Social-ecological Research in Economics (SRE) Discussion Paper 02/2022

Environmental Concern and the Determinants of Night Train Use: Evidence from Vienna (Austria)

by

Brian Buh, Stefanie Peer

Institute for Multi-Level Governance & Development
Department of Socio-Economics
Vienna University of Economics and Business

02 / 2022

WU WIRTSCHAFTS UNIVERSITÄT WIEN VIENNA UNIVERSITY OF ECONOMICS AND BUSINESS

Environmental Concern and the Determinants of Night Train Use: Evidence from Vienna (Austria)

by

Brian Buh, Stefanie Peer

Abstract

This paper investigates which factors determine the intention to take a night train, emphasizing the role of environmental concern. We employ a Theory of Planned Behavior framework. We built a survey based on elicitation study, which resulted in an online survey being conducted on a convenience sample in Vienna (Austria). Our results show that in particular environmental concern and familiarity with night train services play a significant role in the formation of the intention to take a night train. Among the significant factors that are associated with a high intention to take a night train are the belief that night trains are comfortable, that one can save the cost of a night in a hotel, and that night trains tend to arrive at and depart from the city center. Factors that deter travelers from taking a night train include a high price, the sharing of cabins, and long travel times.

Keywords: Environmental Concern, Mode Choice, Night Trains, Theory of Planned Behavior, Long-distance travel

JEL: N74, R40, L92, Q57, D01

Environmental Concern and the Determinants of Night Train Use:

Evidence from Vienna (Austria)

Brian Buh[1] and Stefanie Peer[2]

INTRODUCTION

Motivation

Transportation is one of the largest users of fossil fuels, accounting for about 31% of fuel as a sector in 2010 (Capros et al., 2016; 50). While the large majority of trips tend to be rather short, when measuring passenger kilometers traveled, medium- and long-distance[3] travel have a significant share and contribute (increasingly) to overall greenhouse gas (GHG) emissions (Christensen, 2016; Rothengatter et al., 2015). For instance, in a case study of Germany, Aamaas et al. (2013) estimate that trips over 100 kilometers contribute 51% of all emissions from passenger travel.

In their 2011 White Paper, the European Commission, in an attempt to reduce GHG emissions, proposed more investment into rail with a goal of shifting 50% of all medium-distance travel in Europe to it (European Commission, 2016). Even when factoring in aspects such as electricity source, top speed, and load factor, it can be concluded that a trip by train, with currently available infrastructure is considerably better for the environment in regards to GHG

[1] Wittgenstein Centre for Demography and Global Human Capital (IIASA, OeAW, University of Vienna), Vordere Zollamtsstrasse 3, 1030 Vienna, Austria, brian.buh@oeaw.ac.at
[2] Vienna University of Economics and Business, Welthandelsplatz 1,
1020 Vienna, Austria, stefanie.peer@wu.ac.at
[3] Medium-distance is defined as trips longer than 30 kilometers and up to 300 kilometers. Trips longer than this are defined as long-distance (Follmer & Gruschwitz, 2019).

emissions than the same trip made by both air and road (D'Alfonso et al., 2016; Givoni, 2007; Goeverden et al., 2019; Lindsey et al., 2011).[4]

This paper puts a focus on night trains as an environmentally friendly alternative for medium and long-distance travel. Night trains give an alternative to high-emitting modes because of their ability to travel long distances while travel time can be spent on sleeping in a reasonably comfortable sleeping position. More specifically, this paper investigates what underlying motivations, norms and barriers play a role in whether individuals have an intention to take a night train, based on a qualitative elicitation study and an online survey. Specific emphasis is placed on the role of environmental concern in affecting the intention to take a night train, not at least because this factor is frequently used in advertising night rail travel. The reduced environmental effect was also the most cited reason for interest in night trains as a mode of transport in our elicitation study that preceded the larger-scale survey. For the latter, we make use of the methodological framework of the Theory of Planned Behavior (TPB) (Fishbein & Ajzen, 2011), which has been applied to various mode choice contexts (Chen & Chao, 2011; Geng et al., 2017; Gkargkavouzi et al., 2019; Pan & Truong, 2018), but not yet to taking night trains.

This study has been conducted in Vienna, where the night rail service led by the national Austrian rail provider (Österreichische Bundesbahnen (ÖBB)) has been expanded notably in recent years. This includes opening up new routes as well as purchasing new rolling stock specifically for their night rail service (ÖBB. Austrian Federal Railways, 2019b). Like other providers of night rail services, ÖBB has underlined the benefits of night train travel to lower

[4] For the European Union, the external costs for passenger cars have been estimated at 1.18€/pkm, for buses at 0.475€/pkm, for short haul flights of < 1500 km at 2.39€/pkm and for diesel trains at 0.34€/pkm (European Commission, 2019).

carbon emissions per passenger and kilometer traveled (ÖBB. Austrian & Federal Railways, 2019a).

Our study yields valuable insights to which determinants motivate intention formation and which act as barriers for night train travel. To our best knowledge, this paper is the first behavioral study on night train use.

Mode Choice Behavior for Medium-distance Trips

Private vehicles are the primary mode of transport for medium-distance trips (VCÖ, 2020). Air dominates distances longer than 400 kilometers in Europe (Frei, 2013). Data from the `Mobility in Germany (MiD)' survey 2008 indicates that around 61.9% of all medium- and long-distance trips (defined as trips longer than 300km) were made by private vehicles, 16.4% by train, 14.6% by air, and 7.1% by all other modes (Reichert & Holz-Rau, 2015).

There is a correlation between higher education and train usage (Paulssen et al., 2014), which may, however, have more to do with the higher educated being on average more likely to live in an urban area and having less access to private vehicles. Urban areas have more jobs for the highly educated, and therefore residential location choice acts as a latent variable the selection of trains over other modes (Mokhtarian & Cao, 2008). Better educated individuals often also have jobs they can do remotely, making time spent on trains more efficient than driving or flying (VCÖ, 2020), in particular in light of technological advancements (Lyons et al., 2013).

Numerous studies looking at mode choice behavior for medium-distance trips in Europe have shown that price is a primary determinant (Adler et al., 2010; Behrens & Pels, 2012; Pagliara et al., 2012). When comparing mode choice between air and rail, travel time explains as much as 84% of the modal split on seven European routes (Steer Davies Gleave, 2006). Access journey time also factors into total (door-to-door) travel time. It has been estimated that the

value associated with 1 minute access travel time is equal to the value associated with 2 minutes of in-vehicle travel time (Iseki & Taylor, 2009).

Access to a car increases the ability to follow non-predefined schedules, ease of transporting children and bringing more luggage are significant factors that work in favor of the car (Nerhagen, 2003; Vredin Johansson et al., 2006; Wall et al., 2007). Air favors those who prefer speed of travel to all other aspects of travel (van Birgelen et al., 2011). Train users tend to show a high preference towards departing from and arriving at the city center, comfort and punctuality (Esplugas et al., 2005) and a significant interest in the environment (Nerhagen, 2003). Service frequency and scheduling further determine specific mode choice when comparing the choice of air versus rail (Pagliara et al., 2012). Furthermore, familiarity with a particular mode, route, or schedule may be the most significant latent factor determining future mode choice behavior (Dällenbach, 2020). Finally, due to sleeping, night trains add another layer of complexity to mode choice intention formation. Time takes on a different form as hours spent sleeping are valued considerably different from waking or productive hours (Jara-Díaz & Rosales-Salas, 2020). Travelers may also view sleeping as an opportunity to gain more valued additional hours at the destination (KiM, 2019). Moreover, additional issues like comfort in regards to sleeping, personal security and sharing cabins matter (Burman, 2015; Hödl, 2006; Rüger & Matausch, 2020; Sauter-Servaes & Nash, 2009).

Environmental Concern and Mode Choice

Environmental concern is related to attitudes towards a wide scope of human related activities (personal and other) that cause either positive or negative effects on the environment (Fransson & Gärling, 1999). Therefore, “a person with high environmental concern can be defined as someone who has a good knowledge of (or belief in) the environmental challenges, who feels concerned by those challenges, and who has intention to act to protect the environment”

(Bouscasse et al., 2018; 207). Individual determinants such as sex, age, education or income factor into environmental concern although the results across several studies are mixed (Marquart-Pyatt, 2012). Consistently through time and various studies, age proves to be the best predictor of environmental concern (Jones & Dunlap, 1992) with younger generations showing higher levels (Liu et al., 2014) and evidence that women have higher overall levels of environmental concern.

People with high levels of environmental concern do not always behave in an environmentally conscious manner (Kollmuss & Agyeman, 2002). Behavior is driven by a combination of several factors including identity, attitudes, perceived behavior control, subjective norms, heuristics, habits, and intention (Fishbein & Ajzen, 2011). While there is evidence that people also include the ecological benefit when choosing their transport mode (Gaker et al., 2011), it is not known what role environmental concern plays in situations where night trains are a potential mode alternative. This study intends to update the limited available information on night train mode choice behavior with its regards to the factors extracted from studies of urban transport, other modes of medium- and long-distance transport and conventional and high-speed rail travel.

Structure of the Paper

This paper is structured as follows. Section 2 covers the theoretical model and its operationalization in the context of night trains. Section 3 describes the dataset and empirical methods. Section 4 presents the results, and Section 5 concludes.

THEORETICAL MODEL AND ELICITATION STUDY

Methodological Background

The Theory of Planned Behavior was conceived by Icek Ajzen and Martin Fishbein, with its goal is to explain and predict planned human behavior (Ajzen, 2012). The TPB states that while some decisions humans make are subconscious, many behaviors are based on reasoned decisions (at least during the initial process). The goal of the TPB is to determine the intention of a subject within a time-specific context. Evaluating intention is important since "intention is the immediate antecedent of behavior and is itself a function of attitude toward the behavior, subjective norm, and perceived behavioral control" (Ibid.; 438). The TPB is a quantitative method in which beliefs, norms and perceived controls could be factored into the intention to engage in a specific behavior.

As suggested by Ajzen (2012), we collect data on variables representing direct and indirect measures of attitudes, subjective norms and perceived behavioral controls regarding night train use. Direct measures test for self-attributed motives (e.g., "traveling by night train is enjoyable" or "people who are important to me want me to take the overnight train"), while indirect measures test for implicit motives (e.g., "doing something good for the environment is desirable" or "feeling insecure makes it more likely that I do not choose that mode of transportation") (McClelland et al., 1989). Direct measures are assessed by means of reflective indicators or questions designed to measure the behavior itself (Ajzen, 2020). They take a generic form that is broad sweeping for the entire potential for attitudinal, normative or control beliefs about a behavior (Francis et al., 2004). Indirect measures, by contrast, test specific beliefs about attributes of a behavior (e.g., "because of taking the overnight train, not needing to drive is helpful"). The indirect measurement approach assumes that people can accurately report their beliefs about an associated behavior in a probabilistic way as well as give weights for the importance of that belief to them personally.

According to the Theory of Planned Behavior, intentions are assumed to be influenced by three different pillars (see Figure 1 for a graphical illustration). Each variable representing a direct measure is based on a number of reflective questions about the attitudinal, normative or control beliefs associated with the behavior. Each variable representing an indirect measure is based on paired questions regarding the strength of a specific belief plus a weight for that belief's effect on the behavior under study.

1) *Attitudes* towards a behavior are measured directly and indirectly: TPB assumes that indirect measures of attitude are composed of *Behavioral beliefs*, which are readily accessible beliefs about the consequences of associated behaviors. This variable is then multiplied by the corresponding *Outcome evaluation* (Figure 1) which is the value placed on the importance of these potential consequences. TPB is sensitive to the time in which the evaluation is performed as the perceived strengths and weights of beliefs towards associated behaviors can change over time. Only readily accessible beliefs have a strong effect on composite belief formation which are prone to change with experience.

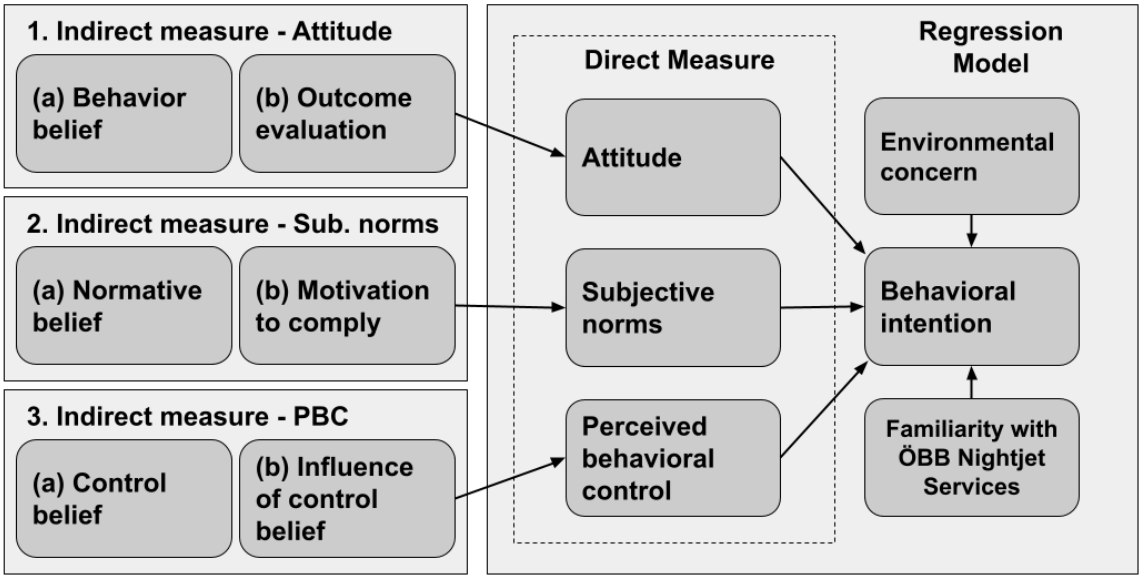
2) *Subjective norms* also include both direct and indirect measurements, with direct measures representing specific social norms or pressure. Indirect measures are composed of *Normative beliefs,* that are "readily accessible beliefs about the normative expectations and actions of important referents and motivation to comply with these referents*"* (Ajzen, 2012; 448), which then lead to *Motivation to comply* created by social pressure that is felt. Referents (people or communities in which a subject refers to when making a behavioral decision) can for instance be spouses, partners, close family, friends or depending on the action larger real and imagined communities (Ibid.: 441).

3) *Perceived behavioral control (PBC)* measures factors that stop a person from forming an intention towards a particular behavior. Direct measures can incorporate aspects of self-efficacy

and/or awareness of barriers. Self-efficacy (one's belief in one's ability to do a behavior) plays an important role in intention formation as it might be more influential to intention than actual behavioral controls themselves (Bandura & Locke, 2003). Indirect measures *PBC* are composed of *Control beliefs*, readily accessible beliefs about the degree of behavioral control, which are then mitigated through the *Influence the behavioral control* or, in other words, the relative strength each control belief has on the formation of the PBC.

Finally, *Behavioral intentions* are then assumed to be the consequence of *Attitude, Subjective norms* and *Perceived behavioral control*. Indirect measures affect direct measures which then affect intention. The intention directly precedes a specific behavior if the degree of actual control over the behavior is sufficiently high. In general, more positive attitudes, stronger subjective norms and low levels of perceived behavioral control have a positive effect on the intention to carry out a behavior. The extent of *Actual Behavioral Control* eventually determining if a behavior is performed or not is not incorporated into our model for data availability reasons. Instead we focus on *Perceived Behavioral Control* and intention formation (as a proxy for future behavior) and collect information on past behavior (as a proxy for familiarity with night train services).

Figure 1: Graphical representation of the relationship between indirect measures and the regression models



The link between intention and behavior has been established in a variety of studies. In a meta-analysis of such meta-analyses, Sheeren (2002) observed an overall mean correlation of 0.53 between intention and behavior. Determining the causal effect of intention on behavior is, however, difficult, and limited to studies that include interventions that lead to a change in intentions, and at the same time are able to measure behavioral outcomes. A meta-analysis of 47 such studies finds that interventions cause a significant change in intentions, which in turn lead to a smaller change in behavior (Webb & Sheeran, 2006). It can therefore be argued that a causal link between intention and behavior is likely to exist in most contexts.

Empirical support for the validity of TPB comes from a number of correlational studies displaying the capacity to predict both intention and behavior. A meta-analysis by Armitage and Conner (2010) found that TPB can explain 11% more variance in behavior than when behavioral measures were based on objective measurements. Collecting data on intentions as well as the subjective components that compose intention allows researchers to gain a better understanding of behavior compared to studies that simply ask people's attitudes towards a particular behavior. Extensions of TPB models are common. For instance, in a review of

published TPB studies that incorporate some aspects of environmental concern, Yuriev et al. (2020) found that 72% of the studies extended the base model. Our TPB model extends the base TPB model using *Environmental concern* and *Familiarity with ÖBB Nightjet services* (Figure 1).

Methodology

In our analysis, we use a standard multilinear regression model (Ajzen & Fishbein, 2008). Our main focus is on exploring the relationship between *Intention* and the direct measures of *Attitude, Subjective norms, PBC* and the extensions *Environmental concern,* and *Familiarity with ÖBB Nightjet services*[5]. The direct measures of attitude and subjective norms ask questions about the beliefs towards night trains themselves rather than objective characteristics. Indirect measures ask about the individual perception of objective characteristics of transport that are associated with night trains. The latter are considered formative indicators as they are assumed to assess the determinants that lead to the formation of attitude, subjective norms and perceived behavioral control (Ajzen, 2020).

While we have also collected data on indirect measures, we found that composite variables comprised of the indirect question items had little additional explanatory power towards behavioral intention. Moreover, combining composite direct and indirect measures variables in one model led to issues with multicollinearity in some instances. We therefore explore the relationship between direct and indirect measures in a separate analysis where we regress the direct measures on the corresponding indirect measures pairs (Figure 1). Regressing indirect measures on the composite direct measures allows us to see which determinants affect the formation of the direct measures of attitude, subjective norms and perceived behavioral control.

[5] Measures of *Previous ÖBB Nightjet use* were not sufficiently independent from measures of familiarity with ÖBB Nightjet services. Thus, the former was dropped in favor of the latter in the later regression model.

It also improves the validity of the direct measures regression model by showing that these beliefs are related to attitudes regarding the features of medium- and long-distance transport.

Elicitation study

Since relatively little previous work has been published that looks at behavioral determinants of mode choice in regards to night trains, in March 2020 we performed an elicitation study for potential determinants to use as an input for the design of the questionnaire. The elicitation study incorporated participants from the Vienna University of Economics and Business as well as individuals waiting in the lounge area directly below the platforms at the Vienna Central Station. Considering the interviews occurred at the train station, it can be assumed the respondents are mainly train users. Since day train and night train use is correlated, the respondents most likely have a higher intention to take a night train then the average resident of Vienna[6]. For the elicitation study, this is preferred, as the respondents can be expected to already have a clearer idea of what it entails to travel by night train. In total, 54 semi-structured interviews were completed. Each subject was asked three questions: 1.) "Why would you take a night train?" and 2.) "What factors could stop you from taking a night train?" 3.) an open ended follow up question about social referents to gain a clearer picture used to select questions for subjective norms. The semi-structured format gave respondents the space to elaborate. The first items mentioned were given extra weight in the subsequent qualitative content analysis, as they are supposedly closer to the conscious. The results of question 1 were compiled to define the attitudinal questions towards night trains. The results of question 2 were compiled to define the questions regarding PBC. Questions about social referents were used to select the questions for subjective norms.

[6] In our sample, past use of ÖBB Nightjet services and past use of general ÖBB services were correlated (0.178 with a p-value of <0.01).

Table 1: Results of the elicitation study

	Number of mentions	Mentioned the factor (%)	First mention (%)
Why would you take a night train?			
Environment	32	59.3	38.9
Comfortable	19	35.2	13.0
Efficient use of time	16	29.6	9.3
Convenience	7	13.0	3.8
Fear of flying/safety	7	13.0	9.3
Built for sleeping	5	9.3	1.9
Relaxing	2	3.7	1.9
Not paying for a hotel	2	3.7	1.9
Other	19	35.2	20.0

Table 2 (Continued): Results of the elicitation study

What factors could stop you from taking a night train?			
Price	42	77.8	64.8
Bad night of sleep	14	25.9	7.3
Personal security	12	22.2	11.1
Cleanliness	7	13.0	0
Booking frustration	6	11.1	0
Sharing space	5	9.3	3.8
Time	5	9.3	1.9
Other	11	20.1	11.1
Whose opinion is important to you about which mode of transport you take?			
Friends	43	79.6	22.2
Family	41	75.9	24.0
Partner	40	74.1	51.9
Co-workers	11	20.4	1.9
Other	7	13.0	0

N=54

Questionnaire

The questionnaire consisted of seven sections with 67 questions: indirect and direct measures of attitudes, subjective norms, perceived behavioral controls, as well as intentions, past behavior, self-reported familiarity with ÖBB Nightjet services, environmental concern, and sociodemographic question items. The questions were informed by the relevant literature and the results of the elicitation study. The scales range from least to most – e.g. very unlikely, very

likely, very inconvenient, very convenient, or strongly disagree, strongly agree– mostly comprising a 7-point Likert scale (Allen & Seaman, 2007; Garland, 1991).

To ensure high validity and reliability, the questionnaire went through various steps of language and data testing. A preliminary sample was collected using a draft questionnaire to test for validity and reliability as well as to remove variables that showed signs of attitudinal ambivalence (Costarelli & Colloca, 2004). The questionnaire was available in both English and German and utilized a cross-translation test to ensure uniformity of language. Before translation, a test sample collected with the English language survey was tested for heteroskedasticity and multicollinearity. The final digital questionnaire was constructed on the LimeSurvey platform. Table 2 lists all variables for which information has been collected by the respondents.

Recruitment

The data collection took place in the larger Vienna area, which was chosen because of the amount of night train options and destinations available. The questionnaire was published in April 2020 and distributed via a university wide research survey email list, which includes all active students and some faculty of the Vienna University of Economics and Business. The list has 18,799 recipients as of April 2020 and 609 people started the survey. The survey was active for 12 days and was completed by 481 participants.

Table 3: Variables and questions included in the questionnaire

Variable/dimension	Items	Mean	S.d.	Reference
Intention	(I1) Next time I travel I will take the ÖBB Nightjet if available	4.49	1.64	Ajzen (2010)
	(I2) Within the next 24 months I will take a night train	4.42	1.68	
	(I3) Within the next 24 months I intend to take a night train	4.79	1.83	
	(I4) Within the next 24 months I would like to take a night train	5.01	1.81	
Direct measure attitude	(DMA1) Traveling by night train is adventurous	4.67	1.59	Bouscasse et al. (2018);
	(DMA2) Traveling by night train is good	5.09	1.37	
	(DMA3) Traveling by night train is beneficial	5.19	1.38	
	(DMA4) Traveling by night train is enjoyable	4.33	1.51	
Direct measure subjective norms	(DMSN1) I feel under social pressure to take the night train	2.22	1.55	Klöckner & Matthies (2004);
	(DMSN2) It is expected of me to take the night train over other modes of transportation	2.30	1.62	
	(DMSN3) People who are important to me want me to take the overnight train	2.21	1.58	
Direct measure PBC	(DMPBC1) The decision to the take the night train is ultimately my decision	6.42	1.17	Bandura & Locke (2003);
	(DMPBC2) For me to take an overnight train is easy	3.20	1.55	
	(DMPBC3) There are factors stoppings me from taking an overnight train	4.67	1.85	
Indirect measure attitude	(IMA1a) Traveling by overnight train is good for the environment	6.30	1.15	Nerhagen (2003);
	(IMA1b) Doing something good for the environment is desirable	0.73	0.44	
	(IMA2a) Traveling by overnight train is a good way to sleep	4.55	1.70	
	(IMA2b) Getting a good night of sleep while traveling is desirable	0.49	0.42	
	(IMA3a) Traveling by overnight train is comfortable	4.38	1.48	Esplugas et al. (2005);
	(IMA3b) A comfortable form of transportation is desirable	0.60	0.38	
	(IMA4a) Traveling by overnight train is good because you depart from and arrive at the city center	5.81	1.32	Iseki & Taylor (2009);
	(IMA4b) Departing from and arriving to the city center is desirable	0.38	0.46	
	(IMA5a) Because of taking the overnight train, not needing to drive is helpful	6.20	1.30	Esplugas et al. (2005);
	(IMA5b) Not needing to drive when traveling is desirable	0.42	0.52	
	(IMA6a) Because of taking the overnight train not needing to pay for a hotel is helpful	5.51	1.49	KiM. (2019):
	(IMA6b) Saving money on nights in a hotel is desirable	0.22	0.55	
	(IMA7a) Because of taking the overnight train arriving in a city in the morning is helpful	5.78	1.41	
	(IMA7b) Arriving in the morning when traveling is desirable	0.28	0.53	
	(IMA8a) Traveling by overnight train is safer, in regards to accidents	5.51	1.49	
	(IMA8b) Traveling by a safe mode of transport in regards to accidents is desirable	0.48	0.51	
Indirect measure subjective norms	(IMSN1a) My close friends think I should take the night train	2.88	1.72	
	(IMSN1b) Generally speaking, how much do you care what your close friends think you should do?	0.04	0.54	

Table 4 (Continued): Variables and questions included in the questionnaire

Indir. Subj. Norms	(IMSN2a) My partner think I should take the night train	2.93	1.84	
	(IMSN2b) Generally speaking, how much do you care what your partner think you should do?	0.32	0.55	
	(IMSN3a) My family think I should take the night train	2.73	1.71	
	(IMSN3b) Generally speaking, how much do you care what your family think you should do?	0.19	0.53	
	(IMSN4a) My coworkers think I should take the night train	2.54	1.60	
	(IMSN4b) Generally speaking, how much do you care what your coworkers think you should do?	-0.28	0.52	
Indirect measure PBC	(IMPBC1a) Traveling by night train is expensive	5.07	1.39	Behrens & Pels (2012);
	(IMPBC1b) When making a decision on mode of transportation price is important	-0.61	0.41	Adler et al. (2010);
	(IMPBC2a) The amount of time spent on the night train is unacceptable	2.87	1.52	Wen & Koppelman (2000);
	(IMPBC2b) The amount of time spent in transport is important	-0.44	0.49	Steer Davies Gleave (2006);
	(IMPBC3a) In regards to personal security, traveling by overnight train is insecure	2.84	1.56	Hödl (2006);
	(IMPBC3b) Feeling insecure makes it more likely that I do not choose that mode of transportation	-0.12	0.64	
	(IMPBC4a) Sharing a cabin on a night train with people I do not know is unacceptable	4.23	1.94	Hödl (2006);
	(IMPBC4b) Sharing a cabin with people I don't know is something that would make it difficult for me to travel	-0.12	0.68	
	(IMPBC5a) Booking a night train on the ÖBB website or smartphone app is difficult	2.72	1.65	
	(IMPBC5b) Errors when using the ÖBB Website or Smartphone App to book night trains would make me stop looking	0.03	0.64	
	(IMPBC6a) In general, ÖBB night trains are very dirty	2.89	1.17	
	(IMPBC6b) An unclean mode of transport could stop me from taking it.	-0.52	0.46	
Environmental concern	(EC1) It is my responsibility to take action to fight Climate Change	5.85	1.34	Dunlap & Jones (2002);
	(EC2) Climate change is one of the biggest issues facing the world	6.37	1.19	Christensen (2016);
	(EC3) When picking a mode of transport, I consider my impact on climate change	5.29	1.54	Gaker et al. (2011);
	(EC4) In regards to Greenhouse Gases, flying emits significantly more	6.16	1.29	D'Alfonso et al. (2016);
Past behavior	I have already taken an ÖBB Nightjet to a destination in Europe (Yes = 1)	0.58	0.49	Bamberg et al. (2003);
	I have taken an ÖBB train in the past 24 months (Yes = 1)	0.86	0.35	
Familiarity	How familiar are you with the services provided by the ÖBB Nightjet Service?	3.92	1.86	Dällenbach (2020);

S.d.: Standard deviation

*Indirect *a* variables are scaled from 1 to 7, Indirect *b* variables are scaled from -1 to 1. Variables without a literature reference provided are based exclusively on the elicitation study.

DATA

In this section, we first explain how the variables for the estimation of the TPB model are computed (Section 3.1). Second, we show the descriptive results from the sample (Section 3.2).

Data Preparation

We first flip the scales of variables with negatively worded questions.

The composite scores of the three direct measures (*DM*), environmental concern (*EC)* and intention (*I*) are created by taking the average of the sum of scores of all relevant question items for each respondent (see Table 3). For instance, the primary dependent variable *Intention,* is composed of 4 question items with slightly different wording to evaluate the scale of intention to take a night train (I1, I2, I3, I4; see Table 3).

The indirect measures (18 in total) are all defined as multiplication of a variable reflecting the strength of a belief (a) [Behavior, Normative or Control] and a weight of importance attached to each belief (b) [Outcome evaluation, Motivation to comply or Influence of control belief] (see Figure 1, where the indirect measurement variables are also labeled as being either (a) or (b), and Table 3). The latter variable type was rescaled on a scale from -1 to 1.[7]

We used Cronbach's alpha test to evaluate the internal consistency of the composite variables. All composite variables have the recommended Cronbach's alpha greater than 0.7 (Kline, 2015) with the exception of the direct measures of perceived behavioral control. The lack of internal consistency within this variable is largely because it reflects both the awareness regarding

[7] This scale was selected as opposed to a 0 to 1 scale as the weight questions of the indirect measures (*b)* were asked on a scale from true negative to true positive (e.g. extremely undesirable, extremely desirable or strongly disagree, strongly agree) instead of neutral to positive. Thus, setting the lower bound to 0 would make a strongly negative weight seem neutral and a neutral weight seem slightly positive. Please see Francis et al., 2004 for more discussion about questionnaire wording and scaling.

control factors and the weight of the known control factors. The alpha of 0.470 for the composite of *Direct measure perceived behavioral control* with 2 questions is still relatively high (Bonett & Wright, 2015; Streiner, 2010). After further consideration, it is our belief that the two measures (*DMPBC2*, *DMPBC3*) sufficiently test for similar concepts and that the composite score should be accepted as reliable. Next, we test for unidimensionality using factor analysis. All composite variables load high on the same factor, suggesting that the assumption of unidimensionality is met with the exception of *DMPBC*. After close examination of the variation and covariation within composite scores, the measure of self-efficacy (*DMPBC1*) was dropped. The mean of *DMPBC1* is very high, confirming little to no existence of a lack of self-efficacy to take a night train (a lack of self-efficacy would act as a perceived barrier to intention formation). After dropping *DMPBC1* we met the unidimensionality assumption. Moreover, we tested the validity of the *Direct measures* through confirmatory factor analysis, which confirmed the independence of each direct measure.

Description of the Sample

Our sample consists of 481 people of whom 282 are women (59%; see Table 3). 390 participants reside in Vienna and 90 reside in neighboring communities outside of the municipal boundaries. As the survey was primarily collected using a university email list, the participants skew heavily towards younger, higher educated individuals who view their primary employment status as students or part-time workers. Finally, we also collected information about income and education, which however are not considered in the following analyses due to their lack of explanatory power. This might be due to a lack of variation as our sample consists mostly of university students.

Table 5: Descriptive Statistics

Definition	Mean	S.d.	Min	Max
Age (in years)	27.04	9.56	18	74

Sex (1 for women, 0 for men)	0.59	0.49	0	1
Live in Vienna (1 for yes, 0 for no)	0.81	0.39	0	1
Travel with children	0.07	0.26	0	1
Intention	4.64	1.57	1	7
Environmental concern	5.91	1.03	1	7
Direct measure attitude	4.81	1.14	1	7
Direct measure subjective norms	2.24	1.41	1	7
Direct measure PBC	3.93	1.39	1	7
Education				
Share with University degree	0.52	0.02	0	1
Income				
Share earning more than 1500 euro monthly	0.26	0.24	0	1
Indirect question pairs				
IMA1 Good for the environment	4.72	2.86	-7	7
IMA2 Good for sleeping	2.24	2.18	-7	7
IMA3 Comfortable	2.69	1.99	-3.33	7
IMA4 Arrive/depart city center	2.47	2.87	-7	7
IMA5 Not needing to drive	2.92	3.33	-7	7
IMA6 Not paying for a hotel	1.66	3.03	-7	7
IMA7 Arrive in the morning	1.98	3.14	-7	7
IMA8 Safe mode of transport	2.82	3.04	-7	7
IMSN1 Close friends	0.44	1.63	-6	7
IMSN2 Partner	1.22	1.93	-6	7
IMSN3 Family	0.74	1.73	-6	7
IMSN4 Coworkers	-0.42	1.41	-6	6
IMPBC1 Price of night train	-3.20	2.44	-7	7
IMPBC2 Time spent in a night train	-1.44	1.86	-7	4
IMPBC3 Personal security	-0.70	2.16	-7	6
IMPBC4 Sharing a cabin	-1.60	3.16	-7	5
IMPBC 5 Errors with online booking	-0.33	2.08	-7	4
IMPBC6 Perceived cleanliness	-1.52	1.63	-7	4

The *Direct measure attitude* has a relatively high mean (4.81 see Table 3) showing a positive overall perception of night train travel. The *Direct measure subject norms* has a significantly lower mean (2.24) confirming the responses in the elicitation study in which people feel very little social pressure to take a night train. The *Direct measure PBC* also has a relatively low mean (3.93), meaning that on average, respondents do not feel that there are excessive barriers to taking a night train. *Environmental concern* is high across all sociodemographic groups with a mean of 5.91 (Table 3), implying a significant awareness of the ecological effects of medium-distance transport. *Intention* also has a fairly high mean of 4.64. Of the *Indirect question pairs*,

attitudes about the environmental benefit of night trains (*IMA1)* has the highest mean, partners (*IMSN2)* are the most important social referent, and price (*IMPBC1)* is the strongest perceived behavioral control with the highest negative mean.

RESULTS AND DISCUSSION

This section contains the main results derived from the dataset by means of regression analyses. It starts by outlining the data testing including evidence of multicollinearity between some variables (Section 4.1). It then proceeds to present the relationship between intention to take a night train and sociodemographic characteristics (Section 4.2), followed by the results of the regression model (Section 4.3), and the role of indirect determinants on direct measures (Section 4.4).

Introduction

A Pearson's correlation was computed to evaluate the relationship between the sociodemographic variables and *Intention* (see Table 4). The results of the correlation test show that there is no significant relationship between any of the sociodemographic variables and *Intention* to take a night train, which is why socioeconomic variables are not considered in the regression analyses presented in Section 4. Further Pearson's correlation analyses show that *Intention* exhibits statistically significant correlations with all variables of the TPB model (see also Section 4.2). To ensure that no issues such as multicollinearity or heteroskedasticity are present, variance inflation factor, correlation of variance, residual-versus-fitted plots and the Breusch-Pagan / Cook-Weisberg test were run on all composite and sociodemographic variables. There were no influential outliers nor issues with heteroskedasticity.

Table 6: Bivariate correlation table between intention and significant sociodemographic and variables of the TPB model

	Int.	Envcon	DMA	DMSN	DMPBC	Fam.
Age	-0.03					
Urban	0.00					
Sex	-0.02					
Income	0.04					
Education	-0.03					
Travel with children	-0.06					
Environmental concern	0.41**	1.00				
Direct measure attitude	0.60**	0.24**	1.00			
Direct measure subj. norms	0.36**	0.20**	0.22**	1.00		
Direct measure PBC	-0.39**	-0.14**	-0.32**	-0.11*	1.00	
Familiarity with ÖBB Nightjet	0.41**	0.13*	0.26**	0.20**	-0.22**	1.00

** p<0.01, *p<0.05 (2-tailed)

Women's Intention to Take the Night Train

We find, using multiple regression, that women have a lower intention to take a night train even when controlling for environmental concern (mean intention 4.62 for females versus 4.67 for males). We also tried controlling for potential gender difference in safety and security concern, but these turned out to be insignificant. In the elicitation study and the *additional comments* feature of the questionnaire, however, multiple women reported that they felt uncomfortable sharing a cabin with male strangers, that they were unable to book all-female berths and worried about security. Consistent with that, regressing the *Indirect measure PBC* security (*IMPBC3*) on the variable *Sex* a significant negative relationship we discover (coefficient -0.047 with a p-value of 0.000). On the other hand, sharing a cabin (*IMPBC4*) is not significant (Table 5). However, when *female* is added as a control to the direct measure regression, it is not significant.

Table 5: Logit regression results of indirect measures of perceived behavioral control on sex

Female	Model 1
IMPBC1 Price of night train	-0.002
	(0.009)
IMPBC2 Time spent in a	0.040***
night train	(0.013)
IMPBC3 Personal security	-0.047***
	(0.011)
IMPBC4 Sharing a cabin	-0.09
	(0.008)
IMPBC 5 Errors with	-0.014
online booking	(0.011)
IMPBC6 Perceived	0.020
cleanliness	(0.015)
Constant	0.620
Observations	464
Pseudo R-squared	0.067

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Regression Model

Table 6 shows the multiple regression analysis of the TPB model. The three measures included in Ajzen's base TPB model have a high explanatory power. As expected, we find that people who generally have a positive attitude towards night trains also have a high intention to take them. *Subjective norms* also has a significant explanatory power. There is a clear relationship between the amount of social pressure a person feels regarding night train use and their intention to take a night train. *PBC* has a strongly negative relationship towards intention[8]. Those respondents who felt there are factors stopping them from being able to take a night train had a lower level of intention to take one in the future. *Environmental concern* has a strong positive relationship to intention. This is consistent with the results of the elicitation study where ecological benefits of night trains were cited by 59.3% of participants and 38.9% of participants

[8] PBC variables are reverse coded in comparison to other measures. A higher PBC score indicates a higher perceived view of a barrier to mode choice.

mentioned environment as their first factor. *Familiarity with ÖBB Nightjet services* is also a strong predictor of intention. This reflects the findings in recent studies published on medium-distance mode choice (Dällenbach, 2020). Sex is, however, insignificant.

Table 6: Regression model explaining intention to take and ÖBB Nightjet

Intention to take an ÖBB Nightjet	Model 1
Attitude	0.565***
	(0.048)
Perceived behavioral control	-0.175***
	(0.039)
Subjective norms	0.165***
	(0.037)
Environmental Concern	0.359***
	(0.051)
Sex	0.038
	(0.103)
Familiarity with Nightjet Services	0.177***
	(0.030)
Constant	-0.625
	(0.424)
Observations	476
R-squared	0.553

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The Role of Indirect Determinants on Direct Measures

Following the example laid out by Karash et al. (2008), we regress the *Direct measures attitude, subjective norms* and *PBC* on the corresponding indirect measures to look at the relative relationship of the indirect measures on formation of attitudinal, normative and control beliefs. Since the direct measures act as reflective indicators and the indirect measures work as formative indicators it is assumed that the formation of each belief is related to the perception of objective characteristics of travel by night train. This allows for a clearer understanding of the relative importance of each factor for the creation of beliefs.

Table 7: Direct measure variables regressed on factors from the indirect measures

Direct measure attitude	Model 1	**Direct measure subjective norms**	Model 2	**Direct measure PBC**	Model 3
IMA1 Good for the environment	0.153*** (0.022)	IMSN1 Close friends	0.383*** (0.047)	IMPBC1 Price of night train	-0.129*** (0.050)
IMA2 Good for sleeping	0.088* (0.033)	IMSN2 Partner	0.272*** (0.042)	IMPBC2 Time spent in a night train	-0.167*** (0.071)
IMA3 Comfortable	0.191*** (0.038)	IMSN3 Family	0.095* (0.045)	IMPBC3 Personal security	-0.068 (0.062)
IMA4 Arrive/depart city center	0.162*** (0.025)	IMSN4 Coworkers	-0.009 (0.046)	IMPBC4 Sharing a cabin	-0.149*** (0.045)
IMA5 Not needing to drive	0.047 (0.020)	Constant	5.759*** (0.218)	IMPBC 5 Errors with online booking	-0.050 (0.062)
IMA6 Not paying for a hotel	0.159*** (0.022)			IMPBC6 Perceived cleanliness	-0.050 (0.083)
IMA7 Arrive in the morning	0.045 (0.022)			Constant	6.591*** (0.232)
IMA8 Safe mode of transport	-0.001 (0.022)				
Constant	15.151*** (0.408)				
Observations	478	Observations	466	Observations	476
R-squared	0.275	R-squared	0.284	R-squared	0.137

Standard error in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results (Table 7) show that the indirect measures of each respective direct measure predict a significant share of the formation of the attitudinal, normative and control beliefs. In the case of the attitudinal beliefs, *Environment (IMA1), Comfort (IMA3), Arriving/departing city center (IMA4),* and *Not needing to pay for a hotel (IMA6)* are all statistically influential in the formation of the *Direct measure attitude*. *Good for sleeping (IMA2)* has a weaker relationship to the *Direct measure attitude*. Related to the elicitation study as well as the role *Environmental concern* plays in the TPB model, the relative environmental benefit of night trains is a significant explainer of attitudinal beliefs. However, it is not the exclusive explanatory factor and several features specific to the sleeping and nocturnal aspects of night trains are important.

Close friends (IMSN1) and *Partners (IMSN2)* have a statistically significant positive relationship with the direct measure of subjective norms, while *Family* (IMSN3) only weakly influences the *Direct measure subjective norms*. These results reflect the elicitation study and suggest that peers are the most significant social referents with regards to transport mode choice (at least for the case of our sample, in which students are strongly over-represented).

All factors have a negative relationship to the *Direct measure PBC* (which measures both self-efficacy and awareness of barriers), with *Price (IMPBC1)*, *Time (IMPBC2)* and *Sharing cabins (IMPBC4)* exhibiting negative coefficients that are statistically significant. In the elicitation study, price was by far the most significant control (mentioned by 77.8% of respondents, with 64.8% mentioning as first factor that would deter them from taking a night train). The perception that the trains could be uncomfortable with regards to sharing space significantly informs the control beliefs towards night trains.

CONCLUSIONS

The study of night trains from a behavioral perspective allows for a better understanding of which underlying determinants motivate or deter intention formation regarding the use of a night train for medium-distance travel. Through the use of literature and an elicitation study the most significant indicators were collected to inform a questionnaire. Our analysis shows that attitudinal and control beliefs are significant in intention formation. Attitudinal beliefs are highly influenced by the environmental benefit of taking night trains, the perceived comfort of night trains, savings on hotels, and arriving at and departing from the city center, thus confirming that factors which positively influence day train use carry over to night train use (Esplugas et al., 2005; Nerhagen, 2003). Control beliefs (which inhibit intention formation), on the other hand, are highly influenced by price, sharing cabins, and time spent on the train.

Our results show that there are five significant factors that influence the behavioral intention to take a night train: *Attitudes, Subjective norms, Perceived behavioral control, Environmental concern* and *Familiarity with ÖBB Nightjet services.* Familiarity with the night train service being a significant indicator is consistent with recent studies of public transport (Dällenbach, 2020). These three behavioral beliefs and the latter two additional influential factors contribute to explaining about half of the total variance.

Environmental concern being an influential factor is consistent with two recent meta studies (Hoffmann et al., 2017; Lanzini & Khan, 2017) which look at the role environmental attitudes have on mode choice behavior. Although, most studies have shown a very weak relationship between mode choice and pro-environmental attitudes (Karash et al., 2008), intentions towards a pro-environmental behavior are still the strongest predictor of actual behavior, generally mediating both environmental attitudes and environmental concern (Levine & Strube, 2012). It can be assumed that continued growth in environmental concern would precede a growth in interest and intention to take night trains (Kaiser et al., 1999).

The sample's younger age skew limits this study's ability to know which types of people are most likely to have a high intention to take a night train. It is likely that the low average includes individuals who are less likely to own a private vehicle, more likely to have grown up with a knowledge of night trains, and are more likely to select services based on price over comfort. Additionally, it is well documented that environmental concern is significantly higher among the cohort of university students sampled than previous cohorts. A larger sample catching more participants from outside the university would likely reduce means of variables like *Intention* and *Environmental concern*, but that does not necessarily mean that the relationship between these variables would be significantly different. A larger sample could also catch more variation in income and educational background allowing for the ability to explore the relationship between these compositional determinants. The limited scope of this study did not allow us to

also capture actual behavior. Future studies could expand this research by asking intention and following up to see if it led to night train use. Finally, all such studies that find that attitude is highly predictive of intention are susceptible to cognitive dissonance. It is possible that individuals in which the night train is the most convenient/economical mode of transport form positive attitudes towards it. This could also be applied to environmental concern and mode choice behavior. Night train riders may also down play negative controls such as uncomfortable sleep conditions. Hence, this paper is not able to explore reverse causality but this is an avenue for future research.

We have chosen to study the determinants of the intention to travel by night train using an empirical framework based on the Theory of Planned Behavior (TPB). TPB places an emphasis on psychological factors – in our case, the part they play in whether someone intends to use a night train or not. This is in contrast to discrete choice models making use of a random utility maximization (RUM) framework, which is commonly used to analyze mode choice behavior, and which measures how respondents react to trade-offs between objective characteristics such as price and travel time (although in recent years applications that include psychological constructs (often via latent variables) have become more common – see for instance Bahamonde-Birke et al. (2017)). These objective characteristics certainly also play a major role in whether someone decides to travel by night train as compared to alternative transport modes (which is further confirmed by the results of the elicitation study). However, given that very little research has so far been conducted on determinants of night train usage and that night train has quite some peculiarities (such as sleeping on the train, often sharing a compartment with strangers, etc.), we aimed to account for a wider variety of potential factors that may contribute beyond the standard generic ones such as travel time and costs. Additionally, the elicitation study substantiated this approach, as a fairly large variety of responses have been obtained. Some of them would have been difficult to include in a RUM-based approach (e.g., (perceived)

safety, quality of the sleep, or cleanliness), as they cannot be well expressed in objective terms; instead, they lend themselves better for inclusion in a TPB framework which places more emphasis on subjective factors. Nevertheless, for future research we recommend to also study the topic of night train usage and its determinants using discrete choice models, or even attempt to integrate the TPB and RUM-based approach (as for instance suggested by Thorhauge et al. (2016)).

Acknowledgements

The authors would like to thank colleagues at the Institute of Ecological Economics at the Vienna University of Economics and Business, especially Julian Kunz, for valuable comments. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

The data that support the findings of this study are available from the corresponding author, [BB], upon reasonable request.

REFERENCES

Aamaas, B., Borken-Kleefeld, J., & Peters, G. P. (2013). The climate impact of travel behavior: A German case study with illustrative mitigation options. *Environmental Science and Policy*, *33*, 273–282. https://doi.org/10.1016/j.envsci.2013.06.009

Adler, N., Pels, E., & Nash, C. (2010). High-speed rail and air transport competition: Game engineering as tool for cost-benefit analysis. *Transportation Research Part B: Methodological*. https://doi.org/10.1016/j.trb.2010.01.001

Ajzen, I. (2010). Constructing a theory of planned behavior questionnaire. *Biofeedback and Selfregulation*. https://doi.org/10.1016/0749-5978(91)90020-T

Ajzen, I. (2012). The theory of planned behavior. In *Handbook of Theories of Social Psychology: Volume 1*. https://doi.org/10.4135/9781446249215.n22

Ajzen, I. (2020). The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies*, *April*, 1–11. https://doi.org/10.1002/hbe2.195

Ajzen, I., & Fishbein, M. (2008). Scaling and testing multiplicative combinations in the expectancy-value model of attitudes. *Journal of Applied Social Psychology*, *38*(9), 2222–2247. https://doi.org/10.1111/j.1559-1816.2008.00389.x

Allen, I. E., & Seaman, C. A. (2007). Likert scales and data analyses. In *Quality Progress*.

Armitage, C. J., & Conner, M. (2010). *Efficacy of the Theory of Planned Behaviour : A Meta-Analytic Review E Y cacy of the Theory of Planned Behaviour : A meta-analytic review*. *July 2017*, 471–499. https://doi.org/10.1348/014466601164939

Bahamonde-Birke, F. J., Kunert, U., Link, H., & Ortúzar, J. de D. (2017). About attitudes and perceptions: finding the proper way to consider latent variables in discrete choice models. *Transportation*. https://doi.org/10.1007/s11116-015-9663-5

Bamberg, S., Ajzen, I., & Schmidt, P. (2003). Choice of Travel Mode in the Theory of Planned Behavior: The Roles of Past Behavior, Habit, and Reasoned Action. *Basic and Applied Social Psychology*. https://doi.org/10.1207/S15324834BASP2503_01

Behrens, C., & Pels, E. (2012). Intermodal competition in the London-Paris passenger market: High-Speed Rail and air transport. *Journal of Urban Economics*, *71*(3), 278–288. https://doi.org/10.1016/j.jue.2011.12.005

Bonett, D. G., & Wright, T. A. (2015). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior*, *36*(1), 3–15. https://doi.org/10.1002/job.1960

Bouscasse, H., Joly, I., & Bonnel, P. (2018). How does environmental concern influence mode choice habits? A mediation analysis. *Transportation Research Part D: Transport and Environment*, *59*(February), 205–222. https://doi.org/10.1016/j.trd.2018.01.007

Burman, F. (2015). Night Train. In *Night Train*. Lund.

Capros, P., De Vita, A., Tasios, N., Siskos, P., & Kannavou, M. (2016). EU Reference

Scenario 2016 - Energy, transport and GHG emissions - Trends to 2050. *European Commission*. https://doi.org/10.2833/9127

Chen, C. F., & Chao, W. H. (2011). Habitual or reasoned? Using the theory of planned behavior, technology acceptance model, and habit to examine switching intentions toward public transit. *Transportation Research Part F: Traffic Psychology and Behaviour*. https://doi.org/10.1016/j.trf.2010.11.006

Christensen, L. (2016). Environmental Impact of Long Distance Travel. *Transportation Research Procedia*. https://doi.org/10.1016/j.trpro.2016.05.033

Costarelli, S., & Colloca, P. (2004). The effects of attitudinal ambivalence on pro-environmental behavioural intentions. *Journal of Environmental Psychology*. https://doi.org/10.1016/j.jenvp.2004.06.001

D'Alfonso, T., Jiang, C., & Bracaglia, V. (2016). Air transport and high-speed rail competition: Environmental implications and mitigation strategies. *Transportation Research Part A: Policy and Practice*, *92*(635867), 261–276. https://doi.org/10.1016/j.tra.2016.06.009

Dällenbach, N. (2020). Low-carbon travel mode choices: The role of time perceptions and familiarity. *Transportation Research Part D: Transport and Environment*. https://doi.org/10.1016/j.trd.2020.102378

Dunlap, R. E., & Jones, R. E. (2002). Environmental Concern: Conceptual and Measurement Issues. *Handbook of Environmental Sociology*.

Esplugas, C. C., Teixeira, P. F., Lopez-Pita, A., & Saña, A. B. (2005). *Threats and Opportunities for High Speed Rail Transport in Competition with the Low-Cost*. 1–21.

European Commission. (2016). Roadmap to a Single European Transport Area – towards a competitive and resource-efficient transport system. In *European Commission*. https://doi.org/10.1017/CBO9781107415324.004

European Commission. (2019). *Handbook on External Costs of Transport*. https://doi.org/10.2832/27212

Fishbein, Martin, & Ajzen, I. (2011). Predicting and changing behavior: The reasoned action approach. In *Predicting and Changing Behavior: The Reasoned Action Approach*. Taylor and Francis. https://doi.org/10.4324/9780203838020

Follmer, R., & Gruschwitz, D. (2019). *Mobility in Germany – short report*. *September*. www.mobilitaet-in-deutschland.de

Francis, J., Eccles, M. P., Johnston, M., Walker, A., Grimshaw, J., Foy, R., Kaner, E. F. S., Smith, L., & Bonetti, D. (2004). Constructing Questionnaire Based on The Theory of Planned Behaviour. In *Newcastle upon Tyne, UK: Centre for Health Services Research, University of Newcastle upon Tyne*.

Fransson, N., & Gärling, T. (1999). Environmental concern: Conceptual definitions, measurement methods, and research findings. *Journal of Environmental Psychology*. https://doi.org/10.1006/jevp.1999.0141

Frei, A. (2013). KITE: A Knowledge Base for Intermodal Passenger Travel in Europe. *Travel Survey Metadata Series*, *31*.

Gaker, D., Vautin, D., Vij, A., & Walker, J. L. (2011). The power and value of green in promoting sustainable transport behavior. *Environmental Research Letters*. https://doi.org/10.1088/1748-9326/6/3/034010

Garland, R. (1991). The Mid-Point on a Rating Scale: Is it Desirable? In *Marketing Bulletin*.

Geng, J., Long, R., Chen, H., & Li, W. (2017). Exploring the motivation-behavior gap in urban residents' green travel behavior: A theoretical and empirical study. *Resources, Conservation and Recycling*, *125*(June), 282–292. https://doi.org/10.1016/j.resconrec.2017.06.025

Givoni, M. (2007). Environmental benefits from mode substitution: Comparison of the environmental impact from aircraft and high-speed train operations. *International Journal of Sustainable Transportation*. https://doi.org/10.1080/15568310601060044

Gkargkavouzi, A., Halkos, G., & Matsiori, S. (2019). Environmental behavior in a private-sphere context: Integrating theories of planned behavior and value belief norm, self-identity and habit. *Resources, Conservation and Recycling*, *148*(January), 145–156. https://doi.org/10.1016/j.resconrec.2019.01.039

Goeverden, V., Nes, V., & Arem, V. (2019). Potentials for reducing greenhouse gas emissions by inducing modal shift in European long-distance passenger travel. In *In F. Witlox (Ed.), Moving towardsmore sustainable mobility and transport through smart systems* (pp. 142–152). BIVEC/GIBET.

Hödl, S. (2006). *Der europäische Markt für Nachtreisezugverkehre: Eine empirische Analyse der Nachfragedeterminanten* (Issue June). Wirtschaftsuniversität Wien.

Hoffmann, C., Abraham, C., White, M. P., Ball, S., & Skippon, S. M. (2017). What cognitive mechanisms predict travel mode choice? A systematic review with meta-analysis. *Transport Reviews*. https://doi.org/10.1080/01441647.2017.1285819

Iseki, H., & Taylor, B. D. (2009). Not all transfers are created equal: Towards a framework relating transfer connectivity to travel behaviour. *Transport Reviews*. https://doi.org/10.1080/01441640902811304

Jara-Diaz, S. (2020). Transport and time use: The values of leisure, work and travel. *Transport Policy*. https://doi.org/10.1016/j.tranpol.2019.12.001

Jara-Díaz, S. R., & Rosales-Salas, J. (2020). Time use: The role of sleep. *Transportation Research Part A: Policy and Practice*. https://doi.org/10.1016/j.tra.2020.03.025

Jones, R. E., & Dunlap, R. E. (1992). The Social Bases of Environmental Concern: Have They Changed Over Time? *Rural Sociology*. https://doi.org/10.1111/j.1549-0831.1992.tb00455.x

Kaiser, F. G., Wölfing, S., & Fuhrer, U. (1999). Environmental attitude and ecological behaviour. *Journal of Environmental Psychology*. https://doi.org/10.1006/jevp.1998.0107

Karash, K. H., Coogan, M. A., Adler, T. J., Cluett, C., Shaheen, S. A., Ajzen, I., & Simon, M. (2008). Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation. In *Transit Cooperative Research Program (TCRP) Report 123*. Transportation Research Board. https://doi.org/10.17226/23124

Kennisinstituut voor Mobiliteitsbeleid | KiM. (2019). *Slapend onderweg: potentieel van de internationale nachttrein van en naar Nederland*. https://doi.org/978-90-8902-207-3

Kline, R. B. (2015). Principles and practice of structural equation modelling (4th ed.). *Methodology in the Social Sciences*.

Klöckner, C. A., & Matthies, E. (2004). How habits interfere with norm-directed behaviour: A normative decision-making model for travel mode choice. *Journal of Environmental Psychology*. https://doi.org/10.1016/j.jenvp.2004.08.004

Knorr, A., & Lueg-Arndt, A. (2016). Intercity bus deregulation in Germany – Intramodal and intermodal effects after two years. *Research in Transportation Economics*. https://doi.org/10.1016/j.retrec.2016.06.005

Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*. https://doi.org/10.1080/13504620220145401

Lanzini, P., & Khan, S. A. (2017). Shedding light on the psychological and behavioral determinants of travel mode choice: A meta-analysis. *Transportation Research Part F: Traffic Psychology and Behaviour*. https://doi.org/10.1016/j.trf.2017.04.020

Levine, D. S., & Strube, M. J. (2012). Environmental attitudes, knowledge, intentions and behaviors among college students. *Journal of Social Psychology*. https://doi.org/10.1080/00224545.2011.604363

Lindsey, M., Schofer, J. L., Durango-Cohen, P., & Gray, K. A. (2011). The effect of residential location on vehicle miles of travel, energy consumption and greenhouse gas emissions: Chicago case study. *Transportation Research Part D: Transport and Environment*. https://doi.org/10.1016/j.trd.2010.08.004

Liu, X., Vedlitz, A., & Shi, L. (2014). Examining the determinants of public environmental concern: Evidence from national public surveys. *Environmental Science and Policy*. https://doi.org/10.1016/j.envsci.2014.02.006

Lyons, G., Jain, J., Susilo, Y., & Atkins, S. (2013). Comparing Rail Passengers' Travel Time Use in Great Britain Between 2004 and 2010. *Mobilities*. https://doi.org/10.1080/17450101.2012.743221

Marquart-Pyatt, S. T. (2012). Contextual influences on environmental concerns cross-nationally: A multilevel investigation. *Social Science Research*. https://doi.org/10.1016/j.ssresearch.2012.04.003

McClelland, D. C., Koestner, R., & Weinberger, J. (1989). How Do Self-Attributed and Implicit Motives Differ? *Psychological Review*, *96*(4), 690–702. https://doi.org/10.1037/0033-295X.96.4.690

Mokhtarian, P. L., & Cao, X. (2008). Examining the impacts of residential self-selection on

travel behavior: A focus on methodologies. *Transportation Research Part B: Methodological*. https://doi.org/10.1016/j.trb.2007.07.006

National Academies of Sciences, Engineering, and M. (2008). Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation. In *Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation*. The National Academies Press. https://doi.org/10.17226/23124

Nerhagen, L. (2003). Travel mode choice: Effects of previous experience on choice behaviour and valuation. *Tourism Economics*. https://doi.org/10.5367/000000003101298240

ÖBB. Austrian & Federal Railways. (2019b). *ÖBB Nightjet - Die neue Generation*. https://www.youtube.com/watch?time_continue=4&v=4FKQ6v3KU0U&feature=emb_logo

ÖBB. Austrian & Federal Railways. (2019a). *Moving Austria: ÖBB compact 2018/19*. 1–70. https://presse.oebb.at/file_source/corporate/presse-site/Downloads/Publikationen/OEBB_Zahlen_2019_en.pdf

Pagliara, F., José, /, Vassallo, M., & Román, C. (2012). High speed vs. air transportation: the Madrid Barcelona case study. *Transportation Research Board, 91st Annual Meeting*.

Pan, J. Y., & Truong, D. (2018). Passengers' intentions to use low-cost carriers: An extended theory of planned behavior model. *Journal of Air Transport Management*, *69*(February), 38–48. https://doi.org/10.1016/j.jairtraman.2018.01.006

Paulssen, M., Temme, D., Vij, A., & Walker, J. L. (2014). Values, attitudes and travel behavior: A hierarchical latent variable mixed logit model of travel mode choice. *Transportation*. https://doi.org/10.1007/s11116-013-9504-3

Reichert, A., & Holz-Rau, C. (2015). Mode use in long-distance travel. *Journal of Transport and Land Use*, *8*(2), 87–105. https://doi.org/10.5198/jtlu.2015.576

Rothengatter, W., Hayashi, Y., Fujisaki, K., Kato, H., Okuda, T., & Shibahara, N. (2015). *Climate Change Impacts of Intercity Transport in the Context of External Costs and Their Internalisation*. https://doi.org/10.1007/978-3-319-06523-6_3

Rüger, B., & Matausch, P. (2020). *High-Speed Overnight Trains—Potential Opportunities and Customer Requirements*. https://doi.org/10.1007/978-3-030-19519-9_9

Sauter-Servaes, T., & Nash, A. (2009). Increasing rail demand by improving multimodal information and ticketing: Results of the night and flight case study. *Transportation Research Record*, *2117*, 7–13. https://doi.org/10.3141/2117-02

Sheeran, P. (2002). Intention—Behavior Relations: A Conceptual and Empirical Review. *European Review of Social Psychology*, *12*(1), 1–36. https://doi.org/10.1080/14792772143000003

Steer Davies Gleave. (2006). *Air and rail competition and complementarity. Case study report prepared for European Commission DG Energy and Transport*.

Streiner, D. L. (2010). Coefficient Alpha and Internal Consistency. *Journal of Personality*

Assessment, *80*(1), 99–103. https://doi.org/10.1207/S15327752JPA8001_18

Thorhauge, M., Haustein, S., & Cherchi, E. (2016). Accounting for the Theory of Planned Behaviour in departure time choice. *Transportation Research Part F: Traffic Psychology and Behaviour*. https://doi.org/10.1016/j.trf.2016.01.009

van Birgelen, M., Semeijn, J., & Behrens, P. (2011). Explaining pro-environment consumer behavior in air travel. *Journal of Air Transport Management*, *17*(2), 125–128. https://doi.org/10.1016/j.jairtraman.2010.12.013

VCÖ (Hg.). (2020). *Klimafaktor Reisen*. https://www.vcoe.at/publikationen/vcoe-schriftenreihe-mobilitaet-mit-zukunft

Vredin Johansson, M., Heldt, T., & Johansson, P. (2006). The effects of attitudes and personality traits on mode choice. *Transportation Research Part A: Policy and Practice*, *40*(6), 507–525. https://doi.org/10.1016/j.tra.2005.09.001

Wall, R., Devine-wright, P., & Mill, G. A. (2007). Comparing and Combining The Case of Commuting-Mode Choice. *Environment and Behavior*, *39*(6), 731–753. https://doi.org/10.1177/0013916506294594

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin*, *132*(2), 249–268. https://doi.org/10.1037/0033-2909.132.2.249

Wen, C. H., & Koppelman, F. S. (2000). A conceptual and methdological framework for the generation of activity-travel patterns. *Transportation*. https://doi.org/10.1023/A:1005234603206

Yuriev, A., Dahmen, M., Paillé, P., Boiral, O., & Guillaumie, L. (2020). Pro-environmental behaviors through the lens of the theory of planned behavior: A scoping review. *Resources, Conservation and Recycling*, *155*(January), 104660. https://doi.org/10.1016/j.resconrec.2019.104660