A Value-Based Approach to Assess the Impact of Life-Styles on Mode Shares

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Initial Word Count: 4,716 words + 6 table (250 words per table) = 6,216 words
Revised Word Count: 5,797 words + 6 table (250 words per table) = 7,297 words

ABSTRACT

Travel behavior research has long been dominated by a rational perspective considering primarily objective factors such as price, travel time, and speed. Only at the end of the 1990s, attention was also paid to subjective factors such as perceptions and attitudes. Since then, a growing number of studies combine objective and subjective factors in explaining travel behavior. This paper adds to this by focusing on the influence of life-styles on mode share. To this end, an online survey was carried out in Belgium, completed successfully by 334 respondents. Life-styles were measured based on a psychographic or value-based approach using the Portrait Values Questionnaire (PVQ) developed by Schwartz. Results of a structural equation model indicate that using value-based life-styles adds new insights to the analysis of mode share. Personal values have not only a direct effect on mode share but also an indirect effect due to interactions with urban residential location choices, car ownership decisions, and activity patterns. The findings suggest that public transport use could be encouraged by promoting it as an act of caring for others. At the same time, policy-makers should invest in creating positive experiences for travelers using public transport.

Keywords: mode share, life-styles, personal values, structural equation model

INTRODUCTION

A long-standing tradition now exists in research on the interaction between the built environment and travel behavior (*1, 2*). Many studies try to model and measure this relationship while controlling for socio-economic and demographic (SED) differences among individuals and households. However, different travel patterns can still be found within similar neighborhoods or within similar socio-economic and demographic population groups. This heterogeneity is (partly) due to the existence of personal life-styles. However, empirical studies on the influence of life-styles are rather scarce in travel behavior research. Moreover, the way in which theses studies measure is questionable. Therefore, this paper aims at contributing to the state-of-the-art by using a value-based approach of the 'life-style' concept in explaining travel behavior. More specifically, this paper analyses how personal values influence mode share, while also accounting for the interaction with decisions related to residential location, car ownership, and activity patterns. By focusing on values, this paper addresses deeply-rooted and abstract motivations that are likely to influence personal attitudes and travel behavior such as mode share (*3*). Personal life-styles have become more important in explaining the social structure of present-day's modern society (*4*). Modern society is much more focused on consumption than production compared to the former industrial society whose social structure used to be dominated by strict(er) social class membership. During the last decennia, prosperity increased, resulting in a higher number of possibilities to choose from. Moreover, the social burden to behave uniformly disappeared because of increasing individualization and decreasing social control. These processes resulted in people leading different personal life-styles (*5-6*). Consequently, taking life-styles into account besides the traditionally used variables in travel modeling might provide us with interesting insights in explaining variations in travel behavior. Although the first empirical life-style studies already date back to the 1960s-1980s, it was until the 2000s that travel behavior researchers became interested in the link between life-styles and travel behavior. Since then, many researchers claim to have studied travel behavior in relation to life-styles, but actually use very different approaches.

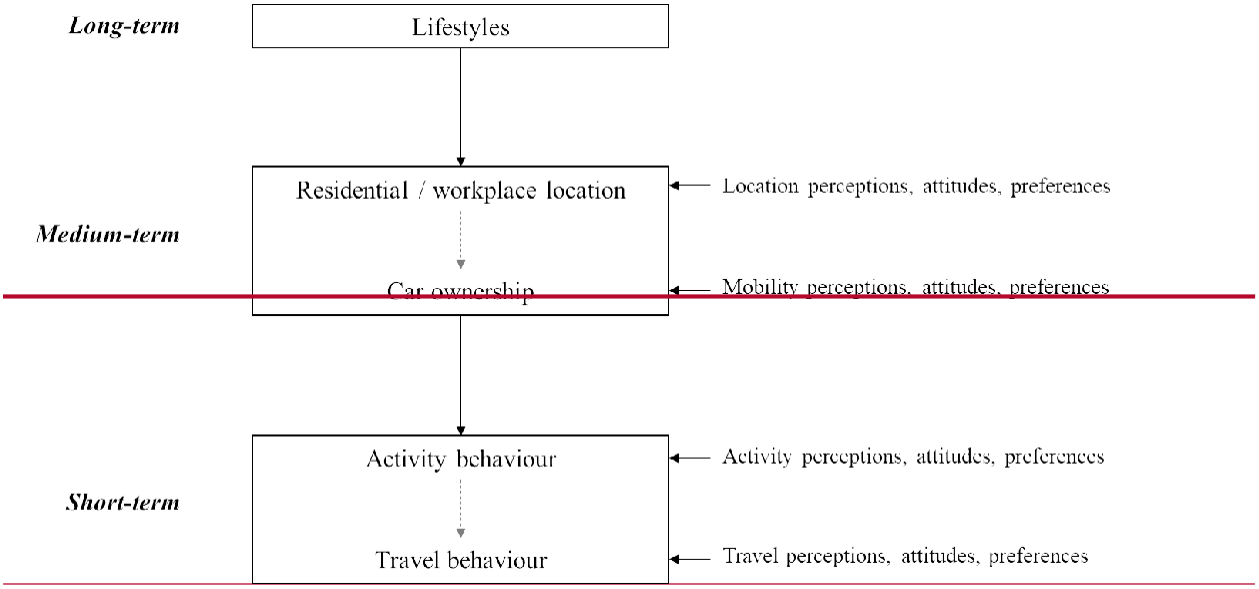
Van Acker (*7*) presented a structured overview of definitions and measurement methods. From this overview, it becomes clear that a distinct definition of 'life-styles' is hard to find. Nevertheless, one essential aspect that all definitions (e.g., *8-10*) share, is the communicative character of life-styles referring to the way an individual indicates his or her social position towards others. Many empirical studies, therefore, focused on specific patterns of behavior, mainly in consumption and leisure behavior, through which individuals might portray their social position. However, academics like Ganzeboom (*10*) argue that life-styles include much more than only observable patterns of behavior. It also refers to opinions and motivations, including attitudes, beliefs, and values. For that reason, it is important to distinguish 'life-styles' from 'life-style expressions' (*11*). In that way, 'life-styles' refer to the individual's opinions and motivations, which manifests themselves through observable patterns of behavior or 'life-style expressions'. This distinction is important to keep in mind, and when applied to this paper, values should be considered as 'life-styles' and mode share as 'life-style expressions'. The methodology of structural equation modeling (SEM) used in this paper will illustrate how values are related to mode share.

LITERATURE REVIEW

Applications of life-style in travel behavior research are mainly in activity-based travel modeling studies. By using the concept of 'life-style', activity-based studies seek to make significant progress toward a more behavioral framework for simulating individual and household

travel behavior. Within this behavioral approach to travel behavior, daily travel patterns are often considered within a hierarchical decision structure (e.g., *12-13*). This hierarchy ranges from short-term decisions on daily activities and travel (such as activity type, activity duration, destination, route, and mode), to medium-term decisions on vehicle ownership, residential and workplace location, and long-term decisions on life-styles (such as family formation, participation in the labour force and orientation toward leisure). It is assumed that within each time block, decisions are made jointly, but decisions in the lower block are made conditional on those in the upper block. Furthermore, these decisions are determined by reasoned influences such as perceptions, attitudes, and preferences (*14*) (see Figure 1). This hierarchical decision structure is based on the influential work by Salomon (*15*), who was one of the first explicitly using the concept of 'life-style' in travel behavior research. Alongside Salomon, the work by Kitamura (*16*) was also very influential because of his argument that the unexplained individual-specific effect in traditional travel studies could arise from the individual's life-style.

Since then, many researchers claim to study life-styles in relation to travel behavior but actually use very different approaches. This literature review, therefore, starts with an overview of different approaches to measuring life-styles.



<FIGURE 1 ABOUT HERE>

Life-styles are measured in different ways (for an overview, see *7*, *17*), but not all approaches are used equally frequently in travel behavior research. The research field is dominated by a demographic, a mechanistic, and a sociographic life-style approach.

Various empirical travel behavior studies (e.g. *18-19*) analyze what they would call life-styles, but in fact combine various objective socio-economic and demographic (SED) characteristics of the individual and the household. This is known as a demographic life-style approach, which rather measures stage of life or household composition than life-styles. Statistical techniques such as cluster and factor analysis are frequently used to determine stage of life groups like youngsters, households with young children, single-parent families, and the elderly. Other studies like Ardeshiri and Vij (*20*) use SED variables as covariates in latent class membership

models explaining the latent construct of modality styles, denoting those aspects of life-styles that are constructed around the use of one or more travel modes.

The advantage of this demographic life-style approach approach is that data on SED characteristics are widely available. However, such a demographic approach is not the best one to measure life-styles given its limited ability to relate to the social position of individuals, which is a key aspect of the life-style definition as described in the Introduction. SED characteristics do not necessarily reflect how people want to represent themselves towards other people socially. Therefore, it is questionable whether a demographic approach can be considered appropriate to measure life-styles. A mechanistic life-style approach is another frequently used approach in travel behavior research. It considers the simplest content of the life-style concept by focusing on specific patterns in time use and activity behavior, and thus resembles 'life-style expressions'. Studies like Bagley and Mokhtarian (*21*) and Van Acker et al. (*22*) asked respondents to indicate from a list with interests and activities, among others, what types of subjects they had read last month, how they spent their last weekend and what type of leisure activities they had conducted within the last year. They used factor analysis to identify life-style factors such as culture lover, family-oriented, and adventurous. These studies thus clearly use behavioral patterns, especially in the field of leisure, as life-styles measurements. Etminani-Ghasrodashti and Ardeshiri (*23*) remarked that this is less relevant in developing societies where four basic social fields of economics, politics, culture, and religion remain closely tied and connected compared to wealthier and more developed countries.

A third frequently used approach is a sociographic life-style approach. This approach goes beyond observable patterns of behavior like in the mechanistic life-style approach. Instead it focuses on individual opinions and attitudes that might determine these behaviors. Studies like Collantes and Mokhtarian (*24*) asked respondents their opinion on statements related to work, family, money, status, and the value of time. The number of statements was then reduced by factor analysis in life-style factors such as status seeker, workaholic, and family-oriented. Walker and Li (*25*) provide a good overview of empirical studies using such a sociographic life-style approach based on attitudes.

Van Acker (*7*) compared the use of the three previously mentioned approaches. Using data of an Internet survey organized in 2007 in Flanders, Belgium, she found no striking differences between the three life-style approaches in relation to active travel for leisure activities. The results were somewhat different for car use. A sociographic approach based on opinions and attitudes related to work, family, and leisure time did not obtain significant results. Only a demographic and mechanistic approach indicated that differences in car use are partly due to personal life-styles. Moreover, the best model fit was obtained in the analysis using a mechanistic life-style approach.

In addition to the demographic, mechanistic, and sociographic approaches that use information on respectively SED characteristics, time use and activity patterns, and individual opinions and attitudes, two more life-style approaches exist, i.e., a psychographic and a cultural approach (*7, 26*). Both approaches focus on values. A psychographic approach analyses values at the individual level, while a cultural approach considers values at a group level. While attitudes and behavior are prone to change over time, values are more stable and persistent (*27-29*). However, research on values in travel behavior is rather limited so far. One exception is the study by Paulssen et al. (*30*). They found that personal values of power, hedonism, and security affect individual mobility attitudes towards flexibility, comfort and convenience, and ownership, which in turn influence the mode choices (in this analysis defined as public transport versus car use).

In this paper, we will explore the usefulness of using other subjective factors than the frequently used opinions and attitudes in defining life-styles. We will instead focus on personal values and, consequently, use a psychographic life-style approach. The next section, therefore, describes how we have measured personal values.

RESEARCH DESIGN

Dataset

In order to assess the impact of personal values on mode share, an online survey was carried out in 2016. Data collection was part of a Master thesis. Respondents were recruited using a snowball approach based on the distribution of flyers on-street and on-campus in Brussels, Belgium. The Internet survey was structured in four sections containing questions on (*i*) background socio-economic and demographic characteristics, (*ii*) weekly activities and trips by transport mode, (*iii*) attitudes related to transport mode choices and residential location choices, and finally (*iv*) personal values. Personal values were queried, adopting the formulation used in the European Social Survey. Detailed information on the measurement of personal values is presented in the next section. After data cleaning, we retained a final sample of 334 respondents. Table 1 presents descriptive statistics of the sample.

TABLE 1 Descriptive Statistics of the Sample

	Frequency			
Gender	43% male; 57% female			
Education	16% low; 84% high			
Occupation	49% professional active; 51% not professional active			
Student	32% yes; 68% no			
Income	83% low; 17% high			
Partner	52% yes; 48% no			
Car driving license	83% yes; 17% no			
Season ticket for bus, tram, metro	57% yes; 43% no			
Season ticket for train	11% yes; 89% no			
	Min.	**Max.**	**Mean**	**Std. dev.**
Age	13	79	37.3	16.61
Number of cars per household	0	6	1.2	1.04

Measurement of Personal Values

Our analysis of the influence of personal values is based on the Portrait Values Questionnaire (PVQ) of Schwartz (*31*), which is a modification of the original Schwartz Values Survey (SVS). This is currently the most widely used scale by social scientists for studying individual differences in values. Previous research has indicated that Schwartz's scale captures more aspects of values than those of others (*32*).

The SVS included 56 value items and claims to embrace all the motivationally distinct values that are recognized across different cultures. Schwarz (*29*) asked schoolteachers and college students from 20 countries to reflect on a list of 56 single values and to indicate the extent to which these values were important as 'guiding principles of one's life'. Based on his examination, he identified a value-based framework both at the level of an individual and a culture. The PVQ was then designed to measure the same values as the SVS but in a less complex way (*33*).

The PVQ questions contain 21 short verbal portraits that describe a person's goals, aspirations, or wishes. Respondents are asked to compare the portrait stated to them and to answer 'How much is this person like you?' on a 6-point Likert scale (with 1 = very much like me, to 6 =

not like me at all). The 21 items of the PVQ are: creativity/originality, wealth, equality for all, show abilities, secure surroundings, new experience, follow rules, understand/listening, inconspicuous/modest, good time/spoil self, free/own decisions, help others, successful, state protect, risk/excitement, behave properly, tell others, loyal/devoted, care for nature, tradition, and fun/pleasure. Our Internet survey used the same formulation as in the original PVQ (*31*). These 21 items can be organized and combined in a specific way so that they measure ten values at the individual level (see Table 2). In this paper, we focus on individuals' mode share. Consequently, we will use Schwartz's framework at the individual level.

TABLE 2 Schwartz's Value-Based Framework (*34*)

Value type at the individual level	Definition	Specific values from 21-item instrument
1. Power	Social status and prestige, control or dominance over people and resource	Wealth, tell others
2. Achievement	Personal success through demonstrating competence according to social standards	Show abilities, successful
3. Hedonism	Pleasure and sensuous gratification for oneself	Good time/spoil self, fun/pleasure
4. Stimulation	Excitement, novelty, and challenge in life	New experience, risk/excitement
5. Self-direction	Independent thought and action - choosing, creating, exploring	Creativity/originality, free/own decisions
6. Universalism	Understanding, appreciation, tolerance, and protection for the welfare of all people and nature	Equality for all, understand/ listening, behave properly
7. Benevolence	Preservation and enhancement of the welfare of people with whom one is in frequent personal contact	Help others, loyal/devoted
8. Tradition	Respect for, commitment to, and acceptance of the customs and ideas that traditional culture or religion impose on the self	Inconspicuous/modest, tradition
9. Conformity	Restraint of actions, inclinations, impulses likely to upset or harm others and to violate social expectations or norms	Follow rules, behave properly
10. Security	Safety, harmony, and stability of society, of relationships, and of self	Secure surroundings, state protect

Other Key Variables

Next to personal values, other key variables in our analysis refer to (*i*) residential location, (*ii*) car ownership, (*iii*) activity behavior, and (*iv*) mode share. Residential location was not questioned directly. However, the survey included two questions that could be used as indicators of residential location. Consequently, residential location will be operationalized as a latent variable in our SEM analysis. Respondents had to indicate the distance from their residence to the nearest public transport stop. 17.7% resides within 500m of a bus, tram, or metro stop, whereas 47.9% resides within 2000m of a railway station. We used these two spatial variables as indicators of an urban location.

Regarding car ownership, the survey asked respondents about the number of cars owned in the household. On average, households own 1.2 cars (see also Table 1).

With respect to activity behavior, respondents were asked how many work, school, leisure, shopping, service, business, drop off and pick-up, and touring activities they do on a weekly basis. Based on this, we calculated the weekly total number of activities. Respondents have on average 15 activities per week.

Concerning mode share, which is treated as the final outcome variable in our SEM analysis, respondents were asked to report their weekly number of trips by various transport modes. Based on this, we calculated the weekly total number of trips and the percentages for each transport mode. Respondents make on average 16 trips per week. The majority of these trips are by car as a driver (32.1%), followed by walking (25.3%) and local public transport (19.2% bus, tram, metro). The share of other transport modes is remarkably lower (10.5% car as passenger; 7.7% bicycle; 4.1% train; 1.1% moped/motorcycle).

The survey also included questions on the underlying motivation of transport mode choices and residential location choices. Respondents were asked to rate on a 7-point Likert scale (1 = not important at all, 7 = extremely important) how important various aspects are in these choices. Since these aspects are highly correlated with each other, a factor analysis (principal axis factoring with

promax rotation) was performed first. The number of factors was determined based on the interpretability of the factors (using factor loadings higher than 0.3) combined with interpretation of the scree-plot and eigenvalues larger than one. This resulted in four mobility related attitudes (i.e., privacy and comfort; time; green and healthy; weather protection – see Table 3) and four residential related attitudes (i.e., safe and pleasant environment; social interaction; accessibility of mandatory work and school activities; accessibility of non-mandatory leisure and social activities – see Table 4).

TABLE 3 Pattern Matrix with Factor Loadings of Four Attitudes towards Mode Choice

	Privacy and comfort	**Time**	**Green and healthy**	**Weather protection**
Eigenvalue	1.793	1.664	1.627	1.588
Privacy-offering	0.734			
Image	0.518			
Comfortable	0.516			
Relaxing	0.430			
Time-saving		0.745		
Reliable		0.638		
Flexible		0.496		
Healthy			0.706	
Environment-friendly			0.628	
Cheap			0.317	
Safe			0.285	
Clothing				0.740
Weather				0.690
Explained variance: 39.6%				

TABLE 4 Pattern Matrix with Factor Loadings of Four Attitudes towards Residential Location

	Safe and pleasant	**Social interaction**	**Accessibility of mandatory work and school activities**	**Accessibility of non-mandatory leisure and social activities**
Eigenvalue	3.316	3.252	2.060	1.531
Social safety. low crime	0.757			
Traffic safety	0.713			
Neatness. tidiness	0.550			
Sufficient parking	0.527			
Appearance of buildings. architecture	0.473			
Quietness	0.411			
Good contact with neighbors		0.772		
Frequent contact with neighbors		0.771		
Presence of bike paths		0.601		
Presence of green areas		0.433		
Presence of sidewalks		0.415		
Close to public transport			0.896	
Close to shops			0.683	
Close to work/school			0.383	
Close to family and friends				0.634
Close to leisure activities				0.493
Explained variance: 47.8%				

Methodology: Structural Equation Model

Based on the available data in our survey, the complex relationships, as depicted in Figure 1, were slightly adjusted to the final model in Figure 2. This model was eventually tested. Note that every variable in the central choice hierarchy is impacting all subsequent variables. This means that, for example, 'life-styles' is not only impacting 'urban residential location' as depicted in Figure 2, but there is also an arrow from 'life-styles' to 'car ownership', 'activity behavior', and 'mode share'. For reasons of clarity, we did not include these additional arrows in Figure 2.

<FIGURE 2 ABOUT HERE>

The relationships as depicted in Figure 2 can be formalized as a series of regression equations. We advance a structural equation model (SEM) instead of simultaneously estimating these equations. In such an approach, a variable can be an explanatory variable in one equation (e.g., car ownership influencing mode share) but an outcome variable in another equation (e.g., car ownership influenced by life-styles). Therefore, the concepts 'exogenous' and 'endogenous' variables are used (*35*-*37*). Exogenous variables are not influenced by any other variable in the model, but instead, exogenous variables influence other variables. Endogenous variables are influenced by exogenous variables, either directly or indirectly, through other endogenous variables.

SEM can be considered as a combination of regression analysis and factor analysis. The regression analysis aspect in a SEM refers to the modeling of all relationships between exogenous and endogenous variables. This is known as 'the structural model' in a SEM. In some cases, some variables can not be observed directly. The so-called 'measurement model' in a SEM, therefore, defines the relationships between such an indirectly observed (or latent) variable and its observed (or manifest) indicators. In our analysis, we will have 'urban residential location' as a latent variable defined by two indicators referring to having a bus stop within 500m from the residence and having a train station within 2000m.

A SEM is estimated by finding the coefficients that best match the resulting model-implied covariance matrix to the empirically-based covariance matrix of the data. As in other statistical techniques, a standard estimation technique is maximum likelihood (ML), which assumes a multivariate normal distribution of all endogenous variables in the model (*36*, *38*). However, the final outcome variable in our analysis, being mode share, is not normally distributed. Therefore, we used ML with bootstrapping. This has been found to be a good alternative for analysis with non-normally distributed data (*35*,*39*). This is also true for travel behavior research, as confirmed by Ory and Mokhtarian (*40*), who compared different empirical models varying in non-normality, sample size, and estimation method. In bootstrapping, multiple sub-samples of the same size as the original sample are drawn randomly to provide data for empirical investigation of the variability of parameter estimates and indices of model fit.

A stepwise approach to modeling was undertaken, starting with modeling the interaction between mode share and its direct influences of activity patterns (in terms of the weekly total number of activities) and the different attitudes towards transport mode choice (as described in Table 3). Only the significant relationships were retained by using a backward selection method. This means that the least significant relationship is dropped first, so long as it is not significant at the chosen critical level (in this case $p < 0.10$). The process then continues by successively refitting reduced models and applying the same rule until all remaining relationships are statistically significant. In a second step, we modeled the interaction with car ownership, then added the urban

residential location factor with its underlying residential location attitudes, and eventually added the value-based life-styles. After this, results were controlled for SED characteristics, and finally, covariances were added between all exogenous variables. This improved model fit without any change in the estimated coefficients. Important to note is that mode shares of all different transport modes were combined into one single SEM analysis. We have not estimated a model for each transport mode separately. Mode shares for different transport modes are dependent on one another, and this dependency was accounted for by adding covariances between the error terms of the mode share of each transport mode considered.

RESULTS

Table 5 summarizes various model fit indices of our final model. A widely used index to determine model fit is the Chi²-statistic, which measures the discrepancy between the observed and model-based covariance matrices. However, Chi²-values increase with sample size and, thus, models based on large sample sizes might be rejected based on their Chi²-value even though small differences exist between the observed and model-based covariance matrices. Therefore, most SEM programs report a dozen of alternative model fit indices (*35-36*). Based on the model fit indices in Table 5, we can conclude that model fit of our final model is very good.

TABLE 5 Model Fit

	Chi² (df) p	**Chi² / df**	**CFI**	**TLI**	**RMSEA**
Cut-off value	p > 0.05	< 2	> 0.90	> 0.90	< 0.05
Model-based value	219.772 (190) 0.068	1.16	0.99	0.98	0.02

<FIGURE 3 ABOUT HERE>

Long-term life-styles do indeed influence mode share. First, we found that some personal values have a direct effect on mode share (see Table 6 and Figure 3). For example, values of benevolence (i.e., helping others, being loyal and devoted) are associated with higher public transport use (especially train use) and lower car use (as a passenger). This is partly in line with findings from Nordlund and Garvill (*41*), who found that values of benevolence are associated with a personal norm to reduce car use. However, other studies (*42-43*) found that public transport use is not so much influenced by values of benevolence (like our study suggests) but rather by values of self-direction (i.e., own decisions) and stimulation (i.e., new experiences). In addition, our study suggests that public transport use (especially bus, tram, metro) is discouraged by values of hedonism (i.e., having a good time, spoiling yourself). At the same time, this specific value also encourages car use (as a driver). Rather surprisingly, we found that values of achievement (i.e., showing abilities and success) are not associated with more car use, but instead, it is significantly associated with more walking. Values of tradition (i.e., being modest and inconspicuous) are associated with less walking but also with more cycling. This contrast, to some extent, the findings from Arroyo et al. (*44*), who used data from Valencia, Spain, and found a negative association between traditional values and active transport modes. The positive association between traditional values and cycling in our study might be related to the specific cycling culture in Belgium, where cycling is part of common mobility practice and not considered as a specific niche (e.g., for hipsters or sports fanatics only).

Second, there is also an indirect effect of personal values on mode share, via the interaction with decisions about urban residential location, car ownership, and activity patterns. For example, values of tradition are associated with living in an urban location, and living in an urban location

on its turn is directly related to less driving, more public transport use (bus, tram, metro in particular), and more walking. Because of this interaction, values of tradition thus also have an indirect effect on driving, public transport, and walking. Furthermore, values of achievement seem to discourage car ownership in the first place, and lower car ownership, on its turn, is associated with less driving, more public transport use (again bus, tram, metro in particular), and more walking. Once more, this interaction results in an indirect effect of personal values on mode share. Finally, the third direction of indirect effects runs by the interaction with activity patterns. Rather surprisingly, values of stimulation (i.e., new experiences, risk excitement) are associated with fewer activities, and such less complicated activities are associated with higher use of local public transport (bus, tram, metro) and lower use of regional public transport (train). Note that four personal values (i.e., power, self-direction, conformity, and security) do not appear in Table 5. Based on our data, we did not find any significant direct or indirect effect of these four personal values on mode share.

1 **TABLE 6 Direct, Indirect and Total Effects on Mode Share**

	% CAR DRIVER			% CAR PASSENGER		
	Direct	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
Value-based life-styles						
Universalism	-	n/a	n/a	0.011*	n/a	0.011*
				0.049		*0.049*
Stimulation	-	n/a	n/a	-	n/a	n/a
Achievement	-	-0.006**	-0.006**	-	-0.006***	-0.006***
		-0.021	*-0.021*		*-0.039*	*-0.039*
Tradition	-	-0.024**	-0.024**	-	-0.005***	-0.005***
		-0.071	*-0.071*		*-0.029*	*-0.029*
Hedonism	0.017*	n/a	0.017*	-	n/a	n/a
	0.053		*0.053*			
Benevolence	-	n/a	n/a	-0.019***	n/a	-0.019***
				-0.090		*-0.090*
Urban location	-0.923***	-0.255**	-1.178***	-	-0.239***	-0.239***
	-0.369	*-0.102*	*-0.471*		*-0.192*	*-0.192*
Residential attitudes						
Safe and pleasant	-	0.019*	0.019*	-	0.004*	0.004*
		0.052	*0.052*		*0.021*	*0.021*
Social interaction	-	0.038***	0.038***	-	0.008***	0.008***
		0.104	*0.104*		*0.043*	*0.043*
Accessibility work/school	-	-0.106***	-0.106***	-	-0.021***	-0.021***
		-0.289	*-0.289*		*-0.118*	*-0.118*
Car ownership	0.056**	n/a	0.056**	0.520***	n/a	0.520***
	0.166		*0.166*	*0.313*		*0.313*
Number of activities	-	n/a	n/a	-	n/a	n/a
Mobility attitudes						
Privacy and comfort	-	n/a	n/a	0.032***	n/a	0.032***
				0.164		*0.164*
Time	0.064***	n/a	0.064***	-0.032***	n/a	-0.032***
	0.162		*0.162*	*-0.165*		*-0.165*
Green and healthy	-0.044***	n/a	-0.044***	-	n/a	-
	-0.109		*-0.109*			
SED						
Male	-	n/a	n/a	-0.040***	n/a	-0.040***
				-0.119		*-0.119*
Age	0.037***	0.038***	0.075***	-	0.008***	0.008***
	0.111	*0.112*	*0.223*		*0.046*	*0.046*
Education. high	-0.034**	-0.096***	-0.130***	-	-0.019***	-0.019***
	-0.037	*-0.105*	*-0.142*		*-0.043*	*-0.043*
Income, high	-	0.024**	0.024**	-	0.022***	0.022***
		0.027	*0.027*		*0.050*	*0.050*
Professional active	0.091***	0.054***	0.145***	-	0.011***	0.011***
	0.136	*0.080*	*0.216*		*0.033*	*0.033*
Student	-	n/a	n/a	-	n/a	n/a
Partner	-	n/a	n/a	-	n/a	n/a
Season ticket BTM	-0.128***	-0.017**	-0.144***	-	-0.016***	-0.016***
	-0.188	*-0.025*	*-0.212*		*-0.046*	*-0.046*
Season ticket train	-	n/a	n/a	-	n/a	n/a
Driving license	0.182***	-0.045*	0.137***	-0.131***	-0.009*	-0.140***
	0.202	*-0.050*	*0.152*	*-0.292*	*-0.020*	*-0.313*
Explained variance	**59.7%**			**22.5%**		

Note: * p < 0.10 ; ** p < 0.05 ; *** p < 0.01; standardized coefficients in italics

- = direct effect has been estimated but found insignificant and therefore excluded from the analysis

n/a = no indirect or total effect has been found because of no significant interrelations

TABLE 6 Direct, Indirect and Total Effects on Mode Share (continued)

	% TRAIN			% BUS. TRAM. METRO		
	Direct	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
Value-based life-styles						
Universalism	-	0.002***	0.002***	-	-0.003***	-0.003***
		0.018	*0.018*		*-0.009*	*-0.009*
Stimulation	-	-0.002**	-0.002**	-	0.002**	0.002**
		-0.018	*-0.018*		*0.009*	*0.009*
Achievement	-	n/a	n/a	-	0.006***	0.006***
					0.028	*0.028*
Tradition	-	n/a	n/a	-	0.011***	0.011***
					0.043	*0.043*
Hedonism	-	n/a	n/a	-0.019**	n/a	-0.019**
				-0.078		*-0.078*
Benevolence	0.015***	n/a	0.015***	-	n/a	n/a
	0.125		*0.125*			
Urban location	-	n/a	n/a	0.271*	0.253***	0.524***
				0.149	*0.139*	*0.288*
Residential attitudes			n/a			
Safe and pleasant	-	n/a	n/a	-	-0.003***	-0.003***
					-0.032	*-0.032*
Social interaction	-	n/a	n/a	-	0.002**	0.002**
					-0.064	*-0.064*
Accessibility work/school	-	n/a	n/a	-	0.006***	0.006***
					0.177	*0.177*
Car ownership	-	n/a	n/a	-0.055***	n/a	-0.055***
				-0.226		*-0.226*
Number of activities	0.011**	n/a	0.011**	-0.014**	n/a	-0.014**
	0.114		*0.114*	*-0.055*		*-0.055*
Mobility attitudes						
Privacy and comfort	-	n/a	n/a	-	n/a	n/a
Time	-0.014**	n/a	-0.014**	-	n/a	n/a
	-0.123		*-0.123*			
Green and healthy	-	n/a		-	n/a	n/a
SED						
Male	-	n/a	n/a	-	n/a	n/a
Age	-	n/a	n/a	-0.027**	-0.017***	-0.044***
				-0.111	*-0.068*	*-0.180*
Education. high	0.038***	n/a	0.038***	-	0.043***	0.043***
	0.144		*0.144*		*0.064*	*0.064*
Income, high	-	n/a	n/a	-	-0.024***	-0.024***
					-0.036	*-0.036*
Professional active	-	n/a	n/a	-	-0.024***	-0.024***
					-0.049	*-0.049*
Student	0.016*	n/a	0.016*	-	n/a	n/a
	0.078		*0.078*			
Partner	-	n/a	n/a	-	n/a	n/a
Season ticket BTM	-	n/a	n/a	0.229***	0.017***	0.245***
				0.462	*0.033*	*0.496*
Season ticket train	0.123***	n/a	0.123***	-0.124***	n/a	-0.124***
	0.401		*0.401*	*-0.158*		*-0.158*
Driving license	-0.035***	n/a	-0.035***	-	0.020*	0.020*
	-0.138		*-0.138*		*0.031*	*0.031*
Explained variance	**28.2%**			**53.3%**		

Note: * p < 0.10 ; ** p < 0.05 ; *** p < 0.01; standardized coefficients in italics

- = direct effect has been estimated but found insignificant and therefore excluded from the analysis

n/a = no indirect or total effect has been found because of no significant interrelations

1 **TABLE 6 Direct, Indirect and Total Effects on Mode Share (continued 2)**

	% CYCLING			% WALKING		
	Direct	**Indirect**	**Total**	**Direct**	**Indirect**	**Total**
Value-based life-styles						
Universalism	-	n/a	n/a	-	n/a	n/a
Stimulation	-	n/a	n/a	-	n/a	n/a
Achievement	-	n/a	n/a	0.008**	0.004**	0.012***
				0.040	*0.021*	*0.061*
Tradition	0.017**	n/a	0.017**	-0.022***	0.020**	-0.002
	0.109		*0.109*	*-0.097*	*0.089*	*-0.009*
Hedonism	-	n/a	n/a	-	n/a	n/a
Benevolence	-	n/a	n/a	-	n/a	n/a
Urban location	-	n/a	n/a	0.829***	0.175*	1.003***
				0.485	*0.102*	*0.587*
Residential attitudes						
Safe and pleasant	-	n/a	n/a	-	-0.016*	-0.016*
					-0.065	*-0.065*
Social interaction	-	n/a	n/a	-	-0.033***	-0.033***
					-0.130	*-0.130*
Accessibility work/school	-	n/a	n/a	-	0.090***	0.090***
					0.361	*0.361*
Car ownership	-	n/a	n/a	-0.038*	n/a	-0.038*
				-0.166		*-0.166*
Number of activities	-	n/a	n/a	-	n/a	n/a
Mobility attitudes						
Privacy and comfort	-0.026***	n/a	-0.026***	-	n/a	n/a
	-0.141		*-0.141*			
Time	-0.027**	n/a	-0.027**	-	n/a	n/a
	-0.144		*-0.144*			
Green and healthy	0.049***	n/a	0.049***	-	n/a	n/a
	0.259		*0.259*			
SED						
Male	0.033***	n/a	0.033***	-	n/a	n/a
	0.103		*0.103*			
Age	-	n/a	n/a	-	-0.032***	-0.032***
					-0.139	*-0.139*
Education. high	-	n/a	n/a	-	0.082***	0.082***
					0.131	*0.131*
Income, high	-	n/a	n/a	-	-0.016**	-0.016**
					-0.027	*-0.027*
Professional active	-	n/a	n/a	-0.084***	-0.046***	-0.130***
				-0.182	*-0.100*	*-0.282*
Student	-	n/a	n/a	-	n/a	n/a
Partner	-0.016*	n/a	-0.016*	-	n/a	n/a
	-0.049		*-0.049*			
Season ticket BTM	-0.058***	n/a	-0.058***	-0.044*	0.011**	-0.032
	-0.180		*-0.180*	*-0.094*	*0.025*	*-0.069*
Season ticket train	-	n/a	n/a	-	n/a	n/a
Driving license	-	n/a	n/a	-	0.038*	0.038*
					0.062	*0.062*
Explained variance	**11.2%**			**38.6%**		

Note: * p < 0.10 ; ** p < 0.05 ; *** p < 0.01; standardized coefficients in italics
- = direct effect has been estimated but found insignificant and therefore excluded from the analysis
n/a = no indirect or total effect has been found because of no significant interrelations

Hence, our findings clearly indicate a significant relationship between personal values and mode share, even when we account for the interaction with residential location, car ownership, and activity patterns. Nevertheless, although their influence is not to be neglected, personal values do not always have the strongest impact on mode share compared to other variables. Standardized coefficients indicate that car use as a driver is mainly influenced by living in a suburban location, car use as a passenger by car ownership and not having a driving license, public transport (be it local public transport or train use) by the possession of a season's ticket, cycling by a green and healthy mobility attitude, and walking by living in an urban location and a positive residential attitude towards accessibility. It is also remarkable that motorized transport modes seem to be more influenced by objective characteristics related to an urban residential location and mobility access. Contrary to active transport modes for which subjective characteristics like mobility and residential attitudes are more important. This finding illustrates that, at least for cycling and walking, other subjective characteristics than values (in this case: attitudes) cannot be ignored. It might also indicate that the influence of values on mode share is perhaps not a direct one, but indirectly via attitudes. This was also tested by Paulssen et al. (*30*), who found the direct effect of values on travel behavior to be small, but the indirect effect through mediating influence on attitudes to be large.

CONCLUSION

Using a value-based approach of life-styles adds new insights to mode share research. One of the most striking findings is that, at least for our Belgian sample, car use seems to be a choice stemming from values associated with personal pleasure and not so much with social status as has been suggested in previous research (*45*). Personal values have not only a direct effect on mode share, but also an indirect effect due to interactions with urban residential location choices, car ownership decisions, and activity patterns. Such a value-based life-style approach helps in understanding the heterogeneity in travel choices made by individuals. It also offers interesting avenues for sustainable mobility policies. For example, the use of public transport seems to be related to the value of benevolence. Promoting the use of public transport as an act of caring for others might, therefore, be effective, especially in times of climate change. In addition, values of hedonism were found to discourage public transport. It is, therefore, important to invest in making train and bus trips a pleasant and exciting experience again (e.g., no delays or unexpected circumstances, a comfortable and safe trip, a stimulating environment).

Although the estimated models suggest a significant effect of personal values on mode share, its magnitude is relatively small when compared with other explanatory variables. Especially when you compare it to objective characteristics, in particular different aspects of mobility access, for motorized transport modes and subjective characteristics, in particular attitudes, for active transport modes. This could be a sign that value-based life-styles only play a marginal role. Besides, the limited influence of values could also be an indication that the chosen life-style approach is not capable of representing relevant differences in mode share. In order to address this issue, survey data should be made available, allowing a comparison of different life-style approaches. Furthermore, one should be careful by making any definite conclusion about the impact of value-based life-styles on mode share. The interaction between personal values and mode share might be much more complex than modeled in this paper. Values might affect people's perceptions and attitudes first, which in turn affect different types of behavior. This would also be consistent with the value-attitude-behavior hierarchy proposed by Homer and Kahle (*3*). It would be interesting to combine this value-attitude-behavior hierarchy with the decision hierarchy of this

paper. Underlying explanations about these results also lie in the layout of Schwartz's survey. Respondents might be prone to choose a more utopian answer when they are inquired about values, which may not be reflected in their actual behavior (*46*).

AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: S. Sandoval, M. Cools; data collection: S. Sandoval, M. Cools; analysis and interpretation of results: V. Van Acker; draft manuscript preparation: V. Van Acker, M. Cools. All authors reviewed the results and approved the final version of the manuscript.

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FIGURE CAPTIONS

FIGURE 1 Lifestyles and travel behavior as part of a decision hierarchy (adapted from *14*).

FIGURE 2 Final model to be tested.

FIGURE 3 Path diagram representing unstandardized path coefficients.

Note: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Figure 2

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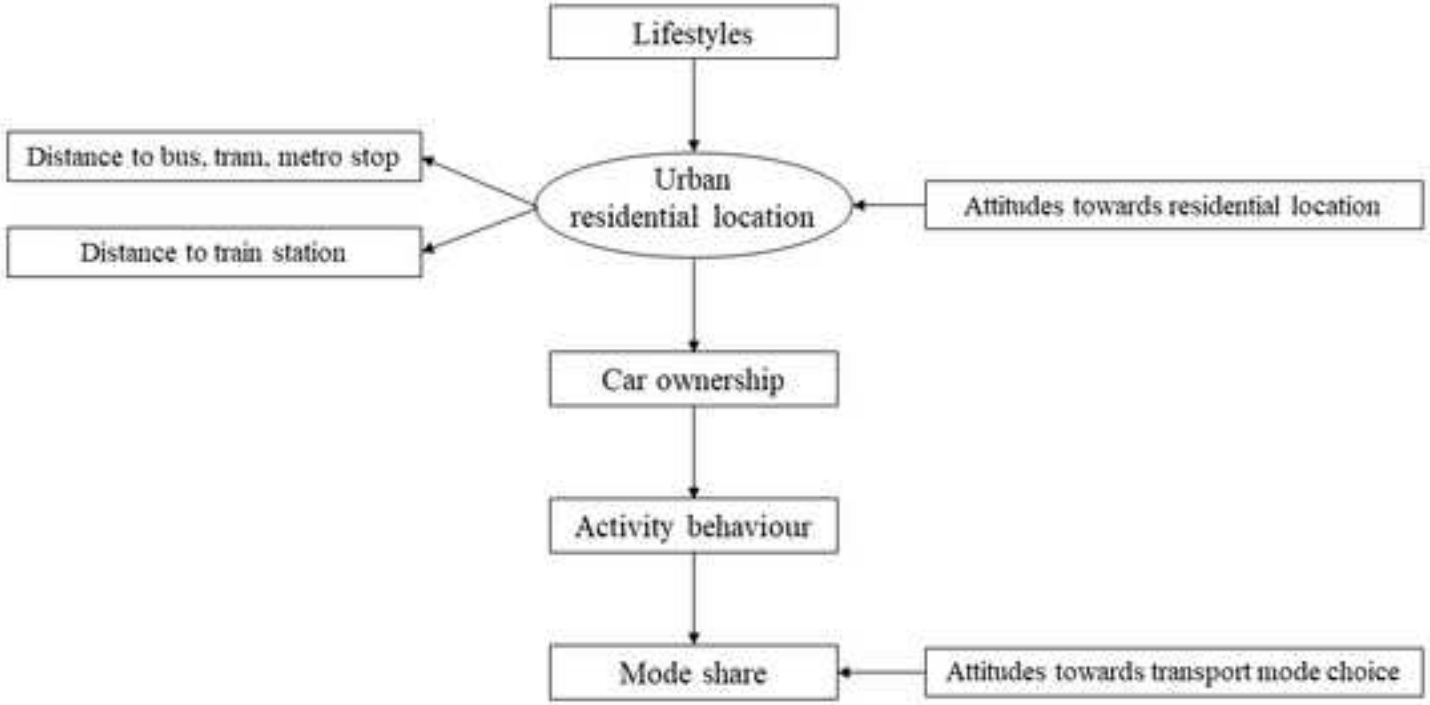

Figure 3

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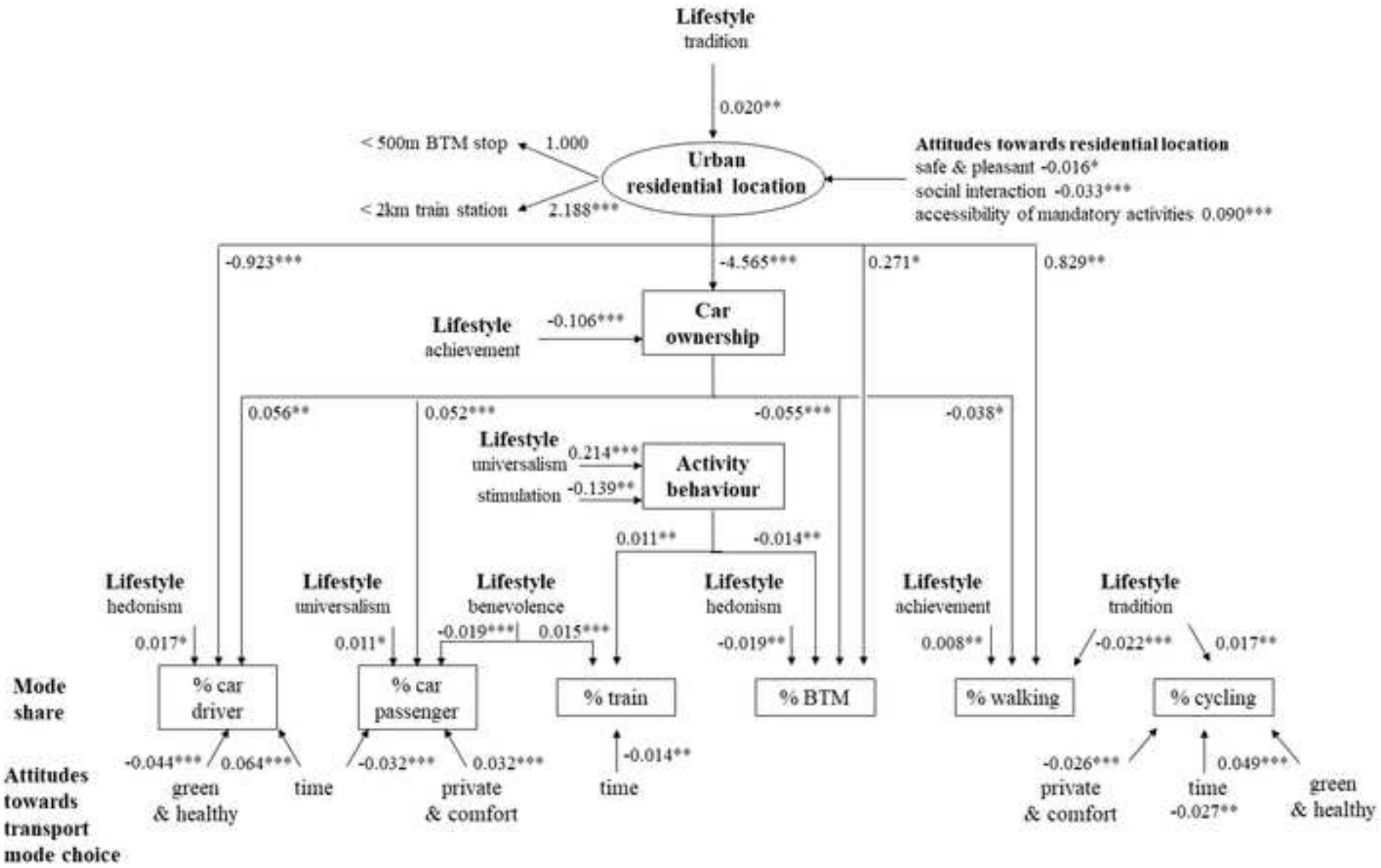

Figure 1

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