FROM MOBILITY MANAGEMENT AND MULTILEVEL MODELLING TOWARDS MODELLING MOBILITY AND MULTILEVEL MANAGEMENT

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ABSTRACT

Governments worldwide aim to decrease the number of Single Occupant Vehicle (SOV) users to reduce traffic congestion and other transport-related problems. The according policies are often termed Mobility Management (Europe) or Travel/Transportation Demand Management (USA) to stress that the focus is on demand management in stead of infrastructure supply. Policy makers often target the home to work travel and as a consequence, employers and their employer transport plans play a significant role in the Mobility Management debate. However, researchers often pay little attention to the workplace, and the promotion of SOV-alternatives there. The Belgian questionnaire Home To Work Travel now enables us to fill this gap because the acquired database takes as viewpoint the workplace. This dataset contains workplace characteristics like size, economic sector and work regimes. However, also contextual factors influence employee travel behaviour. Multilevel regression models allow to incorporate variables both at the workplace and at higher levels (e.g. municipality; city-region). By modelling these different scales simultaneously, contextual factors can be separated from compositional ones. In other

words: the central research question is whether the modal split on a worksite is caused by its location in a given area, or by the workplace characteristics itself?
In the present study we sought to expand on the previous research by using multilevel modelling to analyse the modal split and mobility management at workplaces. However, the final aim is the development of effective transport policies based on these analyses. Thereby, a key question is the allocation of the right measure to the right actor (*Multilevel Management)*. Indeed, a myriad of actors on different levels take initiatives which influence travel behaviour, both towards and away from SOV-alternatives. We will focus on employers, which are used as mediating institutions between government and individuals. Nevertheless, the wider institutional framework will be part of the discussion, as the different public and private levels are connected. In short, this paper contributes to the research on mobility management initiatives by focussing on the role of employers and the related workplace level, and making use of multilevel models and a large database.

Keywords: mobility management, transportation demand management, employer transport plans, commuting, multilevel modelling, Belgium

INTRODUCTION

Traffic congestion, accidents, environmental damage and other transport-related problems exhort governments worldwide to reduce the number of Single Occupant Vehicle (SOV) users. This results in the development of a number of sustainable mobility policies with a primal focus on demand management. The result is the uprise of Mobility Management (Europe) or Travel/Transportation Demand Management (USA) programmes. These concepts stress that the target focus is on demand management instead of infrastructure supply. Furthermore, policy makers often target the home to work travel, as a consequence, employers and their transport plans play a prominent role in the mobility management debate (Ferguson, 1997). However, transport researchers often underestimate the role of the workplace and the promotion of SOV-alternatives there.

Travel reduction measures are not restricted to employer transport plans (Marshall and Banister, 2000). In their overview, Cairns et al. (2008) distinguish ten different categories with next to workplace travel plans, also initiatives like school travel plans, home shopping and teleconferencing. All initiatives have their merits, but home to work travel remains the prime target of policy makers. Indeed, these trips are predominantly made during the congested peak hours and towards the agglomerations troubled by traffic jams.

According to Cairns et al. (2008), mobility management has the potential to reduce UK national traffic levels by about 11%, with reductions of up to 21% in peak period urban traffic. Moreover, the benefit/cost ratios of mobility management strategies are in excess of 10 to 1. However, these numbers are as impressive as the preconditions: a clear national strategy, new revenue funding streams for local authorities, more tax breaks for workplace travel plans, mandatory school travel plans, stronger planning guidance in case of new developments, greater regulation of public transport, a national lead on engaging with 'hard-to-reach' stakeholders (e.g. trade unions); and on the local level: reallocation of road capacity, parking restraint, congestion charging, workplace parking levies, speed reductions in school areas, the encouragement of home shopping,… These preconditions look like a transport planning utopia when comparing it with Hull's (2005) description of the existing situation in the UK characterised by lack of integration, divergent agendas, policy fragmentation and a car-addicted electorate. This negative picture needs qualification as some evolutions can contribute to the success of mobility management. Indeed, the perception of the private car as source of status and freedom is nowadays challenged by notions of 'virtuous cyclists and vicious car drivers' (Cupples and Ridley, 2008). Finally, at least one issue remains clear in the analysis of transport policies, there are many actors in the mobility management debate. Therefore, this research is accompanied with a discussion on the role of the different actors in the transport policy arena. Note that this paper will restrict itself to home to work travel, since this type of travel generates most congestion.

The paper is structured as follows. Section 2 provides an overview of the main actors in mobility management and justifies our focus on the workplace level (i.e. *mobility management*). Section 3 introduces multilevel modelling as a proper technique to model SOV use at the workplace level, while simultaneously taking into account the wider context (i.e. *multilevel modelling*). Section 4 reflects on the results of the model and discusses the merits and drawbacks of the methodology (i.e. *modelling mobility*). Finally, Section 5 formulates some policy recommendations (i.e. *multilevel management*) and is followed by a conclusion section. This research is conducted within the ADICCT-project (Assessing and Developing Initiatives of Companies to control and reduce Commuter Traffic) which is financed by Belgian Science Policy in the Science for a Sustainable Development research programme. Previous papers focused on one SOV alternative, like the bicycle (Vanoutrive et al., 2009a) and carpooling (Vanoutrive et al., 2009b), and on the selection of case studies (Van Malderen et al., 2009). The present paper models SOV use instead of the use of alternatives, and is more directed at policy recommendations.

MOBILITY MANAGEMENT: THE THREE MAIN ACTORS

We classify the myriad of actors in the mobility management debate in three groups. First, different government institutions at different levels develop transport policies and are thus considered as main actors. The second category, the employers, take measures to reduce private car use and their workplaces are the destination of home to work travel. Thirdly, we need to focus on the employee level as it is the individual commuter who really makes the modal choice.

Government

Mobility management is in the first place a government issue. Commuting and congestion frustrates our society (Lyons and Chatterjee, 2008) and people expect an appropriate answer from their governments. Traditionally, governments are responsible for constructing transport infrastructure and organising public transport. However, building new infrastructures to fulfil our travel needs is decreasingly accepted. This supply side approach is criticized for the high costs of new infrastructure, the environmental impact and the attraction of additional traffic. As a result, alternative policies came to the fore with a focus on Travel Demand Management (Ferguson, 2000).

Obviously, government policy deals with more than transport alone. The main issues in home to work travel remain employment and economic growth, and also safety and environmental concerns increasingly shape governments' transport policies. Moreover, transport policy seems to be the favourite tool of politicians to use in other policy domains (Blauwens et al., 2008). Note that 'government' can hardly be described as one actor. Numerous government agencies exist at several levels, and even within governments, different departments have different agendas. There is clearly a need for policy integration in transport planning. Hull (2005) lists the potential for integration in transport planning in six areas: the integration between (i) authorities, (ii) different modes, (iii) infrastructure provision, management and pricing, (iv) transport and land use planning policies, (v) transport and environmental policies, and finally, integration between (vi) transport measures and policies for education, health and wealth creation. The existence of different policy fields also implies that what an employer calls an employee, is a commuter for transport policy, a polluter for environmental policy, and a non-unemployed person for employment policy. The same holds for employers, which are at the same time motors of economic development, meeting places for commuters, and consumers of land and other natural resources.

When focussing on the role of employers in mobility management, the relation and expectations of the government towards employers matter. Several transport policies use the employer to influence the individual commuter. Employers are thus used as mediating institutions to change travel behaviour. This appears to be a politically attractive solution for government since resources for direct government intervention decline, political will to impose direct control over individual behaviour is waning and employers centralise access to employees (DeHart-Davis and Guensler, 2005). Therefore, governments expect that employers invest in mobility management to reduce congestion. However, political attractiveness does not mean that workplace travel plans are popular among employers (Rye, 1999a). Finally, we cannot neglect that the government itself is an important employer.

The Employer

Companies can invest in mobility management for altruistic reasons, but also for self-interest (DeHart-Davis and Guensler, 2005). Easier staff recruitment and a reduction in parking costs are clear examples of mobility management initiatives which are beneficial for employers. The promotion of SOV alternatives can also enhance the green image of a company, and can contribute to its corporate social responsibility policy (Roby, 2010). Furthermore, planning regulations for new developments, and the expansion of a site in general, can require a mobility management answer. These factors leads to Rye's (1999a, p.20) conclusion that the official goal of Employer Transport Plans (i.e. reducing SOV use) is often not their raison d'être. Rye (Rye, 1999a; 1999b) also describes the potential tension between the acceptance and effectiveness of mobility management measures. Parking restrictions are often cited as one of the most effective measures, however, employers will not implement them in fear of human resources discussions. Besides the potential opposition of staff, also higher costs make measures less popular among employers. As a result, financial incentives for SOV alternatives are rather seldom in the UK.

Employers expect from governments a reasonable balance between taxes and offered public investments. Besides this, only necessary regulations with a minimum of administrative costs are appreciated by employers. Unsurprisingly, employers always opposed plans to implement mandatory transport plans, both in the USA and in Europe. In Southern California, employers having 100 or more employees had to implement a plan to decrease SOV use (Giuliano et al., 1993). Similar initiatives emerged in different other regions. However, after lobbying from businesses most regulations disappeared (Rye, 1999a; Ferguson, 2007). In Belgium, proposals for mandatory employer travel plans were dropped after the strongly negative reaction of employers in 1999 (Rye, 1999a; Enoch and Potter, 2003). Only the Brussels capital region now imposes a mobility plan for every workplace with at least 200 employees (100 employees in the future).

Especially in Belgium, we may not ignore the social dialogue between employers and employees (unions). Collective labour agreements specify the height of different allowances, like rail passes, cycling fees, carpooling costs and reimbursements for kilometers driven by car. In Belgium, next to national labour agreements, also collective sector agreements per activity sector, and agreements at the company level exist.

The Employee

Despite government and employer transport policies, the individual employee ultimately decides which mode will be chosen. Therefore, Gärling et al. (2002) propose a conceptual framework grounded in behavioural theories to explain the impact of Travel Demand Management (TDM) on modal choice. In short, amid a TDM measure and a change in behaviour, stands the change in travel options. The first step is thus to specify how a TDM measure affects employee's travel options with respect to cost, time, and convenience. Then, the reaction of the employee on these changes is the research subject. Cao and Mokhtarian (2005) describe travel behaviour and modal choice as an individual adaptation process, and state that travel attitudes, personality, and lifestyle influence the adaptation process (see also Van Acker et al., 2010). Such individual approaches have the merit of taking into account the fact that there is no such thing as an 'average' commuter. However, transport policy demands effects on an aggregated level.

We restricted our quantitative analysis to data aggregated at the workplace level. As a consequence, individual characteristics are modelled by aggregates and proxy variables. This discussion brings us to the traditional division of mode choice research in (i) a focus on the individual commuter and its attitudes and perceptions, and (ii) studies examining the environmental system, whereby individuals are grouped in geographical or administrative areas (Taylor et al., 2009; Verhetsel and Vanelslander, 2010). In the next section, we aggregate commuters in workplaces, which is less common. Nevertheless, the workplace is an appropriate unit to study aggregated commuting behaviour since congestion is mostly destination-related and the characteristics of the work end are stronger mode choice determinants than those of the residential origin (Limtanakool et al., 2006; Chen et al., 2008; Maat and Timmermans, 2009). Moreover, workplaces are the most appropriate units to analyse employer mobility management. Although knowledge on individual characteristics contributes to our understanding of home to work travel, the choice for workplaces as observation units is thus not only based on data availability. Traditionally, discrete choice models, which use individual commuters (or trips) as basic unit, do not fully take into account that employees are nested in workplaces. As a consequence, there is the risk for a reductionist approach, which assumes that aggregated travel behaviour equals the sum of all individual travel choices. To our opinion, research on individual mode choice and on the modal split of aggregates (e.g. workplaces) is complementary.

MULTILEVEL MODELLING

We described above the importance of the workplace in home to work travel and mobility management. Besides the workplace itself, its locational environment also determines the modal split, which is measured using factors like density (Chen et al., 2008). The Belgian database Home To Work Travel (HTWT) 2008 contains data at the workplace level and is enriched with general data at the municipality level. Multilevel regression models allow to incorporate variables both at the workplace and at higher levels of aggregation (e.g. municipality; city-region) (Schwanen et al., 2004). By modelling these different scales simultaneously, contextual factors can be separated from compositional ones (Duncan et al., 1998; Mohan et al., 2005; French and Jones, 2006; Johnston et al., 2007). In other words; is the modal split on a worksite caused by its location in a certain area (contextual), or by the workplace characteristics itself (compositional)? To this end, we adopt a multilevel model whereby the percentage of SOV in the commuting modal split at a workplace is the dependent variable. By definition, this share is 100% minus the shares of alternative modes, of which using public transport, cycling and carpooling are the most important. A first set of variables is workplace characteristics which are not directly related to mobility: size (number of employees), work regimes, share of female employees and economic sector. Table I lists the general findings of previous research about some workplace-related mode determinants (Vanoutrive et al., 2009a; Vanoutrive et al., 2009b). The second group contains, on the one hand, accessibility problems indicated by employers in the questionnaire HTWT, and on the other hand, the mobility management measures present on the workplace. To reduce this large group of binary variables, two exploratory factor analyses were carried out, one for the accessibility problems (A) and one for the mobility management initiatives (B) (Table II).

Table I – Workplace-related determinants of three main SOV alternatives

bicycle	carpool	rail
small sites	small sites	large sites
fixed work schedules	fixed work schedules	flexible work schedules, no shifts
well accessible sites	peripheral locations	good rail accessibility
government, education	construction, manufacturing, transport	central government, universities, finance

Table II – Results of the exploratory factor analyses (Varimax rotated)

FACTOR ANALYSIS A		frequency	factor loadings		
	mobility management measure	**%**	**factor1**	**factor2**	**factor3**
bicycle	secured bicycle storage	36.05	0.25	**0.47**	0.15
	covered bicycle storage	48.62	0.25	**0.77**	-0.01
	changing room	34.34	0.10	**0.91**	-0.07
	showers	35.34	0.11	**0.90**	-0.08
	bicycles available for work trips	11.64	0.12	**0.41**	0.37
	repair facilities or maintenance	5.46	0.14	**0.56**	0.31
	bicycle parking*	continuous	**0.11**	0.04	-0.06
	additional cycling fee	47.21	0.00	-0.02	**0.44**
	additional allowance for work trips by bike	9.36	-0.09	0.20	**0.28**
carpool	organisation of a carpool	7.96	**0.72**	0.06	-0.06
	linking to a central carpool database	8.37	**0.88**	-0.02	0.16
	other (preferential parking and/or guaranteed ride home)	5.29	**0.66**	0.29	-0.02
	distribution of information about carpool	6.78	**0.85**	0.22	0.13
public transport	regular consultation with public transport company	6.43	**0.58**	0.28	0.36
	information on public transport	12.66	**0.59**	0.30	0.39
	supplementary allowance for public transport	25.18	0.12	-0.15	**0.88**
	encouraging public transport for work trips	9.57	0.21	0.25	**0.65**
divers	information on SOV-alternatives	8.77	**0.61**	0.16	0.50
	collaboration with regional & local mobility institutions	8.25	**0.46**	0.26	0.37
	regular consultation with local authorities	9.47	0.33	**0.35**	0.28
	mobility coordinator	9.57	**0.58**	-0.02	**0.53**

FACTOR ANALYSIS B		frequency	factor loadings	
	accessibility problem	**%**	**factor1**	**factor2**
car	dangerous traffic (car)	14.70	**0.71**	0.17
bicycle	dangerous traffic (bicycle)	42.20	**0.78**	0.15
	unsafety (social)	5.44	**0.79**	-0.04
	company image (bicycle)	1.34	**0.64**	0.16
	hilliness**	continuous	**0.24**	-0.06
public transport	no or insufficient public transport service	26.95	0.12	**0.94**
	public transport service not adapted to work hours	28.46	0.27	**0.61**
	public transport travel time	20.58	**0.52**	**0.44**
	low quality, safety and comfort	8.10	**0.70**	0.13
	distance to public transport stop	16.71	0.22	**0.71**
	distance to railway station***	continuous	-0.28	**0.48**
divers	unsafe routes	7.98	**0.52**	0.18
	feeling insecure due to work hours	5.76	**0.42**	0.05
	recruiting problems due to bad accessibility	5.74	0.04	**0.52**

mobility management measures with a frequency lower than 5% were omitted or grouped

highest value in a row in bold; logarithms of continuous variables are taken to reduce non-normality

* log (#bicycle parkings + 1)/(#cyclists+1); mean = 0.17, standard deviation (s.d.) = 0.56

** log(average slope on roads in municipality); mean = 0.28, s.d. = 0.22; Source: Vandenbulcke et al. (2009)

*** log(distance to nearest railway station) + 3.7; mean = 2.98, s.d. = 0.43

software: Mplus (Muthén and Muthén, 2006); Source: database HTWT 2008

for information on factor analysis and the database HTWT, we refer the reader to Vanoutrive et al. (2010)

The results of the factor analyses (A and B, based on the database HTWT 2008), are in line with those of a more extensive analysis of the database HTWT 2005 in Vanoutrive et al. (2010). Table II reveals three types of mobility management measures on the basis of factor analysis A. The first group of measures contains the promotion of carpooling and other SOV alternatives, and collaboration with different institutions. A second set of measures are bicycle facilities, and the last category encompasses financial stimuli. Note that financial measures are popular in Belgium, in contrast with the general finding that expensive measures are rare (Rye, 1999a; 2002; Dickinson et al., 2003). A strong collective bargaining tradition and high taxes on labour can explain the popularity of financial incentives in Belgium. The second factor analysis (B) detected two types of accessibility problems. The first group encompasses both bicycle-related problems like dangerous traffic and hilliness, and problems typical for cities like crime and congestion. The second group of problems may be defined as 'low accessibility by public transport'. The factor scores of these exploratory factor analyses are incorporated in the multilevel regression model, except for the first factor of factor analysis B. Indeed, to distinguish bicycle-related problems from agglomeration problems, separate variables are used instead of a construct based on the factor analysis.

The two last variables in the regression model, job density and hilliness, are measured at the municipality level. An analysis of the model residuals revealed that the effect of job density is not equal among arrondissements. We group municipalities in arrondissements as these areas usually consist out of a central city surrounded by less densely populated municipalities. We also tried to group municipalities in labour basins. However, the dominance of few large basins makes this subdivision less appropriate (Vanoutrive et al., 2009a), which was confirmed by tests with models using alternative subdivisions. The arrondissements were added as a third level in the multilevel model and this addition of an extra level allowed us to vary the slope of the job density estimate. This means that there is a different parameter estimate for job density for all 43 level 3 units, the arrondissements. As a result, the model contains three levels: (1) the workplace, (2) the municipality where the workplace is located, and (3) the arrondissement (district) where the municipality is part of. To evaluate the models, Table IV compares different model setups. It starts with an empty model (1), i.e. a model with only a multilevel structure but without any exploratory variables, model 2 only contains the organisational factors, in model 3 the accessibility measures are added, in model 4 also the variables measured at the municipality level are present (hilliness and job density), and the final model (5) also includes the random slope for job density. The reduction in variance can be used as a goodness of fit measure (Hox, 2002). The last column of Table IV compares the empty with the full model. More than 70% of the variance between municipalities and arrondissements is explained by the model. However, about 75% of the variance attributed to the workplace level remains unexplained. The difference between the two last models in Table IV indicates the improvements made by adding the random slope for job density. The variance at the municipality level is halved and the variance at the arrondissement level decreased with one third. From the empty model we learn that 19% of the variance in car use can be attributed to the wider context. In the full model, only 7.5% of the unexplained variance is attributed to this context (municipality and arrondissement). Consequently, adding extra variables measured at the municipality level, and/or using an alternative division in geographical areas will only generate small improvements in the goodness of fit of the model. Note that the variance between individual commuters is attributed to the workplace level since we lack disaggregated data on employees (Tranmer and Steel, 2001).

The fixed part of a multilevel regression model contains the parameter estimates which are comparable to those of a standard regression analysis. The car is less popular at sites with more employees, among others due to scale economies in the organization of public and private collective transport. A larger share of female employees is related to a higher degree of car use. Dickinson et al. (2003) report personal security and the combination of commuting with shopping and/or transporting children as factors that lower the amount of cycling women. This is in line with the Belgian 2001 census which revealed that 56% of commuter cyclists are male (Verhetsel et al., 2009). Irregular and flexible work schedules are associated with more car commuting, suggesting that the car is still the most flexible mode. We will discuss the results of the three mobility management variables in the next section as these have a central position in this paper. Congestion and a lack of parking space have the expected sign as these are often named as the main car discouraging factors (Van Exel and Rietveld, 2009). Somewhat surprising are the lower levels of car driving at sites which suffer from dangerous traffic, as the bicycle alternative is less attractive there. However, factor analysis B in Table II indicates that dangerous traffic is linked to agglomeration problems. The busy and hectic traffic in cities may explain the negative sign. Also job density is an indicator for cities and the estimate has the expected sign. Outside cities, a low accessibility by public transport leads towards a higher share of car in the workplace modal split. And in a hilly environment, the car is more prominent. The public sector is characterised by lower levels of car use. A notable exception are the workplaces of the public transport companies of the three regions in Belgium. Presumably, metro, tram and bus drivers have difficulties to reach their workplaces by public transport as they start before or quit when the schedule starts or ends. Perhaps the more peripheral location of depots has an impact too. The contrast with the national railway company is large. Note that different labour agreements in different sectors and companies may influence the differences in car use as well. The regional transport company of Flanders does not implement a bicycle mileage allowance until 2010. The economic sector dummy variables partly account for the differences in labour agreements, however, the complexity of the collective bargaining is not completely covered. Moreover, the location of railway stations in city centres and the differences in labour force structure between the railway company and the regional transport companies, influence the attractiveness of SOV alternatives as well.

The interpretation of the estimates for the random slope (Table III) is as follows (Hox, 2002; Rasbash et al. 2005). The parameter estimate for job density is -2.67 which can be interpreted as a standard regression analysis; a job density one standard deviation higher than the mean results in 2.7% less car commuters. However, the individual arrondissement slopes vary about this mean with a variance estimated as 14.2. The intercepts of these arrondissement lines also differ. Their mean is 78.6 and their variance 15.0. Moreover, the covariance between intercepts and slopes is 6.6, suggesting that arrondissements with higher intercepts tend to have steeper slopes. Note that the variance (14.2) exceeds the estimate (-2.7), hence, the differences between districts (arrondissements) are very important. This confirms the importance of the location of a workplace in modal choice.

Table III - Results of the multilevel regression model

random part		**est.**	**s.e.**	**z**
level 3: arrondissement n = 43	constant/constant	15,0	5,5	2,7
	job density/constant	*6,6*	*3,5*	*1,9*
	job density/job density	14,2	4,0	3,5
level 2: municipality; n= 461		7,4	3,5	2,1
level 1: workplace; n = 4912		277,5	5,7	48,4
fixed part	**variable**	**est.**	**s.e.**	**t**
	constant	78,6	1,5	51,7
	size*	-1,0	0,3	-3,5
	female (%)	0,9	0,3	2,5
work schedules	flexible (%)	1,6	0,3	5,0
	shifts (%)	*0,1*	*0,3*	*0,3*
	irregular (%)	1,1	0,4	3,0
mobility management	*divers*[f]*	*-0,3*	*0,5*	*-0,7*
	cycling infrastructure[f]	*0,3*	*0,4*	*0,8*
	financial[f]	-3,0	0,4	-7,9
accessibility	congestion**	-1,5	0,7	-2,4
	lack of parking**	-3,1	0,6	-5,2
	dangerous traffic**	-2,9	0,6	-4,9
	low access. publ. trans. [f]	3,8	0,3	13,1
municipality variables	job density*	-2,7	0,9	-3,1
	hilliness*	2,7	0,5	5,3

fixed part (continued)

economic sector dummy variables**

variable	**est.**	**s.e.**	**t**
railway company	-22,9	2,3	-10,2
central government	-17,4	1,5	-11,7
non profit	-16,5	1,8	-9,0
hotel	-14,5	2,8	-5,2
local government	-13,2	1,6	-8,4
post	-8,6	3,0	-2,9
universities etc.	-5,9	1,8	-3,3
construction	*-4,0*	*2,2*	*-1,8*
education	-4,0	1,5	-2,6
health	-4,0	1,5	-2,6
transport	*-1,3*	*1,8*	*-0,7*
primary sector	*-0,1*	*4,0*	*0,0*
finance	*1,4*	*1,9*	*0,7*
manufacturing	*2,3*	*1,4*	*1,6*
retail	2,9	1,5	2,0
regional transport	*3,7*	*2,2*	*1,7*
energy	7,9	2,2	3,5
services to firms	9,2	1,7	5,5

reference: other community, social and personal services

dependent variable: % car use in home to work travel at a workplace in 2008

* logarithm (to reduce non-normality); ** dummy variable; [f] variable based on factor analysis (Table II)

all non-dummy independent variables are standardised (mean = 0, st. dev. =1)

source: database HTWT 2008; only sites with at least 30 employees in 2005 and 2008 were used; sites with more than 50% for the mode 'other' excluded; more information on the database can be found in Vanoutrive et al. (2010)

Table IV: Comparison between some alternative multilevel models

(*LL = Loglikelihood)	(1) empty model		(2) full model without accessibility and municipality variables		(3) full model without municipality variables		(4) full model without random slope		(5) full model (Table II)		
	est.	s.d.	est.	s.d.	est.	s.d.	est.	s.d.	est.	s.d.	R²
level 3 (arrondissement)	51,7	14,3	56,3	14,6	49,2	12,8	21,7	6,5	15,0	5,5	71,1
level 2 (municipality)	32,3	6,0	23,6	4,5	18,8	3,9	14,6	3,4	7,4	3,5	77,1
level 1 (workplace)	370,8	7,7	287,5	6,0	276,9	5,8	277,2	5,8	277,5	5,7	25,2
total variance	454,8		367,4		344,9		313,4		299,9		
-2 LL*	43286,4		42040,3		41830,1		41779,4		41753,2		

MODELLING MOBILITY

Turning now to the added value of modelling mobility at workplaces using multilevel modelling, we will list some advantages. A first merit of the multilevel structure is the improvement of our understanding of the role that the neighbourhood of a workplace plays in commuting modal choice. The differences between municipalities and arrondissements are partly compositional, i.e. the location of different types of workplaces in different areas explains part of the variance. However, Table IV reveals that the job density variable explains a larger part of the variance between areas than workplace characteristics do, but the largest amount of the explained variance in car use between workplaces can be attributed to organisational factors, like work schedules, size and activity sector.

Second, the model makes workplaces comparable. The model controls for both location and organisational characteristics and can thus deliver a kind of performance index (Subramanian et al., 2001). The model allows to better answer the question if a peripheral industrial plant with 70% car users performs better than a central government office with 60% drivers.

Third, and more general, workplace data enrich transport research by aggregating commuters in meaningful locations, their workplaces. Multilevel modelling allows us to use on the one hand workplace factors, and on the other hand characteristics of the area where the worksite is located. However, the database HTWT does not contain data at the employee level. Part of the unexplained variance at the workplace level can be attributed to the individual level which is not measured directly. Nevertheless, if data at the employee level is available, multilevel modelling has the potential to bridge the gap between research based on individual data and studies that use aggregated and areal data (using e.g. a multilevel multinomial logistic model). Note that adding data at the individual level can imply a change of the conceptual framework in which the analysis is embedded. As a consequence, the analysis presented here does not become redundant when data at the individual level is obtained, since a focus on the workplace is complementary to one on the individual employee. Finally, data on the availability of company cars and on travel distance could improve our data source.

Our model contains three variables which measure the mobility management initiatives taken at workplaces. For two of them, estimates were not significant, only the third category, financial measures, seems to reduce car use. However, conclusions on causality and effectiveness based on regression models must be treated with caution. The model cannot exclude that employers with more sustainable commuters in their staff invest more in mobility management. Indeed, mobility management measures may be used to reward employees for other reasons than transport, and larger groups of non-car commuters may be more effective in inciting their employer to invest in mobility management. This relates to the so-called endogeneity issue in regression analysis (see overview in Dujardin et al., 2009). Endogeneity or the mutual reinforcement between investments in mobility management and the use of SOV alternatives, should cause (significant) estimates that exceed the real causal relationship between measures and effects. However, the model estimated a reduction in car use for only one of the three mobility management variables, the financial measures. This result suggests that financial measures has the potential to reduce car use. For cycling infrastructure, like storage and showers, a non significant increase in car use was estimated. Such bicycle infrastructure is in the first place a treatment of the symptoms and does not affect the underlying problems like distance and complex trip characteristics (e.g. trip chaining caused by dropping-off children; Dickinson et al., 2003). Moreover, investments in cycling infrastructure are less costly and thus more abundant in the less bicycle-friendly urban fringe (Vanoutrive et al., 2009a). Finally, the carpool, public transport and information measures are maybe too 'soft' to change the modal choice of an employee. This is a line of reasoning suggested by Hwang and Giuliano (1990) who categorise this kind of measures as less effective in contrast with the more effective financial measures and parking restrictions (Vanoutrive et al., 2009b). Note that in our explanation of the model estimates, we refer to individual features like commuting distance and other trip characteristics (e.g. dropping-off children, shopping). This substantiates the definition of the individual commuter as a main actor, as we did in the second section.

Finally, multilevel modelling is a proper technique to study the modal split at workplaces. However, for an evaluation of the effectiveness of mobility management by employers, additional case study research remains necessary. In addition, knowledge on the network level is needed since, even with travel plans that induce a modal shift at the workplace level, the impact at the network level is much less clear (Rye, 2002). Furthermore, isolating the impact of the employer from the other actors in transport policy potentially oversimplifies the real world situation. Therefore we will discuss the relations between the different actors in the next section.

MULTILEVEL MANAGEMENT

As mentioned in the introduction, a myriad of actors at different levels take initiatives which influence travel behaviour, both towards and away from SOV-alternatives. The Belgian situation illustrates this. First, the federal government is competent for taxation policy. In Belgium, commuting is regarded as a tax deductible expense, like in different other northwest European countries, while in the USA, the UK and several southern European countries, commuting is viewed as a personal expense (Potter et al., 2006). The Belgian taxation regime encourages private car use and long commuting distances. However, it also encourages cycling by making the cycling allowance tax deductible, but favours at the same time company cars and free fuel cards. As a consequence, company cars are increasingly part of the 'remuneration package' and are viewed as a way to avoid heavy taxes on labour (Potter et al., 1999; Enoch and Potter, 2003; Potter et al., 2006). Besides taxation policy, railways are a competence of the Federal government, while tram, bus and metro are the responsibility of the regions. The three Belgian regions, Brussels, Wallonia and Flanders, also sovereignly decide on land-use, road infrastructure (incl. bicycle paths), environmental, and most other transport-related policies. The Brussels region decided to implement mandatory employer transport plans for companies with at least 200 employees, while the region of Flanders established a commuting fund which subsidises projects of employers to reduce Single Occupant Vehicle commuting. The five Flemish provinces are designated as intermediaries between the companies and the Flemish government. The Walloon region also supports the making of transport plans of companies (Plan de Déplacements d'Entreprises; PDE), however, the focus seems to be on SMEs grouped in zonings, while the major share of the subsidies in Flanders went towards large companies. Industrial zonings are managed by different authorities, like intermunicipal companies and local authorities. Finally, local authorities are partly responsible for land-use planning and road infrastructure.

From an empirical point of view, the question is to what extent these mobility management policies are measurable. The database HTWT offers data at the workplace level, although with a certain degree of noise. Infrastructure policies of governments can also be measured. However, no uniform database exists with for instance cycling paths for the whole of Belgium. The absence of such data complicates comparative studies of municipal, as well as provincial and regional policies. For the Netherlands, Rietveld and Daniel (2004) could use a database containing measurements of municipal cycling policies. Unfortunately, this seems to be a singular case. The interdependencies between actors further complicates quantitative analysis. Presumably, a significant part of the research will remain qualitative.

Taking parking policy as an example, the role of and interdependencies between actors at different levels becomes clear. The federal government can choose to treat free employee parking as a taxable benefit in kind (Potter et al., 2006). The regional land use policies can impose, as is the case in the Flanders region, a mobility impact assessment for large developments. Such assessment can lead to parking restrictions and related measures in a building permit, analogously with the Section 106 agreements in England (Rye, 2002; Roby, 2010). The municipal governments are responsible for parking supply and tariffs, as well as for the granting of most building permits. Within this context, employers can choose to deliver parking for employees at a certain price. The employees are an actor as well as parking is a contentious issue. The social dialogue between employer and unions is thus part of the parking puzzle. Furthermore, neighbouring municipalities often compete to attract employment, which reduces their degrees of freedom in the supply and tariffs of parking space. Similarly, companies compete to recruit and retain staff and the availability of free parking is an instrument in their war for talent (Hendricks and Georggi, 2007). As a consequence, mobility management needs integrated policies where different actors at different levels attune their policies, i.e. multilevel management. Marshall and Banister (2000, p.336-337) summarise this as follows:

> ‘there is a large range of measures available which could potentially reduce travel by car […] The successes in achieving travel reduction are qualified […] To maximise the effectiveness of travel reduction measures, these need to be assembled in policy packages […] a range of decision makers need to be involved from the national and EU levels, as well as from the city and local communities’

To conclude, we will elaborate on the question if an employer is the right actor to invest in mobility management. DeHart-Davis and Guensler (2005, p.675) point employers as ‘logical mediating institutions for public policy because they provide centralized access to individuals'. Indeed, employees share the same workplace with a particular accessibility profile. Moreover, economies of scale makes investments in mobility management at large worksites more efficient, and the idea of employer investments which serve government objectives is politically attractive (Rye, 1999a). However, 'the majority of companies viewed the development of a travel plan as not high on their agenda' (Kingham et al., 2001, p.152) and 'transport will never be the core concern of the vast majority of employers' (Enoch and Potter, 2003, p.58). As a result, mobility management is often used to reach goals outside the field of transport, and in the case of mandatory travel plans most employers will 'work only to the letter rather than the spirit of the regulation' (Rye, 1999a, p.28). A high risk for goal displacements is thus present in mobility management.

Goal displacements occur at all levels in mobility management. Despite the greening of taxation regimes in several European countries, the coexistence of green and (company) car tax incentives undermines the potential to move to a more sustainable transport (Potter et al., 2006). Within transport policies themselves, a modal shift is mostly the main policy objective. Accordingly, the SOV is the main target. A disproportional stress on modal shift in transport policy can induce goal displacements. Marshall and Banister (2000) plead for travel reduction which not only implies switching mode, but also the substitution of trips. Also Boussauw and Witlox (2009) criticise a too narrow focus on modal shift and stress the importance of travel distance in energy use. Unfortunately, the loose spatial planning practice in Belgium goes hand in hand with an emphasis on the freedom of choosing your place of residence. As a consequence, policies which aim to reduce the long commuting distances in Belgium are almost absent, and presumably not stand a chance from the very start. To illustrate, following statement was made during the 2009 election campaign of the Flemish region: 'we usually travel for the right reason, but often not with the right mode'. At the local level, the competition to attract employment and the fear for fly parking in residential areas causes goal displacements in the transport, parking and land-use policies of municipalities.

The principal answer to this plethora of actors and potential goal displacements are policy packages (Marshall and Banister, 2000; Hull, 2005). An example could be the obligation for employers to give a bicycle mileage allowance and to reimburse public transport tickets if they offer free parking. However, without 'hard' measures, real shifts in transport behaviour are not expected.

CONCLUSION

Mobility management, sustainable mobility, transportation demand management and similar terms remind us that transport policy nowadays stresses the 'soft' way to solve congestion and other transport-related problems like air pollution. Accordingly, employer travel plans receive major attention of policy makers since employers centralise access to commuters, commuting is the main source of peak-hour urban traffic congestion, and investments by employers serve public goals without a direct cost for government. Workplaces play a central role since commuting traffic concentrates around work locations and the mobility management measures at a site are the same for all employees. Therefore, we used workplaces as observation units to model the share of commuting by car. A multilevel model allowed us to incorporate characteristics of the municipality where the site is located, next to organisational factors at the workplace level. The large dataset and the multilevel model delivers useful information on the impact of density, work schedules, accessibility problems and differences between economic sectors. Controlling for both spatial and organisational characteristics makes the share of car use at workplaces comparable. However, measuring the effectiveness of mobility management initiatives by employers remains difficult. The model suggested that financial incentives that promote alternative modes can be effective, but the impact of other measures like bicycle infrastructure, is less clear. Besides the model results, additional comments on mobility management were necessary to understand the role of employers. The range of available measures is large, but also the number of actors is impressive. Taxation regimes, collective labour agreements and land-use policies all influence the effectiveness of mobility management at workplaces. Therefore, multilevel management is needed to create policy packages with measures that reinforce each other. To be effective, the promotion of employer travel plans thus requires a reinforcement of the transport policies of governments.

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