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<th>Are psycho-social factors important in shaping non-work travel patterns in the Greater Dublin Region?</th>
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<tr>
<td>Authors(s)</td>
<td>Convery, Sheila; Williams, Brendan; Ahern, Aoife</td>
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<tr>
<td>Publication date</td>
<td>2017-09</td>
</tr>
<tr>
<td>Conference details</td>
<td>Irish Transport Research Network 2017, University College Dublin, Ireland, 31 August-1 September 2017</td>
</tr>
<tr>
<td>Publisher</td>
<td>Irish Transport Research Network</td>
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<tr>
<td>Item record/more information</td>
<td><a href="http://hdl.handle.net/10197/9433">http://hdl.handle.net/10197/9433</a></td>
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THE ROLE OF PSYCHO-SOCIAL FACTORS IN SHAPING NON-WORK TRAVEL PATTERNS IN THE GREATER DUBLIN REGION

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Abstract

Non-work travel behaviour has received considerably less attention than commuting from policy makers, transport service providers and planning agencies. Non-work journeys comprise a considerable portion of daily travel and while often discretionary in nature these trips also reflect wider activity participation choices and lifestyle choices with respect to both peoples’ residential preferences and travel behaviour preferences.

While land use transport characteristics are a key determinant of travel behaviour patterns for non-work journeys, other psycho-social and attitudinal factors also influence both the frequency and mode of non-work trips. A better understanding of non-work journey patterns is needed to ensure that effective transport policies are developed; that service provision is tailored to meet current and future demands and such that sustainable transport goals can be met. In international policy debates achieving more sustainable transport patterns involves a move away from prevalent car dependency.

The paper presents research results from data collected through a postal household survey covering households across the various typologies of urban settlement in the Dublin Region. The results are based on 1298 completed surveys which represented a 21% response rate across the region. The methodology includes a novel approach whereby 6 typologies of land use-transport characteristics were defined using residential density, proximity to transport services mediated by service frequency and proximity to retail services. The population was stratified according to the typologies and households were then randomly selected from each typology. The paper presents the results of both descriptive and inferential statistics exploring the determinants of non-work journey purposes. This supports previously advanced conceptual models for example by Van Acker, which seeks to capture the relationships between daily travel behaviour and spatial, socio-economic and socio-psychological characteristics [1] and Naess (page 29) [2] who considers a behavioural model with assumed links between urban structural, individual and social conditions, accessibility to facilities, rationales for activity participation and location of activities and total travelling distance. Both suggest that subjective, habitual and lifestyle influences are important in influencing travel behaviour.

Findings suggest that strategies to increase sustainable transport use need to consider both land use transport dimensions as well as focusing on specific user groups due to their differing attitudes and influences, to be effective in bringing about travel behaviour change.
Introduction

This paper examines the factors that play a role in determining how non-work travel behaviour is determined. The paper assesses how land use, socio-economics and attitude interact to determine choices made on non-work travel.

There has been a surge of interest in the subjective factors influencing people’s travel patterns, since the emergence of activity-based analyses and individual level analysis rather than demand forecasting for commuting [3], [4], and [5]. This has emerged through the evolution of conceptual approaches to understanding and planning transport over the last 100 years [6]. Heretofore much of the focus has been on commuting and a range of standard measures are applied in order to understand the motivations leading to the observed commuting travel patterns. These approaches are derived from Alonso’s seminal work [7] suggesting a general theory of land rent whereby increasing distances from central business districts results in in lower land values. This means people trade off distance from work opportunities and commute times against affordability of housing.

Internationally total travel times remain quite stable over a 30 year time period at around 60 minutes per day regardless of distance or mode and the average number of journeys made has also remained stable at close to 10,000 trips per person per year (pppy) [8] though changes in long term trends for specific population sub groups have been noted, [9] & [10].

Investment in infrastructure to improve transport systems is typically appraised based on cost benefit analysis and the return on investment with respect to time savings for the largest number of users and by its nature is biased towards people at work (as their economic value is higher than those not at work [11] & [12]. This approach has driven much of transport planning historically. However, there has been a move, especially in the Netherlands, to consider other factors when appraising infrastructure investment in recent years [13] & [14].

Much strategic transport planning has most been supported by the use of aggregate measures and models which attempt to understand behaviour at the aggregate level and at a small geographical scale (i.e. large area). The most used are utility maximization models which are underpinned by the principle that individuals’ decisions are motivated by their desire to choose the most efficient and cost effective outcome for their particular set of circumstances. However, this approach has many short comings, see for example [15] & [16] and is intuitively less relevant for non-working segments of society such as children, students and carers. Objective factors such as availability of transport services, distances and times spent commuting are most often included in models as well as standard socio-economic and demographic indicators such as age, gender, income and work status.

However, these approaches omit the variations on both the supply and demand side. With respect to the supply side changing service frequency on a temporal basis (i.e. off-peak and rush hour services and prices within transport services) is typically not included in land use transport infrastructure planning. While on the demand side the travel behaviour of individuals is inherently complex with much variation demonstrated amongst individuals despite demonstrating similar socio-demographic characteristics as well as needs specific to sub population groups such as children, the elderly and the infirm.

Recently focus has been placed on residential self-selection as a key concept as both i) a confounding factor in respect of the influence of land use on expected travel behaviour and ii) as a lens to better understand some of the complexity with respect to residential preferences, lifestyle elements and people’s travel behaviour patterns.

The current study contributes to the debate by expanding the consideration of influences on travel behaviour by including psycho-social factors such as attitudes to modes (social and environmental) and residential preferences.
Research Objectives

The research objective is to explore the influence of land use and other non-objective factors on travel behaviour patterns for non-work trips. In this way it tests the hypothesis that other factors (not just objective land use transport factors) influence non-work travel behaviour.

To do this the following research questions are investigated:

- Do attitudes of residents to different transport modes vary across land use transport types at residence?
- Is there an association between their attitudes, their level of sustainable mode use and the land use transport type at residence?
- To what extent are respondents influenced by social norms with respect to their mode use?
- Is this associated with their non-work travel behaviour (level of sustainable mode use and volume of non-work trips)?
- What are the characteristics of people who prioritise active mode use through their residential preferences? Do they display a different non-work travel pattern to others? (level of sustainable mode use and volume of non-work trips)
- Assuming that residents live in an area with similar transport land use characteristics, are there socio-demographic-economic factors which influence their non-work travel behaviour?

What are psycho-social factors?

Drawing on social-psychology and linking with key objective transport and land use indicators, the psycho-social factors included in the current research relate to perceptions, attitudes and preferences [17]. These elements relate to how people think, feel and behave toward other people and how these thoughts, feelings and behaviours may be in the same way influenced by other people. A sample of indicators used in other studies is included in Table 1.

<table>
<thead>
<tr>
<th>Type of items</th>
<th>Category of item/Attitude statement</th>
<th>Reference for study</th>
</tr>
</thead>
<tbody>
<tr>
<td>32 attitudinal statements related to travel, land use and environment</td>
<td>Pro-environmental policy Commute benefit Travel freedom Pro-high density</td>
<td>[26]</td>
</tr>
<tr>
<td>Attitudes to cycling</td>
<td>e.g. like cycling, not fit, uncomfortable, not safe</td>
<td>[28]</td>
</tr>
<tr>
<td>105 attitude statements relating to constructs identified such as subjective norms etc.</td>
<td>Moral responsibility to use the car less; Perceived behavioural control for car use; Concern for negative effects of car use</td>
<td>[5]</td>
</tr>
<tr>
<td>Social Norm – i.e. Theory of Planned Behaviour [30]</td>
<td>Family and Friends think I should bike more often Family and Friends think I should get a car Family and friends think I should use Public Transport more frequently</td>
<td>[29], [19] and current paper</td>
</tr>
</tbody>
</table>
In this study the factors operationalized are not comprehensive but aim to represent some of these elements identified within social psychology and have been labelled psycho-social factors. The key research objectives covered in this paper are described in the next section followed by a description of the data collection and methods applied.

**Data and Analysis**

**Household Selection**

Using a GIS analysis, the study region (the Greater Dublin Region as shown in Fig. 1) was classified into 6 different land-use transport types. The criteria are summarised in Table 2, and described below. The criteria were used to categorise small areas defined by the census (CSO, 2011). A detailed description of how the calculations were performed is included in [18].

- Residential density (dwellings per hectare) Census 2011 data provided the number of dwellings (the number of occupied housing units variable) which was calculated for each hectare in the study area.
- Proximity to public transport stops – small areas which were within 1km of a rail/LUAS stop and 500m of a bus stop were selected. The stops were then categorised based on the frequency during the off-peak period 3-4pm on a week day\(^1\). The stops were categorised according to service frequency and the appropriate small areas selected using this criteria \(^2\).
- Proximity to retail services was included by defining small areas that were within 1km of a cluster of retail address points (using An Post Geodirectory data). A min density of 35 units per hectare was chosen as a minimum. This criterion was included such that retail concentrations were within a reasonable distance for access by active transport modes ceterus paribus.

The selection process utilised ensured that no small area was included in more than one land use transport type area to ensure that no household could be included in more than one area type.

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\(^1\) This was chosen to ensure that schedules arising for the after school period and before the peak commuting period were not included in the reference hour to represent off-peak service frequency.

\(^2\) Within 1km of a rail stop/LUAS stop and 500m of a bus stop. Empirical evidence suggests people will walk further to access a higher quality transport service, hence the difference between the distance for bus stop and rail/light rail stop.
A random selection of households from each area type was made to whom a self-completion household survey was administered. The objectives of the survey were to examine in detail the mode choice for a range of journey types and to gather data on other factors which may be linked with mode choice selection for these journeys, both land use elements and other socio-demographic, behavioural and attitudinal characteristics. Questions in relation to attitudes to transport modes were adapted for this survey from previous research including [19]. This included collecting data on peoples’ orientation to different transport modes and their perceptions to the attitudes of family and friends towards their transport mode choices. The survey gathered data on 292 different variables and was administered in October and November 2016 a time period where people’s general travel patterns are likely to be in evidence, i.e. outside of holiday periods and during the school term. Extensive data preparation, data entry and data cleaning were carried out to ensure the integrity of the data.

In Figure 1 the spatial extent of the 6 defined land use transport typologies is illustrated. The strategy segments are as defined by the National Transport Authority [20] and represent the Outer Hinterland areas, the Inner and Outer Metropolitan areas as well as the Inner City core which can be seen in the map inset (black) and the Metropolitan area which can be seen in the map inset (red).

In this paper the land use transport area type 3 is of specific interest. There are sufficient respondents in this LUTT for analysis and there are alternative transport options available (i.e. active and public transport) so that a full range of mode use would be possible by these residents. This is not the case for those in type 5 and 6 who lack good public transport services and is not similar for those in type 1 who have limited reasons to use car transport.

The neighbourhoods in this typology are characterised by: medium residential density (between 55 and 240 dwellings per hectare), within active transport distance of a medium level of public transport service (1-2 services in the off-peak 3-4pm period) and within active transport range (1km) of a retail cluster (>35 units per hectare). The responses of those living in this area type will be analysed to determine if there are any socio-demographic-economic factors influencing their non-work travel pattern. This will help to establish if socio-demographic-economic factors are important in influencing their travel patterns.

<table>
<thead>
<tr>
<th>Land Use Transport Type (LUTT)</th>
<th>Residential density (dwellings per hectare)</th>
<th>Proximity to public transport/Service Frequency</th>
<th>Proximity to retail services</th>
<th>NTA Transport Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>240 - 555</td>
<td>Good</td>
<td>Good</td>
<td>City core</td>
</tr>
<tr>
<td>2</td>
<td>54- 239</td>
<td>Various</td>
<td>Various</td>
<td>Various</td>
</tr>
<tr>
<td>3</td>
<td>54 – 239</td>
<td>Medium</td>
<td>Good</td>
<td>Centre and Inner Metropolitan</td>
</tr>
<tr>
<td>4</td>
<td>54 – 239</td>
<td>Poor</td>
<td>Good</td>
<td>Areas outside the city core</td>
</tr>
<tr>
<td>5</td>
<td>&lt; 55</td>
<td>Poor</td>
<td>Poor</td>
<td>Outer Hinterland</td>
</tr>
<tr>
<td>6</td>
<td>&lt; 55</td>
<td>Poor</td>
<td>Poor</td>
<td>Outer Metropolitan</td>
</tr>
</tbody>
</table>

Table 2. Criteria for definition of Land Use Transport Typologies (LUTTs).
Van Acker et al. [1] situate their conceptual model within a holistic framework which considers the choice making process in the context of social, environmental and individual spheres of influence. This lends itself to an SEM approach (Structural Equation Modelling). In contrast, this research is based on testing specific associations for statistical significance within a framework of both objective and subjective factors from a representative sample of householders. The use of GIS techniques to determine the typologies provides a robust statistical framework for the sample selection.

Fig. 1 Map of the Greater Dublin Region, Ireland showing the 6 typologies of land-use transport characteristics. The INSET (black) shows the core city centre area which is mostly type 3 while the INSET (red) shows the location of types 2 and 4 and parts of 5 & 6

**Overview of Non work Travel in the study region**

**Use of Non Car Modes (walking, cycling, public transport) and Land Use Transport Type**

In looking at the differences in travel behaviour between respondents based on the land use transport characteristics at residence, it is evident that land use transport characteristics play a large part in observed travel behaviour patterns. In this study, this is most evident in areas which are tending towards car dependency. These area types can be seen in the graph as
types 2, 4, 5 & 6 each with more than 20% of respondents always using the car. Conversely
the medium and high levels of sustainable mode use are highest in area type 1 (82.6% combined) and area type 3 (40.8% combined). Fig. 2 shows an analysis of use of sustainable modes\(^3\) by land use transport type.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{proportion_sustainable_mode_use.png}
\caption{Proportion of Sustainable Mode Use by Residence Typology}
\end{figure}

**Attitudes to modes and current mode use**

Findings suggest some correlation between attitudes expressed in the survey and the chosen travel mode for respondents in all area types. Fig 2. gives an overview of responses by land use transport type at residence (1-6). A first finding is that a high proportion of residents in area type 1 (80%) recognise that they do have choices with regard to non-car use. The rate for those in area 6 is also relatively high at (55.6%). Residents of area type 5 with no public transport options and living at relatively long distances from retail services show few available alternatives with 100% agreement that they have no alternatives to car-use. Residents of areas 2, 3 and 4 demonstrate more of a mixture of choices with the highest proportion of agreement with ‘I have no choice but to drive’ in area 4 (66.7%). A selection of results is shown in figure 3.

While it was expected that residents of areas 5 and 6 would have difficulties accessing public transport given the dispersed nature of residential development in these areas it is important to note that residents of area type 4 are perhaps often overlooked in consideration of sustainable transport. These residences appear mostly to be in the areas surrounding smaller towns where distances maybe too far to walk or cycle, or too dangerous but there is also no public transport option, leaving driving as the only option. There is more similarity between areas type 4 and area type 6 than expected. As the areas in type 4 are close to urban centres and retail centres it would be expected that there would be alternatives to car use in line with appropriate consideration of sustainable transport planning requirements. The type 5 areas are not close to retail areas or urban centres and therefore it would be difficult to service these areas with alternative transport options.

\(^3\) No Sustainable Mode Use = No destinations reached by non-car modes. Low = 0-5 destinations reached using non car modes; Medium = 6-9 destinations reached using non car modes and High = 10 – 14 destinations reached using non car modes.
Across residents of all area types there was broad agreement regarding the impacts of car traffic on environment and health with between 40 and 80% agreement across the area types (see figure 2, bottom right chart) type 3 had the most who were neutral on this (60%) and area 5 had the highest disagreement (25%) which is not surprising as area type 5 is the most car-dependent area in the study where more tolerant attitudes to the impact of car use might be expected. Similarly all groups had high levels of agreement in respect of stress caused by traffic (between 57.1% and 77.8% agreed or strongly agreed with the statement 'I find traffic stressful'). Residents in area types 2 and 3 demonstrated the most disagreement at 28.6% and 40% respectively. This may be associated with less driving and more public transport use in these neighbourhoods (for example 30% non-car use in area 2 for work school or college trip and 65% high non-car use across all non-journey types in area 3).

Residents of area type 5 are somewhat mixed in their views of public transport. Questions in the survey attempted to capture general views of different modes, rather than the specifics of individual routes etc., nonetheless it’s accepted that view of modes is to some extent informed by people’s local knowledge. Equal proportions agree and disagree regarding reliability and cost of public transport. Given that mostly these areas have a very poor service level this may warrant further investigation as to why there are such divergent views.

There is an association between perceptions of cycling safety and car use. For example residents of area type 5 are 100% in agreement that they have no choice but to drive and are in 100% agreement that cycling is dangerous and are also most likely to have inadequate alternatives to car use. In addition their perceptions of the negative impacts of car traffic on both environment and health are perhaps less cohesive than the residents of other area types. These findings suggest support for some of the contentions of residential-self-selection whereby people choose to live in areas which ‘fit’ their pre-existing travel preferences. It also suggests that their maybe cases of forced car ownership in evidence in
this area type. Future research could investigate this further and complement work published by Rock [21] & [22], considering transport equity and forced car ownership in suburban Dublin.

Social norms - Influence of family and friends regarding mode use

Survey respondents were asked the extent to which they agreed, neither agreed nor disagreed or disagreed with statements relating to the influence of family and friends and whether they should alter their current travel behaviour.

With regard to the influence of social norms on people’s travel behaviour a significant group were neutral with respect to external influences on their mode choice (between 30 and 40% for each mode) [18]. Orientation to cycling was mixed with 62% in agreement or strong agreement with regard to cycling being a time-saving way of travelling but at the same time 60% agreeing that cycling is dangerous. Given the preponderance of car driving for transport it was unexpected to find that 37.5% agreed that they had no choice but to drive while 40% disagreed.

Some tests were carried out to see if there was a statistically significant association between the response to the statements and the pattern of non-work journeys. To indicate the pattern of non-work journeys, in the first instance the non-work trip frequency was used.

The volume of non-work trips was significantly associated with the direction of the influence of family and friends with respect to public transport use. The result is summarised in the bar chart (Fig. 4).

The chart shows that the mean level for frequency of non-work trips was highest in the case of the respondents who agreed that family and friends said they should use public transport more often. While the mean level for those who disagreed that family and friends said they should use public transport more often was lower.

In testing the other statements relating to the influence of family and friends and the frequency or volume of non-work trips, no statistical associations were found. The results of the tests are shown in the Appendix A for information.

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4 A Welch ANOVA was applied, Welch’s F (2, 181.493) = 3.178, p= 0.044 which gave a statistically significant result. It was used as the requirements for using the standard ANOVA were not met, i.e. there was not homogeneity of variances as assessed by Levene’s test for equality of variances (p=0.031 which is p<0.05).
Assumptions were tested for at each stage of the analysis. A Shapiro-Wilk’s test showed that the NWTrips_total value was not normally distributed as the significance value was p<0.0005 and p< 0.005 (agree). Using a visual inspection the normally distributed assessment was made and it was agreed to continue with the ANOVA analysis as recommended in [32] as the one-way ANOVA is fairly ‘robust’ to deviations from normality.
Fig. 4 Respondents grouped by the level of agreement/disagreement with the statement ‘Friends and Family think I should use public transport more often’. Differences in mean volume of Non work trips were then computed for each group.

Residential Preferences, Mode Use and Land Use Type at Residence

The most important factor with regard to choice of residence was ‘affordability/price’ which was most or 2nd most important for 60% of respondents along with ‘type of housing’ [18].

Respondents were asked to rank a range of factors on how important the factors would be if they were planning to move to a new neighbourhood.

The highest proportion of people who did not rate having proximity to local facilities as important were those with some sustainable mode use (1-5) at 49%. Both views were represented (important (7, 4% and not important (6%)) by those who have a high amount of sustainable mode use (10-14). This is interesting as it would be expected that those with high levels of sustainable mode use would also prioritise it in a residential move, though this appears not to be a big factor for either group. It also may suggest some self-selection occurring with those already living in an existing area which is well served for local facilities not feeling the need to prioritise it in a move as they are used to the level in their own neighbourhood and believe it would be comparable in a new neighbourhood.

Fig. 5 Importance of factors in considering a residential move

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5 Level of sustainable mode as per page 6
The land use type at residence was not statistically significantly associated with the proportion of those who rated proximity of local facilities in their top 3 important factors.\(^6\)

Those people who included ‘Proximity to local facilities’ in their top three important factors were analysed as a separate group. The amount of sustainable mode use for current travel in each group was then examined (illustrated in fig. 5) to see if those who did prioritise local facilities had more sustainable mode use than the others.\(^7\) But the chi-square test was not significant so an alternative was used as described in the next section.

Residential Preferences and Volume of Non Work trips

People who have a higher volume of non-work trips (all modes) are likely to include ‘proximity of local facilities’ in their top 3 most important factors when considering a residential move.

This was tested statistically and a statistically significant association between the volume of non-work trips (annual base) and whether people had rated ‘proximity of local facilities’ in their top 3 most important factors when considering a residential move was found.

A one-way ANOVA was conducted to determine if the volume of non-work trips is different for groups who would have ‘proximity of local facilities’ in their top three most important factors when considering a residential move and those who do not. Respondents were placed in two groups (Proximity in Top 3 \(n = 241\) and not in top 3 \(n = 407\)). There were some outliers which were modified using the next available value see (Appendix B) in 7 cases and the condition of homogeneity of variances as assessed by Levene's test of homogeneity of variances \((p = 0.151)\) was met. Data is presented as mean ± standard deviation. The volume of non-work trips for those who selected proximity of local facilities as important (top three) was higher \(470.43 ± 238.60\) than that found in the group who did not have this factor in the top three \(410 ± 229.19\). As there was only two groups there was no need to run any post hoc analysis. The volume of nonwork trips was statistically significantly linked with the group membership \(F (1,646) = 10.216, p = 0.001\).\(^8\)

This suggests that people who currently engage in high levels of non-work travel (by trip frequency) would like to reduce the distances involved in accessing non-work activities. This might be so that they could use more active modes (as distances would be shorter), so that dependents could travel alone (shorter distances might require less supervision or use of car mode) or that they feel they spend too much time accessing local services.

Socio-demographics and non-work travel patterns?

The influence of socio-demographics on non-work travel behaviour is pronounced in that they strongly influence the travel needs of each individual. For example, international research shows life stage factors are important such as the presence of children in the household ([23], [24]) and work status which may determine whether someone is mostly home based or not.

A selection of socio-economic-demographic factors were tested to see if they had an influence on the non-work travel patterns of respondents who experienced similar land use

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\(^6\) Results of a test for independence gave \(\chi^2 (n=995,5) = 2.04, p = 0.844\)

\(^7\) Results were inconclusive as the chi-square test \((n = 998, 3) = 4.1\) with \(p = 0.251\) which was not significant.

\(^8\) While the Shapiro-Wilk test of normality was not met (significance values were \(p = 0.000\)) a visual inspection of the Normal Q-Q Plot was assessed and it was considered possible to continue with the One Way ANOVA. See Appendix B.
transport patterns i.e. they were all respondents from land use transport type (LUTT) 3 (as described in the section Data and Analysis). The total volume of non-work trips (based on the frequency of visits to each destination in the survey, scaled to give a total number of trips each year to each destination for each respondent) was used as a measure of the non-work travel pattern.

The socio-economic-demographic factors used in the analysis were the family status (i.e. children present in the household); car ownership (car present or not); gender (male or female); income (p.a.) and age profile of the respondent. The multiple regression model was statistically significant and predicted the volume of non-work trips (total per year); \(F(6,160) = 2.6, p< 0.05\). Only one variable, Gender, added statistically significantly to the prediction, \(p< 0.05\). Regression coefficients and standard errors are shown in Table 3. (below)\(^9\).

<table>
<thead>
<tr>
<th>Variable</th>
<th>(B)</th>
<th>Std. Error</th>
<th>(\beta)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>449.983</td>
<td>100.686</td>
<td>100.686</td>
<td>.000</td>
</tr>
<tr>
<td>Children</td>
<td>-63.219</td>
<td>44.681</td>
<td>-117</td>
<td>.159</td>
</tr>
<tr>
<td>Car ownership</td>
<td>90.387</td>
<td>52.222</td>
<td>.140</td>
<td>.085</td>
</tr>
<tr>
<td>Gender</td>
<td>-105.715</td>
<td>38.478</td>
<td>.215</td>
<td>.007</td>
</tr>
<tr>
<td>Income p.a.</td>
<td>0.000</td>
<td>.001</td>
<td>-.042</td>
<td>.607</td>
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<tr>
<td>Age category</td>
<td>21.837</td>
<td>26.738</td>
<td>.066</td>
<td>.415</td>
</tr>
<tr>
<td>Tenure status</td>
<td>-27.407</td>
<td>26.557</td>
<td>-.088</td>
<td>.304</td>
</tr>
</tbody>
</table>

\(B = \) unstandardized regression coefficient; \(SE_B = \) standard error of the coefficient; \(\beta = \) standardized coefficient

Adjusted \(R^2 = 0.055 \ p<0.05\)

Table 3. Summary of multiple regression analysis with 95% confidence intervals reported in parentheses [33].

The reference category for gender was male and the result shows that the difference between the mean level of non-work trips for males was lower than for females \((p= 0.007)\). The difference between the mean value for females compared with males is a factor of -2.17.

Discussion

The analysis explores the role of psycho-social factors such as attitudes, preferences and influence of family and friends on the survey respondents’ non-work travel behavior patterns. In this way the utility maximization approach is considerably expanded upon and the benefits of an activity-based approach are highlighted. The debate regarding the influence of land-use on non-work travel behaviour continues with many researchers highlighting the need to include subjective factors & to take account of attitudinal and behavioural factors. This study

\(^9\) See Appendix C for the results of assumption testing
complements the work of Van Acker et al [1] in advancing a conceptual model of travel behaviour which blends both social psychology and transport geography elements.

It is shown that land use remains the most important influence as it determines transport options and whether active mode use is possible with respect to distances to essential and recreational services. This is born out in the analysis in that when the travel behaviour patterns of residents are examined on the basis of their use of sustainable modes, the areas with alternative options, which promote walking and cycling are clearly seen to deliver higher levels of non-car use.

Residential preferences are also important as affordability is the most important factor for everyone in selecting a neighbourhood (given the opportunity to express a preference with respect to a move to a new neighbourhood within the survey question) and this may well over-ride any other concerns relating to the desirability of high levels of accessibility in a new neighbourhood.

In the study region it is difficult to gauge the full complexity of people’s responses to ‘car dependent’ areas as considerable restrictions in the supply of housing (including affordable units and units representing high sustainable transport indices). In particular a shortage of affordable housing have been in evidence in the region since before the Great Economic Recession and associated collapse of the construction and other sectors in Ireland [25. ]In the event that there was more movement in the housing market an analysis of people’s housing preferences given their housing decisions would be more realistic

Nevertheless, the current work suggests that it is overly simplistic to consider people’s travel behaviour as being guided only on the basis of simple utility-maximization and in order to provide appropriate transport services, examination of the needs of specific sub groups is necessary. These groups have different requirements on the basis of socio-demographic and lifestyle desires which is bound up in lifestyle preferences and psycho-social factors.

In exploring psycho-social factors the study provides some evidence in a statistically robust way that these factors do result in different volumes of non-work trips, but further work is needed to see if there is symmetry with respect to mode shares. Schwanen & Mokhtarian [26] highlight that there is some work already done in this area, but it is framed within the context of residential self-selection. Upcoming work with the current data will provide further detail on mode split for non-work trips using an aggregate total number of trips per mode per annum for each destination for all of the respondents.

Conclusion

Land use transport characteristics continue to dominate the travel behaviour patterns of residents with respect to their non-work travel pattern but mostly as these elements affect the transport options available. Findings related to residential preferences are mixed. As would be expected- affordability was the strongest factor influencing people's decisions regarding a move of residences and this served to dampen the effect of other factors such as proximity of local services as shown in the results. Nonetheless, it would be expected that in the car dependent cases (for example those in areas type 5 and 6) these issues might be less important as everywhere is within a car trip from peoples’ residence. But, the results show that those with higher volumes of all kinds of non-work trips are more likely to prioritise this item. Further analysis investigating the priorities relative to mode split across all journey purposes is suggested for further work.

Findings also suggest that some of the determinants of travel behaviour for work and non-work trips are related in that the land use transport characteristics are the same in respect of
both types of trip. The extent to which the other factors differ for non-work trips compared to work trips requires further research building on early results of Driscoll et.al (2013) who found that the determinants for work and non-work trips are different.

Acknowledgements

This paper provides an overview of on-going research carried out as part of PhD research which is supported by the Earth and Natural Sciences Doctoral Studies Programme which is funded under the Higher Education Authority’s Programme for Research in Third-Level Institutions and co-funded under the European Regional Development Fund.

References

[20] National Transport Authority Travel segments
Appendix A

‘According to family and friends I should bike more often’

A Kruskal-Wallis H test was run to determine if there were differences in the volume of non-work trips between groups depending on whether they agreed, disagreed or were neutral with respect to the influence of family or friends on their bicycle use. The levels were not statistically significantly different between groups, $\chi^2 (2) = 2.3$, $p = 0.313$

Distributions of NWTrips_Total_Freq were similar for all groups, as assessed by visual inspection of a boxplot. Median scores were different for each group for agree (371.5); neutral (392) and for disagree (378.5) but the differences were not statistically significant, $\chi^2 (2) = 2.3$, $p = 0.313$

A one-way ANOVA was not used as there were some outliers (12 approx. in the Disagree) and it was decided that a non-parametric test would make more sense.

‘According to family and friends, I should only use car when no other option’

A Kruskall-Wallis H test was run to determine if there were differences in the volume of non-work trips between groups depending on whether they agreed, disagreed or were neutral with respect to the influence of family or friends on their car use. The levels were not statistically significantly different between groups, $\chi^2 (2) = 4.265$, $p = 0.119$

Distributions of NWTrips_Total_freq was similar for each group as assessed by visual inspection of a boxplot. Median NWTrips_Total_freq were different for each group, agree (436); neutral (397) and disagree (362) but the differences were not statistically significant $\chi^2 (2) = 4.265$, $p = 0.119$

‘According to family and friends, I should get a car’

A Kruskall-Wallis H test was used instead of a one-way ANOVA as the assumptions for ANOVA were not met.

Distribution of NWTrips_total_freq alone were similar for each group, as assessed by visual inspection of a boxplot. Median scores for each group were different but not statistically significantly different between groups, $\chi^2 (2) = 4.036$, $p = 0.133$

Median values were for agree (449, n=67); neutral (378, n=109) and disagree (374, n=157).

In order to conduct the test a number of assumptions were tested including the removal of outliers as identified in the table below.

Some outliers were found in each group and modifications were made

<table>
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<th>Group</th>
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<tr>
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<td></td>
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<tr>
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<tr>
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<td>1044</td>
<td></td>
</tr>
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<td>1050</td>
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<tr>
<td></td>
<td>1579</td>
<td>15</td>
<td></td>
<td>1050</td>
</tr>
</tbody>
</table>
A test for outliers was run and boxplots were visually assessed, no outliers were present after the modifications were carried out.

The NWTrips_Total FREQ Alone was not normally distributed as assessed by Shapiro-Wilk’s test which showed $p<0.05$ for each group $p<0.0005$ for Disagree and Neutral and $p=0.003$ for Agree.

**Appendix B**

*Outliers modified in the One way ANOVA test*

*Prioritise ‘Proximity of Local Facilities’ and Volume of Non work trips*

<table>
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<td>1263</td>
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<td>1048</td>
<td>1026</td>
</tr>
</tbody>
</table>

Looking at the Normal Q-Q Plot the normality assumption is considered met.
Appendix C

A multiple regression was run to predict the total volume of non-work trips, from a suite of socio-economic-demographic indicators. These were children present, car ownership, gender, income (p.a.) and age for respondents. All respondents were located in an area with medium transport accessibility and medium levels of residential density and close to retail clusters (LUTT, type 3). There was linearity as assessed by partial regression plots and a plot of studentized residuals against the predicted values. There was homoscedasticity as assessed by visual inspection of a plot of studentized residuals versus unstandardized predicted values. There was no evidence of multicollinearity as assessed by tolerance values greater than 0.1. There were no studentized deleted residuals greater than ±3 standard deviations, no leverage values greater than 0.2 and values for Cook’s distance above 1. The assumption of normality was met as assessed by the Q-Q Plot. The multiple regression model statistically significantly predicted the volume of non-work trips per annum, $F (6,160) = 2.6$, $p < 0.05$, adj $R^2 = 0.055$. Only one variable Gender, added statistically significantly to the prediction, $p = 0.007$. Regression coefficients and standard errors can be found in Table 3.