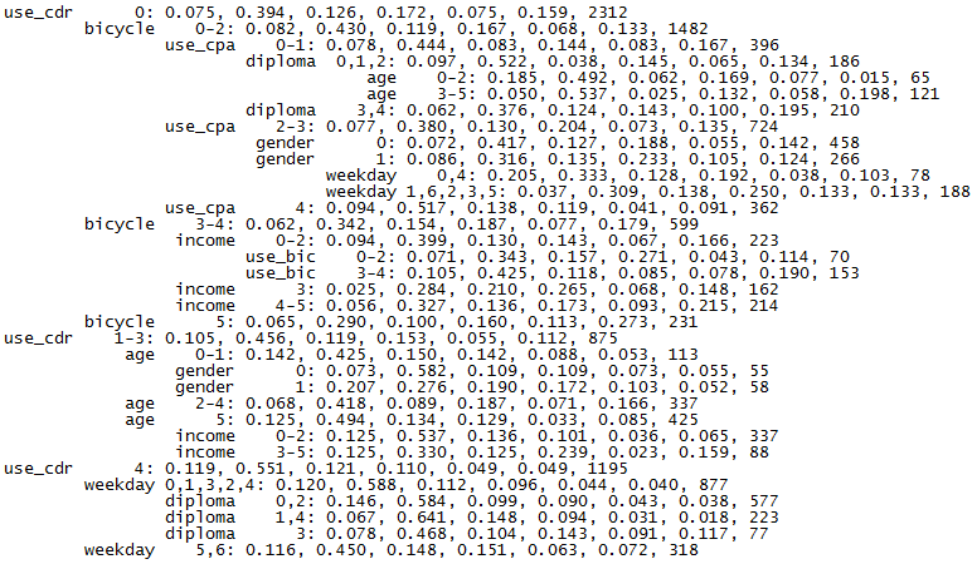

FIGURE 2 Example of CHAID Output Wallonia

The diploma a Walloon person owns does not influence the number of trips he or she makes during the day as much as it does in Flanders. The output above indicates that in Wallonia the use of the car as a driver ("use_cdr") has the biggest influence on the number of trips a Walloon makes during the day. This means that how often a person uses his car as a driver seems to have a big influence on the number of trips a person makes. Some of the other variables with a certain influence are bicycle ownership ("bicycle"), "age", "income", use of the car as a passenger ("use_cpa") and also the "diploma", although with a much less share of influence than the Flanders output.

Chi Square

Knowing which variables have a certain influence on a transport decision is important in order to understand travel behaviour, but what is really important to know is how big that influence really is in predicting the target variable, and how big it is compared with the influences of the other variables. Therefore one can investigate the Chi square value of the independent variables. The higher the Chi square value of an independent variable in the context of a CHAID analysis, the higher its influence consequently is in predicting the target variable.

In this study the Chi square value of every explaining variable is being displayed in a table together with its relative share in predicting the target value. A pie chart gives a visual indication of the differences in influence between the different explaining variables on the target variable, which for example is the number of trips a person makes per day in Flanders. Only the variables with a relative influence share of 2% or more on the target variable are being displayed, the other influences are combined in an 'Others' variable. The following table and figure indicate that the diploma of a Flemish person and his use of the car as a driver are most influential in predicting the number of trips he makes during the day.

TABLE 1 Example Influence Share of Independent Variables on Travel Choice in Flanders

Expl. Var	Chi square	Relative
weekday	44,44	3,38%
gender	0	0,00%
age	0	0,00%
use_bic	77,05	5,87%
use_mot	0	0,00%
use_PT	0	0,00%
use_cdr	425,5	32,40%
use_cpa	2,25	0,17%
diploma	644,04	49,04%
prof_st	43,8	3,33%
dri_lic	2,32	0,18%
cars	0	0,00%
bicycle	0	0,00%
income	0	0,00%
motorc	0	0,00%
oth_veh	74,01	5,63%
	1313,41	**100,00%**

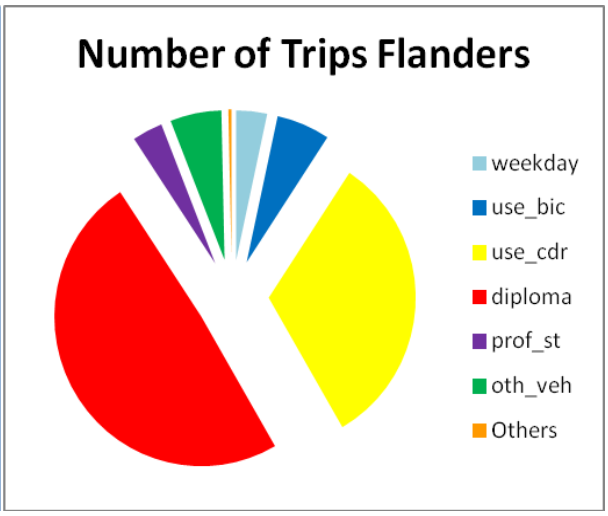

FIGURE 3 Influence Share of Independent Variables on Travel Choice in Flanders

Looking at the same travel choice in Wallonia, the most important variables in predicting the number of trips a person makes during the day are the use of the car and the number of bicycles the household owns. The influence of the diploma is less important compared to the Flanders situation. Variables like age, household income, weekday and the use of the car as a passenger also have a certain influence on the travel choice.

TABLE 2 Example Influence Share of Independent Variables on Travel Choice in Wallonia

Expl. Var	Chi square	Relative
weekday	58,37	6,08%
gender	8,15	0,85%
age	73,04	7,61%
use_bic	4,53	0,47%
use_mot	0	0,00%
use_PT	0	0,00%
use_cdr	384,95	40,09%
use_cpa	90,31	9,40%
diploma	65,38	6,81%
prof_st	0	0,00%
dri_lic	0	0,00%
cars	0	0,00%
bicycle	215,71	22,46%
income	59,89	6,24%
motorc	0	0,00%
oth_veh	0	0,00%
	960,33	**100,00%**

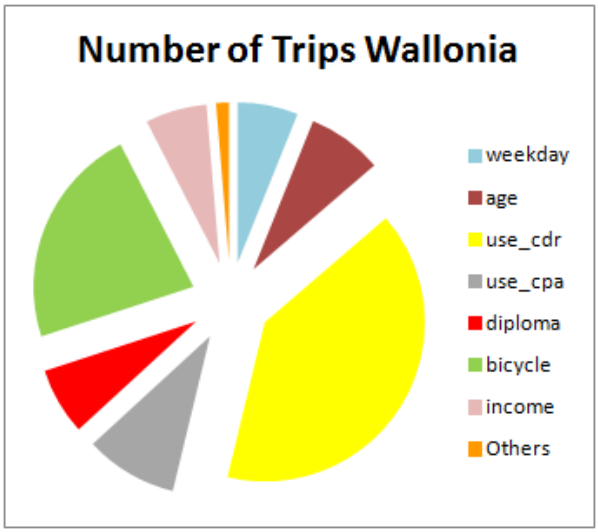

FIGURE 4 Influence Share of Independent Variables on Travel Choice in Wallonia

Impact Tables

Apart from determining which variables are important in influencing the target variable, it is also interesting to know in which way every explaining variable interacts with the target variable. The CHAID analysis in this study is accompanied with an impact table where the impact of the increase or decrease of the value of an explaining variable on the target variable is shown. Depending on the outcomes of the impact tables, it is possible for ordinal explaining variables to

detect a certain pattern which gives the possibility to make conclusions on the influence of that particular variable on the target variable. For nominal variables, like professional status and goal of a trip, it is impossible to detect such an influence pattern.

The following figure presents the impact tables of Flanders and Wallonia concerning the impacts of the different explaining variables on the number of trips made by a person. Variables with a certain impact on the travel choice have impacts values varying from -1.00 to +1.00. A negative impact value, a value between -1.00 and 0.00, means that a value change of a certain independent variable results in a decrease for the impact value of the target variable. The opposite is true for a positive impact value (between 0.00 and 1.00),where a value change results in an increase for the impact value of the target variable. The closer the impact value approaches the extreme values of -1.00 or 1.00 the stronger the impact. It is possible that a certain variable doesn't influence a particular value of the travel choice at all. In that case the variable does not get a value, which is indicated by "-9.00". All of the independent variables which have a certain impact pattern on the number of trips a person makes in the two regions within the BELDAM survey are indicated in bold and framed in red.

TABLE 3 Example Impact of Independent Variables on Traffic Choice

Expl. Var.	1 Trip	2 Trips	3 Trips	4 Trips	5 Trips	5+ Trips
weekday	**0.23**	**-0.30**	**-0.16**	**0.18**	**0.12**	**0.12**
gender	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
age	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
use_bic	1.00	1.00	-1.00	-1.00	1.00	-1.00
use_mot	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
use_PT	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
use_cdr	**0.04**	**1.00**	**-0.35**	**0.24**	**-1.00**	**-1.00**
use_cpa	**-1.00**	**-1.00**	**1.00**	**1.00**	**1.00**	**1.00**
diploma	**-0.98**	**-0.23**	**-0.44**	**0.06**	**0.54**	**0.31**
prof_st	-0.21	0.33	0.11	0.12	-0.23	0.00
dri_lic	1.00	-1.00	1.00	1.00	-1.00	-1.00
cars	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
bicycle	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
income	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
motorc	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
oth_veh	1.00	-1.00	1.00	1.00	-1.00	-1.00

Expl. Var.	1 Trip	2 Trips	3 Trips	4 Trips	5 Trips	5+ Trips
weekday	**-0.35**	**-0.93**	**0.89**	**0.73**	**0.49**	**0.75**
gender	**1.00**	**-1.00**	**1.00**	**1.00**	**1.00**	**-1.00**
age	-0.28	0.69	-0.22	0.00	-1.00	0.38
use_bic	1.00	1.00	-1.00	-1.00	1.00	1.00
use_mot	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
use_PT	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
use_cdr	**1.00**	**1.00**	**0.20**	**-1.00**	**-1.00**	**-1.00**
use_cpa	**1.00**	**0.28**	**1.00**	**-0.14**	**-1.00**	**-1.00**
diploma	**-0.38**	**-0.02**	**0.47**	**0.02**	**0.03**	**0.04**
prof_st	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
dri_lic	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
cars	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
bicycle	**-1.00**	**-1.00**	**-0.24**	**-1.00**	**1.00**	**1.00**
income	**-0.39**	**-0.72**	**-0.00**	**0.43**	**0.40**	**1.00**
motorc	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00
oth_veh	-9.00	-9.00	-9.00	-9.00	-9.00	-9.00

An example of such an impact pattern is the use of a car as a driver ("use_cdr"). This variable can have the following possible values:

- **0** = At least 5 days a week
- **1** = 1 or a few days a week
- **2** = 1 or a few days a month
- **3** = 1 or a few days a year
- **4** = Never

After indicating every notable impact pattern for the two regions, we compare their impacts in order to detect remarkable differences. For example, when comparing the impacts the use of the car as a driver has on the number of trips a person makes during the day, for Flanders a decreasing use indicates a slight increase in the number of people that makes only one trip a day, because it has the positive value of 0.04. It also results in a great increase for people who make two trips a day. On the other hand, a decreasing use of the car as a driver has as a result that the number of people making four trips or more per day will decrease, because they have a value of -1.00. We can conclude that a decrease in car use as a driver has a fairly negative influence on the number of trips a Flemish person makes during the day. When comparing this pattern with the

Walloon outcome, it is noticeable that for Wallonia there is a very clear pattern out of which we can conclude that when the use of car as a driver by a Walloon person decreases, the number of trips he makes a day decreases.

When comparing the results between the given databases, only the explaining variables with a clear difference in impact on the target value, and those which differ from what's normally expected will be shown. An example can be found in the upper table where the impact pattern is almost fully opposite between Flanders and Wallonia, concerning the influence the use of the car as a passenger has on the number of trips a person makes.

It is not always clear which impact pattern is remarkable or unusual. To give an indication of which impact is expected from certain explaining variables on a certain travel decision, a number of hypotheses are being listed up, generated from the outcomes of the BELDAM and OVG studies:

- The more vehicles a household owns, like cars and bicycles, the more a person is inclined to use them as main mode of transport to make a trip.
- People without a driver's license are not likely to use the car as a driver. Instead they are forced to use other means of transport like Public Transport and the bicycle. People younger than 18 and many people older than 65 years do not have a driver's license and are expected to make less use of the car as a driver and make more use of other means of transport.
- Non-motorised transport modes are mostly used to overcome short distances. The car or Public Transport is used to travel to more distant destinations.
- People with higher household income possess more vehicles which makes it possible to make more trips than people with lower household incomes. Therefore they also make more use of the car as a driver then less wealthy people, who make more use of Public Transport and the car as a passenger.
- Men make more trips per day than women and they also travel more kilometres per day on average.
- Men are assumed to make more trips with the car as a driver than women, while women make more trips with the car as a passenger. This is partly caused by the fact that on average more men have a driver's license than women.
- Bicycle use in Flanders is much higher than in Wallonia.

Although these hypotheses are based upon the BELDAM and OVG studies, it doesn't mean that the outcomes of the variable analyses are completely in accordance with those studies. But taking these hypotheses above in to account it is easier to detect remarkable impact outcomes in the analyses of the created data sets, and it can help in understanding possible impact differences between certain studies.

RESULTS

The list of results of the variable analysis through CHAID is shown per target variable for every database investigated. A table with the Chi Square value of every explaining variable is shown together with their relative influence on the target variable. A pie chart is displayed with all the declaring variables with a relative influence of 2% or more on the target variable, to give a clear view on the influence proportions between the declaring variables. Finally an impact table is shown with the specific impacts of the declaring variables on the different values of the target

variable. According to these impacts it is possible to make conclusions about the way in which an independent variable influences the target variable, and thus about a certain mobility decision.

The main purpose of this paper is to indicate the differences between the influences of possible explaining variables and the way they differ in predicting a certain mobility decision. Because many data is being investigated it isn't possible to show every outcome. Therefore only those target variables which do show a clear difference in influence magnitude or impact are being covert in detail.

Comparing Flanders With Wallonia

In order to investigate the daily mobility in Belgium, the BELDAM survey was created in 2010. This survey gathered mobility data for Flanders as well as for Wallonia, which makes it possible to compare the mobility behaviour in both regions and, more importantly, compare the differences in influence of independent variables on certain target variables.

Chi Square

When comparing the amount of influence the selected explaining variables have on a certain travel decision in Flanders and Wallonia, it is necessary to look at the Chi Square values from the CHAID outputs. The relative share of the influence of the explaining variables are visually indicated in a pie chart. When comparing the pie charts of Flanders with the pie charts of Wallonia, following travel decisions show different outcomes between the two regions of interest.

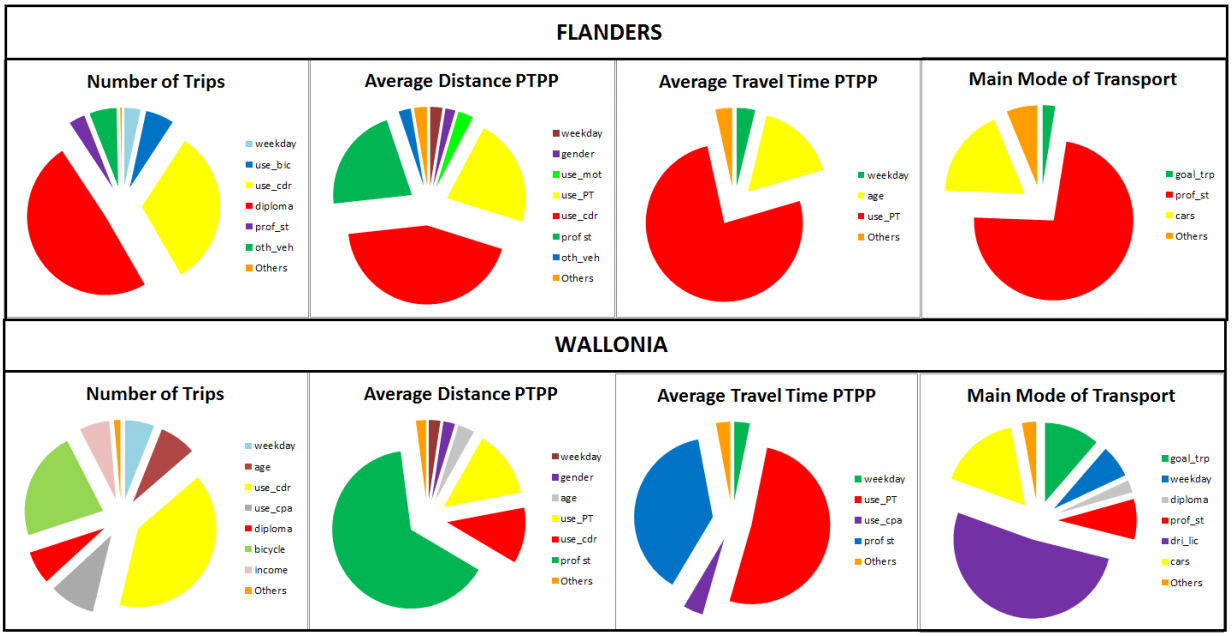

FIGURE 5 Comparing Influence Shares of Independent Variables on Travel Choices between Flanders and Wallonia

In Flanders the diploma of a person is most important in predicting the number of trips a person makes during the day, followed by the level of use of the car as a driver. In Wallonia the influence of the diploma is less compared to Flanders, and variables like the number of bicycles a

household has and the age of a person are more influential. The professional status of a person, the use of Public Transport and the use of the car as a driver are the three most important variables in predicting the average distance of the trips a person makes during the day. The difference between Flanders and Wallonia lies in the shares of influence between the three variables. In Flanders the use of the car as the driver is most important while in Wallonia the professional status of a person is by far the most influential variable. In predicting the average travel time of the trips a person makes during the day the use of Public Transport as main means of transport for making a trip is most important for Flanders as well as Wallonia, but the share of influence is a lot lower in Wallonia. Instead a second important influence, professional status, is of a considerate importance in predicting the average trip travel time. When comparing the average distance and average travel time target variables, it is possible to conclude that travel distance is mainly depending on the use of the car as a driver, which indicates that using a car implies making trips with long distances. On the other hand the travel time is highly depending on the use of Public Transport, which might indicate that travelling with Public Transport is more time consuming than other means of transport. There is a big difference between Flanders and Wallonia when comparing the influences on the main mode of transport a person uses to make a trip. In Flanders the professional status of a person is highly influential, in contrast to Wallonia where having a driver's license is most important in predicting the means of transport with which a person travels. The predicting variables of the other target variables are very similar for Flanders and Wallonia, which makes it less interesting to point out in detail.

Impact Tables

Looking at the following impact tables, there are some differences in the way an explaining variable is predicting the target value. The underlying table indicates that age has quite a different impact on the average distance a person travels in Flanders and Wallonia. In Wallonia the older you are, the shorter your average travel distance will be. In Flanders the opposite is true except for trips with average travel distances under five kilometres. As in Wallonia these trips also occur more often when you get older.

TABLE 4 Comparing Impacts of Independent Variables on Travel Choices between Flanders and Wallonia

FLANDERS						
Average Trip Distance Per Person						
Expl. Var.	0-5 Km	5-10 Km	10-20 Km	20-30 Km	30-40 Km	Plus 40Km
age	1.00	-1.00	-1.00	1.00	1.00	1.00

WALLONIA						
Average Trip Distance Per Person						
Expl. Var.	0-5 Km	5-10 Km	10-20 Km	20-30 Km	30-40 Km	Plus 40Km
age	1.00	1.00	-1.00	-1.00	-1.00	-1.00

Following table shows that men in Flanders make more use of non-motorized transport then women, in contrast to Wallonia. The higher the educational level and the household income in Wallonia is the more one makes use of the car as a driver. This is not the case in Flanders, which is a remarkable outcome because in general it is assumed that the higher the educational level and the household income is, the more trips a person makes with a car. In addition to this, a Flemish person with a higher household income makes more use of Public Transport, while in Wallonia such a person makes less use of Public Transport. In Flanders a decrease of bicycle use as well as a decrease in using the car as a passenger results in an increase of regular use of the car as a driver, which is opposed to Wallonia. On the other hand a decrease in Public Transport usage results in a decrease of regular bicycle usage in Flanders, and a decrease of regularly using the car as a passenger. The opposite is true for Wallonia.

TABLE 5 Comparing Impacts of Independent Variables on Travel Choices between Flanders and Wallonia

FLANDERS					
Main Mode of Transport					
Expl. Var.	Car Driv.	Car Pass.	Weak Tra.	PT	Other
gender	-1.00	1.00	**-1.00**	1.00	1.00
diploma	**-0.30**	0.01	-0.03	0.06	-0.00
income	**-1.00**	0.08	-0.21	**0.31**	0.78
Use of Car as Driver					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_bic	**0.79**	-1.00	-1.00	0.28	0.25
Use of Car as a Passenger					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_PT	**0.91**	-0.57	-1.00	-0.28	0.59
Bicycle Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_PT	**-0.89**	-0.51	-0.16	0.27	0.71
use_cpa	**0.86**	-1.00	-1.00	-1.00	0.74

WALLONIA					
Main Mode of Transport					
Expl. Var.	Car Driv.	Car Pass.	Weak Tra.	PT	Other
gender	-1.00	1.00	**1.00**	1.00	-1.00
diploma	**0.66**	-0.98	0.16	1.00	-0.10
income	**0.37**	0.76	-0.57	**-0.97**	0.16
Use of Car as Driver					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_bic	**-1.00**	-1.00	-1.00	-1.00	1.00
Use of Car as a Passenger					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_PT	**-0.41**	-0.57	-0.34	-0.24	0.56
Bicycle Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_PT	**1.00**	-1.00	-1.00	-1.00	1.00
use_cpa	**-0.60**	-0.07	-0.39	-0.15	0.44

Comparing OVG 3 With OVG 4

Since 1994 OVG tries to identify the travel behaviour of the Flemish people. Up until now, four OVG surveys exist which recorded personal, household and travel data for a certain part of the population. It is not only interesting to see how travel behaviour has evolved in Flanders, but also to investigate if influences of independent variables have changed in predicting target variables like the number of trips a person makes. Therefore we compare the results of OVG 3 (2007-2008) with OVG 4 (2009-2013).

Chi Square

When comparing the pie charts of OVG 3 with OVG 4, following four travel decisions show different outcomes between the two surveys concerning the amount of influence.

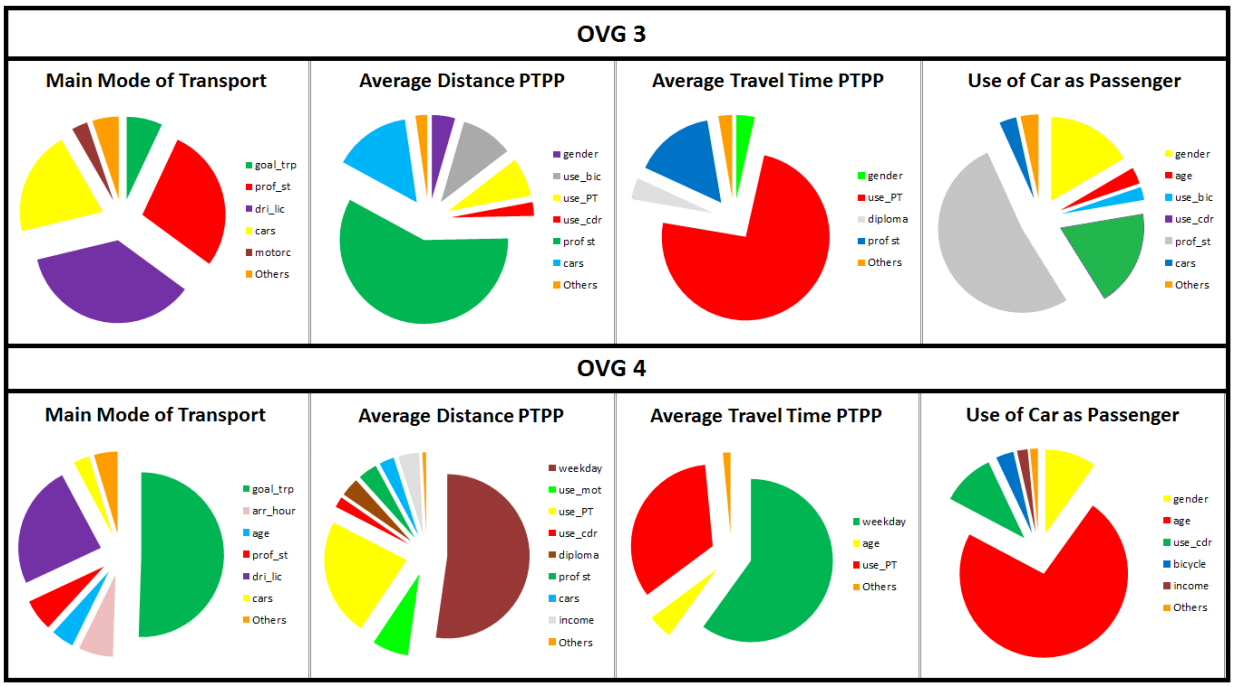

FIGURE 6 Comparing Influence Shares of Independent Variables on Travel Choices between OVG 3 and OVG 4

In deciding which main mode of transport to use for a certain trip, having a drivers licence, a person's professional status and the number of cars the household owns are important in predicting this in OVG 3, while in OVG 4 the goal of the trip has by far the most influence. There is a big difference between OVG 3 and OVG 4 in the amount of influence the explaining variables have on the average distance of the trips a person makes during the day. For OVG 3 the professional status is very important, but in OVG 4 it only has a small influence. In OVG 4 it is the day of the week above all to influence the average distance of the trips. Like in the comparison between Flanders and Wallonia in the BELDAM study, it is the use of Public Transport which is important in predicting the average travel time per trip per person. But for OVG 4 this influence isn't as important as in OVG 3. In OVG 4 weekday again is highly influential. A big difference between OVG 3 and OVG 4 occurs with the use of the car as a passenger as target variable. For OVG 3 it is mainly influenced by the professional status of a person, followed by the use of the car as a driver and a person's gender. In OVG age is most important in predicting the use of the car as a passenger, while the professional status has no influence whatsoever.

Impact Tables

The impact tables below indicate the differences between the impact of independent variables on certain target variables of OVG 3 and OVG 4. Looking at the gender and driver's licence variable it is clear for OVG 3 that women and people without a driver's license make shorter trips then men and people with a license to drive. In OVG 4 the opposite is true except for distances within 5 kilometres. Looking at the trip travel time, somewhat the same conclusion can be made concerning the driver's licence as predicting variable. In OVG 3 people without a driver's licence make trips with shorter distances. The opposite goes for OVG 4, which might be a strange observation because having a driver's licence implies the possibility to make more trips with the car as a driver. This might be explained by the fact that unlike in OVG 3, in OVG 4 people without a driver's licence make more use of Public Transport, which implies making trips with longer travel times on average. In OVG 3 people without a driver's licence turn to non-motorized transport more than Public Transport, which implies making more trips with shorter travel times.

TABLE 6 Comparing Impacts of Independent Variables on Travel Choices between OVG 3 and OVG 4

OVG 3						
Trip distance						
Expl. Var.	0-5 Km	5-10 Km	10-20 Km	20-30 Km	30-40 Km	Plus 40 Km
gender	1.00	1.00	1.00	-1.00	-1.00	-1.00
dri_lic	1.00	1.00	-1.00	-1.00	-1.00	-1.00
Trip Travel Time						
Expl. Var.	0-5 Mi	5-10 Mi	10-20 Mi	20-30 Mi	30-40 Mi	Plus 40 Mi
dri_lic	1.00	1.00	1.00	-1.00	-1.00	-1.00

OVG 4						
Trip distance						
Expl. Var.	0-5 Km	5-10 Km	10-20 Km	20-30 Km	30-40 Km	Plus 40 Km
gender	1.00	-1.00	-1.00	-1.00	1.00	1.00
dri_lic	1.00	-1.00	-1.00	1.00	1.00	1.00
Trip Travel Time						
Expl. Var.	0-5 Mi	5-10 Mi	10-20 Mi	20-30 Mi	30-40 Mi	Plus 40 Mi
dri_lic	-1.00	-1.00	-1.00	1.00	1.00	1.00

In OVG 3 women and young people make most use of the car as a passenger, unlike OVG 4 where men and older people more frequently use the car as a passenger. Age is of course a difficult variable to evaluate, because there are different age groups which are more inclined to use a certain mode of transport more than other groups. People under 18 aren't allowed to use the car as a driver, so they are forced in using other means of transport. On the other hand people above 60 also make less use of the car as a driver. Because of this fact it is difficult to predict which impact pattern will occur, and this pattern is more likely to differ between different studies. In OVG 3 it seems that a decrease of bicycle and Public Transport use indicates a decrease in regular use of the car as a passenger. This is actually a remarkable fact because the opposite would be expected, which is the case in OVG 4. In OVG 3 women and people without a driver's license make more regular use of Public Transport, opposed to OVG 4 which is also very remarkable, especially concerning the driver's license.

TABLE 7 Comparing Impacts of Independent Variables on Travel Choices between OVG 3 and OVG 4

OVG 3					
Use of Car as a Passenger					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	0.36	0.07	-0.03	-0.30	0.21
age	-0.47	0.10	0.25	0.05	0.88
use_bic	**-1.00**	-1.00	-1.00	1.00	1.00
use_PT	**-0.25**	0.20	0.08	-0.03	0.00
Public Transport Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	**-1.00**	1.00	1.00	-1.00	-9.00
dri_lic	**-1.00**	-1.00	1.00	1.00	-9.00

OVG 4					
Use of Car as a Passenger					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	-1.00	-1.00	-1.00	1.00	1.00
age	0.96	1.00	0.71	-0.65	-1.00
use_bic	**1.00**	-0.12	0.21	-1.00	1.00
use_PT	**1.00**	-1.00	-1.00	-1.00	1.00
Public Transport Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	**1.00**	-1.00	-1.00	-1.00	-9.00
dri_lic	**1.00**	1.00	-1.00	-1.00	-9.00

Comparing BELDAM With OVG

After comparing two BELDAM studies and two OVG studies with each other, a study comparing the BELDAM and OVG study can make the picture complete. Therefore we compare BELDAM Vlaanderen with OVG 4, because OVG 4 is the most recent OVG study and is executed in the same period as the BELDAM study.

Chi Square

Most of the comparisons between BELDAM and OVG show somewhat the same results concerning the amount of influence independent variables have on certain travel decisions. But there are also some travel decisions which have totally different outcomes concerning this topic.

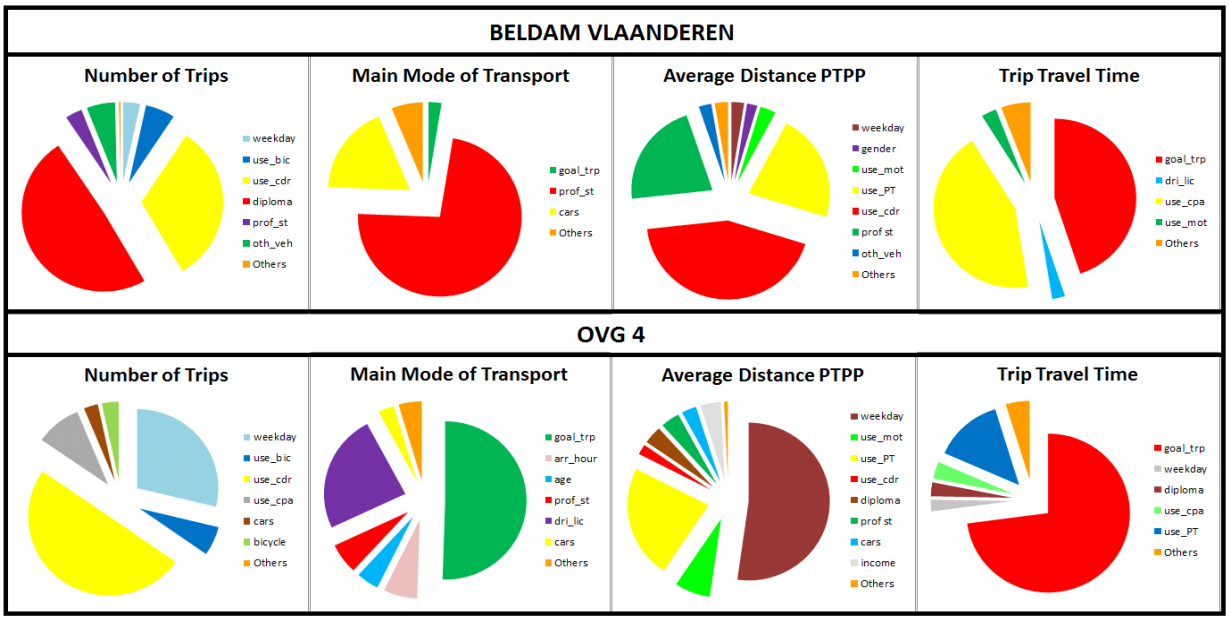

FIGURE 7 Comparing Influence Shares of Independent Variables on Travel Choices between BELDAM VLAANDEREN and OVG 4

In the BELDAM survey the diploma is the most important variable to influence the number of trips a person makes, while this variable has zero influence on the number of trips in the OVG study. Instead the use of the car as a driver and the day of the week are most influential. The professional status of a person has by far the most influence on the main mode of transport a person chooses to make a trip in the BELDAM study. In the OVG study the professional status only has a small influence, and the goal of the trip and having a driver's licence or not is more important. Comparing the average distance per trip per person between the two studies, there again is a big difference. In the BELDAM study the usage of the car as a driver has the most influence while the diploma is most important in the OVG study. The trip travel time in the BELDAM study has two main influential variables, namely the goal of the trip and the use of the car as a passenger. In the OVG study it is mainly the goal of the trip which is important, followed by the use of Public Transport, as the use of the car as a passenger has almost no influence.

Impact Tables

When comparing the impact tables from the BELDAM study with the OVG 4 study, a lot of different impacts can be detected in predicting several travel decisions. As expected, a decrease in bicycle use results in making more distant trips. This is the case for the OVG 4 study but the apparently the opposite goes for the BELDAM study. Looking at the impact the use of the car as a passenger has on the distance of a trip, again the BELDAM and OVG study oppose each other. In the BELDAM study a decrease of car use as a passenger results in making more short and less distant trips, which is not the case in the OVG study.

TABLE 8 Comparing Impacts of Independent Variables on Travel Choices between BELDAM and OVG 4

BELDAM VLAANDEREN						
Trip Distance						
Expl. Var.	0-5 Km	5-10 Km	10-20 Km	20-30 Km	30-40 Km	Plus 40 Km
use_cpa	**0.62**	0.64	-0.23	-0.33	-0.81	-0.91
use_bic	**0.87**	-0.19	-0.76	-0.97	-0.31	-0.94

OVG 4						
Trip Distance						
Expl. Var.	0-5 Km	5-10 Km	10-20 Km	20-30 Km	30-40 Km	Plus 40 Km
use_cpa	**-1.00**	1.00	1.00	1.00	1.00	1.00
use_bic	**-0.66**	0.16	0.48	0.77	0.25	0.63

There are some more remarkable outcomes regarding the impacts on travel decisions between the two studies. For example, not having a driver's license in the OVG 4 study implies an increase in Public Transport use, just like an increase in household income results in making more use of the car as a driver. These results fit the hypotheses, which makes it somewhat strange that the opposite is true for the BELDAM study. On the other hand, the BELDAM study produces impact results as expected concerning the use of the car as a driver, opposed to the OVG 4 study. In the BELDAM study men, persons with a driver's licence and persons owning more cars logically make more regular use of the car as a driver. On the contrary this is not the case in the OVG study. Looking at the use of the car as a passenger as a target variable, it is not easy to specify what kind of impact is expected. That's why many different outcomes may occur, which is the case in this comparison. In the BELDAM study women and young people make more regular use of the car as a passenger then men and older people, which is not the case in the OVG 4 study. In the OVG 4 study people who use the car as a driver on a regular basic will also use the car as a passenger more often. The opposite is true in the BELDAM study. Bicycle usage is positively affected by an increase in the number of bicycles a household owns and adversely effected by an increase in the number of cars, which is to be expected. Apparently this is only true for the BELDAM study, because the OVG 4 study contradicts this statement. A decrease in the use of Public Transport results in an increase in regular bicycle usage for the BELDAM study but not for the OVG 4 study. A possible explanation for this contrast is the fact that respondents from the OVG 4 study might combine bicycle and Public Transport in travelling from A to B. Persons with a higher household income make less use of the bicycle according to the BELDAM study, which is not the case in the OVG 4 study. Also in the BELDAM study a decrease in car use as a passenger has a negative effect on regular bicycle use, while in the OVG 4 study this effect is actually positive.

TABLE 9 Comparing Impacts of Independent Variables on Travel Choices between BELDAM and OVG 4

BELDAM VLAANDEREN					
Main Mode of Transport					
Expl. Var.	Car Driv	Car Pass	Weak Tra	PT	Other
dri_lic	-1.00	1.00	1.00	**-1.00**	1.00
income	**-1.00**	0.08	-0.21	0.31	0.78
Use of Car as a Driver					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	**-1.00**	1.00	1.00	1.00	1.00
use_PT	**1.00**	-1.00	-1.00	-1.00	-1.00
dri_lic	**-1.00**	-1.00	-1.00	-1.00	1.00
cars	**1.00**	0.52	-1.00	-1.00	-1.00
Use of Car as a Passenger					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	**1.00**	1.00	-1.00	-1.00	-1.00
age	**-0.84**	-0.03	0.59	0.80	0.53
use_cdr	**1.00**	0.54	-1.00	-0.91	-1.00
bicycle	**0.81**	1.00	-0.36	-0.54	-1.00
Bicycle Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_PT	-0.89	-0.51	-0.16	0.27	0.71
cars	**-1.00**	-1.00	0.23	1.00	1.00
bicycle	**1.00**	1.00	0.59	0.08	-1.00
Public Transport Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_cpa	**-1.00**	0.04	-0.17	-0.82	0.97
income	**-1.00**	0.19	-1.00	0.75	-0.63

OVG 4					
Main Mode of Transport					
Expl. Var.	Car Driv	Car Pass	Weak Tra	PT	Other
dri_lic	-1.00	1.00	1.00	**1.00**	1.00
income	**0.47**	-1.00	-0.10	1.00	-0.97
Use of Car as a Driver					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	**1.00**	1.00	1.00	1.00	-1.00
use_PT	**-1.00**	-1.00	-1.00	-1.00	1.00
dri_lic	**1.00**	-1.00	-1.00	-1.00	-1.00
cars	**-0.93**	-1.00	-0.93	0.09	1.00
Use of Car as a Passenger					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
gender	**-1.00**	-1.00	-1.00	1.00	1.00
age	**0.96**	1.00	0.71	-0.65	-1.00
use_cdr	**-1.00**	-1.00	-1.00	1.00	1.00
bicycle	**-1.00**	-0.36	-0.57	1.00	0.72
Bicycle Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_PT	0.14	0.27	-0.59	-0.24	0.01
cars	**1.00**	1.00	-0.90	-1.00	-1.00
bicycle	**-1.00**	0.29	0.67	1.00	1.00
Public Transport Use					
Expl. Var.	5d a week	1d a week	1d a month	1d a year	Never
use_cpa	**1.00**	-1.00	-1.00	1.00	-9.00
income	**1.00**	1.00	1.00	-1.00	-9.00

DISCUSSION

Processing the personal travel and household data of the respondents from the BELDAM and OVG study through CHAID made it possible to make conclusions about people's travel decisions and the variables influencing them. The results of the analyses might indicate that there are many differences in the influences of variables and their impacts concerning certain travel choices. This seems so because only the remarkable and differing outcomes are shown in this study. When all of the travel choices and their influences would be displayed, the number of remarkable and differing outcomes actually would be rather small.

On the other hand there really are some differences between the compared studies which are quite remarkable and do not comply with the predefined hypotheses. It is not easy to find an explanation for all these differences because many are possible. For one there is a difference in the number of respondents in the different studies. In the BELDAM study for instance the number of Walloon respondents and households is nearly twice the number of Flemish respondents and households. Taking into account that many data isn't applicable in CHAID because of missing values and so on, the result might be more accurate for one data set than for the other. Another reasons for possible difference might be that some independent variables can also have, apart from a direct effect on the travel choice, an indirect effect through other independent variables. Income for instance has a direct effect on the number of trips a person makes during the day. Apart from this, income also has an influence on the number of vehicles a household owns, which in turn influences the number of trips a person makes.

The BELDAM and OVG surveys offer a lot of interesting variables to include in the analyses of this study, like which type of fuel the cars of the households have or the way in which the household members carpool with each other or with others persons. But including these

variables couldn't be adapted in proper CHAID inputs or would result in a data set which is too small to perform an adequate analysis. That is why a number of potentially interesting variables have been left out of the analysis in this study. Regardless of the variables left out of the analyses, a set of interesting variables is accurately selected for every travel choice. Every selected variable is selected very carefully, in order to create a data set with variables which indicate how important they are in influencing a certain travel choice and in which way they actually influence this choice. Thanks to this it is possible to make certain conclusions about the selected travel choices and eventually about the difference between the studies compared in this paper.

CONCLUSIONS

Travel behaviour is a very important part of road traffic. Studying travel behaviour can help in order to understand, detect and overcome road traffic problems. There are many different variables which have a certain influence on a person's travel behaviour. Therefore it is very interesting to investigate which variables are important in predicting certain travel choices, and in which way they influence a travel decision. The data from the BELDAM and OVG study made it possible to investigate variables influencing travel choices in Belgium and Flanders. When comparing the analysis of variable influences between different studies some interesting results came forward. According to the analyses some travel choices have different variables which are important in predicting these choices, as well as variables which have a clearly differing impact. It is not easy to explain these differences because many explanations are possible, and it also isn't the purpose of this paper to do so. The purpose of this paper is to indicate that there are many different variables with an influence on travel decisions, and some variables are more influential than others in predicting a certain travel choice. Moreover the influence impact of a variable can differ a lot between different studies. This paper tries to give notice to importance of the influence of variables on travel choices, and suggests that further study is desirable in order to further understand travel behaviour. Eventually this might result in detecting road traffic problems more easily and possibly provide the ability to overcome them.

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