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Urban Stud 2002; 39; 507
DOI: 10.1080/00420980220112801

The online version of this article can be found at:
http://usj.sagepub.com/cgi/content/abstract/39/3/507

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
Urban Studies Journal Limited

Urban Studies, Vol. 39, No. 3, 507–527, 2002

Carfax Publishing
Taylor & Francis Group

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[Paper first received, July 2000; in final form, April 2001]

Summary. Many countries now have policies to reduce distances travelled by private car and to favour the use of public transport, cycling and walking. The development of compact urban forms and the design of urban communities which favour walking are seen as particularly effective strategies for reducing car dependency. The factors which determine travel behaviour are not fully understood, so that effective policies influencing travel patterns are difficult to formulate. Apart from urban form and design, personal attributes and circumstances have an impact on modal choice and distances travelled. People with higher incomes are more likely to own and use a private car than low-income households. Families with children use cars more often than one-person households. The purpose of a trip—work, shopping and leisure—also influences travel mode and distance. We used the Netherlands National Travel Survey (OVG) to explore some of these relationships in more depth. The relative importance of personal attributes and the characteristics of residential environments as determinants of modal choice and travel distance were explored. Both sets of factors maintain a clear, strong relationship with travel behaviour in multivariate models of travel behaviour.

1. Introduction

Urban expansion is a current topic of debate among both academics and politicians. In the US, urban sprawl is now at the top of the political agenda. For example, in March/April 1999, *The New Democrat* devoted a special issue to sprawl, reporting voters' concern about poorly planned suburban development and traffic congestion. In north-west Europe, where many governments have pursued a policy of compact urban growth or the containment of urban sprawl, doubts have begun to arise. Such a policy has been in place in the Netherlands for 30 years, but it is now undergoing reconsideration (Dieleman *et al.*, 1999). This is mainly due to consumer preferences for less compact residential environments, and the much higher use of the private car in new compact urban expansions on green-field sites. Also the physical planning regime which was very centralised at the national level, and instrumental in bringing about compact urban growth, is now being remodelled into a more decentralised regime.

There is now a substantial body of academic literature on the development of urban form and the related issues of urban sprawl, private car use and energy consumption for mobility purposes (Newman and Kenworthy, 1999; Jenks *et al.*, 1996). The relationship

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0042-0980 Print/1360-063X On-line/02/030507-21 © 2002 The Editors of Urban Studies
DOI: 10.1080/0042098022011280 1

between the development of urban form and the use of the private car versus public transport, cycling, walking, etc. and distances travelled is particularly difficult to disentangle, because so many different factors influence this relationship. First, those engaging in travel have personal and household attributes. Income, family composition, participation in the workforce all have an impact on mobility behaviour and modal choice.

Secondly, the place of residence (whether city centre or suburb), the compactness of the residential environment and the availability of public transport also influence travel behaviour. Thirdly, the purpose of the trip undertaken is also intertwined with the length of the trip and the choice of travel mode—car or bicycle, for example. In empirical analyses of travel behaviour it is often almost impossible to weigh up the relative importance of the three sets of factors mentioned for modal choice and distance travelled.

The purpose of this article is to consider the influence of the personal attributes and the characteristics of the residential environment on travel behaviour simultaneously. The first research question concerns the relative importance of personal attributes and the attributes of the residential context on travel mode choice and distances travelled. We also considered a wider set of trip purposes than is usual in mobility studies: trips to work, for shopping and for leisure purposes. The second research question considers the influence of travel purpose on travel mode choice and distances travelled. The Travel Survey for the Netherlands (OVG) enabled the evaluation of this combination of factors influencing travel behaviour and trip purposes in one study.

We first summarise the literature on urban form and travel behaviour. We then describe the data and methods used. The results of the analysis are discussed first for mode of transport and then for distances travelled.

2. Literature Review

This section briefly summarises some of the relevant literature on the connections between the built environment and travel. For more comprehensive reviews, see for example Anderson *et al.* (1996), Badoe and Miller (2000), Crane (1999), Ewing and Cervero (2001), Handy (1996), Steiner (1994) and Stead *et al.* (2000). Investigators of the effects of the built environment on travel demand have analysed the impact of city size, density and mixed land use in cities and towns, the supply of public transport and the structure of the urban system. Several aspects of the residential environment were taken into consideration, not only at the macro scale, but also at the micro scale (that is, neighbourhood and activity centre). These studies explored the effect on travel behaviour of residential and employment densities within neighbourhoods or activity centres (for example, Ewing *et al.*, 1994; Frank and Pivo, 1994), land-use mix (for example, Cervero, 1989; Ewing *et al.*, 1996), micro-accessibility (for example, Kitamura *et al.*, 1997; Handy, 1992) and design (for example, Hess *et al.*, 1999; Cervero and Kockelman, 1997). In this article, no detailed review of studies at the micro level is given, because that is not the main focus of this research.

The most extensive and frequently cited study on the impact of density on travel demand is that by Newman and Kenworthy (1989) on energy use by cars in 32 large cities in Europe, the US, Australia, Asia and Canada. Recently (1999), they undertook a follow-up of their previous study. They analysed the costs of car dependence in 37 cities across the world. Both studies show a decrease in gasoline use with increasing population density. A negative relationship between urban density and energy use for transport was also found for relatively smaller cities in Denmark, Norway and Sweden. The population size of the cities in this study varied between 7100 and 1.4 million, and the population density ranged from 15 to 33 persons per hectare in the urban area (Asmervik and Naess, 1995; Naess, 1995). The results are influenced by car ownership, which is lower in large urban areas (Naess, 1995).

Higher densities may be expected to reduce the need to travel long distances. The literature on this hypothesis is ambiguous. In her review of literature on the link between residential density and travel distances, Steiner (1994) concludes that, in the aggregate, studies suggest that residents of high-density areas travel shorter distances than residents of lower-density areas. Levinson and Kumar (1997), however, came to another conclusion on the basis of their study across cities in the US with more than 1 million inhabitants. After controlling for available opportunities, transport infrastructure and the socioeconomic and socio-demographic characteristics of the residents, they found a positive relationship for automobile and transit commuters between metropolitan residential density and average commuting distance.

These ambiguous results could be related to settlement size. Levinson and Kumar (1997) suggest that metropolitan residential density is principally a surrogate for city size. Large settlements offer more services and facilities, which could reduce travel distances and favour the use of slower transport modes and public transport. On the other hand, the dispersion of urban land use over a large area may lead to longer distances, which lead residents to use their cars. The complex interaction between city size and travel distance is illustrated by the work of Gordon and colleagues (1987, 1989). They analysed for US metropolitan areas the influence of the metropolitan population size on distances travelled by car for work and non-work trips. In general, for central-city residents, commuting distances increase with city size. In contrast, for non-working trips, these distances decrease for cities up to 1 million inhabitants and increase for larger cities. Generally, suburban residents are characterised by longer travel distances for work and non-work trips. For these residents, the impact of the metropolitan size is less pronounced and less clear than for central-city residents.

On the basis of a comparison of case studies in the UK, Banister and colleagues (1997) showed that average trip distances were shorter in larger than in smaller settlements. This finding is in accordance with the greater use of cars in smaller than in larger settlements in the UK (see also Banister, 1992). These results show that residents of small settlements, where there are few public transport travel opportunities, have to travel longer distances by car to reach the services and facilities they need. According to Naess (1995), for Swedish commuting regions, the relationship between travel opportunities and average travel distance depends on the population density. The density of individual towns and villages has to be 'sufficiently high' in order to offer residents an acceptable level of services and jobs.

This discussion on settlement size and travel is related to research on the effect of the structure of the urban system on travel behaviour. Most cities in the Western world have developed from a purely concentric, or radial city to a multinucleated, or polycentric, city. Based on commuting data for the US, Gordon and Wong (1985) conclude that travel distances for work trips are shorter in polycentric cities than in their monocentric counterparts. Research carried out by Schmitz (1993) in former West Germany and the investigation by Asmervik and Naess (1995) of Swedish commuting regions reinforce this conclusion. A combination of the decentralisation of jobs and households to small and medium-sized towns, to avoid congestion, affords an explanation for these results (Gordon *et al.*, 1991; Schmitz, 1993; Asmervik and Naess, 1995; Naess, 1995). As far as we know, the effect of the urban structure is unknown for travel distances for purposes other than commuting to work, such as shopping and leisure activities.

Studies on the link between the deconcentration of jobs and the modal split carried out in the San Francisco Bay Area (Cervero and Landis, 1991; Cervero and Wu, 1998), Oslo (Naess and Sanberg, 1996) and Melbourne (Bell, 1991) show the same results. The relocation of jobs, which stimulates the development of polycentric urban systems, caused a shift from using public transport to solo driving by car. Based on his study of the

Paris region, Bolotte (1991) suggests that this change in the modal split could be reduced by sufficient investment in new public transport infrastructure.

Besides urban density in relation to settlement size and the structure of the urban system, the diversity in land use within a community might be expected to affect travel demand. A mixture of land uses could offer residents the opportunity to live, work, shop and enjoy recreation facilities within their own community. This leads to shorter average travel distances and could reduce car use. Diversity of land use is related to such concepts as 'self-containment' and 'jobs–housing balance'. A study in the San Francisco Bay Area carried out by Cervero (1989, 1996) suggests that a benefit of a jobs–housing balance is a higher share of internal, shorter commutes which encourage walking and cycling. However, in Europe, the British new towns, characterised by a high level of self-containment, are highly auto-reliant in comparison with new towns such as Almere in the Netherlands (Banister *et al.*, 1997) and those around Paris and Stockholm (Cervero, 1995).

These results suggest that a high level of self-containment in terms of jobs and residence in urban districts and new towns is not in itself a sufficient condition for reducing automobile dependency in commuting. Factors other than work proximity are important in travel decisions. Two such factors are the integration of walking, cycling and public transport infrastructure with land use, and strong intraregional economic linkages. Both of these factors could decrease car use (Cervero, 1995; Banister *et al.*, 1997). Other factors are the qualitative mismatch between housing and job supply and demand, the growing number of two-earner households who decide to live somewhere between the two workplaces, the desire to spend no more than on average 20–25 minutes on commuting and the increasing importance of non-work trips (Bae and Richardson, 1994; Cervero, 1996; Giuliano and Small, 1993).

This review shows that the relationship between urban form and travel behaviour is highly complex. Different characteristics of the built environment, such as density, city size and urban structure, are interwoven and have a composite impact on travel behaviour. These characteristics also work in tandem with the socioeconomic (income, for example) and demographic characteristics of households (Hanson, 1982; Steiner, 1994; Stead *et al.*, 2000). The analysis of travel behaviour in Uppsala by Hanson (1982) indicates that, for most aspects of travel patterns, socio-demographic variables may be more important than the effects of variables measuring spatial form and land use. Her study shows that age, income, gender and, of course, car availability have a clear impact on travel behaviour.

Our review of the literature on the impact of urban form characteristics on travel choices has revealed that few studies integrate the effects of personal attributes and urban form in the analysis of travel behaviour. The reason for this deficiency seems to be the lack of appropriate data which would make it possible to combine micro-level personal attributes with context characteristics. We expect, on the basis of the few studies available which do pay attention to the influence of personal attributes on travel behaviour, that these attributes may be as decisive for travel patterns as the variations in urban form. The review also shows that the role of trips for purposes other than the journey to work has been largely ignored in the analysis of travel mode choice and travel distance. We expect that travel behaviour for purposes other than work trips may be quite different from the journey to work and that other personal and spatial variables may influence travel behaviour for these purposes.

3. Research Design

To address the research questions posed, we drew on the Netherlands National Travel Survey (Het Onderzoek Verplaatsings Gedrag (OVG)). The OVG survey has been carried out since 1978. Since 1995, at least 70 000 households in the Netherlands have

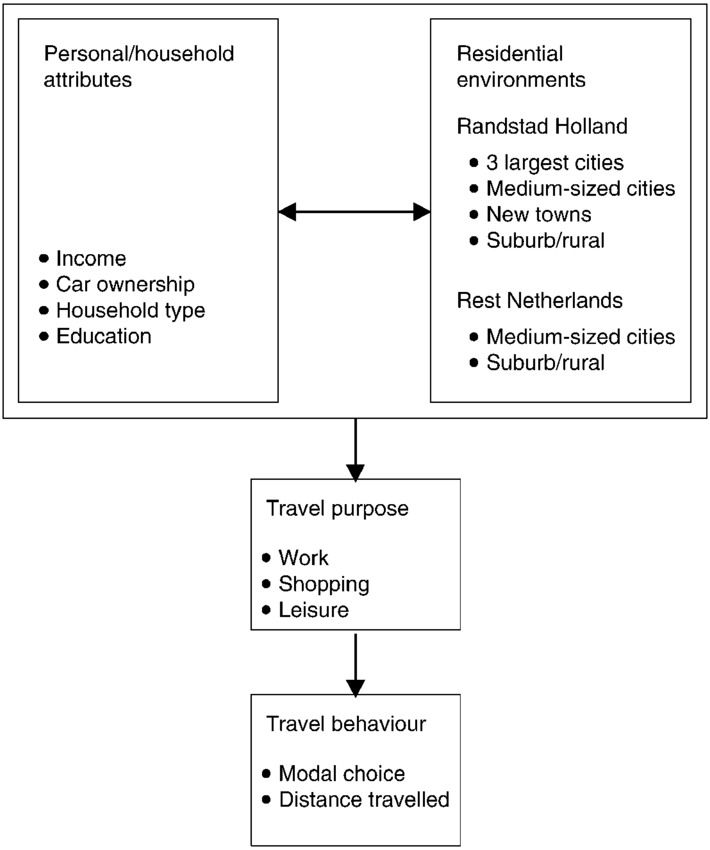

Figure 1. Variables used in the analysis.

been questioned each month. Each member of a household is asked to fill in a travel diary for one day. In total, more than 150 000 people (including children) participate in this survey each year (CBS, 1996). In this paper, we want to focus on the travel behaviour of household members who can undertake trips relatively independently. For that reason, we selected from the OVG survey for 1996 people aged 12 years and older.

Figure 1 summarises the factors in this analysis which are related to travel behaviour and the selection of variables used. Two travel behaviour variables were selected: modal choice and distance travelled. In this analysis, we use five main transport modes for trips undertaken: walking, cycling, public transport (by bus, subway, tram and train), private car (as car driver) and other (mainly car passengers, but also motor cycle, moped and taxi). For the sake of brevity, the multivariate analyses include only three transport modes: private car (driver), public transport, cycling/walking.

The personal/household attributes are operationalised first by the household type to which a person belongs. This typology of households is based on a combination of three characteristics: the size of the household, the number of adults in the household who participate in the labour market and the presence of young children (< 12 years old). On the basis of these characteristics, five household types are distinguished: two-person household with one worker; two-person household with two workers; families with one worker; families with two workers; other household types. Besides this household typology, we also used other characteristics: the yearly household income (six

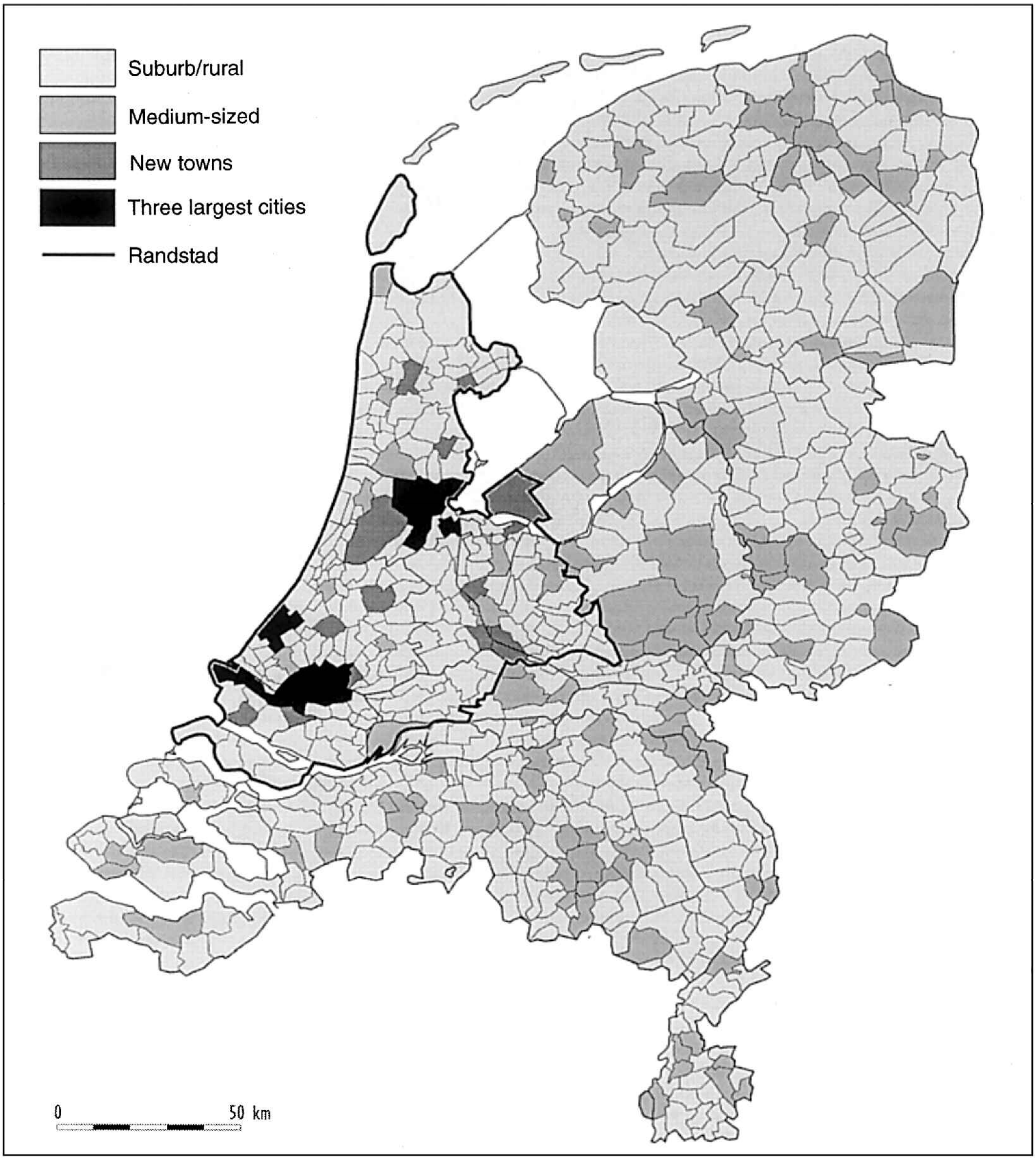

Figure 2. Residential environments in the Netherlands.

income classes), car ownership of the household (yes or no) and the educational level (four classes).

The residential environment of the respondents is based on location within or outside the Randstad Holland and the urbanisation level of the municipality (Figure 2). For the municipalities located within the Randstad Holland, these categories are: the three largest cities (Amsterdam, Rotterdam and The Hague), the medium-sized cities (including Utrecht), the new towns and the suburban/rural communities. In the other parts of the Netherlands, the municipalities are dichotomised into highly urbanised (medium-sized cities) and less urbanised (suburban/rural). The OVG only gives data for the municipal level, so the characteristics of neighbourhoods within municipalities could not be included in the analysis.

For the analyses of trip purposes, we created three main categories: work trips (excluding business trips); shopping trips; and leisure trips (social calls, culture, recreation, sports, walking and driving around).

The OVG data were used first to review some descriptive statistics of the use of transport modes and the distances travelled by the Dutch in different urban forms. Secondly, the data were used in multivariate statistical analyses to analyse the importance of each factor (personal attributes, type of residential environment, trip purpose) for the selected travel behaviour characteristics.

4. Modal Choice

In this section, we consider modal choice and its relationship with household attributes, residential environment and trip purpose (see Figure 1). First, we present some cross-tabulations of modal choice with some of these important determinants. We then give three multinomial logit models of modal choice, one for each of the trip purposes distinguished (work, shopping, leisure).

Descriptive Analyses

In the Netherlands, the private car is the favourite mode of transport (Tables 1–3), although the popularity of the bicycle is well known. Uniquely, for some categories of household and/or residential environment, the number of trips undertaken by bicycle exceeds the number of trips by private car. The category 'other', mainly car passengers, but also those using a motor cycle, moped and taxi, is also quite important and accounts for more trips than public transport.

There are clear relationships between modal split, type of household, type of residential environment and trip purpose. The use of the private car is greater for families than for households without children (Table 1). The reverse is true for cycling and the use of public transport. The presence of children in a household leads to an increase in the number of trips undertaken by private car, because travelling by car is more convenient than cycling or using public transport with children. The presence of children in a household seems to be more important for modal choice than the number of persons participating in the labour force. For households with two workers, the number of trips undertaken by car is somewhat higher than for one-earner households. Probably, the time pressure in households where both partners work is greater and leads to more private car use.

Residential environment also seems to influence the use of the different travel modes (Table 2). Relatively few trips by private car are undertaken by those living in the three largest cities in the Netherlands (Amsterdam, Rotterdam, The Hague). In these cities, relatively many trips are undertaken by foot or public transport. Those living in the suburbs and new towns show the opposite pattern in their modal choice. Although the bicycle is a relatively more important transport mode than in the three largest cities, medium-sized cities show somewhat similar modal choices. A better supply of public transport in Amsterdam, Rotterdam and The Hague gets people off their bicycles. This outcome is confirmed by the results of an investigation by Vidakovic (1985) in the Amsterdam region.

Car use and cycling are relatively extensive outside Randstad Holland, where population density and the provision of public transport are lower than in the more urbanised western part of the Netherlands. However, this two-by-two table (Table 2) fails to make clear to what extent the relationship between modal choice and residential environment may be present, because of the differences in population characteristics of those living in the various types of residential environment. A multivariate analysis is necessary to disentangle these interrelationships in more detail (see below).

Finally in this section, modal split is broken down by trip purpose (Table 3). Table 3 makes clear the importance of including shopping and leisure trips in the analysis of

Table 1. Modal split for all purposes by type of household (number of trips per person), in the Netherlands, 1996

Household type	Walking	Cycling	Private car (driver)	Public transport	Other	Total
Family, one worker	0.80	1.33	1.54	0.04	0.56	4.28
Family, two workers	0.75	1.13	1.85	0.05	0.57	4.36
Two persons, one worker	0.57	1.37	0.90	0.10	0.67	3.62
Two persons, two workers	0.60	1.47	1.02	0.11	0.67	3.88
Other	0.67	0.81	1.18	0.09	0.53	3.53

Source: OVG (1996).

Table 2. Modal split for all purposes by residential environment (number of trips per person), in the Netherlands, 1996

Residential environment	*n*	Walking	Cycling	Private car (driver)	Public transport	Other	Total
Randstad							
Three largest cities	10.415	0.97	0.81	0.94	0.25	0.44	3.40
Medium-sized cities	9.430	0.84	1.10	1.03	0.11	0.48	3.56
Suburb/rural	25.396	0.65	0.96	1.37	0.07	0.56	3.61
New towns	7.564	0.72	0.87	1.26	0.11	0.55	3.51
Rest of the Netherlands							
Medium-sized cities	53.445	0.67	1.05	1.23	0.07	0.53	3.56
Suburbs/rural	20.257	0.51	0.94	1.43	0.05	0.55	3.49

Source: OVG (1996).

Table 3. Modal split by trip purpose (number of trips per person), in the Netherlands, 1996

Travel purpose	Walking	Cycling	Private car (driver)	Public transport	Other	Total
Working	0.06	0.18	0.30	0.02	0.07	0.62
Shopping	0.20	0.26	0.26	0.02	0.11	0.86
Leisure	0.27	0.26	0.34	0.03	0.24	1.13

Source: OVG (1996).

travel patterns. Compared with travelling to the workplace, the number of trips undertaken for shopping and leisure is high. Many of these trips are over fairly short distances (see section 5) and walking and cycling for such purposes are therefore more frequent than in commuting.

Multivariate Analyses

From the review of the literature, it is evident that household attributes and the characteristics of the residential environment both have a strong relationship with modal choice. The purpose of the trip undertaken also influences modal choice. We decided to estimate separate models for the three trip purposes distinguished. The set of independent variables in each of the models is the same, permitting comparisons across the models (Tables 4–6).

In each of the models, we took the use of public transport as the reference category; the parameters given in Tables 4–6 express car use and walking/cycling relative to the use of public transport. For example, in the first model for car use (Table 4), the parameter of 3.360 for owning a car indicates that car use for going to work increases strongly compared with going to work by public transport if one owns a private car, and vice versa for those households not owning a car. There is also a reference category for the categories of any one variable. The parameters of the other categories are expressed with respect to this reference category. So, for example, the parameter of 2.183 for suburban/rural in the rest of the Netherlands on the variable residential environment in Table 4 indicates that those living in such an environment are much more likely to use the car than public transport for going to work than households living in one of the large cities in the Randstad (the reference category). Because this is a regression model, in this last comparison, the influences of income, car ownership, household composition and education are taken into account.

Almost all the parameters for car use versus public transport for work purposes are significant (Table 4). Among the household attributes, car ownership has the strongest relationship with modal choice, as might be expected. Having a car strongly reduces the propensity to go to work by public transport. Household type is also an important determinant of modal choice. Households without children are less likely to take the car to work than those who have one or more children. If there are two employed people in a household, the use of the car increases slightly. Level of education shows a somewhat ambiguous relationship with modal choice. Those with a lower level of education are more likely to use public transport, while car use is more likely among those with a higher education. The influence of income level on model choice is low, probably because this is linked with car ownership.

Even after compensating for household attributes (as in Table 4), the influence of residential environment on modal choice for work trips remains high. In fact, after car ownership, this variable shows the highest correlation with modal choice, so the relatively low car use in larger cities does not just result from these cities having a population with an overrepresentation of those

Table 4. Multinomial logit model of modal choice for work trips (reference category = public transport)

	Car		Cycling/walking	
	B	*R*	*B*	*R*
Car ownership (ref. = no car)	3.360***	0.441	0.460***	0.066
Income	$3.92^{E} - 06$**	0.013	$-1.05^{E} - 05$***	– 0.053
Household type		0.091		0.057
Family, one worker (ref.)				
Family, two workers	0.128	0.000	– 0.205*	– 0.009
Two persons, one worker	– 0.843***	– 0.046	– 0.413**	– 0.024
Two persons, two workers	– 0.783***	– 0.046	– 0.416**	– 0.026
Other households	– 0.707***	– 0.059	– 0.568***	– 0.053
Education		0.043		0.046
Higher (college and higher; ref.)				
Middle, upper (high school, high level)	0.368***	0.039	– 0.237**	– 0.028
Middle, lower (high school, low level)	0.335***	0.034	– 0.391***	– 0.047
Lower (elementary school)	0.004	0	– 0.442**	– 0.031
Residential environment		0.219		– 0.216
Randstad				
Three largest cities (ref.)				
Medium-sized cities	0.714***	0.054	0.899***	0.085
Suburb/rural	1.322***	0.123	1.100***	0.122
New towns	0.686***	0.053	0.410***	0.037
Rest of the Netherlands				
Medium-sized cities	1.743***	0.161	1.659***	0.184
Suburbs/rural	2.183***	0.195	1.586***	0.164
Constant	– 0.154		2.468	

Notes: – 2 log likelihood Car = 9717. – 2 log likelihood Cycling/walking = 2402.
*α = 0.10; **α = 0.05; ***α = 0.00.

more likely to use public transport. Evidently, the properties of the residential environment (density, diversity, provision of public transport services, all linked to the categories distinguished) have an independent effect on modal choice. Car use is fairly low with respect to public transport in the large and medium-sized cities and the new towns in the Randstad; car use increases for those living in suburban or rural areas and is the highest in the rest of the Netherlands.

In modal choice for work trips, the car does not compete very strongly with cycling/walking. In medium-sized cities, especially in Randstad Holland, car use is relatively low compared with cycling/walking (a model with cycling/walking as reference category, not shown here, demonstrates this).

Cycling and walking to work seem to compete much more with public transport than with car use (Table 4). The residential environment is an important determinant; that variable has the highest correlation with the choice between walking/cycling and using public transport for going to work. In the larger cities of Randstad Holland, using public transport is more likely than cycling or walking, but the likelihood of cycling/walking to work increases for the other environments in Randstad Holland and is even higher in the rest of the Netherlands.

The coefficients of the independent vari-

Table 5. Multinomial logit model of modal choice for shopping trips (reference category = public transport)

	Car		Cycling/walking	
	B	*R*	*B*	*R*
Car ownership (ref. = no car)	3.497***	0.362	1.199***	0.119
Income	$1.66^{E} - 05$***	0.074	$-5.62^{E} - 06$**	−0.023
Household type		0.148		0.084
Family, one worker (ref.)				
Family, two workers	0.224	0.000	0.184	0.000
Two persons, one worker	−1.467***	−0.088	−0.847***	−0.053
Two persons, two workers	−1.279***	−0.068	−0.636***	−0.035
Other households	−1.474***	−0.120	−0.821***	−0.067
Education		0.118		0.073
Higher (college and higher; ref.)				
Middle, upper (high school, high level)	−0.351**	−0.029	−0.723***	−0.068
Middle, lower (high school, low level)	−0.365**	−0.030	−0.715***	−0.066
Lower (elementary school)	−1.463***	−0.107	−0.836***	−0.068
Residential environment		0.262		0.172
Randstad				
Three largest cities (ref.)				
Medium-sized cities	0.902***	0.066	0.913***	0.083
Suburb/rural	1.821***	0.160	1.096***	0.113
New towns	1.274***	0.083	0.751***	0.057
Rest of the Netherlands				
Medium-sized cities	2.053***	0.194	1.275***	0.145
Suburbs/rural	2.887***	0.243	1.441***	0.138
Constant	0.959		3.597	

Notes: −2 log likelihood Car = 8238. −2 log likelihood Cycling/walking = 13883.
*α = 0.10; **α = 0.05; ***α = 0.00.

ables for modal choice for shopping trips (Table 5) resemble the coefficients for work trips (Table 4). Again, car ownership strongly increases the likelihood that the car rather than public transport is used for a shopping trip. The other household attributes relate to this choice in the same fashion as for work trips. Again, the likelihood of using the car rather than public transport is quite strongly related to the residential environment of the household making that choice. In the large cities of Randstad Holland, public transport is more frequently used, but the differences between this and the other environments are not as large as for work trips. Cycling and walking for a shopping trip compete strongly with public transport. The chance that people in the Randstad suburbs and the rest of the Netherlands walk or cycle to a shop is greater than in the three large cities.

The patterns of modal choice discussed so far are largely repeated for leisure activities (Table 6). Again, car ownership and residential environments are the most important factors influencing car use rather than public transport. Household type also plays an important part in this case; those households with children are more likely to use the car, as would be expected. For walking or cycling versus use of public transport, residential environment is most highly correlated with

Table 6. Multinomial logit model of modal choice for leisure trips (reference category = public transport)

	Car		Cycling/walking	
	B	*R*	*B*	*R*
Car ownership (ref. = no car)	2.946***	0.356	1.0381***	0.116
Income	$1.86^{E}-05$***	0.090	$-4.32^{E}-06$**	−0.018
Household type		0.148		0.121
Family, one worker (ref.)				
Family, two workers	−0.059	0.000	−0.023	0.000
Two persons, one worker	−1.757***	−0.098	−0.980***	−0.057
Two persons, two workers	−1.579***	−0.080	−0.734***	−0.038
Other households	−1.627***	−0.120	−1.319***	−0.097
Education		0.104		0.035
Higher (college and higher; ref.)				
Middle, upper (high school, high level)	0.174**	0.015	−0.170**	−0.015
Middle, lower (high school, low level)	0.207**	0.018	−0.064	0.000
Lower (elementary school)	−0.865***	−0.070	0.189**	0.013
Residential environment		0.198		0.162
Randstad				
Three largest cities (ref.)				
Medium-sized cities	0.829***	0.063	0.859***	0.074
Suburb/rural	1.406***	0.127	1.079***	0.108
New towns	0.985***	0.064	0.756***	0.054
Rest of the Netherlands				
Medium-sized cities	1.481***	0.149	1.176***	0.133
Suburbs/rural	2.043***	0.187	1.420***	0.143
Constant	1.060		3.251	

Notes: −2 log likelihood Car = 11663. −2 log likelihood Cycling/walking = 17482.
*$\alpha = 0.10$; **$\alpha = 0.05$; ***$\alpha = 0.00$.

this choice. Living in a suburban location or outside Randstad Holland leads to more cycling and walking for leisure activities, other things being equal.

5. Distance Travelled

Descriptive Analyses

As for modal choice with respect to distance travelled, we first give some cross-tabulations of distance travelled against three important factors: household type; residential environment; trip purpose. We then present separate regression models for distance travelled for work trips, shopping trips and leisure activities.

In 1996, each Dutch person interviewed in the OVG survey travelled on average 37 kilometres per day. Of course, if one considers distance travelled rather than number of trips as in section 4 the car predominates, because it is used for the longer distances. Walking clearly occurs only for trips of up to 1 kilometre; an average cycle trip is roughly 4 kilometres (one way). Because of this small range of action, these travel modes are less important in the total number of kilometres travelled. The part played by public transport remains substantial when distances travelled are considered. This mode of transport is used for 1 kilometre out of 7.

As for modal choice, type of household is clearly related to distance travelled for all purposes with the various modes of transport. The use of the private car (by the driver) is

Table 7. Average number of kilometres travelled per person per day for all purposes, by type of household and travel mode

Household type	Walking	Cycling	Private car (driver)	Public transport	Other	Total
Family, one worker	0.9	3.4	19.8	2.5	9.7	36.3
Family, two workers	0.9	3.4	24.3	3.7	9.6	41.8
Two persons, one worker	0.8	4.3	14.4	6.2	10.9	36.5
Two persons, two workers	0.8	4.8	15.7	7.1	10.8	39.2
Other	0.9	2.7	18.5	5.7	9.0	36.8

Source: OVG (1996).

extensive for families compared with two-person households (Table 7). The presence of children in the household clearly increases the propensity to use the car for most of the distance travelled. The number of people in the household participating in the labour force also means that a higher proportion of the total distance travelled is by car, although again the number of people seems to be less important than the presence of children in the family. On the other hand, cycling and the use of public transport decrease in the total travel distance of those types of household that are likely to travel by car.

As shown in Table 8, the type of residential environment is clearly related to distance travelled with the different modes of transport. The number of kilometres travelled by private car is much lower in the three largest cities than in suburban and rural environments. Medium-sized cities hold the middle ground in this respect. Relatively long distances are travelled by public transport by people living in large and medium-sized cities and new towns, where services are more readily available than elsewhere. The distance cycled does not seem to differ substantially between the various residential environments, although the medium-sized cities seem to be environmentally most suitable for cycling over somewhat larger distances. Residents of suburban/rural municipalities, especially outside Randstad Holland, are less likely to walk long distances.

Trip purpose is strongly related to the number of kilometres travelled (Table 9). Of all trips, the largest number of kilometres are travelled for leisure trips and at a distance also for commuting. The use of the private car plays a relatively large part for these purposes compared with shopping trips. As shown by the kilometres reported for ‘other motorised’ (mostly car passengers), the aver-

Table 8. Average number of kilometres travelled per person per day for all purposes, by residential environment and travel mode

Residential environment	Walking	Cycling	Private car (driver)	Public transport	Other	Total
Randstad						
Three largest cities	1.2	2.7	14.0	7.5	7.6	33.0
Medium-sized cities	1.1	3.5	16.3	8.0	8.1	37.0
Suburb/rural	0.9	3.0	21.0	4.5	9.8	39.1
New towns	1.0	2.7	21.1	6.6	10.7	42.1
Rest of the Netherlands						
Medium-sized cities	0.9	3.2	18.4	4.8	9.3	36.5
Suburb/rural	0.6	3.0	21.6	3.3	10.5	39.0

Source: OVG (1996).

Table 9. Average number of kilometres travelled per person per day, by trip purpose and travel mode

Travel purpose	Walking	Cycling	Private car (driver)	Public transport	Other	Total
Working	0.1	0.7	5.9	1.4	1.3	9.4
Shopping	0.2	0.6	1.9	0.4	1.1	4.1
Leisure	0.5	1.1	6.0	1.7	5.0	14.3

Source: OVG (1996).

age car occupancy is higher for leisure trips than for other purposes. For travel purposes, Table 3 showed no differences in number of trips by public transport. We may conclude that the larger quantity of kilometres travelled for commuting and leisure is a consequence of the longer average travel distance for each trip.

Multivariate Analyses

In order to investigate the relative importance of the various attributes of persons and residential environments for travel distance, we estimated three regression models for each of the three trip purposes (Tables 10–12).

For work trips, the distance travelled by car depends mostly on car ownership and income level (Table 10). Car ownership leads to car use over longer distances; in other words, those owning a car tend to live further from their work than those without a car. Car ownership leads to lower usage of public transport, bicycle and less travel by foot, as would be expected. A higher income strongly increases the likelihood of travelling longer distances to work by car, but also by public transport and less by the slower modes of travel, cycling and walking. In general, people with higher income categories have more specialised jobs which cannot readily be found in the proximity of their homes. Residential environment remains important as a factor in distance travelled to work, even after compensating for the relationship between travel distance, car ownership and income. Those living in the suburbs and rural regions have to travel longer distances to work, either by car or public transport, than those living in the large or medium-sized cities. Household type and education play a smaller part in the distance travelled to work, except for the use of public transport.

For shopping trips, car ownership and higher income lead to longer distances travelled by private car, as with the commuting trips discussed above (Table 11). However, in relative terms, these two variables do not dominate distance travelled to shops as much as distance travelled to work. This makes intuitive sense, because shopping trips are usually much shorter. Residential environment plays a substantial part in the distance travelled by public transport. Those using this mode for shopping travel longer distances via public transport if they live in the suburbs or rural areas in the Randstad, or in the rest of the Netherlands. Household type and education are relatively more important in accounting for travel distance for shopping than for work trips. Noteworthy is that people living alone or in a two-person household shop over longer distances than families do by public transport, by bicycle or on foot. The part played by children in shopping trips seems responsible for this pattern.

The coefficients in the models for travel distance for leisure purposes show fewer strong relationships and less clear patterns than in the models for the other trip purposes (Table 12). Evidently, the travel patterns for leisure activities are more diffuse than for the more routine trips to workplace or shops. With respect to the number of kilometres travelled by private car, high income and car ownership again lead to longer distances. Distance travelled on public transport for leisure activities does not relate strongly to these variables. Residential environment is

Table 10. Regression models for kilometres travelled by mode, for work trips

	Car		Public transport		Cycling/walking	
	β	R^2 change	β	R^2 change	β	R^2 change
Car ownership (ref. = no car)	0.104***	0.021	−0.008	0.003	−0.142***	0.009
Income	0.161***	0.029	0.158***	0.044	0.150***	0.013
Household type		0.001		0.004		0.005
Family, one worker (ref.)						
Family, two workers	−0.029***		−0.003		−0.021*	
Two persons, one worker	0.008		0.009		0.000	
Two persons, two workers	−0.030		−0.004		−0.008	
Other households	−0.019**		−0.038		−0.075***	
Education		0.002		0.018		0.005
Higher (college and higher; ref.)						
Middle, upper (high school, high level)	−0.035***		−0.137***		0.032***	
Middle, lower (high school, low level)	−0.048***		−0.124***		0.078***	
Lower (elementary school)	−0.019***		−0.084***		0.056***	
Residential environment		0.007		0.057		0.008
Randstad						
Three largest cities (ref.)						
Medium-sized cities	−0.005		0.164***		0.031***	
Suburb/rural	0.033***		0.177***		0.007	
New towns	0.031***		0.140***		−0.015	
Rest of the Netherlands						
Medium-sized cities	−0.031***		0.255***		0.096***	
Suburbs/rural	0.062***		0.163***		0.014	

*α = 0.10; **α = 0.05; ***α = 0.00.

Table 11. Regression models for kilometres travelled by mode, for shopping trips

	Car		Public transport		Cycling/walking	
	β	R^2 change	β	R^2 change	β	R^2 change
Car ownership (ref. = no car)	0.033***	0.004	0.018	0.000	− 0.061***	0.004
Income	0.106***	0.008	− 0.101***	0.009	0.031***	0.000
Household type		0.007		0.004		0.002
Family, one worker (ref.)						
Family, two workers	− 0.031***		0.030		0.012	
Two persons, one worker	0.029***		0.083**		0.019**	
Two persons, two workers	− 0.008		0.080**		0.025***	
Other households	0.061***		0.095**		0.052***	
Education		0.002		0.003		0.005
Higher (college and higher; ref.)						
Middle, upper (high school, high level)	0.017*		− 0.055		0.015*	
Middle, lower (high school, low level)	0.042***		− 0.043		0.017***	
Lower (elementary school)	0.043***		− 0.073**		0.075***	
Residential environment		0.004		0.043		0.004
Randstad						
Three largest cities (ref.)						
Medium-sized cities	− 0.006		0.067**		0.033**	
Suburb/rural	− 0.004		0.192***		0.022***	
New towns	0.016*		0.127***		0.018**	
Rest of the Netherlands						
Medium-sized cities	− 0.026**		0.111***		0.082***	
Suburbs/rural	0.046***		0.170***		0.029***	

*α = 0.10; **α = 0.05; ***α = 0.00.

Table 12. Regression models for kilometres travelled by mode, for leisure trips

	Car		Public transport		Cycling/walking	
	β	R^2 change	β	R^2 change	β	R^2 change
Car ownership (ref. = no car)	0.034***	0.006	−0.050	0.001	−0.024***	0.000
Income	0.114***	0.016	−0.015	0.000	0.074***	0.002
Household type		0.006		0.001		0.006
Family, one worker (ref.)						
Family, two workers	−0.011		0.011**		0.016**	
Two persons, one worker	0.025***		0.005		0.044***	
Two persons, two workers	0.027***		0.041		0.045***	
Other households	0.079***		0.026		0.092***	
Education		0.002		0.010		0.005
Higher (college and higher; ref.)						
Middle, upper (high school, high level)	−0.050***		−0.080**		0.013	
Middle, lower (high school, low level)	−0.056***		−0.120***		0.060***	
Lower (elementary school)	−0.021**		−0.094***		0.085***	
Residential environment		0.002		0.024		0.002
Randstad						
Three largest cities (ref.)						
Medium-sized cities	0.025***		0.110***		0.043***	
Suburb/rural	0.017**		0.083***		0.019**	
New towns	0.044***		0.079***		0.010	
Rest of the Netherlands						
Medium-sized cities	0.015*		0.147***		0.044***	
Suburbs/rural	0.038***		0.111***		0.014*	

*α = 0.10; **α = 0.05; ***α = 0.00.

the most closely associated factor; on average, people living outside the three largest cities travel longer distances when using public transport. More highly educated people also travel relatively long distances by public transport for leisure destinations.

6. Conclusions and Discussion

We have analysed the influence of personal characteristics and the attributes of the residential environment simultaneously. Both sets of factors have a clear, strong influence on modal choice and distance travelled. Personal characteristics remain important in travel behaviour when residential environment is taken into account. The characteristics of residential environment retain their impact on modal choice and distance travelled when personal characteristics are held constant, as the results from the multivariate analyses demonstrate. The two sets of factors are of about equal importance for modal choice and distance travelled, although trip purpose modifies these relationships considerably, especially for distances travelled for shopping and leisure. The results of our analyses contrast with those of Hanson (1982), who asserts that socio-demographic variables are the most important in accounting for differences in travel behaviour.

Of the personal characteristics, car ownership is of course by far the most important variable for explaining modal choice. If people own a car, they use it. Household type, especially the presence of children, also influences modal choice. Households with children are more likely than others to use the car, all else being equal. This makes perfect sense; travelling with young children by public transport, by bicycle or on foot is tiresome. Car use is fairly low in the large and medium-sized cities of Randstad Holland, where many trip purposes are within reach by foot or cycle and where public transport is relatively abundant. The combination of density, diversity and the supply of good public transport clearly reduces car use in these residential environments compared with more suburban and rural settings.

Governments seeking to reduce car mobility have to ascertain which residential environments could be expected to yield the highest return on investments promoting the use of public transport, cycling and walking. The largest reduction in car use is theoretically possible in suburban and rural communities (where most people live), because current car use is so extensive there. However, very high investments in public transport would be necessary to reach this goal, because of the low building densities in these communities. Alternatively, to reach an additional reduction in car use in the large and medium-sized cities would require a very high investment in the collective transport system, because the use of public transport is already fairly high. It is not yet clear which alternative would offer the best solution.

Investments in public transport also need to be considered carefully from another point of view. We have seen that local public transport in the Netherlands is in competition with cycling, especially when this transport system is of high quality. We should develop and implement policies which use the complementarity of cycling and public transport in a more efficient way. We could leave the shorter travel distances (less than 1 kilometre) to the bicycle and invest more in public transport for distances longer than 1 kilometre. Public transport companies ought to allow passengers to take along a bicycle with guaranteed smooth access and egress. This complementary, multimodal system could offer an attractive alternative to private car use at local and regional levels.

We have shown that an increase in the number of households with two workers does not necessarily lead to an increase in car use. The presence of children, especially in combination with two partners who have paid work, is a far more important factor influencing car use than straightforward participation in the labour market. The combination of work and family leads to more people experiencing the time pressures which evidently lead to more frequent use of the private car. Car use is especially high in residential environments where the distances to service locations have become longer as a result of the enlargement of scale and suburbanisation of functions. Corner shops are being absorbed into big retail centres within or outside the city; school locations tend to become sparser when school districts merge. Alternative transport systems could be considered and subjected to experimental trial to reduce a household's car dependence when under time pressure and living in an environment where distances to schools and shopping centres have increased.

A step in this direction would be to set up for each separate use of the private car an alternative mobility plan tailored to the demands of the target households. An impression of these mobility plans can be obtained by considering two functions of the private car: shopping trolley; taxi.

Shopping trolley. People use their cars as a convenient shopping trolley. Car use for shopping trips can be reduced by a more professional organisation of the distribution of goods purchased in shopping centres. In the Netherlands, home delivery services are currently provided by individual shops, not a combination of shops located in one centre. Collection of all purchased goods at one point in a shopping centre and distribution to customers could reduce the costs of home delivery services. The use of (cold) shopping goods boxes at home or in a neighbourhood service centre would make this delivery system more time-efficient for distributors and customers alike.

Taxi. Parents have important reasons for driving children to school or sports events by private car. The fear of violence, harassment or abduction as well as the traffic conditions lead them to the conclusion that walking or cycling to these activity places is not safe for children (Steiner and Crider, 1999). The increase in scale of schools, sport facilities and so forth reduce the opportunities of using the slower transport modes for travelling. Clustering children's activity places in the neighbourhood of the schools and the design of safe walking and cycling routes would decrease children's dependence on their parents. These planning measures could particularly reduce the time pressure for households in which both parents have paid work.

In Western countries, we hear strident calls for more planning at local and regional levels. Good examples of this trend are the 'new urbanism' movement in the US and the spatial development policy published by the Netherlands Scientific Council for Government Policy (WRR, 1998). These policies would not only do greater justice to the specific situations and interests found at local and regional levels, but could also increase the effectiveness of transport and spatial policies (Dijst, 1999).

References

Anderson, W. P., Kanaroglou, P. S. and Miller, E. J. (1996) Urban form, energy and the environment: a review of issues, evidence and policy, *Urban Studies*, 33, pp. 7–35.

Asmervik, S. and Naess, P. (1995) The sustainable city and the use of energy, in: *The European City: Sustainable Urban Quality, Part 2: Selected Conference Papers*, pp. 7–19. Copenhagen: Ministry of Environment and Energy, Spatial Planning Department.

Badoe, D. A. and Miller, E. J. (2000) Transportation–land-use interaction: empirical findings in North America, and their implications for modeling, *Transportation Research*, 5D, pp. 235–263.

Bae, C.-H. C. and Richardson, H. W. (1994) *Automobiles, the environment and metropolitan spatial structure*. Paper prepared for the Federal Highway Administration-Lincoln Institute of Land Policy *Conference on Metropolitan America in Transition: Implications for Land Use and Transportation Planning*, Arlington, VA.

Banister, D. (1992) Energy use, transport and settlement patterns, in: M. J. Breheny (Ed.) *Sustainable Development and Urban Form*, pp. 160–181. London: Pion.

Banister, D., Watson, S. and Wood, C. (1997) Sustainable cities: transport, energy, and urban form, *Environment and Planning B*, 24, pp. 125–143.

Bell, D. A. (1991) Office location—city or suburbs? Travel impacts arising from office relocation from city to suburbs, *Transportation*, 18, pp. 239–259.

Bolotte, L. (1991) Transport in Paris and the Ile de France, *Built Environment*, 17, pp. 160–171.

CBS (1996) *Onderzoek Verplaatsingsgedrag: Documentatieset*. Heerlen: CBS.
CERVERO, R. (1989) Jobs–housing balancing and regional mobility, *APA Journal*, Spring, pp. 136–150.
CERVERO, R. (1995) Planned communities, self-containment and commuting: a cross-national perspective, *Urban Studies*, 32, pp. 1135–1161.
CERVERO, R. (1996) Jobs–housing balance revisited: trends and impacts in the San Francisco Bay Area, *Journal of the Americal Planning Association*, 62, pp. 492–511.
CERVERO, R. and KOCKELMAN, K. (1997) Travel demand and the 3Ds: density, diversity, and design, *Transportation Research*, 2D, pp. 199–219.
CERVERO, R. and LANDIS, J. (1991) *Suburbanization of jobs and the journey to work*. Working Paper No. 83. The University of California Transportation Center, Berkely, CA.
CERVERO, R. and WU, K. L. (1998) Sub-centring and commuting: evidence from the San Francisco Bay Area, *Urban Studies*, 35, pp. 1059–1076.
CRANE, R. (1999) *The impacts of urban form on travel: a critical review*. Working Paper WP99RC1, Lincoln Institute of Land Policy.
DIELEMAN, F. M., DIJST, M. J. and SPIT, T. J. M. (1999) Planning the compact city: the Randstad Holland experience, *European Planning Studies*, 7, pp. 605–621.
DIJST, M. (1999) Action space as planning concept in spatial planning, *Netherlands Journal of Housing and Spatial Planning*, 14, pp. 163–182.
EWING, R. and CERVERO, R. (2001) *Travel and the Built Environment—Synthesis*. Washington: Transportation Research Board.
EWING, R., DEANNA, M. B. and LI, S.-C. (1996) Land use impacts on trip generation rates, *Transportation Research Record,* 1518, pp. 1–6.
EWING, R., HALIYUR, P. and PAGE, G. W. (1994) Getting around a traditional city, a suburban planned unit development, and everything in between, *Transportation Research Record*, 1466, pp. 53–62.
FRANK, L. D. and PIVO, G. (1994) Impacts of mixed use and density on utilization of three modes of travel: single-occupant vehicle, transit, and walking, *Transportation Research Record*, 1466, pp. 44–52.
GIULIANO, G. and SMALL, K. A. (1993) Is the journey to work explained by urban structure?, *Urban Studies,* 30, pp. 1485–1500.
GORDON, P. and WONG, H. L. (1985) The costs of urban sprawl: some new evidence, *Environment and Planning*, 17A, pp. 661–666.
GORDON, P., KUMAR, A. and RICHARDSON, H. W. (1987) *Congestion and City Size*. Los Angeles: School of Urban and Regional Planning and Department of Economics, University of Southern California.
GORDON, P., KUMAR, A. and RICHARDSON, H. W. (1989) Congestion, changing metropolitan structure and city size in the United States. *International Regional Science Review*, 12, pp. 45–56.
GORDON, P., RICHARDSON, H. W. and JUN, M.-J. (1991) The commuting paradox: evidence from the top twenty, *Journal of the American Planning Association*, 57, pp. 416–420.
HANDY, S. L. (1992) Regional versus local accessibility: neo-traditional development and its impact for non-work travel, *The Built Environment*, 18, pp. 253–267.
HANDY, S. L. (1996) Methodologies for exploring the link between urban form and travel behavior, *Transportation Research*, 1D, pp. 151–165.
HANSON, S. (1982) The determinants of daily travel-activity patterns: relative location and sociodemographic factors, *Urban Geography*, 3, pp. 179–202.
HESS, P. M., MOUDON, A. V., SNYDER, M. C. and STANILOV, K. (1999) *Neighborhood Site Design and Pedestrian Travel*. Washington, DC: Transportation Research Board.
JENKS, M., BURTON, E. and WILLIAMS, K. (1996) *The Compact City: A Sustainable Form?* London: E & FN Spon.
KITAMURA, R., MOKHTARIAN, P. L. and LAIDET, L. (1997) A micro-analysis of land use and travel in five neighborhoods in the San Francisco Bay Area, *Transportation*, 24, pp. 125–158
LEVINSON, D. M. and KUMAR, A. (1997) Density and the journey to work, *Growth and Change*, 28, pp. 147–173.
NAESS, P. (1995) *Urban Form and Energy Use for Transport: A Nordic Experience*. Trondheim: NTH.
NAESS, P. and SANDBERG, S. L. (1996) Workplace location, modal split and energy use for commuting trips, *Urban Studies*, 33, pp. 357–380.
NEWMAN, P. W. G. and KENWORTHY, J. R. (1989) Gasoline consumption and cities: a comparison of US cities with a global survey, *Journal of the American Planning Association*, 55, pp. 24–37.
NEWMAN, P. and KENWORTHY, J. (1999) *The Costs of Automobile Dependence: A Global Survey of Cities*. Washington, DC: Transportation Research Board.
SCHMITZ, S. (1993) Tangential statt radial: langfristige Veränderungen der Berufspendlerströme in Deutschland, *BfLR-Mitteilungen*, February, pp. 5–6.
STEAD, D., WILLIAMS, J. and TITHERIDGE, H. (2000) Land use, transport and people: identifying the connections, in: K. WILLIAMS, E. BURTON and M. JENKS (Eds) *Achieving*

Sustainable Urban Form, pp. 174–186. London: E & FN Spon.

STEINER, R. (1994) Residential density and travel patterns: review of the literature, *Transportation Research Record*, 1466, pp. 37–43.

STEINER, R. L. and CRIDER, L. B. (1999) *Safe Ways to School: Combining Resources at the State, County and Local Level to Improve Safety to Schools*. Washington, DC: Transportation Research Board.

VIDAKOVIC, V. (1985) *Amsterdammers Onderweg*. Amsterdam: Dienst Ruimtelijke Ordening, Gemeente Amsterdam.

WRR (1998) *Ruimtelijke ontwikkelingspolitiek*. Den Haag: WRR.