

Available online at www.sciencedirect.com**ScienceDirect**

Transportation Research Procedia 10 (2015) 335 – 344

**Transportation
Research
Procedia**

www.elsevier.com/locate/procedia18th Euro Working Group on Transportation, EWGT 2015, 14-16 July 2015,
Delft, The Netherlands

Investigation of factors that stimulate car drivers to change from car to carpooling in city center oriented work trips

Peter van der Waerden ^{a*}, Andreas Lem ^b, Wim Schaefer ^c^a Urban Planning Group, Eindhoven University of Technology, PO Box 513, 5600 MB Eindhoven, The Netherlands^b Movares Consultancy & Engineering, PO Box 2855, 3500 GW Utrecht, The Netherlands^c Construction, Management & Engineering Group, Eindhoven University of Technology, PO Box 513, 5600 MB Eindhoven, The Netherlands

Abstract

The current study aims to get more insight into the attributes that stimulate car drivers to use carpool as an alternative for their commuting trips in which the car is still the most used travel mode. The study was set up as a stated choice experiment. In the experiment, car drivers were asked to evaluate various hypothetical carpool alternatives. The alternatives were described using eight attributes: travel time to and waiting time at start location, travel time in (carpool) vehicle, uncertainty in travel time, costs of the trip, number of persons in the vehicle, parking situation at work location, car/bike availability at work location, and flexibility of arrival and departure times. Each generated carpool alternative was included in a choice task together with the respondent's current car alternative. The choices were analyzed using a mixed multinomial logit model. The model estimation process showed that almost all attributes significantly influence the attractiveness of carpooling in an expected direction. Most influential are the time and costs related attributes. No significant effect was found for the minimum number of persons in the carpool vehicle.

© 2015 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Peer-review under responsibility of Delft University of Technology

Keywords: Carpooling, Work trips, Stated choice

* Corresponding author. Tel.: +31402474684; fax: +31402438488.
E-mail address: p.j.h.j.v.d.waerden@tue.nl

1. Introduction

Many cities in the Netherlands face increasing traffic flows, especially in the morning peak at entrance roads. Most of these entrance roads are not able to manage a large amount of car traffic often resulting in congested roads. These congested roads form a problem because they produce pollution, noise, and unreliable travel times. This unpleasant situation forces municipalities to consider alternatives for the car such as public transport, bicycles, and carpooling. Because of its flexibility and more personal atmosphere, carpooling is considered as an interesting alternative for solo car use (e.g., Caulfield, 2009). Other reasons make carpooling as an interesting alternative as well. For example, Wang (2011) stated that in China, carpooling becomes more popular when gas prices rise or when local regulations (e.g., driving restrictions, restricted parking policy) are implemented. Several, mostly small scale, initiatives are set up with varying success when looking at commuters' travel mode switching behavior. It appears that there is limited insight into the attributes that might stimulate car drivers to change to carpooling (e.g., Nurul Habib et al., 2011; Wang, 2011; Wang & Chen, 2012).

The aim of this study is to contribute to the existing insights regarding the attributes that stimulate car drivers to change from solo car driving to carpooling. The focus of the study is on home originated work trips in Dutch urbanized areas (cities with more than 75,000 inhabitants) in which the car is still the main mode of travel. This focus is not only based on the increased problems regarding traffic flows but also because of the discussion regarding the use of bus lanes in urban areas by cars with a high occupancy. The remainder of the paper is organized as follows. First, a brief overview is given of previous studies on the structure of carpooling and factors that influence the use of carpools. Next, the adopted research approach is explained. This section is followed by a description of the data collection and some details of the research sample. The results of the analyses are presented in the proceeding section. The paper ends with the conclusions and suggestions for future research.

2. Literature review

In the past, several studies have been published regarding carpooling as alternative travel mode for solo car driving. Some studies focus on the factors that stimulate car drivers to switch mode from single occupancy vehicle (SOV) use to high occupancy vehicle (HOV) use (e.g., Correia & Viegas, 2011). Other studies focus on solutions to overcome one or more problems that are related to carpooling such as guaranteed ride home service (e.g., Menczer, 2007), carpool matching programs (e.g., Galland et al., 2014), and special infrastructure such as HOT-lanes (Burriss et al., 2014). In the studies, different definitions of carpooling are presented. The content of most definitions is more or less similar. One example of a definition that is close to the objective of the current study is presented by Arbour-Nicitopoulos et al. (2012): 'the sharing of transportation to work or school in a private vehicle with other workers or students that result in the prevention of a vehicle trip'. The subject of carpooling is investigated for different target groups such as workers in home-work trips (e.g., Vanoutrive et al., 2012); parents in home-school trips (e.g., Arbour-Nicitopoulos et al., 2012); and students and employees in home-university trips (e.g., Bruglieri et al., 2011).

In the literature, two significant reasons to stimulate carpooling are presented (e.g., Arbour-Nicitopoulos et al., 2012; Bellemans et al., 2012; Wang & Chen, 2012):

- a. Decreasing the number of cars travelling to/from a destination;
- b. Broadening the possibilities to intervene in travelling for longer distances (more than 3 kilometers);
- c. Contribute to environmental quality.

These three reasons are strongly related to the interest of politicians and planners. Of course, there are also reasons from the perspective of the car drivers themselves.

- d. Decrease of travel costs (e.g., Qian & Zhang, 2011; Seyedabrishami et al., 2012);
- e. Benefit from other company organized measures such as special parking spaces (e.g., Brugliere et al., 2011).

When studying carpooling, researchers make a distinction regarding the way carpooling is organized. For example, Brugliere et al. (2011) distinguish *casual* and *organized* carpooling. The first type refers to the situation that a car driver picks up passengers for example to be able to use a high occupancy vehicles lane or to share costs. The participants in the carpool are more or less formed on the spot. The second type of carpooling deals with a more

regulated service like RideSearch, eRideShare, and Carpoolworld (for details see Bruglieri et al, 2011). Another subdivision is based on the composition of the carpool members (see Vanoutrive et al., 2012): *household* and *non-household* based carpools. In the first case, the participants of the carpool are members of the same household with common origin of the trip and a high level of trust. Sometimes, carpool trips are subdivided into groups based on the basis of the type of matching between origins and destinations, including an intermediate location to start or end the carpool trip (e.g., Morency, 2007).

Most studies indicate that it is very difficult to attract solo car drivers towards carpooling. For example, Wang & Chen (2012) investigated the switch from single occupancy vehicle (SOV) to carpool based on the Puget Sound Transportation Panel. They distinguished structural factors describing the objective characteristics of a decision scenario, and person-level psychosocial factors capturing one's cognitive assessment of a mode. Despite the low number of switchers, they found some variables that significantly influence the demand for switching from SOV to carpool: commute time (structural factor) and respondents' affective bias towards carpooling (psychosocial factor).

Bruglieri et al. (2011) found in their study among students and employees of the University of Milan, that students are interested in carpooling when the following conditions are fulfilled: reserved parking spots, traveling with known students, always same crew, and reliable compatibility of departure and arrival times. The findings of Brugliere et al. are strongly related to the findings of Correia and Viegas (2011) who suggest a so-called carpooling club to overcome the psychological and scheduling barriers of carpooling. The psychological barriers are associated with riding with strangers, while the scheduling barriers concern the inflexibility of reschedule when activity times change. In more detail, Correia and Viegas found that the probability of carpooling is significantly influenced by attributes of the alternatives (e.g., time, costs, and number of persons involved), socio-demographic profile of the respondent (e.g., age, profession, and type of car), and commuter trip characteristics (e.g., ease of parking, departure time, and constraint in car use). They stated that the most promising carpools are young persons who are studying or do not have a liberal profession or manager position, with a limited salary level.

In 2011, Nurul Habib et al. presented a joint model for the consideration of carpooling in the traveler's choice set and the choice of commuting mode. It appeared that the following attributes significantly influence the carpooling consideration utility: having the option of flexible office hours, work arrival time between 6 and 7 am, frequency of carpooling in the last months, possibility of finding a potential partner, having the option of driving alone when necessary, availability of convenient parking place for carpooling, if no personal vehicle needed for work, and if working hours are regular. The choice for carpooling as means to commute is influenced by gender of the respondent and the possibility of flexible office hours.

From a different perspective, Vanoutrive et al. (2012) found some interesting results regarding differences in carpool shares at different workplaces. The location of a workplace is a relevant characteristic in this context because it determines the accessibility of the workplace. Also organizational factors such as work schedule and activity sector determine the attractiveness of carpooling. The most carpool-oriented sectors are construction and manufacturing. In these sectors, regular work schedules and a smaller number of employees at a site are positively correlated with a higher share of carpooling employees. Regarding the effect of carpool promotion, they confirm the idea that 'sticks' like parking charge and restrictions, transport allowance are more effective than carrots like marketing, preferential parking an setting up a matching service.

3. Research approach

To get insights into the effects of various attributes that might trigger car drivers to change travel mode from car to carpool the following research approach was adopted. The focus of this study was on car drivers who did not carpool yet or at least have limited experience with carpooling, it was decided to set up a stated choice experiment. The advantages of using a stated choice experiment to investigate the influence of attributes are described in detail by Hensher *et al.* (2005). The main advantages concern the researcher's control of the attributes that are investigated and the correlation between selected attributes, the inclusion of non-existing alternatives, and the possibility to present more than one choice task to respondents.

In the experiment that is set up for this study, car drivers are invited to evaluate various choice tasks concerning the choice between solo driving and carpool (similar to Correia & Viegas, 2011). The carpool alternative is defined

by eight attributes (see Table 1). The investigated attributes are selected from a long list of attributes that have been investigated in the past (for an extensive overview see Lem, 2014, page 95). The attributes originate from three stages of the trip: pre-stage, in vehicle stage, and the post-stage. All attributes consist of three levels. Some attributes are specified in terms of percentages of the current attribute value of the car alternative. For example, in the case of ‘travel time to and waiting time at the meeting or start point’ 0 percent means that there is no travel time (carpool starts at travelers home location), while 20 (or 40) percent means that the travel time to and waiting time at the meeting point is equal to 20 (or 40) percent of the total car travel time between home and work location. In the case of travel costs, 100 percent means that the costs for carpool are the same as for solo driving. The attribute ‘travel time uncertainty’ refers to the extra time a solo car driver/carpooler calculates for en-route delays (including delays at the meeting point). The attribute is applicable to both solo car and carpool trip. The total costs include fuel, toll, and parking costs. These costs also depend on the type of car a respondent drives. Three attributes are specified in more general terms. In the case of ‘flexibility of departure time’, the following levels are included: High (unlimited flexibility of departure time), Average (limited flexibility of departure time), and Low (almost no flexibility of departure time). The levels of the attribute ‘parking situation at work place’ are Good (it is easy to find a -reserved- parking space and the -reserved- parking spaces are available at short distance of work location), Average (it is easy to find a -reserved- parking space but the spaces are at some -reserved- distance from the work place), and Bad (it is hard to find a free -reserved- parking space even at some distance from the work place).

Table 1. Overview of selected attributes and attribute levels

Trip stages	Attributes	Levels
Pre-stage	Travel time to and waiting time at the meeting/start point	0 percent
		20 percent
		40 percent
In vehicle stage	Minimum required number of persons in vehicle	2 persons
		3 persons
		4 persons
	Total costs of trip	100 percent
		70 percent
		40 percent
	Travel time in vehicle	100 percent
		85 percent
		70 percent
	Travel time uncertainty	100 percent
80 percent		
60 percent		
Flexibility of departure time	High	
	Average	
	Low	
Post-stage/at work location	Parking situation at work place	Good
		Average
		Bad
	Availability of car or bike at work location	Car or bike
		Bike only
		None

The attribute levels were combined into carpool alternatives using a 3⁸ fractional factorial design. The design generated 27 different carpool alternatives. Each carpool alternative was placed against the respondent’s current car alternative. This car alternative was described using the car driver’s real life situation regarding travel time and travel costs (see Table 2). The travel costs were based on the travel distance and the type of vehicle used. In addition, the number of persons was set to ‘1’, the flexibility of departure time was set to ‘High’, and the availability of car at work place was set to ‘Car’. The service level of the parking situation at the work place was evaluated by

the respondent him or herself. Because several travel related decisions (including the choice of travel mode) are made at home, this focuses on the home to work trip.

Besides a textual explanation as described above, the various parts of the carpool trip were also graphically presented in the questionnaire (see Figure 1). The figure is shown at each page of the questionnaire together with a detailed description of the car and carpool alternative (see Figure 2).




Fig. 1. Representation of the various parts of carpool alternative as used in the online questionnaire

Table 2. Overview of respondent’s car alternative

Trip stages	Attributes	Levels
Pre-stage	Travel time to and waiting time at the meeting/start point	0 minutes
In vehicle stage	Number of persons in vehicle	1 person
	Total costs of trip	Current costs*
	Travel time in vehicle	Current travel time*
	Travel time uncertainty	Current uncertainty*
Post-stage/at work location	Flexibility of departure time	High
	Parking situation at work place	Good* Average* Bad*
	Availability of car or bike at work location	Car


* Levels are based on respondent’s own identification

The stated choice experiment is included in an online questionnaire (see Figure 2). Each respondent was invited to evaluate 9 different choice tasks. The evaluation consisted of two parts: choice between solo driving and carpool, and the evaluation of the carpool alternative on a 5-points scale ranging from very poor to very good. Before starting the actual evaluation, the respondents were invited to study and evaluate an example choice task. The questionnaire also included questions regarding current home-work trip (travel time, travel costs, level of uncertainty, and parking situation), attitudes towards carpooling (e.g., atmosphere, safety, and service), and personal characteristics (e.g., gender, age, educational level, and income). The car drivers’ attitudes towards carpooling are measured on a 5-points scale ranging from very low importance to very high importance. The attitudes are not included in the model presented in this paper.



Technische Universiteit
Eindhoven
University of Technology


adviseurs
mobiliteit




Carpooling in city center oriented work trips

2. Choice situations


Reis- en wachttijd opstaplocatie




Aantal personen in (carpool)voertuig




Reistijd in voertuig




Onzekerheid reistijd



Parkeersituatie bij werklocatie



Beschikbaarheid over auto/ fiets op werklocatie



This page shows an example of a choice task for a city center oriented work trips.

In each task you are invited to choose between your solo driving with your car or carpooling. Both alternatives are described using various attributes. What travel mode would you choose given the next choice situation?

Attributes	Solo driving	Carpooling
Travel time to and waiting time at meeting point	0 minutes	7 minutes
In (carpooling) vehicle travel time	50 minutes	35 minutes
Travel time uncertainty	8 minutes	6 minutes
Total planned travel time	58 minutes	48 minutes
Costs of one-way trip	2 euro	1 euro
Minimum number of persons in vehicle	1	3
Parking situation at workplace	Average	Good
Availability of car/bike at workplace	Car	None
Flexibility in arrival/departure time	High	Low
What travel mode would you choose?	<input type="radio"/>	<input type="radio"/>
What score would you give to the carpooling alternative?		<div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 0 auto;"> <div style="background-color: #4a86e8; color: white; padding: 2px;">▼</div> <div style="padding: 2px;">Very poor</div> <div style="padding: 2px;">Poor</div> <div style="padding: 2px;">Neutral</div> <div style="padding: 2px;">Good</div> <div style="padding: 2px;">Very good</div> </div>

[Click here for an explanation of the attributes](#)

Previous
Next

Berg Enroute System © 2007 Design Systems

Fig. 2. Stated choice task as included in the online questionnaire

4. Data collection

The respondents were recruited from the panel of PanelClix Online Market Research (www.panelclix.co.uk). This existing panel includes a variety of members all around the Netherlands who are easily accessible by email. A preselection was conducted based on three characteristics of the respondents: the respondent has to work outside the home location (city); the respondent has to work in a city of at least 75,000 inhabitants, and the respondent regularly uses the car for the home-work trip (at least once per week).

In total 354 respondents completed the online questionnaire. Table 3 presents some details of the respondents. It appears that the composition of the sample is acceptable with a good distribution across almost all characteristics. The high number of respondents who do not want to provide details of their income was expected.

Table 3. Overview of characteristics of the sample (N=354)

Characteristics	Levels	Percentage
Gender	Female	41.0
	Male	59.0
Age	35 years or younger	43.8
	36 years or older	56.2
Education	Medium level	49.4
	High (university) level	50.6
Income	Less or equal to 40,000 per year	35.0
	More than 40,000 per year	48.0
	Unknown	16.9
Home location	Randstad region	42.7
	Other	57.3
Work location	Major city	50.6
	Other	49.4
Work trips	Sometimes in my home town	45.5
	Never in my home town	54.5
Employment status	Full time (>35 hours per week)	69.8
	Part time (< 36 hours per week)	30.2
Total		100.0

5. Model analyses

The 354 car drivers evaluated 3186 choice situations consisting of a choice between current car alternative and carpool alternative. The choices have been investigated using a Mixed Multinomial Logit (ML) model with panel effects. This model takes into account random taste variation in the population of decision makers and the fact that one decision maker makes more than one decision. The model is flexible enough to completely relax the independence and identically distributed error structure of the standard Multinomial Logit (MNL) model (e.g., Bhat et al., 2008). Several examples show that ML models perform better than the standard MNL models (e.g., Hess & Polak, 2009; Borgers et al., 2010). Because of differences in measurement level of the attributes, some attributes (all travel time related attributes and the number of persons) are included in the estimation with their actual values (minutes and number). Some details of these attributes are presented in Table 4. The ordinal level attributes flexibility of departure time and availability of transport mode are coded using effect coding. The attribute parking situation represents the comparison between the car driver's evaluation of the current situation (S_Poor, etc.) and the suggested parking situation for carpooling (C_Poor etc.). The five different combinations are also coded using effect coding. Before starting the model estimation a correlation analysis was carried out that showed the presence of some acceptable correlations (less than 0.5) between the travel time related attributes.

Table 4. Attribute details of solo driving (N=354)

Trip stages	Attributes	Minimum	Maximum	Mean
In vehicle stage	Costs of trip	0 euros*	82 euros	7.47 euros
	Travel time in vehicle	10 minutes	70 minutes	35.14 minutes
	Travel time uncertainty	3 minutes	18 minutes	10.33 minutes

* travel costs are paid by employer

The results of the model estimation process (ML with 1,000 draws) are presented in Table 5. The model's goodness-of-fit shows that the model outperforms the null model (all parameters equal to zero). The calculated value of the Log-likelihood Ratio Statistic (1746.00) is much higher than the Chi-squared test-value for 28 degrees-of-

freedom which is approximately 41.3. In addition, both the Rho^2 (0.395) indicate that the model is very well able to represent the respondents' observed choices. Basically, the value of McFadden's Rho^2 varies between 0 (no fit) and 1 (perfect fit). Values between 0.2 and 0.4 are considered to be indicative of 'extremely' good model fits (Louviere et al., 2000). According to Hensher et al. (2005), a Rho^2 of 0.3 or higher represents a 'decent' fit for a discrete choice model. The adjusted Rho^2 includes the number of parameters (or degrees-of-freedom) used to compose the optimal model, in the calculations. Looking at the values of Rho^2 it appears that the performance of the ML model is higher than the performance of the standard MNL model.

Almost all estimated parameters significantly influence the respondents' choices. The signs and sizes of the parameters show the following influences. The negative value of the constant indicates that, in advance, respondents are not willing to choose for carpooling. Regarding the pre-carpool trip, it appears that the longer the travel time between home and the meeting/starting point, the less attractive the carpool alternative becomes. For the travel time and the uncertainty in travel time, the positive parameters indicate that the larger the difference is between solo driving and carpooling in favor of carpooling, the higher the attractiveness of the carpooling alternative. The positive parameter of travel costs indicates that if the difference in costs between solo driving and carpooling increases (again in favor of carpooling), the carpool alternative becomes more attractive. As expected, if the flexibility of arrival and departure time is low, the attractiveness of carpooling decreases. In the case that a car is available at the workplace, the attractiveness of carpooling increases. Finally, an equal (compared to the situation for solo driving) or better parking situation for carpool vehicles increases the attractiveness of carpooling.

Table 5. Overview of parameter estimates

Trip stages	Attributes	Levels	Mean*	Std.dev.*
	Constant		-2.4391	2.3401
Pre-stage	Travel time to and waiting time at the meeting/start point		-0.1928	0.0950
In vehicle stage	Minimum required number of persons in vehicle		-0.1546	0.3578
	Costs of trip		0.2329	0.3640
	Travel time in vehicle		0.1285	0.1285
	Travel time uncertainty		0.0757	0.2244
	Flexibility of departure time	Low	-0.2007	0.2971
		Average	-0.1336	0.0054
		High**	0.3343	
Post-stage/at work location	Parking situation at work place for solo driving (S) versus carpool (C) parking	S_Poor+C_Perfect	0.1772	0.0187
		S_Poor+C_Medium	0.4870	0.1110
		Both equal	0.3214	0.3078
		S_Medium+C_Poor	-0.1203	0.6261
		S_Perfect+C_Poor**	-0.8053	
	Availability of car or bike at work location	Car or bike	0.3205	0.6790
		Bike only	-0.0172	0.1628
		None**	-0.3033	
<i>Goodness-of-Fit</i>				
	LL(β)			-1335.37
	LL(0)			-2208.37
	LRS (test value for 28 degrees-of-freedom: 41.3)			1746.00
	ML Rho^2			0.395
	ML Adjusted Rho^2			0.390
	MNL Rho^2			0.231
	MNL Adjusted Rho^2			0.228

* **Bold**: significant at 90 percent or higher confidence level

** Part-worth utility based on parameter estimates and effect coding of first and second attribute levels

In addition, it appears that the assumption of heterogeneity is supported by a significant standard deviation for a number of attribute levels. This means that there is random variation across the respondents regarding these attribute levels. Note that in one case (Minimum number of persons in the carpool) the standard deviation is significantly different from zero, while the corresponding mean value is not. This suggests that preferences of individuals regarding these attribute levels fluctuate around zero, cancelling out the neutral mean values.

6. Conclusions

The aim of the study described in this paper is to provide some insights into the factors that can be used to stimulate car drivers to switch to carpooling. The study especially pays attention to commuting trips in the direction of congested inner city areas of cities with more than 75,000 inhabitants in the Netherlands. Commuters' preferences are collected using a stated preference experiment in which the car drivers are invited to compare their current travel mode with a hypothetical carpool alternative.

In general, the findings of the current study are in line with previous findings of Correia and Viegas (2011) and Nurul Habib et al. (2011). Travel time, travel costs, and flexibility of working hours are the most influential attributes. Almost all included attributes significantly influence the attractiveness of the carpool alternative in the expected direction. The only exception is the contribution of the number of persons involved in the carpool. For this attribute, only the standard deviation was significant.

In addition to previous insights, this study added some extra attributes to this list; the difference in parking situation for solo drivers and carpoolers, uncertainty in travel time for both solo driving and carpooling, and the availability of a car or bike at the respondent's workplace. Also, the use of a mixed logit model to describe respondents' choices seems to be more successful than previous model estimations. In contrast to the other studies, the model performance is considerably higher. The adjusted R^2 of the 'constant only model' is equal to 0.262 (current study) while the others are equal to 0.08 (Nurul Habib et al., 2011) and 0.123 (Correia & Viegas, 2011).

In line with previous studies, the next step of the study concerns the extension of the model with background characteristics of the respondents and their commuting trips. The current study focuses on the home to work trip. In addition, some specific aspects of the return trip such as guaranteed ride home service and travel party, could be included in future research. The same is true for the separate inclusion of car drivers' personal characteristics and attitudes towards carpooling. Another relevant extension concerns the inclusion of social interactions in the choice between solo driving and carpooling as suggested by Sunitiyoso et al. (2011). Finally, the implementation of travelers' choice between solo driving and carpooling in an agent based simulation (e.g., Bellemans et al., 2012; Galland et al., 2014) will be explored.

References

- Arbour-Nicitopoulos, K., Faulkner, G.E.J., Buliung, R.N., Lay, J. & Stone, M. (2012) The School Run: Exploring Carpooling as an Intervention Option in the Greater Toronto and Hamilton Area (GTHA), Canada, *Transport Policy* 21, 134-140.
- Bellemans, T., Bothe, S., Cho, S., Giannotti, F., Janssens, D., Knapen, L., Körner, C., May, M., Nanni, M., Pedreschi, D., Stange, H., Trasarti, R., Ul-Yasar, A. & Wets, G. (2012) An Agent-Based Model to Evaluate Carpooling at Large Manufacturing Plants, *Procedia Computer Science* 10, 1221-1227.
- Bhat, C.R., Eluru, N. & Copperman, R.B. (2008) Flexible Model Structure for Discrete Choice Analysis. In: D. Hensher & K.J. Button (eds.) *Handbook of Transport Modeling*, Second Edition, Elsevier Ltd, Oxford, UK, 75-104.
- Borgers, A., Kemperman, A., Toll, L. & Timmermans, H. (2010) Measuring Preferences for Parking Facilities in Old Residential Areas. In: *Proceedings of the 7th International Symposium on City Planning and Environmental Management in Asian Countries*, Fukuoka, Japan, 1-14.
- Bruglieri, M., Ciccarelli, D., Colornia, A. & Luè, A. (2011) PoliUniPool: A Carpooling System for Universities, *Procedia Social and Behavioral Science* 20, 558-567.
- Burris, M., Alemazkoo, N., Benz, R. & Wood, N.S. (2014) The Impact of HOT lanes on Carpools, *Research in Transportation Economics* 44, 43-51.
- Caulfield, B. (2009) Estimating the Environmental Benefits of Ride-sharing: A Case Study of Dublin, *Transportation Research D* 14, 527-531.

- Correia, G. & Viegas, J.M. (2011) Carpooling and Carpool Clubs: Clarifying Concepts and Assessing Value Enhancement Possibilities through a Stated Preference Web Survey in Lisbon, Portugal, *Transportation Research A*, 81-90.
- Galland, S., Knapen, L., Yasar, A., Gaud, N., Janssens, D., Lamotte, O., Koukam, A. & Wets, G. (2014) Multi-agent simulation of individual mobility behavior in carpooling, *Transportation Research C*, 45, 83-98.
- Hensher, D.A., Rose, J.M. & Greene, W.H. (2005) *Applied Choice Analysis: A Primer*, Cambridge University Press, Cambridge, UK.
- Hess, S. & Polak, J.W. (2009) Mixed Logit Estimation of Parking Type Choice. In: B.W. Sloboda (ed.) *Transport Statistics*, J. Ross Publishing Inc., Fort Lauderdale, USA, 77-102.
- Lem, A. (2014) Motivating City-Commuters to Carpool: Exploring the Stimulus of various Factors and Policies, *Master thesis Construction, Management & Engineering*, Eindhoven University of Technology/KenWib, Eindhoven, the Netherlands.
- Louviere, J.J., Hensher, D.A. & Swait, J.D. (2000) *Stated Choice Methods: Analysis and Application*, Cambridge University Press, Melbourne, Australia.
- Menczer, W.B. (2007) Guaranteed Ride Home Programs: A Study of Program Characteristics, Utilization, and Cost, *Journal of Public Transportation* 10, 131-150.
- Morency, C. (2007) The Ambivalence of Ridesharing, *Transportation* 34, 239-253.
- Nurul Habib, K.M., Tian, Y. & Zaman, H. (2011) Modelling Commuting Mode Choice with Explicit Consideration of Carpool in the Choice Set Formation, *Transportation* 38, 587-604.
- Sunitiyoso, Y., Avineri, E. & Chatterjee, K. (2011) The Effect of Social Interaction on Travel Behavior: An Exploratory Study using a Laboratory Experiment, *Transportation Research Part A* 45, 33-344.
- Vanoutrive, T., Van de Vijver, E. Van Malderen, L. Jourquin, B., Thomas, I., Verhetsel, A. & Witlox, F. (2012) What determines Carpooling to Workplaces in Belgium: Location, Organization, or Promotion? *Journal of Transport Geography* 22, 77-86.
- Wang, R. (2011) Shaping Carpool Policies under Rapid Motorization: The Case of Chinese Cities, *Transport Policy* 8, 631-635.
- Wang, T. & Chen, C. (2012) Attitudes, Mode Switching Behavior, and the Built Environment: A Longitudinal Study in the Puget Sound Region, *Transportation Research Part A* 46, 1594-1607.