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DOI
10.1016/j.tbs.2021.07.003

Publication date
2021

Document Version
Final published version

Published in
Travel Behaviour and Society

Citation (APA)
Faber, R., Merkies, R., Damen, W., Oirbans, L., Massa, D., Kroesen, M., & Molin, E. (2021). The role of travel-related reasons for location choice in residential self-selection. *Travel Behaviour and Society*, *25*, 120-132. https://doi.org/10.1016/j.tbs.2021.07.003

Travel Behaviour and Society 25 (2021) 120–132

Contents lists available at ScienceDirect

Travel Behaviour and Society

journal homepage: www.elsevier.com/locate/tbs

The role of travel-related reasons for location choice in residential self-selection

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ARTICLE INFO

Keywords:
Travel behaviour
Residential self-selection
Attitudes
Travel-related reasons
Structural equation modelling
Mobility panel Netherlands

ABSTRACT

Residential self-selection (RSS) is the theoretical mechanism that explains that the impact of the built environment on travel behaviour is weaker than bivariate correlations suggest, because mode attitudes influence both the built environment and travel behaviour and therefore at least partially account for the bivariate relationship. Recently, the concept of travel-related reasons for residential choice has been introduced, which reflects the actual extent to which the travel-related characteristics of the built environment were considered during the relocation decision. In this paper, we hypothesize that travel-related location reasons are stronger predictors of the built environment choice than generic mode attitudes. This hypothesis is examined by estimating both a cross-sectional and a longitudinal Structural Equation Model using data gathered in the Netherlands. The results suggest that the travel-related location reasons are indeed stronger predictors for built environment location than travel mode attitudes and that the directions of causality between attitudes, travel-related location reasons, the built environment, and travel behaviour often run in both directions. Substantively, our findings indicate that public transport use is most strongly affected by the built environment (after controlling for both stated reasons and attitudes), while car and bicycle use are hardly affected. From a practical point of view, this suggests that transforming the built environment to be more friendly to public transport may increase the use of public transport, but that, at least in the Netherlands, such a strategy would not work well if the aim were to reduce car use or increase bicycle use.

1. Introduction

The car is the dominant travel mode in the European Union, accounting for more than half of all trips in 2015 (Fiorello, Martino, Zani, Christidis, & Navajas-Cawood, 2016). Even in the Netherlands, a densely populated country with a strong cycling tradition and an efficient public transport system, about 75% of all kilometres travelled are made by car (Kennisinstituut voor Mobiliteitsbeleid, 2019). Decreasing the reliance on the car and increasing the travel share of other modes is seen as desirable to increase sustainability (Wang, Wang, Fang, & Li, 2019), improve public health (de Nazelle, Morton, Jerrett, & Crawford-Brown, 2010; Grabow et al., 2011) and (possibly) reduce congestion (Hensher & Puckett, 2007). With this policy goal in mind, an important research objective has been to find factors that reduce the distance travelled by car.

One area of focus is the influence of the built environment, whose relation to travel behaviour has been widely established (Cervero & Hansen, 2002; Chen, Gong, & Paaswell, 2008). Theories indicate that denser and better-connected areas promote the use of more active travel modes (public transport, walking and cycling), whereas environments characterised by loose suburban sprawl increase car dependence (De Vos et al., 2018; Humphreys & Ahern, 2019). Based on the assumption that the built environment influences travel behaviour, policies have been developed to increase the connectivity, density, and public transport accessibility of the built environment to facilitate the use of alternative travel modes to the private car (Cao, Mokhtarian, & Handy, 2009; Ewing & Cervero, 2010).

However, the existence of a causal effect of the built environment on travel behaviour is contested. This is the result of the notion of residential self-selection (RSS), where demographics, travel preferences, and residential preferences underlie both the decision to live in a certain built environment and travel behaviour (Boarnet & Sarmiento, 1998;

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https://doi.org/10.1016/j.tbs.2021.07.003
Received 10 December 2020; Received in revised form 20 June 2021; Accepted 2 July 2021
Available online 14 July 2021

Cao, 2015; Chatman, 2009; van Wee, 2009). This notion of RSS then means that the direct effect between the residential built environment and travel behaviour can be explained, at least to some extent, by travel preferences. Policies aimed at changing the built environment will then have a weaker effect than expected when based on research that does not take RSS into account.

A recent development in this research area is the distinction between attitudes and more deliberate travel-related reasons to choose a specific residential location, which was made by Ettema & Nieuwenhuis (2017). This is an answer to one of the main questions regarding the RSS mechanism, namely to what extent attitudes determine a person's choice to reside at a specific location (Mokhtarian & Cao, 2008). These deliberate travel-related reasons are not simply residential preferences, as they do not reflect some favour or disfavour towards residential styles or layouts. They reflect the extent to which a travel preference actually affected the final decision to live in a certain neighbourhood.

Previous studies on travel-related location reasons have generally shown that they have a strong effect on the residential location decision and its built environment (e.g. Jarass & Scheiner, 2018; Wolday, Cao, & Næss, 2018). Based on the distinction between attitudes and reasons Ettema & Nieuwenhuis (2017) made two interesting observations. The first of these is the finding that attitudes toward travel modes and residential location choice are only associated to a limited extent, which seemingly contradicts the main body of residential self-selection literature (Cao et al., 2009; Guan, Wang, & Jason Cao, 2020; van Wee & Cao, 2020). This finding can be explained by the notion that part of the seeming association between attitudes and residential location is explained instead by the travel-related location reasons. The second finding, that travel-related location reasons may be regarded as a more direct indicator of self-selection than travel attitudes, seems to provide more evidence for this notion.

This study builds on this conceptual distinction between travel attitudes and deliberate travel-related location reasons and further investigates the notion of residential self-selection when this distinction is made. The main hypothesis is that the concepts of travel attitudes and travel-related location reasons play a different role within the self-selection process. The travel-related location reasons are conceptually more direct indicators of the residential location choice, and we thus hypothesize them to have a stronger, more direct effect on the choice of built environment when compared to travel attitudes. On the other hand, travel attitudes capture more general travel preferences and are hypothesized to have a stronger effect on travel behaviour. If this is the case, future researchers of residential self-selection should try to include both attitudes and reasons in their work. This research thus does not directly intend to quantify the impact of RSS on the estimated effect of the built environment on travel behaviour. Rather, it seeks to increase the understanding of the mechanisms behind RSS.

To test these hypotheses data from the Netherlands Mobility Panel (MPN) are used, a panel that is broadly representative of the Dutch population. This is an improvement on the previous study of Ettema & Nieuwenhuis (2017), who used data gathered from connected, dense residential areas with high-quality public transport infrastructure. Another improvement in this study is the use of structural equation modelling, which enables the estimation of multiple equations simultaneously, where the dependent variable in one equation can be the independent variable of another equation (Bagley & Mokhtarian, 2002). SEM, especially when employing a longitudinal structure, is one of the preferred modelling techniques for studying RSS, because of the complex relationships between residential built environments, travel behaviour, attitudes, and reasons which have been outlined above and are discussed in more detail in Section 2. Finally, the use of the MPN enables longitudinal testing of the relationships that are assumed to exist in the context of RSS. This is especially important given that the causal direction of the relationships between both the built environment and travel behaviour and travel attitudes and travel behaviour is unclear. This paper is the first to employ a longitudinal SEM to simultaneously test the effects of both travel attitudes and travel-related location reasons on travel behaviour and the choice of built environment.

The remainder of this paper is organized as follows. Section 2 dives deeper into the state of the literature and the available theories surrounding RSS and results in a conceptual model. Section 3 describes the research methods, operationalization, and model specification and estimation procedures. The results from the modelling procedure are described and interpreted in Section 4. The conclusions are drawn in Section 5, together with a short discussion of the paper and the policy implications that follow from the conclusions.

2. Theory and conceptual model

To test the research hypotheses, a conceptual model has been developed. The following sections will elaborate on the concepts and relations in this model, providing the theoretical underpinning and evidence from the literature. Section 2.1 introduces the foundation of the model: the built environment and travel behaviour. Section 2.2 builds upon this foundation with the notion of residential self-selection and its related concepts. Section 2.3 describes the concepts of travel attitudes and travel-related location reasons and the relation between the two concepts. The resulting conceptual model is shown in Section 2.4.

2.1. Influence of the built environment

The geographical layout and characteristics of the built environment have long been shown to influence travel behaviour. For example, Cao, Handy, & Mokhtarian (2006) used a quasi-longitudinal design to show that changes in the built environment affected travel behaviour. This geographical perspective has been used to claim that developments like urban sprawl are one of the causes of the increasing use of the private car. An extensive *meta*-analysis by Ewing & Cervero (2010) found that no individual part of the built environment is responsible for a substantial change in travel behaviour, but that many small changes in the built environment can have a combined effect that is large. Urban form characteristics such as density, settlement size, land-use mix, accessibility, and local street layout have been shown to have a cumulative effect on travel behaviour (Headicar, Banister, & Pharaoh, 2009). The measurement of the built environment then plays a critical role on the estimated impact of the built environment on travel behaviour. Typically, studies focus on the 'five D's' of density, diversity, design, destination accessibility and distance to transit (Guan et al., 2020), which according to the authors of this review study might neglect social environment factors such as safety. Some studies also look into the perceptions of the built environment (Ma and Cao, 2017), although using objective measurements is still the standard in RSS research.

2.2. The role of residential self-selection

Initial studies focusing on the effects of the built environment on travel behaviour typically controlled for the possible confounding effect of socio-demographic variables (see e.g., Cervero & Kockelman, (1997) and Crane & Crepeau (1998). Following the recognition that socio-demographics probably only partially capture self-selection mechanisms (Kitamura, Mokhtarian, & Laidet, 1997), later studies also included travel attitudes as control variables (see e.g., Handy, Cao, & Mokhtarian (2005, 2006). These travel attitudes have been linked to both travel behaviour and residential location choice (Cao et al., 2009; Wolday et al., 2018). Studies have indicated that people tend to move to neighbourhoods which facilitate the use of their preferred travel mode to some extent (e.g., De Vos et al., 2012; Handy et al., (2005); Schwanen & Mokhtarian, (2004). In this case, the underlying travel attitudes can explain at least some part of the relationship between the built environment and travel behaviour. For example, neighbourhoods close to train stations are more attractive to people who have a positive attitude towards using the train, which partly explains why people living in these areas are indeed more likely to use the train for their travel. As explained in the introduction, this mechanism is called residential self-selection (RSS).

Most studies into RSS find that controlling for travel attitudes does indeed decrease the estimated size of the effect of the built environment on travel behaviour, although a significant independent effect of the built environment is still found in nearly all cases (Cao et al., 2009). There is still much uncertainty about the size of the impact of RSS on the estimated effect on the Built Environment (Mokhtarian & van Herick, 2016; van Herick & Mokhtarian, 2020). These studies find that controlling for RSS results in estimated effects of the built environment of between 34 and 100 percent of the effect that was found without controlling for RSS, based on a review of other studies. A comparison of methodologies to estimate this proportion results in a best estimate that roughly 62% of the apparent effect of the built environment still exists after controlling for RSS (and thus that RSS accounts for the remaining 38%).

In addition to this uncertainty, most papers on RSS use empirical data from OECD countries (van Wee & Cao, 2020) and the estimate of its impact in non-OECD countries is even more unclear. The literature does show that differences between countries exist, even within OECD countries. It is therefore natural to assume that results from a specific country do not necessarily generalise to other countries, and that the differences between results grow larger the more the countries diverge in terms of travel behaviour, land use mix, transportation system, and other built environment characteristics.

2.3. Attitudes and reasons

One key question revolves around the link between the travel attitudes and the residential location. The choice of residential location is of course affected by many other factors than just those related to travel (Cao & Chatman, 2016). This may lead to a dissonance between residential location choice and travel attitudes, as for example people who prefer to use the train are not always able or willing to reside close to railway stations. This possible dissonance led to the introduction of travel-related residential preferences by Næss (2009). People with strong travel-related residential preferences are more likely to move to residential areas that match their travel preference. A more direct measurement of the extent to which travel preferences influence the decision to live in a certain residential area are the deliberate travel-related location reasons introduced by Ettema & Nieuwenhuis (2017). These reasons reflect the actual extent to which the travel-related characteristics of the built environment were considered during the relocation decision. The two concepts of travel attitudes and travel-related location reasons are introduced in more detail in the following paragraphs.

Of these two concepts, travel attitudes are more often studied in the context of residential self-selection. In this paper the definition used by Bohte, Maat, & Van Wee (2009) is followed, which stems from Eagly & Chaiken (1993, p.1): "Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour". Travel mode attitudes could therefore be considered to be the degree to which the traveller favourably or unfavourably evaluates the use of the travel mode in question. This evaluation could be based on the functional performance of the mode, for example in terms of travel time. It could also refer to symbolic-affective evaluations of the travel mode, for example the status associated with the use of the mode (Anable, 2005; Hunecke, Haustein, Grischkat, & Böhler, 2007). This research uses both evaluations in the measurement of attitudinal indicators, which are combined into a single latent attitude for each travel mode. More information on the operationalisation of the travel attitudes can be found in Section 3.2.

Travel-related residential preferences reflect the extent to which people prefer to live in a residential environment with certain travel-related characteristics, such as short distances to public transport access/egress points. Deliberate travel-related residential location reasons are more directly linked with residential location choice as they are meant to indicate to which extent these travel-related characteristics of the residential location have been considered in the relocation choice (Jarass & Scheiner, 2018). Conceptually, these travel-related location reasons are thus directly related to the decision to live in the current residential area. Broadly speaking then, travel attitudes are general evaluations of the various travel modes, whilst travel-related location reasons are more directly tied to the (re)location choice.

2.4. Causal relations in the context of RSS

Research into RSS uses several concepts: travel behaviour, the built environment, and travel attitudes. This research also brings up the concept of travel-related location reasons. As noted by both the recent reviews on RSS by van Wee & Cao (2020) and Guan et al. (2020), the causal order between these concepts is not always clear. Below these causal orders are discussed: first the classic specification is described, with the addition of location reasons. Then we highlight why this classic specification might be misleading, prompting the need for longitudinal models.

In their relatively early review of methodologies in the context of RSS, (Mokhtarian & Cao, 2008) describe multiple possible causal specifications between the three main concepts in the RSS context: attitudes as antecedents of both travel behaviour and the built environment, attitudes intervening in the relationship, and attitudes as a secondary or irrelevant concept. (Heinen, van Wee, Panter, Mackett, & Ogilvie, 2018) extend these specifications with multiple others. The specification that is mainly used in the context of RSS-research is that where attitudes are antecedents of both built environment and travel behaviour, and where the built environment also directly affects travel behaviour. This classic specification is also used in the cross-sectional model specified in this research. The location reasons are specified similarly to the attitudes, as antecedents of both the built environment and travel behaviour. The only remaining relation then is that between attitudes and location reasons. This research postulates that travel attitudes have an effect on the travel-related location reasons. The rationale here is that people who feel more positively about public transport are more likely to make public transport access an important factor in their decision to relocate. In effect the attitudes thus precede the reasons in the causal order, where travel-related location reasons can be conceptualised as a concept in between attitudes and behaviour. Attitudes then are antecedent to all other concepts in this model.

A recent line of research, which has increasingly gained traction, has revealed that several of the relationships are bi-directional in nature. For example, Kroesen, Handy, & Chorus (2017) revealed bi-directional relationships between travel behaviour and travel-related attitudes using panel data. In a similar fashion, De Vos et al. (2018); Kroesen (2019) and Van De Coevering et al. (2016) show that the residential location choice is not only influenced by travel-related attitudes and travel-related location reasons, but, in turn, also shapes the attitudes and/or reasons (at a later point in time). In a cross-sectional study, it is not possible to specify and assess these bi-directional relationships, instead only the traditionally assumed directions of causation are specified. To alleviate these concerns a longitudinal model is estimated, where the causal order between concepts is not imposed but estimated. The combination of both models are interpreted and discussed in the conclusion.

2.5. Conceptual model

The previous sub-sections have explained the concepts and links that are present in the conceptual model. The model builds on the basic notions of the influence of the built environment and socio-demographics on travel behaviour explained above. This basic model is extended by adding the notion of residential self-selection, where travel preferences underlie both the location choice (built environment) and travel behaviour. These travel preferences have been split into two distinct concepts, namely travel-related location reasons and travel mode attitudes, both of which are placed in an antecedent position relative to the built environment and travel behaviour. Furthermore, a causal relation between the more general travel attitudes and the more specific location reasons is specified as well. Finally, socio-demographics are assumed to affect all concepts presented in the study. The conceptual model is given in Fig. 1.

The model estimates the effect of the built environment on travel behaviour after controlling for both mode attitudes and travel-related location reasons. By doing so the effects of both the mode attitudes and location reasons on the (residential) built environment choice and travel behaviour are revealed. This enables us to check the hypothesis of this paper, which is that these two concepts have a different effect on both the choice of built environment and travel behaviour. Note that the causal order as given in the conceptual model is imposed on the cross-sectional model, but not on the longitudinal model, which tests these directions instead.

3. Methods

This section explains how the structural equation model is specified. Structural Equation Modelling (SEM) is a modelling approach with which one can simultaneously estimate a series of linked regression equations (Bollen, 1989). Such a series of linked regression equations is also called a path model, in which a relationship between two variables is called a path. A standardized coefficient estimated for a path has a similar interpretation as a standardized regression coefficient in ordinary regression analysis: it indicates the weight of the causal path and, therefore, how strong an independent variable influences the dependent variable, controlling for other variables in the model.

When using cross-sectional data, an empirical test of causality with SEM is not possible. The structure of the model is then informed by theoretical notions of causality (as discussed in Section 2), leading to the assumed causal relationships visualized in the conceptual model in Fig. 1. In addition, the use of SEM enables the inclusion of latent variables measured by multiple indicators whilst accounting for measurement errors in the measurement model. Since attitudes are psychological variables that are impossible to measure directly, measurement errors are expected and accounted for, which improves the accuracy of the modelling results.

The longitudinal analysis of this paper employs a two-wave Cross-Lagged Panel SEM (Finkel, 2011). This model makes no assumptions about the causal structure between variables in the model. Instead, it estimates relations between all variables measured in one wave and all variables measured in the other wave. Variables measured within the same wave are assumed to be correlated with one-another. This technique thus does not test a specific structure, but rather empirically measures possible causal relations between variables.

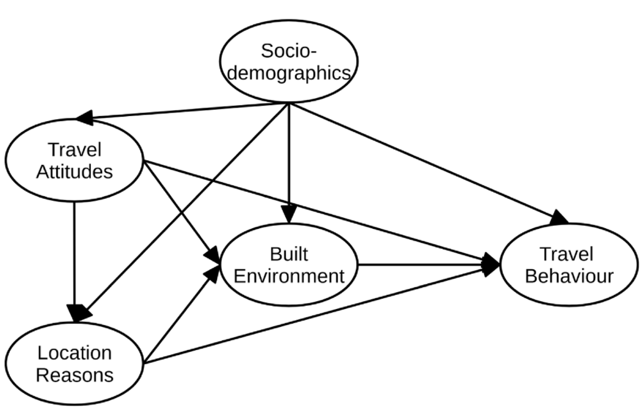

Fig. 1. Conceptual model of the concepts and relationships studied in this paper.

The dataset, sample selection and data preparation are described in Section 3.1. Section 3.2 contains the operationalisation and a description of the variables used in the model and Section 3.3 describes the model specification and estimation procedure.

3.1. Data description and preparation

The data used for the analysis is the second and fourth annual wave of the Netherlands Mobility Panel (MPN), collected in autumn 2014 and autumn 2016 respectively. The MPN is a web-based longitudinal activity-based household travel survey (Hoogendoorn-Lanser et al., 2015).. The sample for the MPN is drawn from an existing access panel, managed by a fieldwork agency. Respondents in the panel are not able to register themselves, reducing selection biases. Furthermore, respondents can be drawn from the existing access panel based on socio-demographics, enabling the MPN to invite a broad range of respondents from the Netherlands to ensure the panel is roughly representative of the Dutch population. For more information on the sampling design the reader is referred to the paper by Hoogendoorn-Lanser et al. (2015) on the design of the MPN.

The MPN consists of both questionnaires and a travel diary. This research uses information gathered in the questionnaires, which are collected on both a personal and household level. The survey data is enriched with geospatial characteristics based on the residential location of the respondents. Further preparation of the data was conducted before being used in the structural equation model. For example, respondents younger than 18 years old were excluded based on the assumption that they have never actively decided on a residential location. Respondents with missing values on questions pertaining to the travel-related location reasons and/or the travel attitudes were removed as well, resulting in a final sample of 4.238 respondents for the cross-sectional analysis. Of these respondents, a total of 1.677 also had complete data for wave 4 and were thus included in the longitudinal analysis. The sample composition for both the cross-sectional and the longitudinal sample is given in Table 1.

Table 1
Sample distribution of socio-demographic variables.

Variables	Levels	Sample Distribution Cross-sectional (%)	Sample Distribution longitudinal (%)
Age (years)	18–39	38.5	39.4
	40–59	46.6	48.3
	60+	14.9	12.3
Employment	Employed	67.3	74.6
	Not employed	32.7	25.4
Education	Low	25.3	16.1
	Middle	40.3	39.1
	High	34.4	44.8
Ethnicity	Western	97.7	98.7
	Non-Western	2.3	1.3
Gender	Male	46.3	47.4
	Female	53.7	52.6
Personal Net Income (€/month)	None (0)	8.8	5.7
	Low (1–1500)	35.2	31.2
	Middle (1500–2500)	31.7	36.1
	High (>2500)	12.1	14.7
	Unknown	12.2	12.3
Nr. of children in household	0	78.2	77.5
	1	12.2	11.9
	2	7.6	8.2
	3+	2	2.4

3.2. Operationalisation

The process of operationalisation entails taking the concepts from the conceptual model and specifying how these concepts are measured by indicators.

The following socio-demographic variables were considered relevant: age, gender, education, ethnicity, employment, personal income, and the number of children in the household. Age is measured in years and treated as a continuous variable in the model. The other socio-demographic variables are categorical variables, which have been dummy-coded. Travel behaviour is measured by the frequency of use of various travel modes. Respondents could provide answers on a 7-point scale, ranging from "Never" for the lowest value of 1 to "Four or more days per week" for the highest value of 7.

For the travel mode attitudes six indicator questions are used for each travel mode. Each indicator is scored on a 5-point Likert scale. Questions relating to the train and bus, tram, and metro (BTM) are treated as indicators of a latent public transport attitude. The indicators and their factor loadings, resulting from principal axis factoring, are given for each mode in Table 2.

The travel-related location reasons are measured differently for each mode. Five questions are used in total, with one question being used for car-related reasons and two each for reasons related to public transport and the bicycle. The level of agreement with each statement is measured using a 5-point Likert scale. The statements read as follows:

1. The short distance to a highway was an important factor in my choice to reside at my current address.
2. The presence of a train station within walking or cycling distance was an important factor in my choice to reside at my current address.
3. The presence of a bus, tram or metro station within walking distance was an important factor in my choice to reside at my current address.
4. The cycling distance to my workplace(s) was an important factor in my choice to reside at my current address.
5. A short walking and/or cycling distance to shops was an important factor in my choice to reside at my current address.

The public transport reasons (nr. 2 and 3) are specified as a latent variable, which is measured with two indicators. The other questions are included as directly observed variables in the model.

The built environment of the residence is measured using two types of variables. The first is the urban density of the municipality where the household resides. This density is measured using a log-10 transformation of the inhabitants per square km in the municipality. The second category consists of computed straight-line distances from the home to relevant locations (Hoogendoorn-Lanser et al., 2015), such as a train station or the nearest urban centre. To avoid multi-collinearity problems, a principal component analysis was used to cluster these distances revealing three distinct components. The results of this analysis are given in Table 3, where factor loadings on the three components below 0.3 are not given.

Two of the components were straightforward to interpret, as the high-loading indicators related only to the distance to a tram/metro station for one dimension and the distance to bus stations for the other. The final dimension however consisted of more varied distances: the distance to the urban centre, distances to highway entry/exit ramps, and the distance to the nearest train stations and frequently serviced bus stops. This dimension is interpreted as the centrality of the residential location, as train stations and frequently serviced bus stops are typically located in or near city- or village centres. Factor scores are calculated for these three dimensions.

Table 2
Indicators and their factor loadings on latent mode attitudes.

	Car	Public Transport		Bicycle
		Train	BTM	
Travelling by (mode) is comfortable	0.828	0.762	0.789	0.818
Travelling by (mode) is relaxing	0.767	0.739	0.777	0.847
Travelling by (mode) saves me time	0.725	0.659	0.703	0.616
Travelling by (mode) is safe	0.704	0.495	0.541	0.632
Travelling by (mode) is flexible	0.725	0.740	0.745	0.752
Travelling by (mode) is satisfying	0.836	0.787	0.802	0.863

Table 3
Built environment clusters and factor loadings.

Computed distance between the home and …	Centrality	Bus stop	Tram/metro stop
Nearest city centre	0.826		
Nearest highway entry- or exit ramp	0.674		
Nearest intercity train station	0.861		
Nearest train station	0.617		
Nearest bus stop that is serviced at least 4x / hour	0.514	0.404	
Nearest bus stop that is serviced at least 2x / hour		0.761	
Nearest bus stop that is serviced at least 1x / hour		0.870	
Nearest bus stop		0.737	
Nearest metro or light rail stop			0.976
Nearest tram stop			0.977

To reduce the complexity of the model one indicator is specified for all latent variables, calculated as a sum score of all indicators related to the respective construct. To account for the measurement errors in these composite indicators, the error variance of each composite indicator is fixed. This is calculated as the proportion error variance multiplied by the variance of the composite scale (Joreskog & Sorbom, 1993; Joreskog, Sorbom, Du Toit, & Du Toit, 2001). The proportion error variance is equal to one minus the reliability, as measured by Cronbach's alpha. Unidimensionality is a critical assumption underlying this calculation, so principal axis factoring is used to determine the unidimensionality of all constructs. These analyses revealed that all constructs were found to be unidimensional, allowing us to compute a composite (sum) score for each latent construct.

The operationalisation of the main concepts aside from socio-demographics in the conceptual model is given in Table 4 below. This table also contains the summary statistics for the latent variables, namely their reliability, variance, and error variance.

3.3. Model specification

Two models are specified: a cross-sectional model and a longitudinal model. The cross-sectional model's specification is based on the structure of the conceptual model, as informed by the current literature on residential self-selection. The longitudinal model empirically tests part of these relations, based on panel data.

The cross-sectional model incorporates public transport (PT), car, and bicycle use as the (final) dependent variables. Structural relations as specified in the conceptual model are added to the model and exogenous variables can covariate with each other. Endogenous variables that are on the same level of the causal order are covaried as well. The model is estimated using maximum likelihood estimation as implemented in AMOS 26. After the initial estimation of the model, insignificant paths (p-value < 0.1) are removed from the model. Variables that do not have any causal relations with any other variable in the model are then also removed from the model to ensure the model is parsimonious.

Model fit of the cross-sectional model is assessed using four different goodness-of-fit statistics. The final estimated model has a chi-square value of 104.1 with 87 degrees of freedom and a p-value of 0.102. The CFI is 0.998, SRMR is 0.041 and RMSEA is 0.007. All goodness-of-fit statistics indicate good model fit (Hooper, Coughlan, & Mullen, 2008)

After the cross-sectional model was estimated, a smaller longitudinal model was specified as well. This model is based on public transport reasons and attitudes, as these variables are shown to have the biggest

Table 4
Operationalisation of the concepts.

Concept	Variable(s)	Measured/Latent	Information on latent variables			
			# Indicators	Variance	Cronbach's Alpha	Error variance
Travel Behaviour	Car Use	Measured				
	BTM Use	Measured				
	Train Use	Measured				
	Bicycle Use	Measured				
Passive Attitudes	Car Attitude	Latent	6	15.4	0.863	2.11
	PT Attitude	Latent	12	67.0	0.913	5.83
	Bicycle Attitude	Latent	6	16.7	0.847	2.56
Location Reasons	Car Reason	Measured				
	PT Reasons	Latent	2	6.07	0.731	1.63
	Bicycle reason work	Measured				
	Bicycle reason shops	Measured				
Built Environment	Density	Measured				
	Distances	Clustered - Bus - Metro/Tram - Centrality				

effect on the built environment and travel behaviour in the cross-sectional model. All variables except for the socio-demographic variables are entered within the model for both the 2014 and 2016 waves: since socio-demographics cannot be dependent variables, they were only entered for the 2014 wave. Then all variables within the same measurement wave are allowed to covary with the other variables in this measurement wave. Finally causal connections are drawn between all variables in the 2014 wave and all variables in the 2016 wave. To make the model more parsimonious, all non-significant paths (p-value < 0.1) are then removed.

An overview of the structural model relations can be seen in Fig. 2. This figure shows which structural relations are estimated between the various concepts. A structural line denotes that at least one variable within a concept is connected to at least one variable in another concept.

Indicators and covariances are omitted to further improve visibility. All variables in bold are included in the longitudinal model as well.

4. Results

This section discusses the empirical results of this study. It does so in

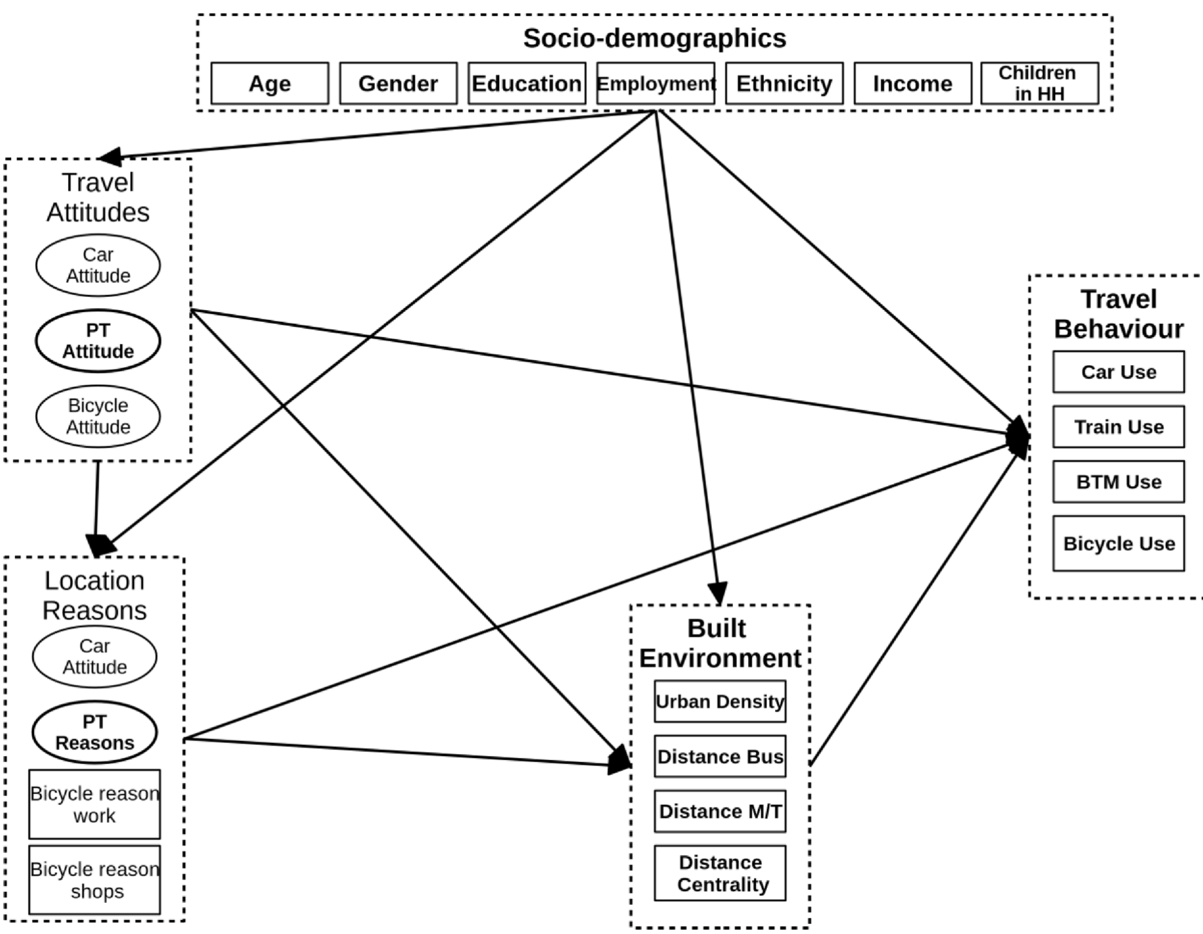

Fig. 2. Structure of the estimated cross-sectional structural equation model. **Bold** variables are included in the longitudinal model as well.

two parts: first the results from the cross-sectional model and then the results from the longitudinal model are presented and interpreted.

4.1. Cross-sectional results

Table 5 presents the estimated standardized direct paths from all independent variables towards the dependent variables. It also includes the standardized total effects of all variables on the main dependent variables of the model, those being Car use, Train use, BTM use, and Bicycle use. Since all non-significant paths (at a 10% threshold) were removed from the structural equation model during the model estimation procedure, all effects presented in Table 5 are statistically significant at this threshold. The T-values of the direct effects are presented in appendix A.

First the effects of the residential built environment on travel behaviour are interpreted, followed by an interpretation of how the travel-related location reasons and travel mode attitudes affect both the choice of built environment and travel behaviour and how these effects are different between the two concepts.

Overall, the effects of the variables related to the residential built environment on the travel behaviour variables are rather small, although an effect does still exist after controlling for both travel attitudes and travel-related location reasons. This finding itself is in accordance with the literature, but some differences between the travel modes can still be highlighted. First, the only built environment variable with an effect on car use is the urban density of the residential environment. This effect size (-0.125) is the second largest of any individual effects of the built environment on travel behaviour. Meanwhile, we find only a small effect of the built environment on bicycle use (-0.044 for the distance of metro/tram stops). Use of the train is only affected by distance centrality (-0.075), a clustered variable that encompasses the distance to train stations. BTM use is affected by all built-environment variables, although to varying degrees. As expected, the distance to bus-stops has the largest effect (-0.130), followed by the centrality (-0.085), density (0.051) and distance to metro- and tram stops (-0.042).

When looking at the effects of attitudes and reasons on the residential built environment, the first thing that stands out is the minimal effect of attitudes. Four small effects are found: from car attitudes on density (-0.034) and bus stop distances (0.036), from PT attitudes to bus stop distances (0.029) and from bicycle attitude to density (0.030). The effects of the travel-related location reasons on the choice of built environment are both considerably stronger and more numerous. Particularly PT reasons have a strong effect on the density (0.341) and both the centrality (-0.203) and bus (-0.339) distances of the chosen residence. These findings support the hypothesis formulated in the introduction that the travel-related location reasons are a stronger, more direct indicator of the choice of built environment than travel attitudes.

More favourable mode attitudes have a direct positive effect on use of the same mode (0.205 for car; 0.255 for PT on train and 0.294 for PT on BTM; 0.511 for bicycle). The bicycle and the train seem to be complementary modes, as a more favourable attitude towards one of these modes leads to increased use of the other mode (0.056 for bike attitudes on train use; 0.028 for the reverse). Bicycle attitudes however have a negative effect on bus use (-0.033), indicating that these modes are less complementary. The private car is a clear competitor of the other modes, with more positive car attitudes leading to decreased train (-0.111), btm (-0.047) and bicycle (-0.131) use and more positive PT and bicycle attitudes leading to reduced car use (-0.033 and −0.111 respectively). The directions of the effects of the travel-related location reasons for choosing a residential location show a similar pattern, with two noticeable exceptions. The first being the change in direction between the train and the bicycle. As seen before, bicycle attitudes have a positive effect on train use, and PT attitudes have a positive effect on bicycle use. However, our results indicate that bicycle-related reasons have a negative effect on train use (-0.095 for bicycle to work; −0.155 for bicycle to shops) and that public transport reasons have a negative effect on bicycle use (-0.096). The second exception is the positive effect of bicycle to shop on car use (0.102). The effect of bicycle to work on car use meanwhile is in fact negative (-0.049), which is an interesting difference even if the effects are not large. This could possibly be explained by the fact that cycling to shops is relatively common in the Netherlands, when cycling to work is not. Having shops nearby thus is a more universal reason, whereas having a commute that one can cycle is only a strong reason for a location decision for more enthusiast cyclists who use the car less.

Differences between the effects of attitudes and reasons on travel behaviour can also be observed when looking at the effect sizes. The effect of the PT reasons on both train and BTM use is substantially larger than that of the PT attitudes (0.457 and 0.350 respectively for train; 0.430 and 0.294 respectively for BTM). Also noteworthy is the strong effect of PT reasons on car use (-0.326), which is again substantially larger than the effect of the PT attitudes (-0.033). For car reasons and attitudes the difference is much smaller, as the effect of car reasons and attitudes on both car use (0.213 and 0.205 respectively) and train use (-0.152 and −0.111 respectively) ais roughly similar. The effect of reasons is stronger on BTM use (-0.140 and −0.047 respectively), whilst the effect of attitudes is stronger on bicycle use (-0.045 and −0.131 respectively). Bicycle attitudes and reasons also follow an unclear pattern, caused in part by the sometimes different directions of the two bicycle reason variables. Bicycle attitudes seem to have a stronger effect on bicycle use (0.511) than bicycle reasons (0.133 for bicycle distance to work and 0.059 for bicycle distance to shops), whereas reasons have a stronger effect on train and BTM use.

These findings seem to shed a more nuanced light on the differences between travel attitudes and travel-related location reasons than the second formulated hypothesis, which stated that travel attitudes have a more general and stronger effect on travel behaviour than travel-related location reasons. The findings indicate a more exclusionary effect of travel-related location reasons, in particular with respect to the bicycle and public transport. The effects of public transport reasons on travel behaviour are stronger than the effects of public transport attitudes, contradicting the hypothesis. Bicycle attitudes meanwhile do have a stronger effect on travel behaviour than bicycle reasons, whilst car reasons and car attitudes have roughly equally strong effects on travel behaviour.

4.2. Longitudinal results

To complement the above cross-sectional model, a longitudinal analysis based on two waves is specified as well. Table 6 contains the standardized direct effects as estimated in the longitudinal model. All paths that were insignificant on a 10% threshold were removed. T-values of the direct effects are given in appendix A.

First, the effects of a variable on itself are interpreted. These paths are indicated by an underscore in Table 6 and can be interpreted as the stability of the variable across the two measurements. The stability of the built environment variables is remarkably high, up to 0.968 for distance bus. This makes sense, given the relatively small gap between the two measurements (2 years). In this time, it stands to reason that not many people moved to a new environment and not many changes were made to the built environment. The main difference is the distance to a Metro or tram stop, which has a comparatively lower stability (0.803). Attitudes and reasons are less stable (0.725 and 0.718 respectively), but their stability is still higher than that of the travel behaviour variables (0.504 for car, 0.634 for train, 0.598 for btm, and 0.654 for bicycle). Especially car use seems to be a relatively unstable variable, which we did not necessarily expect. The results indicate that there is a small effect from PT attitudes on PT reasons (0.053), but no opposite effect. This is some evidence to support the notion that the more general attitudes would probably affect the reasons stated in Section 2.4 which was reflected in the conceptual model of this study.

With respect to the built environment some effects on travel

Table 5
Standardized direct and total effects of the cross-sectional model.

Dependent Variables *Independent variables*	Built Environment				Attitudes			Reasons				Car use		Train Use		BTM Use		Bicycle Use	
	Density	Distance Centrality	Distance M/T	Distance Bus	Car	PT	Bike	Car	PT	Bike Work	Bike Shop	Direct Effect	Total Effect	Direct Effect	Total Effect	Direct Effect	Total Effect	Direct Effect	Total Effect
Socio-Demographics																			
Western ethnicity	−0.056	0.031		0.040		−0.039		−0.060	−0.072		−0.040		0.020		−0.035		−0.047	0.030	0.037
Gender (Male)				0.043	0.071						−0.069		0.013		−0.001	−0.025	−0.028	−0.042	−0.057
Age	−0.075	0.051	0.048	−0.051	−0.102	0.063	0.051		−0.084	−0.047		0.081	0.083	−0.281	−0.250	−0.243	−0.250	−0.070	−0.028
High Education	0.064	−0.096			−0.098	0.035	0.091	0.065	0.096		0.060		−0.065	0.133	0.198	0.080	0.141	0.046	0.100
Employment				−0.050	0.051	−0.123			−0.142	−0.065	−0.057	0.106	0.184	−0.088	−0.192	−0.101	−0.205	−0.054	−0.061
Children in hh		0.028		−0.047		−0.084		0.047	−0.120	−0.036		0.025	0.091	−0.102	−0.194	−0.084	−0.178		0.003
Income (None)	−0.045	0.053						0.036				−0.045	−0.031		−0.009		−0.012	0.032	0.030
Income (Medium)				−0.057	0.059			0.046		−0.023		0.041	0.068	0.040	0.025	0.032	0.028	−0.040	−0.053
Income (High)				−0.077	0.081			0.076				0.049	0.089	0.072	0.048	0.050	0.039		−0.015
Built Environment																			
Density												−0.125	−0.125			0.051	0.051		
Distance Centr.														−0.075	−0.075	−0.085	−0.085		
Distance M/T																−0.042	−0.042	−0.044	−0.044
Distance Bus																−0.130	−0.130		
Attitudes																			
Car Attitude	−0.034			0.036				0.046	−0.144	−0.132	−0.056	0.205	0.23	−0.111	−0.165	−0.047	−0.110	−0.131	−0.140
PT Attitude				0.029					0.216	0.035	0.027	−0.033	−0.112	0.255	0.350	0.294	0.392	0.028	0.013
Bike Attitude	0.030								0.036	0.150	0.111	−0.111	−0.124	0.056	0.042	−0.033	−0.047	0.511	0.534
Reasons																			
Car Reasons	−0.161			0.062								0.213	0.233	−0.152	−0.152	−0.140	−0.062	−0.045	−0.045
PT Reasons	0.341	−0.203		−0.339								−0.326	−0.369	0.457	0.472	0.430	0.339	−0.096	−0.096
Bike Work	−0.073			0.141								−0.049	−0.040	−0.095	−0.095	−0.088	−0.110	0.133	0.133
Bike Shop	0.113		−0.093	0.074								0.102	0.088	−0.155	−0.155	−0.153	−0.074	0.059	0.063

Table 6
Standardized direct effects of the longitudinal model.

Independent variables (2014)	Dependent variables (2016)									
	Built Environment				Attitudes & Reasons		Travel Behaviour			
	Density	Distance Centrality	Distance Bus	Distance M/T	PT Attitudes	PT Reasons	Car Use	Train Use	BTM Use	Bike Use
Socio-demographics										
Western ethnicity										
Gender (Male)										
Age					0.059				0.041	0.043
High Education								0.091	0.040	0.032
Employment										
Children in hh						0.039				0.046
Income (None)	0.019							−0.035		
Income (Medium)										
Income (High)										
Built Environment										
Density	0.934				0.059				0.033	
Distance Centr.	−0.022	0.957		0.068	0.043	−0.054				
Distance Bus	−0.013		0.968						−0.062	
Distance M/T				0.803				0.027		
Attitudes & Reasons										
PT Attitude					0.725	0.053		0.038		
PT Reasons						0.718	−0.139	0.055	0.077	
Travel Behaviour										
Car Use	−0.017	0.015					0.504	−0.069	−0.058	−0.098
Train Use	−0.015		−0.014	0.031	0.055			0.634	0.088	
BTM Use						0.059		0.054	0.598	
Bike Use							−0.052			0.654

behaviour are found, even when controlled for attitudes and reasons. The effects are smaller and less numerous than in the cross-sectional model, but they do follow the pattern that PT use is most affected (despite only including PT-related attitudes and reasons). Especially the effect of the distance to bus stops on bus use (-0.062) is perhaps not entirely unsurprising, but it is strong evidence that the built environment has at least some independent effects on travel behaviour when controlling for RSS. Both attitudes and reasons have no effect on the built environment, which was surprising given the close conceptual relation between especially reasons and the built environment. Relations in the opposite direction were found however, indicating that people who in live more centrally located, denser neighbourhoods, are more likely to later state that the proximity of PT access points was an important factor in their decision to relocate to such areas. Distances to bus and metro/tram stops still have no effect on PT attitudes and reasons. Keep in mind that the time between the two measurements is relatively limited, which will probably impact these results as attitudes (and to a lesser extent reasons) are relatively stable over time, as is the built environment.

The effects between attitudes and reasons on one side and travel behaviour on the other are interesting for multiple reasons. First, we do find effects in both directions (both from attitudes/reasons to behaviour and the other way around). This means that the cross-sectional model always overestimates the effects of attitudes and reasons on travel behaviour, and thus possibly overstates the effects of RSS. Second, the effects are different for BTM and train use. For BTM use, we find effects on PT reasons (0.059), but not on PT attitudes. For train, we only find effects on PT attitudes (0.055) and not on PT reasons. In the reverse direction, PT reasons both affect train (0.055) and BTM (0.077) use, whereas PT attitudes only affect train use (0.038). Third, the effect of PT reasons on travel behaviour are stronger than the effect of PT attitudes, which contradicts our hypothesis stated in the introduction that attitudes would have a stronger effect on travel behaviour than reasons. Finally, the estimated effects of attitudes and reasons on travel behaviour are slightly stronger than the effects in the opposite direction.

5. Conclusion and discussion

This paper made use of a distinction between travel mode attitudes and deliberate travel-related reasons for residential location choice, first proposed by Ettema & Nieuwenhuis (2017), to investigate their separate effects in the mechanism of residential self-selection. The two main hypotheses were that travel-related location reasons have a stronger effect on the choice of built environment than travel attitudes, whereas travel attitudes would have a stronger effect on travel behaviour.

The results from the cross-sectional model seem to suggest that travel-related location reasons have a much stronger direct effect on the choice of built environment than travel attitudes for all three modes, and that public transport related location reasons have the largest effect on the choice of built environment. More specifically, the results suggest that people for whom public transport access was an important factor in their location decision are much more likely to live in denser areas with shorter distances to central facilities and bus stops. However, the longitudinal model was unable to find such a relation. Instead, a much smaller effect in the opposite causal direction was found. This would suggest that people who start to live in more centrally located neighbourhoods then retroactively say that public transport access was an important reason in their relocation decision. The same reverse causal effect was found between attitudes and the built environment. The first hypothesis of this paper, that deliberate travel-related reasons are more direct indicators of the built environment choice than travel attitudes, thus cannot be fully supported by the conducted analyses, despite the results from the cross-sectional model providing at least some indication that it may hold.

A further difference between the two concepts can also be observed in relations with travel behaviour. First, travel-related location reasons more often have a negative effect on the use of other modes than travel attitudes, a finding that holds across both models. This is seen most clearly in the bicycle and public transport attitudes and reasons of the cross-sectional analysis. More positive attitudes towards the bicycle and public transport cause an increase in the use of the other mode, whilst increasing values for transport related location reasons for one of these modes causes a decrease in the use of the other mode. Further evidence is found in the longitudinal analysis, where public transport reasons have a relatively strong negative effect on car use, whereas no effect of public transport attitudes on car use is found. This could be explained by the fact that people who have moved to a certain location due to their travel preferences are likely to 'lock-in' on that preference, meaning that they are less likely to use any other mode. Second, attitudes have a stronger effect on use of the same mode for car and bicycle than reasons. For public transport however, the travel-related location reasons seem to have a stronger effect based on the cross-sectional model. This result could partly be explained by the inability of the cross-sectional model to account for the possible bidirectional causal relations between the built environment and these reasons, as evidenced by the reverse causal effect found in the longitudinal analysis. Since the built environment affects behaviour more strongly for public transport compared to the other two modes, this could lead to an overestimation of the effect of the travel-related location reasons on public transport use.

Regarding the effects of the built environment on travel behaviour (when controlled for both underlying travel attitudes and travel-related location reasons), these are much larger for public transport than for either the car or the bicycle. In fact, both car and bicycle use are only affected by a single variable in the cross-sectional analysis and by no variables in the longitudinal analysis. Whilst in general terms these findings are not surprising given the findings in the literature (Cao, Mokhtarian, & Handy, 2007; Cao et al., 2009; Mokhtarian & van Herick, 2016), the small effect of the built environment on car and bicycle use does stand out. Our findings show that distances to bus stops, metro/tram stops, and living in a centrally located neighbourhood have no impact on the use of the car. Interestingly, the findings also indicate that bicycle use is hardly affected by the built environment at all, which could be explained by the relatively high quality of the cycling infrastructure in the Netherlands combined with the proximity of most facilities. This means that most areas in the Netherlands are conducive to cycling at least to some degree. Hence, to accurately assess the role of the built environment on this mode of transportation, a multi-country perspective is necessary to obtain sufficient variation in the independent variables, i.e., the (general) proximity to locations and the quantity and quality of the cycling infrastructure.

To summarize, our findings provide some first, but inconclusive, evidence that the travel-related location reasons for choosing a residential location seem to reflect the effect of travel preferences on the residential location choice more accurately than travel attitudes. The attitudes reflect a more general effect of predispositions on travel behaviour. The travel-related location reasons have a stronger exclusionary effect on travel behaviour however. We also find evidence for the reverse causality hypothesis, both in the cases of the relations between attitudes/reasons with travel behaviour and with the built environment. This ties in with the current debate in the academic literature, identified both by Guan et al. (2020) and van Wee & Cao (2020) surrounding the direction of causality in the context of RSS. Our findings that the effect in the opposite causal direction is roughly as strong as the classic causal direction in the context of RSS are similar to findings of other recent research in a more general context (Kroesen & Chorus, 2018; Kroesen et al., 2017; Van De Coevering et al., 2016).

In the context of RSS, the finding of bi-directional causal effects would imply that adding attitudes and reasons to models could run the risk of adding an endogenous variable, thereby underestimating the actual independent effect of the built environment on travel behaviour. On the other hand, not accounting for deliberate travel-related reasons for relocation could result in an overestimation of the independent effect on the built environment, given the relations we find between these reasons and both travel behaviour and the built environment. Which of these mechanism holds more, and thus whether research not encompassing travel-related reasons under- or overestimates the independent effect of the built environment, depends on the relative strengths of the bi-directional causal effects between these reasons and both the built environment and travel behaviour. This research provides some first evidence in this regard, namely that the relative effects are roughly of an equal size, but further research in this area is needed.

The findings of our research have several implications for policies that aim to reduce car use. Firstly, finding an independent effect of the built environment when accounting for residential self-selection implies that policies aimed at creating a built environment that is more friendly to public transport might increase the use of this mode. However, the independent effect on car use appears to be minimal due to underlying attitudes and reasons. This implies that policies aimed at reducing car use should also try to affect these variables. There is already a large body of work addressing the question of how travel-related attitudes can be influenced or better addressed by targeted policy efforts (see e.g., Anable 2005; Bamberg 2013; Hunecke, Haustein, Böhler, & Grischkat 2010).

There are four main limitations to this research, which could be improved upon by future research. First, there is a limited time between the two waves of the longitudinal analysis, which means that especially the built environment was very stable. Adding a third wave and/or focusing on those individuals who relocated during measurements could substantively change the findings of this research. The second limitation of this research is the measurement of the built environment, which arguably did not capture specific aspects related to bicycle use, such as the quantity and quality of the cycling infrastructure near the residence. Ideally, such variables should be included in future research efforts, especially since many cities across the world are trying to stimulate the use of this mode. The third limitation is the omission of the more indirect residential preferences. Knowing how travel attitudes, residential preferences, and travel-related residential reasons are connected to one-another and to travel behaviour and the choice of built environment would further our understanding of RSS. Finally, this research only uses data collected in the Netherlands, a dense, well-connected OECD country. Using data from other areas of the world, especially non-OECD areas, could paint a more complete picture of the relations between the built environment, attitudes, travel-related residential reasons, and travel behaviour.

Funding

This research did not receive any specific grants from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Roel Faber: Conceptualization, Data curation, Methodology, Visualization, Software, Writing - original draft. **Raimbard Merkies:** Conceptualization, Methodology, Software, Writing - original draft. **Wouter Damen:** Conceptualization, Methodology, Writing - original draft. **: .** **Leonard Oirbans:** Conceptualization, Visualization, Writing - original draft. **Davide Massa:** Conceptualization, Writing - original draft. **Maarten Kroesen:** Supervision, Writing - original draft, Writing - review & editing. **Eric Molin:** Supervision, Writing - original draft, Writing - review & editing.

Appendix A:. T-values of estimated direct effects

Independent variables	Built Environment				Attitudes			Reasons				Travel Behaviour			
	Density	Distance Centrality	Distance M/T	Distance Bus	Car	PT	Bike	Car	PT	Bike Work	Bike Shop	Car Use	Train Use	BTM Use	Bike Use
Socio-demographics															
Western ethnicity	−3.95			2.64		−2.63		−4.16	−4.93		−2.89				2.37
Gender (Male)				2.84	4.10						−5.69				−3.27
Age	−5.05	3.28	3.17	−3.12	−5.93	3.87	3.08		−6.18	−3.35		5.36	−20.3	−17.62	−5.03
High Education	−6.30	−6.30			−5.58	2.20	5.47	4.19	6.35		4.28		9.61	5.84	3.40
Employment				−3.14	2.87	−7.78			−9.14	−4.25	−3.95	6.60	−6.14	7.12	−3.52
Children in HH		2.09				−5.41		3.37	−8.49	−2.55		1.73	−7.56	−6.25	
Income (None)	−3.27	3.44						2.64				−3.04			2.29
Income (Medium)				−3.57	4.17			3.22		−1.709		2.73	2.86		−2.92
Income (High)				−4.78	3.16			5.19				3.370	5.16	3.43	
Built Environment															
Density												−8.52		3.37	
Distance Centr.													−5.94	−5.87	
Distance M/T														−3.73	−3.54
Distance Bus														−10.9	
Attitudes															
Car Attitude	−2.46			2.05				2.787	−7.86	−8.01	−3.35	13.19	−7.56	−3.21	−8.78
PT Attitude				1.73					12.86	2.11	1.71	−1.94	15.95	18.56	1.71
Bike Attitude	2.46								2.10	9.02	6.91	−6.89	3.72	−2.32	32.87
Reasons															
Car Reasons	−10.72			3.12								11.50	−8.91	−8.13	−2.68
PT Reasons	13.197	−12.148		−9.54								−9.50	14.40	13.15	−3.18
Bike Work	−4.86			7.34								−2.78	−5.81	−5.37	8.01
Bike Shop	6.326		−6.07	3.20								4.89	−7.81	−7.73	2.99

Independent variables (2014)	Dependent variables (2016)									
	Built Environment				Attitudes & Reasons		Travel Behaviour			
	Density	Distance Centrality	Distance Bus	Distance M/T	PT Attitudes	PT Reasons	Car Use	Train Use	BTM Use	Bike Use
Socio-demographics										
Western ethnicity										
Gender (Male)										
Age					3.22				2.84	2.38
High Education								5.79	2.49	1.80
Employment										
Children in hh						1.68				2.52
Income (None)	2.89							−2.55		
Income (Medium)										
Income (High)										
Built Environment										
Density	110.8				2.76				2.00	
Distance Centr.	−2.508	139.9		4.62	2.05	−2.32				
Distance Bus	−1.80		165.1						−4.07	
Distance M/T				64.68				1.94		
Attitudes & Reasons										
PT Attitude					34.16	2.01		2.31		
PT Reasons						23.06	−5.63	2.59	3.47	
Travel Behaviour										
Car Use	−2.14	2.36					23.15	−4.02	−3.29	−5.27
Train Use	−2.05		−2.43	2.294	2.61			29.46	3.95	
BTM Use						−2.12		2.60	27.45	
Bike Use							−2.57			36.06

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