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PETER VAN DER WAERDEN, EINDHOVEN UNIVERSITY OF TECHNOLOGY, P.J.H.J.V.D.WAERDEN@BWK.TUE.NL,
(CORRESPONDING AUTHOR)

HARRY TIMMERMANS, EINDHOVEN UNIVERSITY OF TECHNOLOGY, H.J.P.TIMMERMANS@BWK.TUE.NL

ANTÔNIO NÉLSON RODRIGUES DA SILVA, UNIVERSITY OF SÃO PAULO, ANELSON@SC.USP.BR

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Peter van der Waerden

Urban Planning Group, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, the Netherlands, p.j.h.j.v.d.waerden@bwk.tue.nl, (corresponding author)

Harry Timmermans

Urban Planning Group, Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, the Netherlands, h.j.p.timmermans@bwk.tue.nl

Antônio Néelson Rodrigues da Silva

University of São Paulo, São Carlos School of Engineering, Department of Transportation Engineering, Av. Trabalhador São-Carlense, 400 - Centro 13566-590 - São Carlos - SP - BRAZIL, anelson@sc.usp.br

ABSTRACT

This paper discusses some results of a study on the influence of car drivers' characteristics on habitual parking behavior. First, the level of habitual parking behavior is determined in two ways: car drivers' regularity in choosing a parking facility and car drivers' self-reporting scores for habitual behavior. The data are collected using an internet based questionnaire that was distributed in Belgium and the Netherlands. The results show that car drivers regularly/often choose the same parking facility when visiting a central business area. In line with this finding, car drivers impute themselves as being highly habitual. A multinomial regression analysis shows that personal (gender, education, and country of residence) and trip (visit purpose) characteristics are related to the level of self-reported habitual scores.

INTRODUCTION

With a variety of planning measures, both planners and operators of parking facilities try to optimize the use of the urban road network and connected parking facilities in their city or administration. One of the comments often mentioned in practice concerns the sensitivity of car drivers to change parking facility. Car drivers often state 'I always use the same parking when visiting a certain (shopping) destination'. This might indicate that, at least for some car drivers, parking choice is a habit. According to Gärling and Axhausen (2003), it is important to consider habitual behavior because of its role in travel demand management strategies. They stated '*A choice that is non-deliberate may in fact be difficult to influence with rational arguments (e.g., increased costs) since the person making the choice tends to discount relevant information*'.

Empirical knowledge about habitual behavior in the transportation literature is limited and mostly restricted to mode choice behavior and repetitive behavior in comprehensive activity-travel patterns. In a study on household energy consumption, Heijs (2006) made a clear distinction between habit and habitual behavior. He defined habit as '*a mental structure, composed of a situation or domain, a related goal, a behavioral disposition to reach this goal and a cue (...), that is learned through reinforced repetition of the behavior in that particular situation and in response to that particular cue*'. In addition, he describes habitual behavior as '*the manifestation of a habit in repeated, overt (non)behavior*'. In the context of travel choices, Gärling and Axhausen (2003) gave an extensive overview of various aspects

of habitual behavior; the role of habit in travel behavior, measuring habitual behavior, transition from choice to habit, and breaking bad travel habits. They defined habit as ‘the repeated performance of behavior sequence’. In addition, habitual choice is defined as choosing to perform a behavior without deliberation. Based on findings in other studies, Gärling and Axhausen (2003) stated that travel habits exist if only a limited number of all possibilities are chosen over time. They suggest looking at long-term rhythms and intrapersonal variability (see also Schlich & Axhausen, 2003).

In 2009, Gardner investigated the effect of habit on the intention-behavior relationship within established commuting contexts. It appeared that in a stable travel context like commuting, habit and intentions were strongly positively correlated: a stronger intention results into a higher development of habits. Moreover, ‘habit moderated the motivation-behavior relationship so that intention did not inform behavior where habit was strong’. More recently, Chen and Chao (2011) and Chen and Lai (2011) also presented results concerning habits and travel mode decisions in the context of commuting. Based on structural equation model analysis, Chen and Chao (2011) found both direct and indirect effects of habit on mode choice switching intentions toward public transport by private vehicle uses. They also found differences in the effects between motorcyclists and car users. In an empirical study in Taiwan, Chen and Lai (2011) found a significant influence of habit on mode choice behavior. It appeared that habit increases the choice probabilities for motorcycle use.

An examination of the literature, however, shows that the issue of habits in parking choice behavior has only received scant attention. One exception concerns the study of Griffioen-Young *et al.* (2004), who discussed habitual behavior more specifically in the context of parking. They stated that characteristic of habits is that they are performed without being preceded by a conscious thought process and, thus, directly influence (parking) behavior. Griffioen-Young *et al.* (2004) defined three factors that make up habits: the degree to which the decision is thought out, the familiarity with the parking location, and self-reported habit. In the data collection, they only asked respondents about the degree to which their parking decisions are dictated by habit. It appears that for many trips the choice where to park is likely to be driven by habits, developed as a result of having made comparable trips many times in the past. The authors admitted that this was not sufficient because they believe that habits guide ‘many of our parking decisions’. This makes that additional research on the development and influence of habits is required.

The following research questions guided the search for more insights into habitual behavior in the context of parking.

- How can habitual behavior be defined in the context of parking?
- Does habitual behavior occur in the context of parking?
- Do personal or trip characteristics influence the level of habitual behavior in the context of parking?

The remainder of the paper is organized as follows. First, attention is paid to measurements of habitual behavior in the context of travel behavior. Next, the adopted research approach is discussed. This section is followed by a brief description of the data collection and the composition of the sample. Findings are presented in the following section. The paper ends with the conclusion and suggestions for future research on this topic.

MEASURING HABITUAL BEHAVIOR

In general, habitual behavior can be measured using repeated measurement (e.g., travel diaries over a longer time period, Schlich & Axhausen (2003), or over a one-week time period, Shannon *et al.* (2006) and Gardner (2009). In the context of revealed behavior,

indicators of habitual behavior can be annual vehicle miles (for mode choice), size of activity space (for destination choice), and occurrence of departure time (for departure time choice). Also other approaches or measurements can be used to determine habitual behavior, such as presenting respondents different choice situations and asking them to evaluate these situations (e.g., Aarts, *et al.*, 1997; Chen & Lai, 2011). In Aarts *et al.* (1997), respondents were asked to mention as quickly as possible the first (mode) alternative that came to mind when facing 9 globally described trips (e.g., going to a supermarket). Verplanken and Orbell (2003) presented a self-report habit index to measure the strength of habit. The index is based on twelve items related to features of habit: a history of repetition, automaticity, and expressing identity. Another, more sophisticated approach is suggested by Han *et al.* (2010) who related habitual behavior to the difference between individual's aspiration level and expected outcome. They assume that if a tolerance range is exceeded respondents will switch from habitual behavior to a conscious choice. Finally, Chen and Chao (2011) collected information concerning habits by asking respondents to indicate 'how often on average they use a motorcycle (or car) when commuting within a week'.

RESEARCH APPROACH

To get more insight into the appearance of habitual behavior in the context of parking, the following research approach is adopted. First, it was decided to concentrate on trips to central business areas because of the following reasons:

- Central business areas are usually surrounded by a variety of parking facilities;
- When visiting a central business area, car drivers often have fewer things to carry compared to for example visiting a supermarket, and hence their choice is potentially less constrained.

For central business areas oriented trips different questions were posed related to the issue of habitual behavior. The first two questions concerned the frequency of car use and parking facility use (Figure 1). A five points-scale was used ranging from 'Never' to 'Always'. The questions do not refer to habitual behavior directly but can be used to determine whether habitual (parking) behavior exists.

The screenshot shows a web-based questionnaire interface. At the top left is the logo for 'universiteit hasselt'. The title of the questionnaire is 'Habitual Parking Behavior'. Below the title is a progress indicator consisting of five small squares, with the first one filled. The first question is 'How often do you use the car for non-weekly shopping?' followed by a horizontal scale with five radio button options: 'Never', 'Rarely', 'Regular', 'Often', and 'Always'. The second question is 'How often do you choose the same parking facility for non-weekly shopping?' followed by a similar five-point scale. At the bottom of the questionnaire are two buttons: 'Previous' and 'Next'. A footer at the very bottom reads 'Berg Enquête System © 2007 Design Systems'.

Figure 1 Part of the internet based questionnaire, car and parking use

In the second question, respondents were asked to evaluate their parking choice behavior in the context of non-weekly shopping trips (Figure 2). The answer ranges from ‘Not habitual at all’ to ‘Strongly Habitual’. For those who could not rate their behavior, the answer ‘I do not know’ was added.

The screenshot shows a questionnaire interface for 'universiteit hasselt'. The title is 'Habitual Parking Behavior'. The first question is 'How would you rate your parking choice behavior for non-weekly shopping?'. Below this is a table with six columns: '1 (not habitual at all)', '2', '3 (average)', '4', '5 (strong habitual)', and 'I do not know'. Each column has a radio button. Below the table is the question 'On average how long does it take you to find a parking space for non-weekly shopping?' followed by a text input field and the word 'minutes'. At the bottom are 'Previous' and 'Next' buttons. The footer reads 'Berg Enquête System © 2007 Design Systems'.

1 (not habitual at all)	2	3 (average)	4	5 (strong habitual)	I do not know
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 2 Part of the internet based questionnaire, habitual behavior

The questions were included in a larger internet based questionnaire concerning car drivers' travel and parking behavior. The questionnaire also included questions regarding the respondents' personal characteristics (gender, age, educational level, and location of residence) and travel behavior (visit frequency and trip purpose) when traveling to a city center.

DATA COLLECTION

The respondents for this study were recruited in two different ways. Approximately 2500 invitation cards were distributed door-to-door in surrounding villages of Hasselt and Genk in Belgium. In addition, the mailing list of the Parking Panel of the Eindhoven University of Technology (approximately 600 panel members) was used to send an invitation for participation to the internet-based questionnaire. In total, 436 respondents (response rate of 14.1 percent) completed the questionnaire. Table 2 presents some details of the respondents who participated in the study. Unfortunately, the sample is not fully representative for the population of Belgium and The Netherlands. Nevertheless, responses do show some interesting trend.

Table 1 Overview of car drivers' personal and trip characteristics

Characteristics	Levels	Frequency	Percentage	Coding*
Personal characteristics				
Gender	Female	148	33.9	-1
	Male	288	66.1	+1
Age	Younger than 50 years	212	48.6	-1
	50 years and older	224	51.4	+1
Educational level	Medium	163	37.4	-1
	High	273	62.6	+1
Location of residence	Urban	248	56.9	-1
	Suburban	188	43.1	+1
Country of residence	Belgium	101	23.2	-1
	The Netherlands	335	76.8	+1
Trip characteristics				
Visit frequency	Less than once per week	305	70.0	-1
	Once per week or more	131	30.0	+1
Visit purpose	Shopping	225	51.6	-1
	Other	211	48.4	+1
Total		436	100.0	

* coding used in the multinomial regression analysis

ANALYSES

As mentioned before, the findings of this study are primarily meant to explore the issues raised. The focus is on the convenience sample; no claims are made in terms of generalization of the results. The first aspect concerns the use of the car for non-weekly shopping and the use of the same parking facility. Figure 3 shows that the car is not often used when traveling to a central business area. Approximately half of the respondents never or rarely use the car. When the respondents use the car to travel to a central business area, the majority (approximately 80 percent) regularly/often parks the car at the same parking.

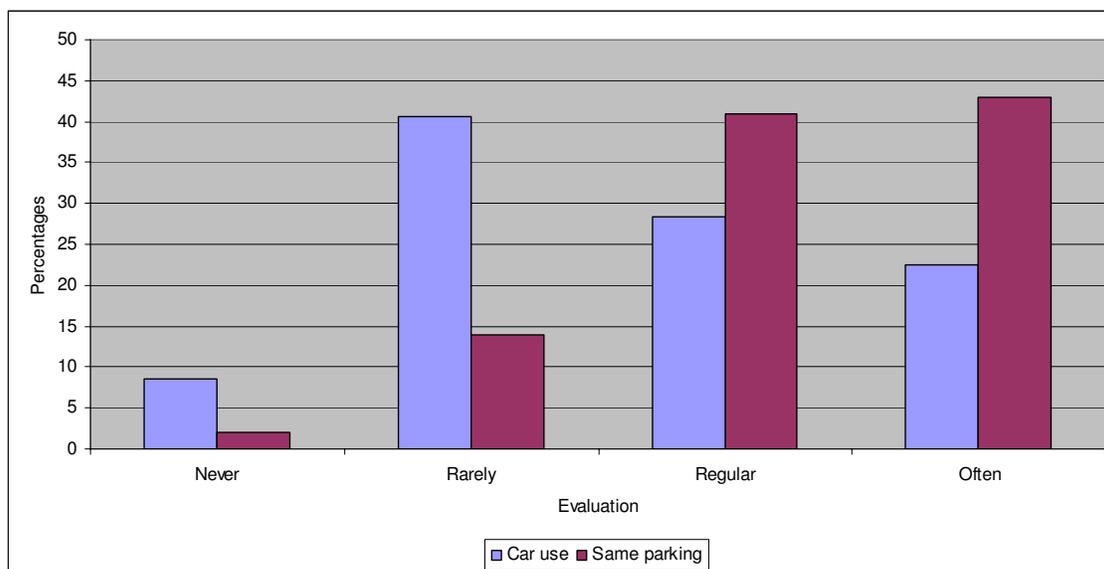


Figure 3 Car use and use of same parking facility

In a separate question, respondents could indicate what they think about their own behavior when choosing a parking facility (*self-reported habitual behavior*). Most respondents (more than 90 percent) are willing and/or able to evaluate their level of habitual behavior regarding parking. A large amount of respondents (approximately 75 percent) see their behavior as ‘(strong) Habitual’ (Figure 4). Only a few respondents (approximately 5 percent) consider their parking behavior as ‘Not habitual’.

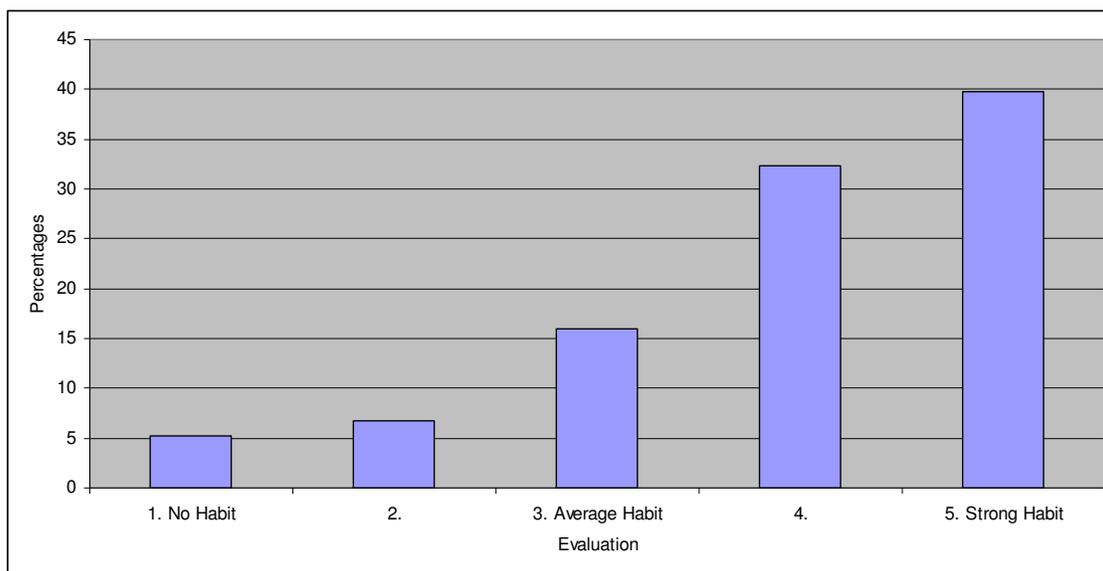


Figure 4 Self-reported level of habitual behavior

The relationship between the self-reported habitual and the respondents’ personal and trip characteristics is investigated using the multinomial regression analysis that is included in the software SPSS. The different self-reported evaluation scores are considered as categories (dependent variable). The answer category ‘Strong habitual’ is used as reference category. To describe the effect of the characteristics, effect coding is used (see Table 1). Before entering the characteristics in the regression model, the correlations between the characteristics are calculated. Based on the correlations (the largest correlation is -0.312), it was decided that no characteristic has to be removed from as independent variable. The results of the estimation are presented in Table 2.

The Rho-square value of 0.133 and the significant chi-square test value show that the model performance is acceptable. The estimated model outperforms the model with all parameters equal to zero (null model). In general, it appears that various personal and trip characteristics are related to the self-reported evaluation scores. This holds especially for gender, education, country of residence, trip frequency and trip purpose. It seems that there is no relation between the self-reported value and the characteristics age and location of residence. The parameter estimates show that the probability of the category ‘No habit’ decreases (in comparison with the probability of class ‘Strong habit’) in the case a respondent is a male, high educated, living in the Netherlands, and visiting the central business area for shopping. A similar effect can be noticed for answer category ‘2’.

Table 2 Estimation results of multinomial regression analysis

<i>Habitual score</i>	<i>Characteristics</i>	<i>Parameter</i>	<i>Significance</i>
1, No Habit	Gender	-0.368	0.050
	Age	0.084	0.644
	Educational level	-0.528	0.004
	Location of residence	-0.196	0.312
	Country of residence	-0.536	0.008
	Visit frequency	0.476	0.015
	Visit purpose	-0.158	0.403
2	Gender	-0.349	0.060
	Age	0.119	0.507
	Educational level	-0.391	0.030
	Location of residence	-0.449	0.023
	Country of residence	-0.562	0.006
	Visit frequency	0.543	0.005
	Visit purpose	-0.235	0.207
3, Average habit	Gender	-0.275	0.101
	Age	-0.028	0.859
	Educational level	-0.277	0.090
	Location of residence	-0.116	0.490
	Country of residence	-0.262	0.155
	Visit frequency	0.007	0.969
	Visit purpose	-0.113	0.491
4	Gender	-0.185	0.229
	Age	-0.086	0.548
	Educational level	-0.048	0.751
	Location of residence	-0.088	0.556
	Country of residence	0.015	0.931
	Visit frequency	-0.141	0.403
	Visit purpose	-0.291	0.051
<i>Goodness-of-fit</i>			
-2 * Log-likelihood null model		728.325	
-2 * Log-likelihood optimal model		631.736	
Chi-square value (df = 28)		96.589 (sign. 0.000)	
McFadden's Rho square		0.133	

Reference category is 'Strong habit'

CONCLUSION AND DISCUSSION

This paper presents some findings of a study about habitual parking behavior. In the study only a limited number of parking related aspects were included. The focus in this study was on parking 'choice' behavior or more specifically on the choice of the same parking facility when visiting a central business area. An internet based questionnaire was designed to get more insight in this phenomenon. The main questions concern the use of the car and the same parking facility and car drivers' self-evaluation of their habitual behavior when choosing a parking. It appears that half of the respondents regularly or often use the car to travel to a central business area and regularly/often use the same parking facility to park their car. Respondents ascribe themselves strong habitual behavior (scores 4 and 5 on a five points scale) when choosing a parking facility in this context. It appears that some personal and trip characteristics influence the probability of the self-reported evaluation classes. The probability of the class 'No habit' decreases compared to the class 'Strong habit') in the case a respondent is a male, high educated, living in the Netherlands, and visiting the central business area for shopping.

Some general suggestions for future studies could be extracted from this experience. As suggested in previous studies, a combination of past and intended behavior might be useful to get insights into habitual behavior. This implies a repetitive questionnaire that will be considered in future data collection. Regarding the analyses, of course all outcomes can be related to the car drivers' personal and trip characteristics. In addition, car drivers' context could be included into the analysis as well. Interesting context variables are car drivers' familiarity with the local parking situation and car drivers' habits in the context of other travel decisions such as destination, route and departure time choice.

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