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Changes in travel behavior during the transition from secondary to higher education: A case study from Ghent, Belgium

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Abstract: Over the past few decades, the number of students attending universities and university colleges in Belgium has increased considerably. In many Western countries, this trend is accompanied by a decline in car use among young adults. Therefore, it is important to have better insights into how travel behavior changes during the transition from secondary to higher education. This research fits into the larger framework of mobility biographies, where travel behavior is analyzed over a life course, taking into account certain life events. Hierarchical logistic regressions are used to analyze car use data for mandatory activities (going to school and grocery shopping) and leisure activities (fun shopping) of 404 first-year university and university college students in Ghent (Belgium). The results indicate that holding a driver's license or owning a car facilitates car use irrespective of students' residential location and lifestyle, and this is true for all activities. The built environment only seems to become an important factor explaining car use when students are attending university or university college. The influence of lifestyles appears to become somewhat more important for leisure activities, such as fun shopping. The emerging lifestyle of students appears to become more individual and more independent from the lifestyle of others, especially the parents. This is supported by the declining influence of social networks, notably the family.

Keywords: Modal choice, mobility biographies, lifestyles, students, Belgium

1   Introduction

Over the past few decades, the number of students that enter universities and university colleges in Belgium has increased substantially. Several reasons explain this trend. Universities and university colleges have become more accessible because of the so-called democratization of the higher education system. Young adults are also more convinced that holding a degree increases their job opportunities. In addition, since fewer jobs are available to them, young adults tend to postpone their job search and study longer (Steunpunt Werk en Sociale Economie, 2012). In many Western countries, this trend is accompanied by a decline in car use among young adults (Delbosc & Currie, 2013; Kuhnimhof et al. 2012a). Therefore, it is important to gain better insights into the current modal choice of this expanding group of students and to understand how this modal choice changes over time.

This paper provides insights into the modal choices of students who make the transition from secondary to higher education. In Belgium, these students are 18 to 19 years old. The following four research questions are put forward: (i) What are the attitudes toward mobility among students in higher education, and are there important differences between past and current attitudes? (ii) How do modal choices, especially car use, change during the transition from secondary to higher education? (iii) Do lifestyles influence modal choices, even after controlling for socio-economic and demographic characteristics, the built environment, and the social network? (iv) Are the results different for mandatory and leisure activities?

2   Literature

2.1   Travel behavior of young adults

Around the turn of the millennium, many Western countries reached 'peak car' status (Goodwin, 2012; Goodwin & Van Dender, 2013). After decades of growth, Millennials or Generation Y (people born between 1980 and 2000) are now less likely to obtain a driver's license and even if they do get a license, they are driving less (Chatterjee et al., 2017; Delbosc, 2017; Delbosc & Currie, 2013, 2014a; Kuhnimhof et al., 2012a). The decline in the driver's license rate is apparent among students and young adults living in urban areas (Cedersund & Henriksson, 2006; Hjorthol, 2016; Krantz, 1999; Le Vine & Jones, 2012; McDonald & Trowbridge, 2009; Nordbakke, 2002). Berrington and Mikolai (2014) add that young adults living in the parental home are also less likely to drive (despite having a driver's license) and suggest that the driver's license rate among these young adults will further decline. Many young adults use car transportation less often in favour of public transport, cycling, and walking (Goodwin, 2012; Hjorthol & Bjørnskau, 2005; Kuhnimhof et al., 2012a; Kuhnimhof, Buehler, Wirtz, & Kalinowska, 2012b). It is, however, not clear whether this is because young adults who live in urban areas feel less the need of having a driver's license or because they do not have a license and therefore need to live in more accessible areas (Berrington & Mikolai, 2014).

The decline in car use can possibly be explained by changing attitudes toward the environment and mobility. A Dutch study by Jorritsma & Berveling (2014) suggests that private ownership (such as a car) is being replaced by using services and that the smartphone is replacing the car as a status symbol, possibly due to more environmental awareness (Berrington & Mikolai, 2014; Delbosc & Currie, 2013; Kuhnimhof et al., 2012a). Some studies (Sivak & Schoettle, 2012) argue that e-communication reduces young adults' need for mobility by replacing face-to-face communication. This favors the use of public transport since it is forbidden to use a mobile phone while driving (Berrington & Mikolai, 2014). Ad-

ditionally, smartphone applications might facilitate the use of public transport with real-time and other useful information (Delbosc & Currie, 2013; Sakaria & Stehfest, 2013). It is also possible that young adults adopt an urban lifestyle independent of the car because they perceive it as more practical. When they live and work in the same city, distances become shorter and it becomes easier to access different activities (Hjorthol, 2016; Hjorthol & Bjørnskau, 2005). Another possible reason is that young adults perceive a car as rather expensive because of increasing costs of insurance, obtaining a driver's license, the cost of fuel, maintenance, and taxes (Latinopoulos, Le Vine, Jones, Polak, 2013; Le Vine, Polak, & Kuhnimhof, 2013; Noble, 2005; Office for National Statistics, 2013).

However, other research shows that young adults are not necessarily more environmentally aware or less car-oriented than older generations (Delbosc & Currie, 2014b; Le Vine, Jones, Lee-Gosselin, & Polak, 2014; Van Acker, 2017). Many young adults feel the need to buy a car in the future (Jorritsma & Berveling, 2014; Swinnen & Valkeneers, 2002). Some say that a car can still be perceived as a symbol of social status (Berrington & Mikolai, 2014; Deloitte, 2009). Others mention that the car is more related to elements such as responsibility, freedom, independence, and comfort (Delbosc & Currie, 2014b; Jorritsma & Berveling, 2014). A car and a house in the suburbs still remain a common future ideal for many young adults (Jamieson, Cunningham-Burley, & Rawlins, 2012). It also seems that e-communication is not replacing face-to-face communication, but is instead seen as a supplement to it (Delbosc & Currie, 2013).

It is important that policy makers try to change travel behavior of young adults in favor of more sustainable travel modes. It is possible that changes to the built environment indirectly affect attitudes toward the environment and travel modes (De Vos, Derudder, Van Acker, & Witlox, 2012; Kitamura, Mokhtarian, & Laidet, 1997). However, it is also important to influence attitudes directly, because they have an important influence on the environment and the travel mode choice (Bagley & Mokhtarian, 2002). If travel behavior is explained by attitudes, then travel behavior will be rather stable. For example, if car use by young adults decreases, this trend will possibly continue. But if travel behavior is explained by the built environment and socio-economic characteristics, then travel behavior will be temporary. If young adults start to work or move, travel behavior will possibly change again in favor of the car (Delbosc & Currie, 2013; Jorritsma & Berveling, 2014).

2.2   Mobility biographies

This research fits into the larger framework of using mobility biographies to study travel behaviour (Beige & Axhausen, 2006; Lanzendorf, 2003; Müggenburg, Busch-Geertsema, & Lanzendorf, 2015; Scheiner, 2007). The basic idea is that, in general, travel behavior is rather stable and constant, but it can change due to certain important life events. We know that different dimensions affect travel behavior: personal, social, temporal, and spatial. An individual can be influenced by a personal experience toward mobility (Scheiner & Holz-Rau, 2013). An individual can also be influenced by mobility socialization. Individuals are mainly affected by their family, but they can also be influenced by friends, fellow students, colleagues, and other social groups (Döring, Albrecht, Scheiner, & Holz-Rau, 2015; Haustein, Klöckner, & Blöbaum, 2009). An individual can be influenced by the past (lagged effect), the present (situational effect), or by expectations toward the future (lead effect) (Albrecht, Döring, Holz-Rau, & Scheiner, 2014; Van Acker, 2015). Besides these dimensions, historical, political, and technological contexts will also impact travel behavior (Döring et al., 2015). Objective variables, such as the built environment and socio-economic characteristics, and subjective variables, such as attitudes, of the transport system are specific to a socio-cultural setting. This can be described as mobility cultures, which consist of mobility-related discourses and political strategies as well as institutionalized travel patterns and the built environment (Deffner et al., 2006; Götz & Deffner, 2009; Klinger, Kenworthy, & Lazendorf,

2013). Individuals must adapt to these different dimensions and contexts and every alternative must be carefully taken into consideration.

Life events influence the education or employment, residential, household, and mobility biography. These biographies are interrelated and changes in one type of biography can influence other biographies (Döring et al., 2015; Scheiner & Holz-Rau, 2013). The effects of several work-related life events on travel behavior have been examined in previous studies. Concerning the education or work biography and mobility biography, the entry into the labor market (Harms, 2007), income changes (Dargay, 2001), and retirement (Ottmann, 2007) have all been explored. The transition from secondary to higher education is an important life event which can change travel behavior. However, to our knowledge, changes in travel behavior during the transition from secondary to higher education have received little to no attention in travel behavior research.

2.3   Lifestyles and attitudes

Travel behavior is a multidimensional concept comprising elements such as travel mode choice and trip characteristics (e.g., trip frequency, travel distance, and travel time), and is affected by elements such as people's activity patterns, the built environment and the social environment (Mokhtarian & Cao, 2008; van Wee, 2002). In the past, academics mainly explained travel behavior by objective variables such as the built environment, and socio-economic characteristics. Since the 1990s, subjective variables like attitudes and lifestyles have been considered (Kitamura et al., 1997; Van Acker, 2016; Van Acker, Goodwin, & Witlox, 2016). According to Munters (1992), a distinction can be made between lifestyles and lifestyle expressions. A lifestyle is not observable and includes internal opinions, motivations, and orientations. A lifestyle seems to be rather stable and changes will only occur in the long term by changes in attitudes, values, and preferences (Kitamura, 1988). A lifestyle can manifest itself in a lifestyle expression that is observable (Munters, 1992). Therefore, travel behavior can be regarded as a lifestyle expression (Van Acker et al., 2016). In the remainder of this paper, the 'lifestyle' concept is used when referring to multiple personal or individual attitudes.

Lifestyles can partially explain travel behavior and sometimes they even provide a better explanation than the built environment and socio-economic characteristics (Bagley & Mokhtarian, 2002; De Vos et al., 2012; Kitamura et al., 1997; Schwanen & Mokhtarian, 2005a, 2005b). Research shows that lifestyles have a significant influence on leisure trips, but they only explain travel behavior to work or grocery stores to a limited degree (Scheiner, 2010; Van Acker, Mokhtarian, & Witlox, 2011). On the other hand, travel behavior also affects lifestyles. Travel behavior can strengthen related attitudes. For example, when people use their car more often, attitudes toward car use will probably become more positive while the attitudes toward other modes might become more negative (Bagley & Mokhtarian, 2002).

3   Data and methodology

3.1   Questionnaire

Data for this study was collected in the city of Ghent (Belgium). An online survey was organized among first-year students of the higher education institutions present in Ghent. Around the time of the research (2013-2014), there were approximately 12,192 first-year students enrolled in higher education in Ghent (Stad Gent, 2016). Students were asked information about their past and current travel patterns with respect to activities such as education, grocery shopping, and fun shopping, and which travel mode

they used (car as driver and passenger, train, bus or tram, moped or motorcycle, bicycle, or foot). The survey also contained sections on attitudes toward mobility in general and past and current attitudes toward different travel modes. Furthermore, the influence of previous and current social networks was asked. The survey concluded with several socio-economic and demographic issues. It should be noted that travel information from the last year of the students' secondary education was gathered by asking retrospective questions. As a result, it is possible that a certain level of recall bias occurs.

At the university, the study was announced by email in the monthly newsletter, at several faculties, and on the forums of the digital learning platform of the university. At multiple university colleges, the survey was only distributed via email. Some university colleges refused permission to distribute the invitation to participate in this study. As a solution the study was announced on the Facebook groups of these higher education institutions. Data was collected between December 2013 and January 2014. This resulted in 404 fully completed questionnaires that were used for further analysis. This equals a response rate of 3.3%, assuming that all first-year higher-education students were informed (which is not the case). This rather low response rate would make it impossible to perform a descriptive analysis of the total population of first-year students of the higher education in Ghent. It has to be noted that low response rates, lower than 10.0%, are often found in travel behavior studies (Ben-Elia, Alexander, Hubers, & Ettema, 2014; Cao, 2012; De Vos, Mokhtarian, Schwanen, Van Acker, & Witlox, 2016a). However, since the main goal of this study is an analytical exploration of the relationship between the independent variables and travel behavior, it is more important to have a large and sufficiently diverse sample than to have a fully representative sample (Groves, 1989). Since our sample size is relatively large and comparable with the sample sizes in many other travel behavior studies, it is possible to estimate the coefficients to characterize specific relationships with reasonable confidence and precision.

A distinction was made between students who commute to Ghent and students who live in student dorms in Ghent. The sample includes 62.8% commuting students and 37.2% students who lived in student dorms. More than half of the students (59.2%) lived in an urbanized environment. Most of the students (81.9%) were born in 1995 and were 18 years old at the time of the survey. Almost three-quarters of the students were women (72.8%). Almost one-third of the students (30.0%) held a driver's license and more than half of the households (60.5%) owned two cars.

3.2   Conceptual framework

Explaining travel behavior is rather complex. This complexity is shown in Figure 1, presenting a conceptual model of travel behavior during the transition from secondary to higher education (based on Van Acker, van Wee, & Witlox, 2010). This conceptual model will be used to organize this research.
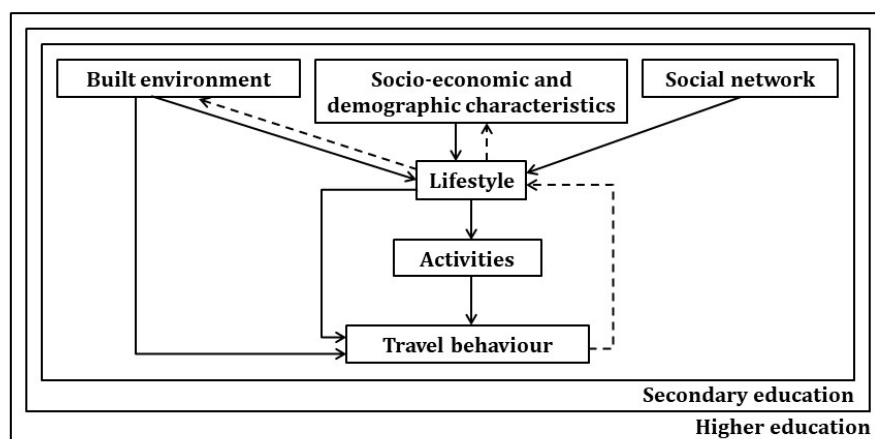

Figure 1: Conceptual model of travel behavior during the transition from secondary to higher education

Lifestyles can affect the choice to live in a particular residential area, but the residential area of young adults is mainly determined by the parents' residential location choice. In this case, the influence of the built environment on lifestyles will be more important. The built environment can also have a direct effect on travel behavior. The socio-economic and demographic (SED) characteristics, such as the family situation, level of education, car ownership or availability, age, and gender, can have an influence on lifestyle. But lifestyles can also affect socio-economic characteristics. Young adults who are more climate aware might be less likely to obtain a driver's license or buy a personal car. Socio-economic and demographic characteristics can also have a direct effect on travel behavior. If a young adult belongs to a single parent household it is possible that there is less money available to use a car. Furthermore, family, friends, other students, and acquaintances can have an impact on the lifestyle of a young adult or even directly on travel behaviorr. This young adult can also influence his or her social network, which is included in the person's lifestyle. A lifestyle is often linked with performing specific activities. These activities are spatially spread, influencing elements such as travel distance and the travel mode choice. People can choose different travel modes partly based on their lifestyle. Travel behavior also tends to strengthen mobility-related attitudes (Kroesen, Handy, & Chorus, 2017). Travel behavior of first-year university or university college students can be influenced by their travel behavior in secondary school. As a result, travel behavior during secondary education is in the conceptual model in Figure 1 embedded within travel behavior during higher education.

3.3   Descriptive analysis

A descriptive analysis shows the past and current modal split for pupils and students to school, grocery stores and fun shops. For going to school, pupils mainly used the bicycle (49.5%) during secondary education, which was followed by 26.0% who used the bus or tram. A subdivision between pupils inside and outside Ghent shows that inside Ghent 61.5% travelled by bicycle and 19.2% by bus or tram, and that outside Ghent 47.7% cycled and 27.0% used the bus or tram to go to school (inside N = 52 and outside N = 352). Compared to outside Ghent, pupils inside Ghent cycled more and made less use of bus or tram. Students who are currently living in student dorms in Ghent mainly cycle to university or university college (64.2%), followed by walking (24.5%). Students commuting to Ghent mainly travel by public transport (train 53.8% and bus or tram 22.5%). A large proportion of students living in Ghent now goes to the university or university college by foot and many commuting students go by train.

For grocery shopping, the car was most commonly used by pupils as a passenger (55.0%), followed by the bicycle (22.0%). Inside Ghent 46.2% travelled as a car passenger and 34.6% by bicycle, and outside Ghent 56.3% travelled as a car passenger and 20.2% cycled. Inside Ghent, pupils cycled again more and made less use of the car as a passenger. Students who live in student dorms mainly go grocery shopping on foot (46.6%) or by bicycle (45.0%). If students who commute go grocery shopping it is mainly by car as a passenger (42.3%), followed by the bicycle (24.5%). The modal choice of commuting students does not change much compared to when they were in secondary school, however, a reasonable share now goes grocery shopping by car as a driver (14.6%).

For fun shopping, pupils travelled mainly by car as a passenger (47.0%), or by bus or tram (20.0%). Inside Ghent 23.1% travelled as a car passenger and 34.6% by bus or tram, and outside Ghent 50.6% travelled as a car passenger and 17.9% by bus or tram. Inside Ghent, pupils made less use of the car as a passenger and more of the bus or tram. Students who live in student dorms mainly go fun shopping by bicycle (47.7%) or on foot (27.8%). Students who commute make use of the car as a passenger (34.0%) with family and friends to go fun shopping. They also use the bus or tram (29.2%) to go fun shopping.

Commuting students probably travel now less by car as a passenger and more by bus or tram to shops. The modal choice of students living in Ghent appears to change more than that of commuting students.

3.4   Statistical method

Travel behavior of participating students was analyzed using logistic regressions. This statistical method examines the probability that a person chooses a specific travel mode for a particular activity. For this study, we look at the probability that a student used or uses the car as a driver or passenger to school, grocery stores, and fun shops. This probability is influenced by elements ranging from socio-economic and demographic characteristics, the built environment, the social network, lifestyles to trip characteristics. The variables were added in SPSS 25 in a hierarchical way in different blocks with the use of the conditional forward selection method. The first block includes the socio-economic[1] and demographic characteristics, followed by the built environment, the social network[1] , lifestyles, and trip characteristics. This method adds the variables that contribute the most to the model until the model cannot be further improved. The socio-economic and demographic characteristics block includes gender (woman or man), presence of siblings (Y/N), dual-earner household (Y/N), the obtained level of secondary education (general secondary education or technical and vocational secondary education), holding a (permanent) driver's license (Y/N), possession of a car (Y/N), possession of a bicycle (Y/N), and car availability in the household (Y/N). The built environment comprises the urbanized or rural environment based on a classification using the postal code[2] of the respondents' residential location. The division between urban and rural residents is based on the "Spatial Structure Plan for Flanders" (Ministerie van de Vlaamse Gemeenschap, 1997). This spatial structure plan divides the Flemish municipalities into categories ranging from metropolitan areas to countryside. We consider respondents residing in metropolitan areas to small urban areas as urban residents and respondents residing outside such urban areas as rural residents. Note that this subdivision is rather crude and may have its shortcomings.[3] Gradual differences in residential neighborhoods are not included in the analyses. Besides, the subdivision is based on administrative units which do not necessarily correspond with the actual built environment. However, as this classification of urban and rural municipalities is of big importance in the "Spatial Structure Plan for Flanders" it has the advantage of putting forward potential spatial planning interventions possibly discouraging car use of students. Furthermore, it has to be noted that Flemish municipalities are relatively small (i.e., average surface area is 43.9 km^2)—making the subdivision relatively detailed—and that this subdivision has also been used in other empirical studies (De Vos et al., 2012; De Vos, van Acker, & Witlox, 2016b). The social networks block includes the travel companions (alone, with friends, family, pupils/students, acquaintances, and strangers) toward a specific activity and a trend (overall decrease, no change, or increase) in the number of family, friends, and acquaintances. The lifestyle incorporates attitudes toward mobility in general, past and current attitudes toward specific travel modes (see Section 3.5), and the perceived features of the car (good for my image, independency, environmentally friendly, healthy, relaxing, comfortable, time saving, flexible, cheap, offering privacy, social, safe, reliable, and possibility to perform other activities). To conclude, the trip characteristic travel distance (< 500 meters, 500 m – 1 km, 1 – 2 km, 2 – 5 km, 5 – 10 km, 10 – 20 km, > 20 km) was added to the model. To get an explorative insight into the relationship between the independent variables and travel behavior, the current

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[1]Only partly used for explaining the past travel behaviour.

[2]We do not have the exact residential location of the respondents. Because of this, it is not possible to add specific elements that define the built environment, such as the distance to the closest city center, accessibility, density, diversity, and design.

[3]A more extensive subdivision of respondents based on their residential location was possible. However, we chose not to do so because the distinction between the various urban and suburban neighbourhoods is often difficult to make as suburban neighbourhoods in Flanders, Belgium, are rather diverse and predominantly urbanised (Meeus and De Decker, 2013); while the differences in neighbourhoods between rural municipalities and the group of urban municipalities is most clear.

travel behavior of higher education students will be compared with their past travel behavior during secondary education, using various logistic regressions. The data are cross-sectional and can therefore only give an indication about how students' travel behavior has changed.

3.5   Lifestyles

The lifestyle concept needs to be defined before it is added to the statistical model. Using common factor analysis, the concept was defined by exploring the constructs behind the current attitudes toward mobility in general, the past attitudes toward travel modes, and the current attitudes toward travel modes. Respondents were asked to indicate on a 5-point Likert scale (1 = totally disagree, to 5 = totally agree) how much they agree with general statements about mobility, such as "I like to travel". Respondents were also asked to score (with 0 = highly dissatisfied, to 10 = highly satisfied) different travel modes now and in the past. To facilitate the interpretation, a promax rotation was used. A factor analysis, however, is only useful if the initial variables are correlated. This was tested with the Kaiser-Meyer-Olkin Measure of Sampling Adequacy that must be larger than 0.50 and the Bartlett's Test of Sphericity which tests the null hypothesis and suggests that the correlation matrix is equal to the identity matrix. Factor loadings greater than 0.20 in magnitude explain a considerable amount of variance from the original variable. For the different cases, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy is larger than 0.50 and the null hypothesis can be rejected.

Table 1: Pattern matrix of general attitudes toward mobility (N = 404)

	Travel liking	Pro-car	Travel disliking
I like to travel	0.674		
Travelling is a waste of time	-0.661		
The majority of my friends have a car		0.576	
People look down on public transport, cycling and walking		0.484	
People expect that I buy a car in the next 10 years		0.406	
I feel frustrated in traffic			0.701
I feel safe in traffic			-0.349
I think public transport is complicated			0.260
54.4% explained variance			

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.568

Bartlett's Test of Sphericity: χ^2 = 245.475; df = 28; p = 0.000

The attitudes toward mobility in general are shown in Table 1. Three possible factors can be identified: travel liking, pro-car, and travel disliking. Travel liking refers to students who like to travel and do not see travel as a waste of time. Pro-car refers to students who are influenced by people in their environment who have a car, they perceive that people in general look down on other travel modes than the car, and they sense a social pressure to obtain a driver's license and buy a car in the future. Travel disliking refers to students who feel frustrated in traffic, do not feel safe in traffic, and think that public transport is rather complicated.

Based on the past attitudes toward travel modes, two possible factors are identified: pro-active and public transport (PT), and pro-car/motorcycle (Table 2). During secondary education, students with pro-active and PT attitudes valued travelling by foot, bicycle, and public transport better. While students with pro-car/motorcycle attitudes appreciated travelling by car or motorcycle.

Table 2: Pattern matrix of past attitudes toward travel modes (N = 404)

	Pro-active and PT	Pro-car/motorcycle
By foot	0.583	
Bicycle	0.561	
Train	0.470	
Bus or tram	0.419	
Car		0.661
Motorcycle		0.316
50.6% explained variance		

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.615

Bartlett's Test of Sphericity: χ^2 = 187.863; df = 15; p = 0.000

Besides the past attitudes, also the current attitudes toward travel modes were examined. Based on the current attitudes toward travel modes, three possible factors are identified: pro-active, pro-PT, and pro-car/motorcycle (Table 3). Students with pro-active attitudes appreciate travelling by foot or bicycle. Students with pro-PT attitudes value travelling by bus, tram or train better. Students with pro-car/motorcycle attitudes rate travelling by car or motorcycle better. Based on Table 2 and Table 3, it can be argued that respondents' travel preferences have become more diverse. While respondents' past attitudes toward active travel and public transport seem to be considerably correlated (as the representing variables are grouped together in one factor), their current attitudes toward active travel and public transport are less correlated (as the representing variables are split in two factors).

Table 3: Pattern matrix of current attitudes toward travel modes (N = 404)

	Pro-active	Pro-PT	Pro-car/motorcycle
Bicycle	0.760		
By foot	0.458		
Bus or tram		0.604	
Train		0.553	
Car			0.492
Motorcycle			0.449
67.7% explained variance			

Kaiser-Meyer-Olkin Measure of Sampling Adequacy: 0.618

Bartlett's Test of Sphericity: χ^2 = 205.885; df = 15; p = 0.000

4   Results

The past and current impact of socio-economic and demographic (SED) characteristics, the built environment, the social network, the lifestyle, and trip characteristics on the choice of travel mode to school, grocery stores, and fun shops will be analyzed. As it is important to get a better understanding of why young adults up till now still use the car so often, we will focus on car use. The car is however barely used to go to school, grocery shopping, or fun shopping by students living in student dorms. Therefore, car use of students in dorms will be disregarded. All the variables in the models are significant at the 95% confidence level. The tables also include some non-significant p-values, which is a shortcoming of the conditional forward selection method used.

4.1   Trips to school

In the past, no pupils went to school by car alone, the chosen reference category to define the travel company in "Block 3: Social network." If they went to school by car, all pupils were accompanied by family, other pupils, or friends. Because there is no variation in this social network variable, we chose to adjust our model by removing this block. The choice to commute to school by car was, according to our model, only influenced by the lifestyle. It appears that pupils who liked to travel by car or motorcycle and tend to find car use rather cheap, were more likely to travel by car. There was already a positive attitude toward cars present. However, the perceived low price to use the car reflects more the travel behavior of the parents than that of the pupils. If we consider Nagelkerke R^2, the lifestyle variables only contribute to a limited extent in explaining car use variance of pupils to secondary school (Table 4).

Table 4: Past travel behavior of pupils to school by car (N = 249)

	B	S.E.	Wald	df	Sig.	Exp(B)
Block 1: SED characteristics						
-						
Block 2: Built environment						
-						
Block 3: Lifestyle						
Pro-car/motorcycle attitude	1.182	0.427	7.668	1	0.006	3.260
Feature car:						
Cheap	1.999	0.973	4.223	1	0.040	7.381
Block 4: Trip characteristics						
-						
Constant	-2.577	0.279	85.086	1	0.000	0.076
Model Fit	**Chi²**	**df**	**Sig.**	**-2LL**	**Cox & Snell R²**	**Nagelkerke R²**
Block 1: SED characteristics	-					
+ Block 2: Built environment	-					
+ Block 3: Lifestyle	12.489	2	0.002	145.410	0.049	0.104
+ Block 4: Trip characteristics	-					

To analyze the current travel behavior to university or university colleges, we were able to use "Block 3: Social network." The choice to commute by car to higher education institutions is influenced by socio-economic and demographic (SED) characteristics, the built environment, and the lifestyle (Table 5). Students who hold a degree in general secondary education appear to be more likely to use the car to go to higher education institutions. This can probably be explained by the fact that it is more common to pursue an academic or professional degree at a university or university college following general secondary education. Students holding a driver's license (and owning a personal car) are also more likely to travel by car. Besides the socio-economic and demographic characteristics, the choice to commute by car is also influenced by the residential environment. Students who live in a more rural environment are more likely to use the car. Further, commuting students who like to travel in an active manner are less likely to use the car compared to other travel modes. Commuting students also tend to find car use rather cheap. The independent variables explain a considerable amount of variance in current car use for going to university or university college. A possible explanation for this good fit is that students now have more socio-economic resources, such as a driver's license (and a personal car), to use the car according to their residential location and lifestyle.

Table 5: Current travel behavior of commuting students to school by car (N = 246)

	B	S.E.	Wald	df	Sig.	Exp(B)
Block 1: SED characteristics						
General secondary education	2.288	0.919	6.196	1	0.013	9.859
Owning a driver's license	2.425	0.764	10.079	1	0.001	11.306
Owning a car	1.160	0.689	2.835	1	0.092	3.190
Block 2: Built environment						
Urbanized environment	-1.695	0.628	7.280	1	0.007	0.184
Block 3: Social network						
-						
Block 4: Lifestyle						
Pro-active attitude	-0.683	0.316	4.659	1	0.031	0.505
Feature car:						
Cheap	2.878	1.356	4.506	1	0.034	17.786
Block 5: Trip characteristics						
-						
Constant	-5.736	1.145	25.099	1	0.000	0.003
Model Fit	**Chi²**	**df**	**Sig.**	**-2LL**	**Cox & Snell R²**	**Nagelkerke R²**
Block 1: SED characteristics	41.012	3	0.000	97.700	0.154	0.356
+ Block 2: Built environment	48.883	4	0.000	89.829	0.180	0.418
+ Block 3: Social network	-					
+ Block 4: Lifestyle	57.094	6	0.000	81.618	0.207	0.481
+ Block 5: Trip characteristics	-					

4.2 Trips to grocery stores

Travel behavior during secondary school was probably influenced by socio-economic and demographic characteristics, the social network, and the lifestyle (Table 6). Pupils who have two working parents have a higher probability to go grocery shopping by car. If the trip was made with family members, there appeared to be a larger probability that the car was being used. In the past however, it were mainly the parents that made the decision to go grocery shopping by car and not the pupil, but it does give an indication of the image that pupils get during secondary education of the combination of car use and grocery shopping. Safety is for this activity not necessarily associated with car use. The contribution of the independent variables in explaining the variance of past car use to grocery stores can be considered as good.

Table 6: Past travel behavior of pupils to grocery stores by car (N = 232)

	B	S.E.	Wald	df	Sig.	Exp(B)
Block 1: SED characteristics						
Dual-earner household	1.464	0.659	4.936	1	0.026	4.325
Block 2: Built environment						
-						
Block 3: Social network						
Travel company (ref. nobody):			68.198	4	0.000	
Friends	1.344	0.772	3.028	1	0.082	3.834
Family	4.591	0.582	62.224	1	0.000	98.593
Pupils	-18.447	17,186.502	0.000	1	0.999	0.000
Acquaintances	23.202	40,192.969	0.000	1	1.000	11,928,391,843.941
Block 4: Lifestyle						
Feature car:						
Safe	-1.785	0.468	14.522	1	0.000	0.168
Block 5: Trip characteristics						
-						
Constant	-3.464	0.775	19.964	1	0.000	0.031
Model Fit	**Chi²**	**df**	**Sig.**	**-2LL**	**Cox & Snell R²**	**Nagelkerke R²**
Block 1: SED characteristics	3.937	1	0.047	310.752	0.017	0.023
+ Block 2: Built environment	-					
+ Block 3: Social network	133.885	5	0.000	180.804	0.438	0.591
+ Block 4: Lifestyle	150.253	6	0.000	164.436	0.477	0.642
+ Block 5: Trip characteristics	-					

Travel behavior of commuting students who go grocery shopping by car is influenced by almost the same blocks as in the past but in a slightly different way (Table 7). Holding a driver's license increases the probability of using a car to go grocery shopping. The car is probably mostly used if the trip is made with family. If students attach importance to comfort, there appears to be a larger probability that they will use the car to go grocery shopping. But safety is probably also for this activity not necessarily associated with car use. The overall travel distance is significant. The car is probably used for rather medium-long distances. The individual travel distances are however not significant, which is presumably caused by a low presence of students who actually travel by car in the used last reference category of > 20 km (2.5%), while there were even no observations in the first category. The model of the current travel behavior is rather similar to that of the past travel behavior, and the independent variables also explain a large amount of variance in the dependent variable. But there are some differences noticeable. Holding a driver's license is an important element that can facilitate students' car use. The influence of the social network, especially the parents, remains important but appears to be less strong (given the somewhat lower contribution by this block in the current model compared to the past model). The attitude toward the car, appreciating comfort, is now more intuitively understandable than in the past.

Table 7: Current travel behavior of commuting students to grocery stores by car (N = 230)

	B	S.E.	Wald	df	Sig.	Exp(B)
Block 1: SED characteristics						
Woman	0.565	0.472	1.433	1	0.231	1.760
Owning a driver's license	2.987	0.634	22.183	1	0.000	19.825
Car availability	0.354	0.447	0.627	1	0.429	1.424
Block 2: Built environment						
-						
Block 3: Social network						
Travel company (ref. nobody):			39.621	3	0.000	
Friends	0.893	0.814	1.203	1	0.273	2.442
Family	3.334	0.543	37.698	1	0.000	28.060
Students	-19.003	40,192.970	0.000	1	1.000	0.000
Block 4: Lifestyle						
Feature car:						
Comfort	1.788	0.527	11.515	1	0.001	5.979
Safety	-0.762	0.447	2.904	1	0.088	0.467
Block 5: Trip characteristics						
Distance (ref. > 20 km):			13.898	6	0.031	
< 500 m	-22.298	10,928.836	0.000	1	0.998	0.000
500 m – 1 km	-0.821	1.447	0.322	1	0.570	0.440
1 – 2 km	-0.313	1.418	0.049	1	0.825	0.731
2 – 5 km	1.156	1.420	0.663	1	0.416	3.176
5 – 10 km	1.044	1.449	0.519	1	0.471	2.841
10 – 20 km	0.226	1.586	0.020	1	0.887	1.254
Constant	-4.215	1.575	7.157	1	0.007	0.015

Model Fit	Chi²	df	Sig.	-2LL	Cox & Snell R²	Nagelkerke R²
Block 1: SED characteristics	36.697	3	0.000	272.059	0.147	0.200
+ Block 2: Built environment	-					
+ Block 3: Social network	109.949	6	0.000	198.807	0.380	0.514
+ Block 4: Lifestyle	122.386	8	0.000	186.371	0.413	0.559
+ Block 5: Trip characteristics	153.027	14	0.000	155.729	0.486	0.658

4.3 Fun shopping trips

When students were in secondary school, fun shopping by car was mostly explained by their social network and the lifestyle (Table 8). If the fun shopping trip was made in the company of family, there was a higher probability that the car was being used compared to other travel modes. If the travel company consisted of friends or other pupils, they were probably also more likely to use the car to make the trip. Pupils who do not like to travel or like to travel by car were also more likely to use the car to go fun shopping. These independent variables explain a considerable amount of the variance in the dependent variable.

Table 8: Past travel behavior of pupils for fun shopping by car (N = 238)

	B	S.E.	Wald	df	Sig.	Exp(B)
Block 1: SED characteristics						
-						
Block 2: Built environment						
-						
Block 3: Social network						
Travel company (ref. nobody):			55.563	4	0.000	
Friends	1.270	0.787	2.600	1	0.107	3.560
Family	3.703	0.802	21.307	1	0.000	40.566
Pupils	1.265	0.900	1.975	1	0.160	3.544
Strangers	-19.908	40,192.970	0.000	1	1.000	0.000
Block 4: Lifestyle						
Travel liking attitude	-0.517	0.196	6.945	1	0.008	0.596
Pro-car attitude	0.713	0.227	9.919	1	0.002	2.041
Block 5: Trip characteristics						
-						
Constant	-2.478	0.756	10.734	1	0.001	0.084
Model Fit	**Chi²**	**df**	**Sig.**	**-2LL**	**Cox & Snell R²**	**Nagelkerke R²**
Block 1: SED characteristics	-					
+ Block 2: Built environment	-					
+ Block 3: Social network	65.177	4	0.000	262.337	0.240	0.321
+ Block 4: Lifestyle	80.531	6	0.000	246.983	0.287	0.384
+ Block 5: Trip characteristics	-					

Travel behavior of students who commute to Ghent and go fun shopping by car is mostly explained by socio-economic and demographic characteristics, the social network, and the lifestyle (Table 9). Commuting students who have brothers or sisters are more likely to go fun shopping by car. Students with a personal car (and a car at their disposal) are also more likely to use the car. The chance to use the car to go fun shopping increases if the trip is made with family members. The car is probably preferred by students who dislike travel and who want to travel independently by car or motorcycle. The car is probably less used for rather short distances, as can be seen for 1 – 2 km. This is however not visible for < 500 m and 500 m – 1 km, which is presumably caused by a low presence of students who actually travel by car in these categories, respectively 0.8% and 3.3%. The overall travel distance is also not significant. The contribution of the independent variables in explaining the variance of car use for fun shopping is satisfactory. Compared to the model of the past, there is again a stronger influence of socio-economic and demographic characteristics. The influence of the social network, in particular the family, seems to be less strong and it appears that lifestyles are becoming somewhat more important.

Table 9: Current travel behavior of commuting students for fun shopping by car (N = 232)

	B	S.E.	Wald	df	Sig.	Exp(B)
Block 1: SED characteristics						
Brothers or sisters	1.477	0.531	7.731	1	0.005	4.378
Owning a car	1.156	0.469	6.082	1	0.014	3.177
Car availability	0.663	0.412	2.591	1	0.107	1.940
Block 2: Built environment						
Urbanized environment	-0.565	0.402	1.973	1	0.160	0.568
Block 3: Social network						
Travel company (ref. nobody):			38.778	4	0.000	
Friends	1.485	1.112	1.784	1	0.182	4.415
Family	3.891	1.116	12.161	1	0.000	48.938
Students	2.677	1.440	3.453	1	0.063	14.536
Strangers	-17.876	27371.069	0.000	1	0.999	0.000
Block 4: Lifestyle						
Travel disliking attitude	0.419	0.248	2.843	1	0.092	1.520
Pro-PT attitude	-0.750	0.263	8.147	1	0.004	0.472
Pro-car/motorcycle attitude	0.985	0.355	7.720	1	0.005	2.678
Block 5: Trip characteristics						
Distance (ref. > 20 km):			11.433	6	0.076	
< 500 m	-21.291	28395.552	0.000	1	0.999	0.000
500 m – 1 km	-0.649	1.134	0.328	1	0.567	0.522
1 – 2 km	-2.503	1.163	4.629	1	0.031	0.082
2 – 5 km	-0.479	0.679	0.498	1	0.481	0.620
5 – 10 km	-0.681	0.527	1.669	1	0.196	0.506
10 – 20 km	0.617	0.473	1.701	1	0.192	1.853
Constant	-4.366	1.288	11.499	1	0.001	0.013

Model Fit	Chi²	df	Sig.	-2LL	Cox & Snell R²	Nagelkerke R²
Block 1: SED characteristics	33.355	3	0.000	283.837	0.134	0.180
+ Block 2: Built environment	39.776	4	0.000	277.416	0.158	0.211
+ Block 3: Social network	82.852	8	0.000	234.340	0.300	0.403
+ Block 4: Lifestyle	105.724	11	0.000	211.468	0.366	0.491
+ Block 5: Trip characteristics	122.186	17	0.000	195.006	0.409	0.549

5 Discussion and conclusion

The hierarchical binary logistic regressions show that car use during secondary education is mainly explained by the travel company of family member(s) and lifestyles. These elements also explain modal choice during higher education in combination with socio-economic and demographic characteristics, the built environment and trip characteristics. Socio-economic and demographic characteristics become more outspoken with elements such as holding a driver's license or owning a car when young adults travel to educational institutions, grocery stores and fun shops. These resources facilitate car use according to the students' residential location and lifestyle. Besides the socio-economic and demographic

characteristics, the built environment also becomes more important for going to university or university college by car, but not for doing groceries and fun shopping. If the residential environment is more rural, the chance to use the car to go to educational institutions becomes greater. It also appears that lifestyles become somewhat more important for fun shopping, because a slightly higher amount of variance in car use for fun shopping is being explained by the current lifestyle block compared to that of the past travel behavior. This was also found by Scheiner (2010) and Van Acker et al. (2011). This reflects that the emerging lifestyle becomes more individual and independent from the lifestyle of others, especially the parents, for leisure activities. This finding is also supported by the declining influence of social networks, in particular the family, in our model for fun shopping and grocery shopping. The trip characteristic travel distance seemed only important for current car use to grocery stores and fun shops, whereby young adults who live further away from grocery stores and fun shops are probably more likely to use the car. During the transition from secondary to higher education, the travel behavior of students who came to live in Ghent changed the most, although travel behavior of students commuting to Ghent also changed, but to a lesser extent (see Section 3.3). Based on the analysis of the questions in the questionnaire, it also became clear that young adults still attach importance to a car and feel social pressure to obtain a driver's license and to buy a car in the future.

If policy makers want to alter travel behavior in favor of more sustainable travel modes it is important to influence the variables affecting travel behavior, such as the built environment, lifestyles, and economic characteristics. An environment with a high density and diversity in combination with an adjusted design should encourage the use of public transport, cycling, and walking (Cervero & Kockelman, 1997; De Vos, 2015; Ewing & Cervero, 2010; Næss, 2014; Næss, Cao, & Strand, 2017). Besides changing the built environment, it is also important to influence young adults' attitudes because these are more stable. Our findings indicate that pro-active and pro-public-transport attitudes should be promoted since these related attitudes are associated with more sustainable travel modes. This should be combined with making car ownership and car use more expensive because we found that young adults perceive them as rather cheap. This can be supported by the economic characteristics such as holding a driver's license or owning a car that facilitate car use. Making it more difficult to obtain a driver's license and to buy or use a car can discourage car use. It is also important to note that the political planning horizon is rather short to change travel behavior if we keep in mind that attitudes will probably remain constant in the short term (Munters, 1992). If policy makers can develop a uniform policy over the long term, it should be possible to shape travel behavior of children in favor of more sustainable travel modes, for instance through educational programs.

Further research about travel behavior and young adults is necessary because this group is often neglected in scientific research. It is important to get a better understanding of young adults' travel behavior, especially because they develop their own defined lifestyle. The survey used in this paper, but also most other travel-related surveys, focuses on the individual student with a limited reference to wider social influences like impacts from parents and friends. The effect of the social environment provides interesting avenues for further research. This social environment of parents and friends can have a direct influence on travel behavior (as already indicated by our analysis), but an indirect influence might also exist, e.g., through the interaction with attitudes. Previous research has already indicated that family and friends might have an important influence on personal mobility attitudes (Baslington, 2008; Döring, Albrecht, Scheiner, & Holz-Rau, 2014; Döring et al., 2015; Emond & Handy, 2012; Haustein et al., 2009; Klöckner & Matthies, 2012). Such indirect effects can be best analyzed with structural equation modelling (SEM). SEM can be considered as a set of simultaneously estimated interrelated regressions where a variable can be an independent variable in one regression and at the same time a dependent variable in another regression. This could give us better insights into mobility socialization and could

explain young people's attitudes toward car use even better. SEM was not used in this paper because this current research is rather explorative. Furthermore, SEM can be quite data intensive. A general rule of thumb is that sample sizes need to be at least ten times the number of variables in the model. However, this might increase rapidly depending on type of SEM, multivariate non-normality of the data, model complexity, etc. (Hair, Hult, Ringle, & Sarstedt, 2013). Travel behavior of students in higher education seems to be rather sustainable, but this does not imply that this behavior will be pursued in the future when they start searching for a job, have a job, or relocate. The data we used are not longitudinal and only give an indication about how travel behavior has changed. It would also be interesting to set up a panel study to analyze these possible changes more thoroughly through time.

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