

## AN ANALYSIS OF NON-WORK TRAVEL IN THE GREATER DUBLIN REGION

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### Abstract

The emphasis in transportation research and infrastructure planning has been focussed on the challenges of providing sufficient infrastructure for peak travel to work periods and reducing congestion (Banister, 2012 & 2002, Caulfield et al, 2013). Land use policies promoting mixed-use developments and higher densities close to public transport nodes are frequently pursued as a means of addressing unsustainable travel patterns. There are continued efforts to encourage mode shift away from car based transport to more sustainable modes including public transport, walking and cycling (Department of Transport, 2009a, 2009b; National Transport Authority, 2011, UNECE&WHO, 2009). Environmental and quality of life imperatives are likely to continue to promote more sustainable travel patterns which should extend to non-work journeys, given that they comprise a significant component of daily travel.

Non-work travel has received less attention due to its inherent complexity and issues of data availability and the economic importance of the work trip. However, in Ireland for example, the National Transport Authority's *2012 National Household Travel Survey* reports that 80% of trips are for non-work purposes. Understanding travel behaviour in relation to non-work trips and in particular the determinants of mode choice for non-work trips is limited (Handy et al 2002). This paper outlines future research examining the potential factors influencing mode choice for non-work journeys. It describes ongoing debates in the literature regarding the link between urban form and travel behaviour as well as methodologies applied in understanding travel behaviour and their application in research regarding non-work travel. The paper concludes by outlining objectives for future research and the research design for the PhD study.

### Introduction

The emphasis in transportation research and infrastructure planning has been on travel to work given the challenges of providing sufficient infrastructure for peak periods and reducing congestion (Banister, 2012 & 2002; Levinson & Krizek, 2008; Caulfield et al, 2013). Land use policies promoting mixed-use developments and higher densities close to public transport nodes are pursued as a means of addressing unsustainable travel patterns for both work and non-work trips though the effectiveness of these measures is debated. Central questions addressed by researchers include how large a role does land use play in shaping travel behaviour and how effective are land-use policies in changing land use patterns (van Wee & Handy, 2014:233; Boarnet & Sarmiento, 1998). Motivated by previous research considering the potential environmental impacts of contrasting strategic planning policy

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aspirations on the urban environment in the Greater Dublin Region (Williams & Convery, 2012) the current research will explore the interface of land use and transport planning with an emphasis on travel for non-work journey purposes.

The paper is part of a research project which will examine travel for non-work journey purposes in the Greater Dublin Region by measuring car dependency in a number of neighbourhoods in the Region. Given that non-work journeys comprise a significant component of daily travel it is suggested that increased understanding of travel behaviour in this respect will have important implications for land use and transport policy prescription particularly in addressing environmental, health and quality of life concerns.

### **Previous Research Context**

Researchers at UCD have previously explored city and regional development patterns and policy developments through applications of the capabilities of GIS, Spatial Decision Support Systems and geo-spatial models. These tools can be viewed as part of an integrated ecological approach to decision making with a strong science and quantitative basis. The team has led international projects EcoArm2ERA & LUMAN and are liaising to develop best practice evidence of both analytical tools and policy applications available in Europe, Canada and New Zealand. In addition through the national Urban Environment Project ([www.uep.ie](http://www.uep.ie)) the research team has established networks with policy application interests including the Environmental Protection Agency and Regional Authorities using the MOLAND dynamic land use change model, which was developed for the European Commission's Joint Research Centre.

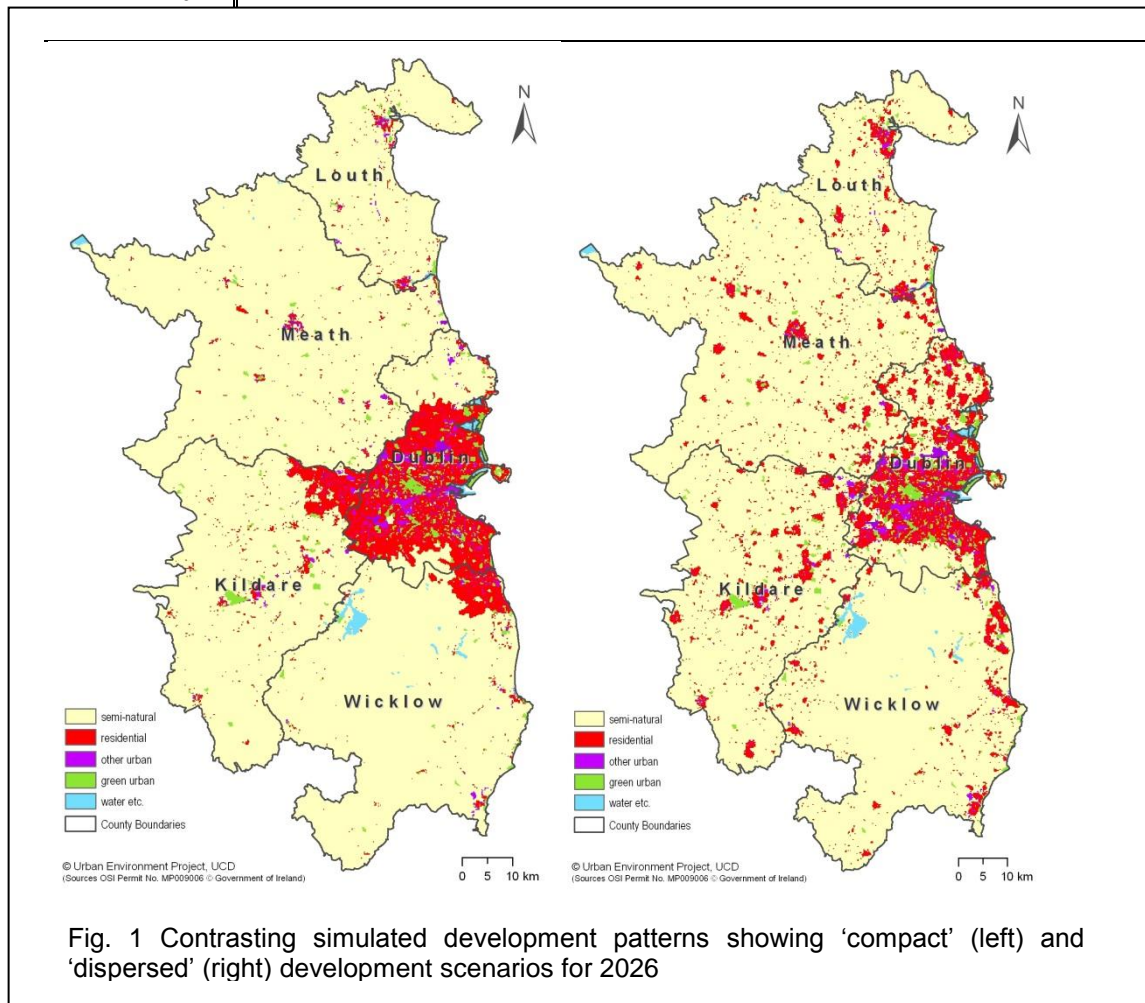
Using the scenario analysis approach alternative policy aspirations were systematically evaluated and compared using a decision support system. This can provide a framework for structured discussions and awareness amongst decision makers (Newbury et al., 2010; Barredo et al., 2003) whilst the calculation of indicators to compare output scenarios provides a means of quantifying the impacts of alternative patterns on a range of environmental and planning variables (Petrov et al., 2011; Petrov et al, 2009). This research complemented previous work relating to potential transport impacts of alternative zoning and policy developments on transport patterns in the Greater Dublin Region (see Williams & Convery, 2012) and assessment of the potential economic impacts in the Dublin – Belfast corridor (Williams et al., 2013)

As part of current PhD research the emphasis has shifted towards development outcomes and examination of actual land use transport patterns and the influence this has on accessibility for non-work activities. In this research existing residential neighbourhoods with contrasting transport-land use characteristics will be selected and a detailed survey will be administered gathering data on residents' travel behaviour patterns in different neighbourhood types.

### **Scenario analysis –**

Previous work with the MOLAND land-use change model examined a range of scenarios of existing and future development patterns for the Greater Dublin Region (Convery & Williams, 2012) including demonstrating the results of contrasting policy aspirations with regard to national and regional development priorities. For example, the contrasting scenarios of a 'compact city' development strategy and a 'dispersed city' development strategy were simulated in order to illustrate alternative evolving/future development patterns in the region. See fig. 1 below.

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As part of the debate around optimal location of new residential developments and how to manage sprawl type development patterns the issue of transport planning and travel behaviour is significant. There has been considerable research focussing on commuting and travel behaviour in connection with the work trip, but data and associated research examining non-work journey purposes is limited.

### Non work trips and their role in transport demand

Non-work trips are a considerable proportion of overall travel demand. For example Metz (2010) reports that the share of trips by journey purpose excluding commuting in 1985/1986 and in 2005 stayed relatively stable in the UK, comprising approximately 65% of all trips with the biggest proportion of trips made for shopping, followed by visiting friends, commuting, education, personal business and other escort trips. Similarly in the US, data from the 2001 National Household Travel Survey as reported by Levinson & Krizek (2008) show work trips comprising 14.8% of total trips with family and personal business the most frequent type of trip (44.6%), followed by social and recreational trips (27.1%) and work-related, other and school & religious observance making up the remainder. In the Irish case data from the National Transport Authority's *National Household Travel Survey* (2012) show that more than half of all trips relate to non-work travel.

In the Irish case, there are four principal data sources available which include journey purposes other than work. The Central Statistics Office provides data on travel to work, school and college as part of the 2011 census (Place of Work, College and School Census of Anonymised Records POWSCAR, CSO, 2011) and conducted a travel survey as part of the Quarterly National Household Survey (2009) in 2009. The National Transport Authority conducted a National Household Travel Survey in 2012 and in 2006 the Greater Dublin Area

Household Survey was carried out by the Dublin Transportation Office<sup>1</sup>. These datasets will be supplemented by primary data collection by survey as part of the proposed PhD research.

In each survey data on all journey purposes was collected. (apart from POWSCAR which collects travel for education and work purposes, but not other purposes) comparison across the survey results is difficult given that the categories in each survey were not uniform nor were the size of sample or survey. However, of note is the substantial component of trips which relate to non-work purposes in all of the populations surveyed, comprising at least half of the journeys in each case. The split by journey purpose in each survey is presented in Table 1 below.

Table 1. Journey purpose as a proportion of total trips in each dataset.

	CSO National Travel Survey (QNHS (2009))*#	NTA National Travel Survey (2012)	GDA Travel Survey **+(2006)
Work	24%	20%	32%
Shopping	25% (food/drink)	20%	16%
School/Education	2%	20%	10%
Family/Friends	16%	Sport/Leisure (20%)	10%
Personal business	10%	20% (other)	8%

In the CSO NTS journey purpose (work) includes business and commute travel.

+\*companion trips not included in figures in this table.

\*\*trips over less than one mile not included

#Source: Driscoll, Á. et al., 2013. *Comparing the Determinants of Mode Choice across Travel Purposes*, Economic and Social Research Institute. Available at: <http://mpr.a.uib.uni-muenchen.de/46034/> [Accessed November 13, 2013].

Driscoll et.al (2013) compare the determinants of mode choice for different journey purposes in Ireland using the National Travel Survey 2009 dataset and find that the determinants are different in the case of work trips and non-work trips, highlighting that generalising the determinants of mode choice for different journey purposes is not possible. However, they also note that the mode choice for non-work journeys is influenced by the mode taken for the journey to work, particularly for car users, which highlights the possible role of trip chaining in relation to non-work activities. The study omits land use characteristics explicitly, as it deals with supply-side determinants except to infer a compact city form where multiple public transport options (i.e. bus, train, Dart and LUAS) are available.

In complementary research Murphy (2012) considers off-peak travel in the Greater Dublin Area as a proxy for non-work travel, using alternative data sources. The analysis relies on data from the Dublin Transportation Offices traffic models incorporating both public and private transport modes (1991 and 2001) and utilises travel demand simulation model data for the 2-3pm period as a proxy for non-work travel. Using the concept of commuting efficiency and calculating shadow prices for locational advantage for both origins and destinations the analysis shows changes in locational advantage between 1991 and 2001. Spatial advantage for car users has moved substantially into peripheral areas for non-work activities. However this shift is not observed in the case of public transport users over the time period. It is suggested that patterns of trip-making in the off peak period are substantially different to the peak period which has implications for the delivery of high quality public transport services.

In the international literature, approaches to considering non-work travel are largely driven by the availability of detailed household travel survey data, large-scale time use surveys and

<sup>1</sup> The Dublin Transportation Office was subsumed into the National Transportation Authority in Dec 2009.

increasingly longitudinal or panel surveys on travel behaviour and travel demand simulation models. A range of methodological approaches and conceptual frames are utilised informed by the various disciplinary traditions concerned with understanding travel behaviour and the emphasis of the research questions pursued within the different disciplines

### Urban Form & Travel Behaviour

At metropolitan scale, policy interests discuss the contrasting strategies of compact or dispersed development patterns in consideration of a range of development and environmental concerns. By comparison transport-land use researchers tend to consider theoretical urban spatial structure types which describe the location of residences and jobs and typical commuting patterns observed. These typologies are underpinned by an interest in the maximally efficient zoning of both residences and employment in order that both land use is optimised whilst transport costs (both time and money) are reduced (e.g. Chang, 2006 for a review, Horner and Mefford, 2007, Levine, 1998, Carreras et al., 2001).

Urban spatial structure theory describes inter alia the classic 'monocentric city' which feature a high concentration of jobs in the centre which is well served by public transport and a radial commuting pattern (O'Sullivan, 2009) in contrast to polycentric cities a typology sub divided into 'random movement' and 'urban village' types (see Bertaud, 2004) these are illustrated in Fig. 2 below. In the first of these there are sub-centres but no dominant centre and complex travel patterns result whilst in the second the sub-centres are independent and there is not much travel between the centres.

### Schematic Representation of Trip Patterns within a Metropolitan Area

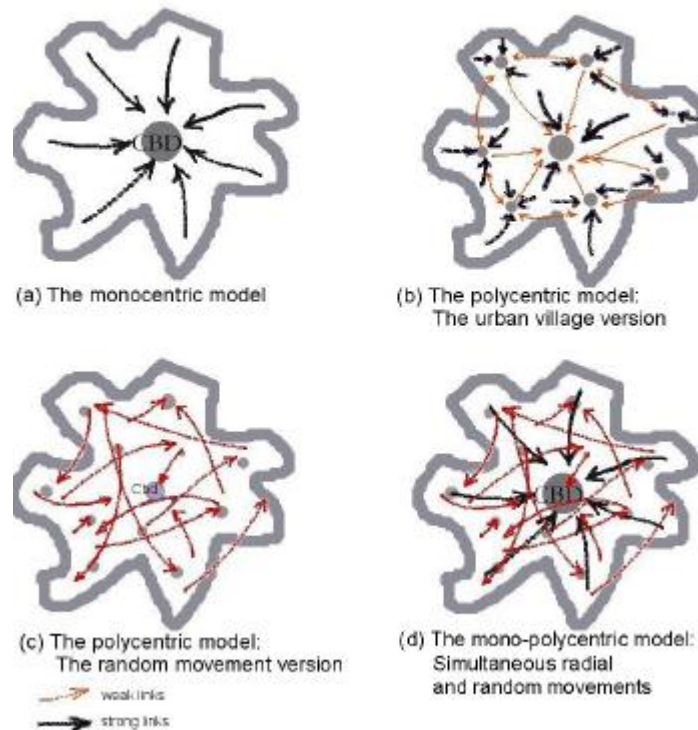


Fig. 2 Typical Urban Spatial Structures including trip patterns

Source: Bertaud, A., 2004. The Spatial Organisation of Cities: Deliberate Outcome or Unforeseen Consequence?, Working Paper. Institute of Urban and Regional Development, UC Berkeley, Berkeley, California.

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Handy (1996b) explains that urban form is a broad concept that describes characteristics of the transportation system, urban design features and land use patterns. Researchers frequently use urban form and built environment interchangeably, particularly when focussing on neighbourhood or street scale influences on travel behaviour (e.g. Susilo and Maat, 2007; Crane and Crepeau 1998) She asserts that urban form is a composite of a multitude of characteristics. In measuring urban form, Rajamani et al (2003) highlight that frequently a single measure of urban form is used, most often density or in some cases a single composite measure such as accessibility. Sometimes additional measures are simultaneously considered for example density and land use mix; land use balance; composite pedestrian environment factors; population and retail densities and to a lesser extent perceptions of the quality of the walking environment. Tsai (2005) highlights the effect of spatial scale and how it influences understanding and measurement of urban form. Urban form or the spatial configuration of land use and transport infrastructure influences the quantity and quality of travel options available. Many commentators contend that car dependency comes about as a result of inadequacies in the transport land use nexus (Neuman, 2006, Levinson and Krizek 2008).

### **Car dependency**

With the publication of 'Cities and Automobile Dependence: An International Sourcebook' in 1989 Newman and Kenworthy developed the concept of car dependency by collecting data on the trends in vehicle miles travelled over time in a wide range of cities. The concept has further evolved since then (Newman and Kenworthy, 1999). Litman (2014) defines automobile dependency as 'transportation and land use patterns that cause high levels of automobile use and reduced transport options'. Litman's definition includes both the influence and effect of land use patterns as well as the availability of transport options and the behaviour of individuals. Litman conceptualises car dependency as a 'self-reinforcing cycle of increased car ownership, reduced travel options and more dispersed car-oriented land use patterns'. He asserts that car dependency is a matter of degree which is important to note in defining car dependency in the current PhD study. A number of attributes of car dependency will inform the definition used in the proposed study. Litman (2014) includes vehicle ownership, vehicle travel, vehicle trips, quality of transport alternatives, relative mobility of non-drivers, land use patterns, transport system, roadway design, shopping options, market distortions favouring car use, mode split for commuting, mode for non-work journey purposes and selection of performance indicators for evaluating the transport system.

Meanwhile, Handy (1996a) proposes the concept of accessibility as a tool to resolve questions relating to how and whether certain types of development influence the quantity and pattern of car based travel, specifically in relation to suburban development patterns. The concept is useful because it can be operationalized at multiple spatial scales. It is also useful in consideration of non-work journey purposes. In the literature there are multiple concepts utilized for examining land-use transport interactions typically concerning the location of jobs and residences and therefore commute travel rather than non-work travel. For example, jobs/housing balance (Levine, 1998) and commuting efficiency (Horner and O'Kelly, 2007) are concepts applied in consideration of optimal spatial layout for efficient transport provision. Frequently these approaches do not include fine grain objective urban design considerations and are usually applied at a regional scale. (e.g. Cervero, 1996).

### **Methodologies employed in studies of travel behaviour and urban form**

Travel behaviour studies are wide ranging and consider both the observed and simulated travel patterns of individuals and the motivation for travel choices in both space and time which includes behavioural, attitudinal, socio-psychological factors, socio-demographic

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factors, time and financial costs. As travel is inherently spatial, the influence of land use characteristics and access to transport networks is important and there is large body of research examining the link between urban form and travel behaviour but there is a long running and inconclusive debate as to the direction of the influence and whether it is a causal relationship. There is also a growing literature on transport equity (e.g. Kamruzzaman and Hine, 2012) which relates to the fair and just distribution of transport impacts, both negative and positive as well as research looking at individual active transit modes (e.g. Wilson et al., 2012; Pucher and Dijkstra, 2003; Rabl and de Nazelle, 2012) which is not the principal focus of the current literature review.

Handy (1996c) provides an overview of the research literature considering the influence of urban form on travel behaviour from a methodological perspective and identifies five broad categories. In the first category aggregate measures to characterize and test the relationship between urban form and travel patterns at the city scale are employed such as total vehicle miles travelled by different modes and how trends are changing over time (for example Newman and Kenworthy, 1999; Newman and Kenworthy, 2006; van de Coevering & Schwanen, 2006; Goodwin, 2012) in addition to studies at the neighbourhood or zonal scale. These studies most frequently use established measures of urban form such as density and explore the effect on trip frequency, average trip lengths or mode split. The drawback of this approach is that whilst strong relationships between aspects of travel such as mode split or total vehicle kilometres travelled and urban form can be demonstrated the underlying mechanisms by which individual decisions are reached cannot be determined.

Disaggregate studies on the other hand rely on data collected at the household or individual level though these are also analysed at various spatial scales such as neighbourhood or zonal level. Typically individual or household socio-economic and travel characteristics are considered (see for example McDonald, N., 2008; Dieleman et al., 2002; Krizek, 2003). In some cases detailed objective and subjective measures of urban design characteristics are considered at both the origin and destination but only for a selection of journey purposes, (Handy, 1996b; Cervero and Radisch, 1996; Kitamura et al., 1997) or only in the case of active transit modes (see Pucher et al., 2010 for review).

At zonal levels of analysis, within zone variations can be measured by observing the strength of relationships between individuals characteristics (e.g. income, education level) urban form characteristics (e.g. residential density, quality of the transport network, mix of uses, design) and the observed travel behaviour (frequency of trips, length of trips, time of day, mode choice etc.). However these studies do not necessarily consider the individual decision making processes or how travel behaviour is influenced by social-psychological and behavioural elements. Nor do they explicitly consider life stage factors as influencing travel behaviour.

In considering the choice making process itself a number of theories and methodologies are employed. Those influenced by social-psychology include consideration of the influence of both internal psychological processes and the influence of social norms and social mores on peoples' behaviour and are most often utilised in considering how to change peoples' travel behaviour. A number of behavioural models and theories are employed in these studies see Dijkstra et al. (2008) for a review) including the theory of planned behaviour (Ajzen, 1991) and norm-activation theory (Bamberg et al., 2011) the role of habit in behaviour (Garling and Axhausen, 2003) and the influence of attitudes and perceptions (Anable, 2005; Gatersleben and Appleton, 2007). These approaches inform an understanding of how decisions are made in relation to travel choices and why particular choices are made, providing an increased potential for encouraging travel behaviour change. However, these studies may eschew consideration of how the urban form might limit the travel options available resulting in limited choices from which to choose.

A more formalised consideration of choices available is most often explored using discrete choice models to predict the probability of an individual choosing a particular alternative based on the utility of that alternative relative to others. These models rely on well-developed theory from the field of economics and are useful in that they can be utilised to give an indication of how new choices may be received and how travel behaviour may

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change in the case of different choices. (Ben-Akiva and Lerman, 1985; Ewing et al., 2004). To a large extent the travel choices available for a particular individual are determined by socio economic and urban form characteristics which makes this approach particularly promising in consideration of the interaction between urban form and travel behaviour. However, frequently the urban form characteristics are implicit in the modelling approach (Driscoll et al., 2013) with the quality of public transport provision serving as a proxy for the urban form characteristic.

The next category of methodologies relies on activity-based analyses. Kitamura (1988) provides a partial review of activity based approaches and evaluates their usefulness for transport planning or as a research tool to promote a better understanding of travel behaviour. He considers their contribution within the broader context and motivation of transport research which he believes is to develop the capability to predict how individuals respond to changes in their travel environments and how the responses are temporally correlated (Kitamura, 1988:10). Buliung and Kanaroglou (2007) highlight latest developments in the area of activity-based travel behaviour research and explain that activity-based approaches are characterised by a diverse array of research interests underpinned by a plethora of modelling approaches and tools for analysis. The individual is the primary unit of analysis in most activity-based travel studies which consider inter alia the complex interactions between household members in respect of activity and travel behaviour, the variability in travel behaviour over different timelines (day-to-day against week to week) as well as issues arising in the application of activity-based approaches with regard to spatial analysis and activity-travel processes in both space and time.

Van Acker et al (2010) present a comprehensive conceptual model (see Fig. 3 below) which attempts to incorporate the influences on individual decision making which are not necessarily captured in decision-theory approaches such as the effect of habits, norms and perceptions with spatial-temporal influences on travel behaviour deriving from transport geography. Using the sub-concept of lifestyle the conceptual model defines the long term and medium term influencers of travel behaviour through the lens of life style. Van Acker et al (2010: 225) define activity decisions (in the short-term) and location decisions (in the medium-term) as being determined by an individuals' lifestyle choice. The potential benefit of this conceptualisation is that it also takes account of locational preferences with regard to residential, activity and travel whilst incorporating behavioural and attitudinal influences and the effects of the wider social and spatial environment. Rarely are all of these aspects considered in conceptual models advanced in travel behaviour studies.

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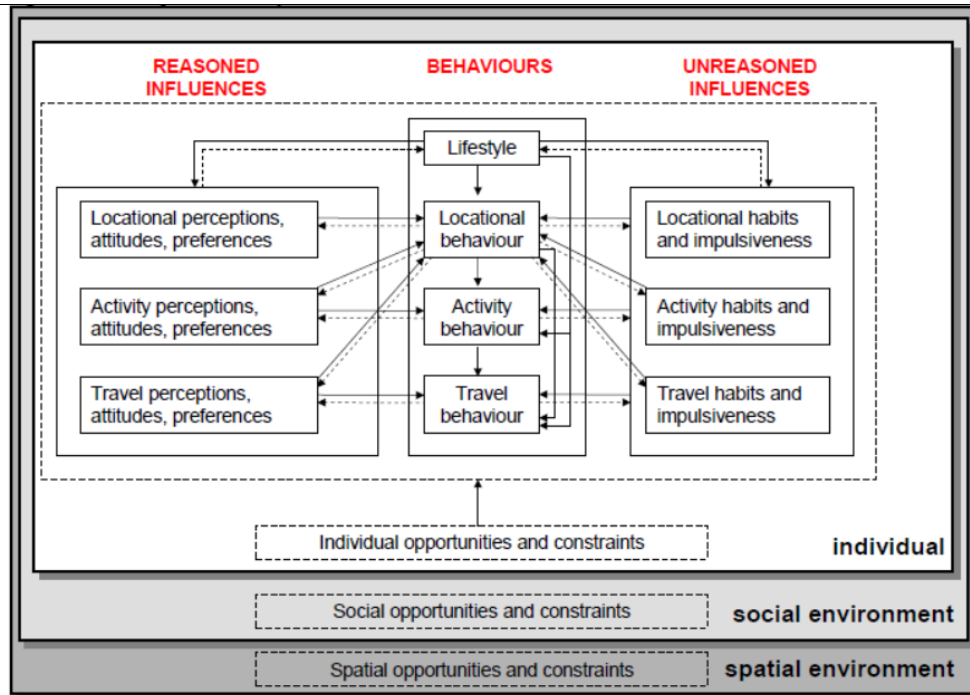


Fig. 3 A conceptual model of travel behaviour  
Source: Van Acker et al, 2010 (page 221)

## Summary

The literature review has set out to provide a context for the research study in illustrating the relative dearth of research focussing on non-work trips yet highlighting the importance of non-work travel as a significant component of daily travel and the implied environmental, social and quality of life impacts of car based transport, regardless of journey purpose. In reviewing commonly applied methodologies in consideration of urban form influences on travel behaviour (and vice versa) the chosen research design for this study is set in context. The focus of future research will be to address the following research objectives.

## Research objectives

In this research the overarching assumption is that non-work trips are fundamentally different to work trips and therefore need to be explored in order to establish what are the factors that influence mode choice for these trips.

The work trip itself: Does car use for work trips lead to car use for non-work trips?

Land-use transport characteristics: The perceived wisdom is that mixed-use, high density developments close to high quality public transport nodes reduces car use for non-work trips. But is this the case in practice?

Transport and Land Use Policies – should policymakers be encouraging more high density, mixed-use developments? Are they effective in bringing about sustainable travel patterns.

Lifestage: Is car use influenced by life stage and the associated impact on household composition e.g. from young singles to nuclear families to adults without children.

Lifestyle : Do some people choose car dependency?

Six neighbourhoods will be selected which demonstrate different transport-land-use characteristics and an individual and household level survey will be administered to collect data on travel behaviour in these neighbourhoods for both work journeys and non-work journeys. This will provide a rich data source which will allow for an exploration of some of the factors influencing mode choice for non-work journey purposes.

## **Conclusion**

The paper sets out to define the research topic for the proposed PhD study and provides an exploration of the literature in regard to current debates and methodological approaches pursued in understanding travel behaviour. In focusing on travel behaviour relating to non-work travel it is necessary to consider approaches applied in addressing commute travel in that much of the theoretical and methodological developments in the literature have been focussed to this end. This will complement previous work relating to potential transport impacts of alternative zoning and policy developments on transport patterns in the Greater Dublin Region (see Williams & Convery, 2012)

The next steps in the research process involve devising the survey instrument, refining the selection of the case study areas and running an initial pilot of the survey amongst a smaller sample of individuals in order to further refine the survey before it is fully administered.

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## References

Ajzen, I., 1991. The theory of planned behavior. *Organizational behavior and human decision processes* 50, 179–211.

Anable, J., 2005. “Complacent Car Addicts” or “Aspiring Environmentalists”? Identifying travel behaviour segments using attitude theory. *Transport Policy* 12, 65–78. doi:10.1016/j.tranpol.2004.11.004

Bamberg, S., Fujii, S., Friman, M., Garling, T., 2011. Behaviour theory and soft transport policy measures. *Transport Policy* 18, 228–235.

Banister, D., 2002. The limitations of transport planning, in: *Transport Planning*. Spon Press, London and New York

Banister, D., 2012. Viewpoint: Assessing the reality—Transport and land use planning to achieve sustainability. *Journal of Transport and Land Use* 5:3 p1-14 doi:10.5198/jtlu.v5i3.388

Barredo, J., I., Lavallo, C., Demicheli, L., Kasanko, M., McCormick, N., 2003. Sustainable urban and regional planning: The MOLAND activities on urban scenario modelling and forecast. Luxembourg: Publications Office of the European Union.

Bertaud, A., 2004. The Spatial Organization of Cities: Deliberate Outcome or Unforeseen Consequence?, IURD Working Paper Series.

Ben-Akiva, M., Lerman, S., 1985. *Discrete Choice Analysis: Theory and Application to Travel Demand*. MIT Press, Cambridge Massachusetts.

Bertaud, A., 2004. The Spatial Organisation of Cities: Deliberate Outcome or Unforeseen Consequence?, Working Paper. Institute of Urban and Regional Development, UC Berkeley, Berkeley, California. Available at <http://escholarship.org/uc/item/5vb4w9wb#page-1>

Boarnet, M., G., Sarmiento, S., 1998. Can Land-use Policy Really Affect Travel Behaviour? A Study of the Link between Non-work Travel and Land-use Characteristics. *Urban Studies* 35, 1155–1169.

Buliung, R.N., Kanaroglou, P.S., 2007. Activity–Travel Behaviour Research: Conceptual Issues, State of the Art, and Emerging Perspectives on Behavioural Analysis and Simulation Modelling. *Transport Reviews* 27, 151–187.

Carreras, J., Armstrong, M., Wen, F., 2001. *The New Economy and Jobs/Housing Balance in Southern California*. Southern California Association of Governments, Los Angeles, California.

Caulfield, B., Bailey, D., Mullarkey, S., 2013. Using data envelopment analysis as a public transport project appraisal tool. *Transport Policy* 29, 74–85.

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Central Statistics Office (2011) Census 2011. CSO: Dublin.

Cervero, R., 1996. Jobs-Housing Balance Revisited: Trends and Impacts in the San Francisco Bay Area. *Journal of the American Planning Association* 62, 492–511.

Cervero, R., Radisch, C., 1996. Travel choices in pedestrian versus automobile oriented neighborhoods. *Transport Policy* 3, 127–141.

Central Statistics Office, 2011. *National Travel Survey 2009*, Dublin: Stationery Office.

Chang, J.S., 2006. Models of the Relationship between Transport and Land-use: A Review. *Transport Reviews* 26, 325–350. doi:10.1080/01441640500468432

Crane, R., Crepeau, R., 1998. Does neighborhood design influence travel?: A behavioral analysis of travel diary and GIS data. *Transportation Research Part D: Transport and Environment* 3, 225–238.

Department of Transport, 2009a. Ireland's First National Cycle Policy Framework. Department of Transport, Dublin, Ireland.

Department of Transport, 2009b. *Smarter Travel A Sustainable Transport Future - A New Transport Policy for Ireland 2009 - 2020*. Government of Ireland, Department of Transport, Dublin.

Dieleman, F., Dijst, M., Burghouwt, G., 2002. Urban Form and Travel Behaviour: Micro-level Household Attributes and Residential Context. *Urban Studies* 39, 507–527. doi:10.1080/00420980220112801

Dijst, M., Farag, S., Schwanen, T., 2008. A comparative study of attitude theory and other theoretical models for understanding travel behaviour. *Environment and Planning A* 40, 831–847. doi:10.1068/a39151

Driscoll, Á., Lyons, S., Morgenroth, E., Nolan, A., 2013. Comparing the Determinants of Mode Choice across Travel Purposes (MPRA Paper no. 46034). Economic and Social Research Institute.

Ewing, R., Schroerer, W., Greene, W., 2004. School Location and Student Travel Analysis of Factors Affecting Mode Choice. *Transportation Research Record: Journal of the Transportation Research Board* 1895, 55–63.

Garling, T., Axhausen, K., W., 2003. Introduction: Habitual travel choice. *Transportation* 30, 1–11.

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Gatersleben, B., Appleton, K., M., 2007. Contemplating cycling to work: Attitudes and perceptions in different stages of change. *Transportation Research Part A: Policy & Practice* 41, 302–312.

Goodwin, P., 2012. Peak Travel, Peak Car and the Future of Mobility: Evidence, Unresolved Issues, Policy Implications, and a Research Agenda ( No. Discussion Paper 2012-13). International Transport Forum, Paris, France.

Handy, S.L., 1996a. Regional versus Local Accessibility: Implications for Nonwork Travel. *Transportation Research Record*, 1400, pp.58–66.

Handy, S.L., DeGarmo, A., Clifton, K.J., 2002. Understanding the Growth in Non-work VMT. Southwest University Transportation Center, Texas.

Handy, S., 1996c. Methodologies for exploring the link between urban form and travel behavior. *Transportation Research Part D: Transport and Environment* 1, 151–165.

Handy, S.L., 1996b. Understanding the Link Between Urban Form and Nonwork Travel Behavior. *Journal of Planning Education and Research* 15, 183–198.

Handy, S.L., DeGarmo, A., Clifton, K.J., 2002. Understanding the Growth in Non-work VMT. Southwest University Transportation Center, Texas.

Horner, M.W., O’Kelly, M.E., 2007. Is non-work travel excessive? *Journal of Transport Geography* 15, 411–416. doi:10.1016/j.jtrangeo.2006.12.003

Horner, M.W., Mefford, J.N., 2007. Investigating urban spatial mismatch using job-housing indicators to model home-work separation. *Environment and Planning A* 39, 1420–1440.

Kamruzzaman, M., Hine, J., 2012. Analysis of rural activity spaces and transport disadvantage using a multi-method approach. *Transport Policy* 19, 105–120.

Kitamura, R., Mokhtarian, P.L., Laidet, L., 1997. A micro-analysis of land use and travel in five neighborhoods in the San Francisco Bay Area. *Transportation* 24, 125–158.

Kitamura, R., 1988. An evaluation of activity-based travel analysis. *Transportation* 15, 9–34.

Krizek, K.J., 2003. Neighborhood services, trip purpose, and tour-based travel. *Transportation* 30, 387–410.

Levine, J., 1998. Rethinking Accessibility and Jobs-Housing Balance. *Journal of the American Planning Association* 64, 133–149. doi:10.1080/01944369808975972

Levinson, D.M., Krizek, K.J., 2008. *Planning for Place and Plexus* Metropolitan land use and transport. Routledge, New York and London.

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Litman, T., 2014. Automobile Dependency - Transportation and Land Use Patterns that cause High Levels of Automobile Use and Reduced Transport Options [WWW Document]. Online Transportation Demand Management Encyclopedia. URL <http://www.vtpi.org/tdm/tdm100.htm> (accessed 7.31.14).

Metz, D., 2010. Saturation of Demand for Daily Travel. *Transport Reviews* 30, 659–674. doi:10.1080/01441640903556361

Murphy, E., 2012. Urban spatial location advantage: the dual of the transportation problem and its implications for land-use and transport planning. *Transportation Research Part A: Policy & Practice* 46, 91–101.

National Transport Authority, 2011 *Greater Dublin Area Draft Transport Strategy 2011-2030 2030 vision*, 2011. National Transport Authority, Dublin.

National Transport Authority (2013) National Transport Authority National Household Travel Survey 2012. National Transport Authority. Dublin.

Neuman, M., 2005. The Compact City Fallacy. *Journal of Planning Education and Research* 25, 11–26.

Newbury, D., Echenique, M., Goddard, J., Heathwaite, L., Morris, J., Schultz, W., Swanwick, C., Tewdwr-Jones, M., 2010. *Land Use Futures: Making the Most of Land in the 21st Century*. Government Office for Science, London.

Newman, P.W.G., Kenworthy, J.R., 1999. *Sustainability and Cities: Overcoming Automobile Dependence*. Island Press, Washington, D.C.

O'Sullivan, A., 2009. *Urban economics*, 7th edition. ed. McGraw Hill, Boston, Toronto.

Petrov, L., Lavalle, C., Kasanko, M., 2009. Urban land use scenarios for a tourist region in Europe: Applying the MOLAND model to Algarve, Portugal. *Landscape and Urban Planning* 92, 10–23.

Petrov, L., Shahumyan, H., Williams, B., Convery, S., 2011. Scenarios and indicators Supporting Urban Regional Planning. *Procedia Social and Behavioral Sciences* 21, 243–252.

Pucher, J., Dijkstra, L., 2003. Promoting Safe Walking and Cycling to Improve Public Health: Lessons from the Netherlands and Germany. *American Journal of Public Health* 93, 1509–1516.

Pucher, J., Buehler, R., Bassett, D.R., Dannenberg, A.L., 2010. Walking and cycling to health: A comparison of recent evidence from city, state, and international studies. *American Journal of Public Health* 100, 1986–1992.

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Rabl, A., de Nazelle, A., 2012. Benefits of shift from car to active transport. *Transport Policy* 19, 121–131.

Rajamani, J., Bhat, C.R., Handy, S., Knaap, G., Song, Y., 2003. Assessing the impact of urban form measures on nonwork trip mode choice after controlling for demographic and level-of-service effects. *TRB 2003 Paper # 03-3392*.

Susilo, Y.O., Maat, K., 2007. The influence of built environment to the trends in commuting journeys in the Netherlands. *Transportation* 34, 589–609. doi:10.1007/s11116-007-9129-5

Tsai, Y.-H., 2005. Quantifying Urban Form: Compactness versus “Sprawl”. *Urban Studies* 42, 141–161.

United National Economic Commission for Europe (UNECE) and World Health Organisation (WHO) 2009 Amsterdam Declaration Making THE Link: Transport choices for our health, environment and prosperity. WHO Regional Office for Europe. Copenhagen.

Van Acker, V., Van Wee, B., Witlox, F., 2010. When Transport Geography Meets Social Psychology: Toward a Conceptual Model of Travel Behaviour. *Transport Reviews* 30, 219–240. doi:http://dx.doi.org/10.1080/01441640902943453

Van de Coevering, P., Schwanen, T., 2006. Re-evaluating the impact of urban form on travel patterns in Europe and North America. *Transport Policy* 13, 229–239.

Van Wee, B., Handy, S., 2014. Do Future Land-Use Policies Increase Sustainable Travel?, in: Garling, T., Ettema, D., Friman, M. (Eds.), *Handbook of Sustainable Travel*. Springer, Netherlands, pp. 231–242.

Williams, B., Convery, S., 2012. STRIVE Report Series No. 92: Urban Environment Project Decision support tools for managing urban environment in Ireland (No. 92), Strive Report. Environmental Protection Agency, Wexford, Ireland.

Williams, B., Foley, W., Shahumyan, H., Petrov, L., 2013. Transport Policy, Land-Use Dynamics and Economic Development Patterns: Scenario Modelling for the Dublin-Dundalk-Newry-Belfast Corridor. *Borderlands: The Journal of Spatial Planning in Ireland* 95–112.

Wilson, L.-A., Giles-Corti, B., Turrell, G., 2012. The association between objectively measured neighbourhood features and walking for transport in mid-aged adults. *Local Environment* 17, 131–146.

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