

## **Trip Characteristics and Travelers' Willingness to Change Transport Mode in Favor of Public Transport**

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**Bijdrage aan het Colloquium Vervoersplanologisch Speurwerk  
20 en 21 november 2008, Santpoort**

## **Samenvatting**

### *Verplaatsingskenmerken en de bereidheid van reiziger om over te stappen op het openbaar vervoer*

Dit paper verschaft enkele inzichten in de bereidheid van reizigers om over te stappen van auto of fiets naar het openbaar vervoer in de context van regelmatige verplaatsingen. Respondenten is gevraagd aan te geven of ze voor het maken van een regelmatige verplaatsing bereid zijn over te stappen op het openbaar vervoer. De regelmatige verplaatsingen zijn beschreven in termen van vervoerswijze, verplaatsingsdoel, verplaatsingsafstand, vertrektijd, en verplaatsingsfrequentie. In totaal hebben 1326 respondenten uit twee verschillende regio's deelgenomen aan de studie. De bereidheid om over te stappen is sterk afhankelijk van de gebruikte vervoerswijze en de verplaatsingsafstand. De persgebonden kenmerken geslacht, leeftijd, woonlocatie, opleiding, en beschikbaarheid van openbaar vervoer abonnement zijn nader bestudeerd. Het blijkt dat bijna alle persoonskenmerken invloed hebben op de bereidheid om over te stappen. De mate van invloed loopt echter sterk uiteen.

## 1. Introduction

The privatization of the public transport companies in The Netherlands has resulted in an increased emphasis on the performance of public transport services [e.g. Martens, 2007; Mouwen & Konijnendijk, 2006; Ongkittikul & Geerlings, 2006]. The ambition of the companies is to increase the number of travelers, travelers' kilometers and/or travelers' revenues [Volinski, 2006]. To that end, companies have a variety of services at their disposal. With these services public transport companies try to stimulate travelers to use public transport instead of car or bike. According to Hensher [2007] there is still a lot to achieve by adding more buses, adjusting fare schedules, improving information systems, and integrating ticketing.

In general, factors influencing mode choice can be classified into three groups [Ortúzar & Willumsen, 2001]: characteristics of the trip maker (e.g., income, car availability, and household structure), characteristics of the trips (e.g., trip purpose and time of the day), and characteristics of the transport facility (e.g., travel time, monetary costs, and availability of parking). The use of a certain transport mode and mode switching behavior is strongly related to these groups of characteristics. Most studies focus on the relationship between the use of transport mode and the characteristics as described above. Insights into the relationship between the characteristics of individuals, trips and transport facilities, and transport mode switching behavior are still limited. The study of Paulley *et al* [2006] is one of the few examples in this context. They found that the effects of public transport (fare, quality of service, income) and personal characteristics on public transport use are influenced by time period, trip purpose, and car ownership.

The goal of the study described in this paper is contribute to this line of research and get more insight into the influence of trip characteristics on travelers' willingness to change transport mode in favor of public transport. The study focuses on regular car and bike trips that are defined as trips frequently made with the same transport mode, departure time, final destination, and trip purpose. This study is part of an extensive study concerning potentials of public transport and effects of marketing in this context [Van der Waerden *et al*, 2007].

The remainder of the paper is organized as follows. First, some previous findings of willingness to change transport mode are described. Next, the research approach adopted in this study and the data collection are presented. The analyses are described in the following section. The paper ends with the conclusions.

## 2. Willingness to change

Two different groups of approaches can be found in literature: mode choice approaches and mode switching approaches. The first group of approaches focuses on the choice of a mode for specific trips not dealing with current mode (if available). In contrast, the second group of approaches deals with the change of the mode used for a certain (regular) trip. The present study deals with the latter approach. In the past, several studies have been carried out about travelers' willingness to change transport mode. Most studies have been carried out in the context of commuting. In 1997, Curtis and Headicar [1997] published their study which tried to identify which car drivers are likely to be the best targets for marketing non-car modes (bike, public transport and walk).

They found that most car commuters are highly car oriented and are not susceptible to mode change. Most susceptible for changes were males, respondents between 30 and 39 years, respondents who frequently travel to work, and respondents who travel over a distance 5 miles or lower. Similarly, Kingham *et al* [2001] found a limited willingness to move out of the car for the trips to work with one of the main barriers being a perception that the alternatives are not viable. Of all respondents who indicated that they might change mode, approximately 50% will shift to public transport. Kingham *et al* did not take into account any trip related characteristics.

Shannon *et al* [2006] studied the effect of travel distance on the potential to change. They found that the shorter the distance the higher the potential to change to active transport modes walk, cycling, and public transport. Albert and Mahalel [2006] investigated one trip characteristic, arrival time in relation to travel costs (congestion for rush hour and parking costs for other times of the day). They found that of all travelers confronted with congestion toll, 19 percent is willing to change from car to public transport. Almost 30 percent of the travelers who are meeting the parking costs is willing to change. Meland [2007] investigated the effects of the relocation of a workplace from the fringe to the centre of the city of Trondheim (Norway). The relocation gave improved public transport and restrictions in parking facilities changing the travel time and costs of employees. Approximately 33 percent of the respondents indicated that the relocation has affected their car use consistently. Half of these respondents changed from car to public transport. The restricted parking facilities were mentioned as a major cause of this shift.

This literature research suggests that the accumulated evidence and insight into correlates of willingness to change transport mode primarily concern travelers' characteristics and to a lesser extent characteristics of travel modes. It may explicitly or implicitly indicate that analysts have assumed that willingness to change transport mode is invariant. We argue that this point of view is unrealistic. Travelers' willingness to change transport likely depends on trip characteristics which serve as the decision context for transport mode choice. At the very least it seems of interest to empirically analyze this assumption and examine whether willingness to change transport mode varies by decision context. Such an analysis would augment the limited past research on the influence of trip related characteristics such as travel distance, travel time, and departure of arrival time on willingness to change transport mode.

### **3. Research approach and data**

To get insight into the influence of trip characteristics on travelers' willingness to change from car or bike to public transport, the following research approach was adopted. Respondents were asked to describe a regular trip in terms of frequency (number of times per week), departure time (between 7:00 and 9:00 hours; 9:00 and 16:00 hours; 16:00 and 18:00 hours; and 18:00 and 7:00 hours), trip purpose (work/study, shopping, leisure, and other), distance to final destination (less than 5 kilometers, between 5 and 10 kilometers, 10 and 20 kilometers, 20 and 30 kilometers, 30 and more kilometers), and transport mode (car, bicycle, and public transport). In the case of a car or bike trip, respondents were asked to state if they were willing to change the transport mode used for the trip into public transport after the implementation of certain planning measures (see also Kingham *et al* 2001).

The data were collected in two different regions in The Netherlands: Apeldoorn (2005) and North-Holland (2006). In total 1326 respondents completed self-completed mail questionnaire or an Internet-based questionnaire. Table 1 presents some descriptive statistics of the research sample. The numbers show that all kinds of respondents are represented in the sample. The sample is not representative for the Dutch population as far it concerns the characteristic Gender. The present paper will focus on the sample. This non-representativeness of the sample however means that weighing would be required should the data is used for marketing assessment or predictive purposes. The low number of respondents not possessing a public transport card is in accordance with the overall situation in The Netherlands.

**Table 1:** Descriptive statistics of the research sample (N=1326)

<i>Characteristic</i>	<i>Level</i>	<i>Frequency</i>	<i>Percentage</i>
Age	Younger than 40 years	741	41.4
	40 years and older	549	55.9
	Unknown	36	2.7
Gender	Female	833	62.8
	Male	488	36.8
	Unknown	5	0.4
Residential location	North-Holland	649	48.9
	Apeldoorn	677	51.1
Education level	High	565	42.6
	Medium	751	56.6
	Unknown	10	0.8
Public Transport card	Yes	229	17.3
	No	1053	79.4
	Unknown	44	3.3

#### 4. Analyses

The relation between willingness to change transport mode for a regular trip and the characteristics of the regular trip is analyzed by means of a binary logistic regression model. The willingness to change from car or bike to public transport is used as dependent variable with two levels: *Yes* and *No* (Table 2). The majority of the respondents indicate that they are willing to change transport mode after the implementation of certain measures).

**Table 2:** Travelers willingness to change their current transport mode

<i>Willingness</i>	<i>Frequency</i>	<i>Percentage</i>
Yes	1015	76.5
No	311	23.5
Total	1326	100.0

Trip characteristics and their mutual interactions were used as independent variables. The interaction effects represent the jointly appearance of two trip characteristics. The

model is extended with personal characteristics of the respondents. Three different models are estimated: a model with main effects of trip characteristics only, a model with main and interaction effects of trip characteristics, and model with main and interaction effects of trip characteristics and main effects of personal characteristics. The overall estimation results are presented in Table 3. Based on the log-likelihood ratio chi-square, it appears that a more complex model outperforms a less complex model.

**Table 3:** Results of the model comparison

<i>Model</i>	<i>Number of parameters</i>	<i>Optimal Log-likelihood</i>	<i>Likelihood Ratio Chi-square<sup>1</sup></i>	<i>Critical Chi-square</i>
Main effects	6	-689.797	-	-
Mains effects + interaction effects	16	-645.102	89.392	18.31 (degrees of freedom 10)
Main effects + interaction affects + personal characteristics	21	-622.518	45.167	11.07 (degrees of freedom 5)

<sup>1</sup> -2(Log-likelihood of model 1 minus Log-likelihood model 2)

The parameter estimates of the most extensive model are presented in Table 4. The positive parameter for the constant indicates that in advance travelers are willing to change their transport mode in favor of public transport for the regular trip (see also table 2). The probability of willingness to change increases in case the bike is used for the regular trip. It implies that bikers are more inclined to change to a public bus than car drivers are. From a bus company's marketing perspective, this is an interesting result, but from the perspective of sustainable development it is not. Thus, this result seem to confirm earlier results obtained elsewhere in the world that it is difficult in general to trigger car drivers to change to public transport.

The results for travel purpose indicate that the willingness to change to public transport is slightly lower for the work commute, compared to other travel purposes. This finding confirms previous findings. Respondents of trips starting in the early morning are less willing to change than respondents who started their trip during daytime. This finding might be related to the previous finding (see also interaction effects). The probability of willingness to change transport mode increases when the trip is made frequently and decreases when the trip is made infrequently. Both findings are as expected.

Regarding the interaction effects, only three effects are significant. The parameter of the interaction effect Purpose and Time indicates that respondents with a regular work trip in the early morning are significantly less willing to change transport mode than other respondents traveling for other purposes in the morning. The same holds for respondents who travel frequently over a short distance. These respondents are less willing to change transport mode than other respondents traveling over a short distance. Respondents who frequently leave their home in the early morning are more willing to change than other respondents, traveling in the early morning.

In addition to the trip characteristics, two personal characteristics age and residential location significantly influence the willingness to change transport mode. It appears that young respondents are less willing to change than older respondents. Respondents living in the North-Holland region are less willing to change than respondents living in Apeldoorn. This effect might be caused by the fact that the public transport system in Apeldoorn is denser than the system in North-Holland.

**Table 4:** Estimation results of binary logistic regression model

<i>Characteristic</i>	<i>Base level</i>	<i>Parameter</i>	<i>Significance</i>
Constant		0.7792	0.000
<i>Main effects</i>			
Transport mode	Bike (versus Car)	0.2872	0.008
Travel purpose	Work (versus Other)	-0.4224	0.000
Travel distance	Short (versus Long)	-0.0769	0.461
Departure time	Early (versus Late)	-0.1739	0.041
Travel frequency	Frequent (versus Infrequent)	0.2429	0.033
<i>Interaction effects</i>			
Mode - purpose		0.0411	0.687
Mode - distance		-0.1602	0.100
Mode - time		-0.1275	0.239
Mode frequency		-0.1080	0.228
Purpose - distance		-0.0338	0.716
Purpose - time		-0.3160	0.001
Purpose - frequency		-0.1074	0.189
Distance - time		-0.0174	0.864
Distance - frequency		-0.2876	0.000
Time - frequency		0.3283	0.000
<i>Personal characteristics</i>			
Age	Younger than 40 years	-0.5828	0.000
Gender	Female	-0.0534	0.604
Residential location	North-Holland	-0.3827	0.000
Education level	High	-0.1345	0.183
Public transport card	Yes	-0.0252	0.770
Goodness-of-fit			
Number of parameters		21	
Log-likelihood model with constant, $LL_c$		-722.2777	
Log-likelihood optimal model, $LL_b$		-622.5182	
$-2(LL_c-LL_b)$		199.5189	
Rho-square		0.323	

## 5. Conclusions

The study described in this paper focuses the effect of trip characteristics on the willingness to change transport mode in favor of public transport for a regular trip. It appears that characteristics of the trip influence the willingness of travelers to change transport mode in favor of public transport. This holds especially for the trip characteristics transport mode, travel purpose, departure time and travel frequency. Also interaction effects of trip characteristics and personal characteristics influence the willingness to change.

Most of these findings are in line with result obtained elsewhere, suggesting that the processes underlying willingness to change are quite general. There are a few differences however. First, we did not find any significant effect of travel distance, whereas other studies typically did. This difference is however likely an artifact of the study design. While most other studies examined switching from car, in this study the focus was on switching to public transport from car or bike. Because the car is used typically for longer distance and the bike for shorter distance, it appears that the two contrasting effects have largely canceled out in the present analysis. Another difference concerns the effect of age. In this study young respondents are not willing to change while previous studies found that this group is likely to change transport mode. Again, this contrast might be caused by the research approach adopted in this study where we focus on the change from car or bike to public transport. Probably young respondents will use the bike more than older respondents.

New findings are related to the effect of transport mode, the effects of interactions between trip characteristics, and the effect of residential location. The findings of this study suggest that willingness to change transport mode not only depends on socio-demographic characteristics, but also on decision context. This implies that pricing and marketing efforts to stimulate switching behavior may be more effective if targeting not only to particular segments of the population, but also at particular trip characteristic and decision contexts.

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