Multiple Purposes at Single Destination: a Key to a Better Understanding of the Relationship between Tour Complexity and Mode Choice

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1 Objectives

Although a tour is generally referred to as travel involving single or multiple purposes to single or multiple destinations, the destination and the spatial distribution of activities are rarely investigated. In particular, the explicit representation and quantification of travel involving multiple purposes at a single destination (MPSD) are noticeably absent from activity and tour based analyses. Moreover, research reporting the relationship between tour complexity and mode choice has mixed outcomes with some studies suggesting that as tours become more complex, public transport as an inflexible travel mode is less likely to be used [1]. However, other studies have found the opposite: that public transport tours on average involve more activities than car tours [2, 3]. This ambiguity, which seems to appear from the tour complexity definitions used, motivates the current investigation that aims to explain the differences in the reported research.

This paper proposes a new approach to the typology of tours that takes into account the spatial distribution of activities to examine the differences in nature of tours undertaken by public transport and car, and to explore the relationship between tour complexity and mode choice. In particular, the paper aims to answer three research questions: (a) Whether public transport tours can be as complex as car tours or whether public transport tours are always less complex; (b) How travel involving MPSD influences mode choice; and (c) Whether the effect of tour complexity is different across travel purposes.

2 Methodology

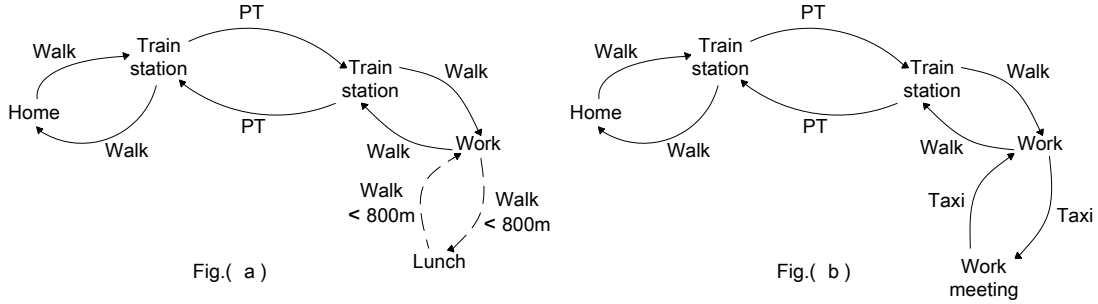
2.1 Home-based tour dataset creation

Using the Sydney Household Travel Survey, this paper creates a home-based tour dataset from unlinked person trips. By mode, the tours are spread across ferry, train, bus, car, taxi, cycling, and walking. Each tour is classified into one of four different types according to its main purpose and ordered on a hierarchical basis with work activities as the highest priority, followed by education, maintenance, and discretionary activities. Given the focus on mode choice between public transport and car, 19,866 eligible tours involving public transport and car are studied. This paper analyses tour complexity using the number of intervening activities (not changing mode, not returning home).

2.2 MPSD identification

A home-based tour is considered as MPSD if three conditions are simultaneously satisfied. First, the trip segment to that activity involved an intervening activity. Second, the activity location is reached by walking (other non-motorised modes were rare) and the location is within a walkable distance of 800 metres of the immediately preceding activity. Third, the purpose of the immediately preceding trip segment was not 'changing mode'. The proposed approach classifies tours into single purpose at single destination (SPSD), multiple purposes at multiple destinations (MPMD) and MPSD while the traditional approaches classify tours as simple (involving one activity) or complex (with or without information on the number of activities chained into a tour) [1, 2]. Figure 1 illustrates two home-based tours with one involving MPSD and shows how tour complexity is coded by the proposed approach, compared to the traditional approaches.

For multiple activities at one destination, one activity is considered as the primary activity (the main reason for visiting the destination) while others are referred to as secondary activities. In the example tour plotted in Figure 1a, work is considered as the primary activity and is also the main purpose of the whole tour. On the other hand, 'lunch' and 'return to work' are considered as secondary activities, sharing the same destination with work activity.



Tour typology	Tour Complexity Fig.(a)	Tour Complexity Fig.(b)
Categorial classification	Complex	Complex
Total no. of activities	Quite complex with 3 activities (Work; Lunch; Return to work)	Quite complex with 3 activities (Work; Work-related; Return to work)
Destinations & no. of activities	MPSD Main activity = Primary activity: work Secondary activities: lunch; return to work	MPMD with 3 activities Main activity: work

Figure 1 Example Tours and Tour Complexity Defining Methods

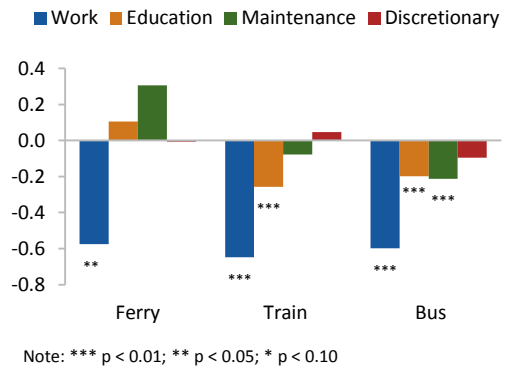
2.3 Analysis approach

This paper uses descriptive and modelling analysis to study the relationship between tour complexity and mode choice. Descriptive analyses provide a basic understanding of the nature of tours undertaken by car and sub-modes of public transport. With modelling, a nested logit model is developed to provide new evidence on the strength of the relationship between tour complexity and mode choice.

3 Findings

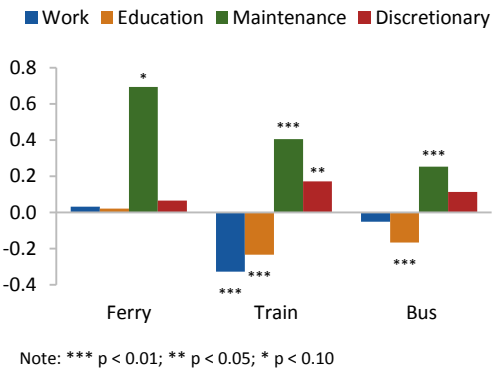
In the Sydney dataset, travel involving MPSD represents about one-fifth of tours with more than one out-of-home activity. Figure 2 indicates differences in complexity of public transport tours relative to car tours and shows that when the destinations visited are taken into account (as with the proposed definition in this paper), public transport tours are less complex than car tours for all purposes where the differences are significant. Conversely, when tour complexity is represented solely by the number of activities, public transport tours are more complex for maintenance and discretionary activities but less so for work and education. This reconciles the different results reported in the literature.

(a). Difference in destinations and number of activities



Note: *** p < 0.01; ** p < 0.05; * p < 0.10

(b). Difference in number of activities



Note: *** p < 0.01; ** p < 0.05; * p < 0.10

Figure 2 Difference in complexity for public transport tours compared to car tours by tour main purpose: two approaches to tour complexity

With approach proposed in this paper, activities chained into a tour are classified into two groups: those undertaking at different places (variable *N_Acts*) and those sharing a place with others (variable *MPSD*). The full paper investigates all hypotheses. The model estimation results presented in Table 1 confirm that including activity locations in tour definitions is relevant. When tour complexity is represented solely by the number of activities, corresponding coefficients are counter-intuitive.

Table 1 Estimated coefficients and specification tests of the alternative approaches to tour complexity using a nested logit model for mode choice [*]

Choice [a]	**Traditional approach** [b]	**Proposed approach**	
	$\beta_{N\_Acts} = \beta_{MPSD}$	β_{N_Acts}	β_{MPSD}
Work - Public transport	0.144^{***}	-0.183^{***}	0.779^{***}
Education - Public transport	-0.057^{*}	-0.216^{***}	0.353^{***}
Maintenance - Public transport	0.209^{***}	-0.126^{***}	0.850^{***}
Discretionary - Public transport	0.055^{*}	-0.128^{***}	0.517^{***}
Log-likelihood	-29,406.34	-29,180.17	
2* Log-likelihood difference	452.34		
Significant level	< 0.0001		

[*] Significant at the 10% level; [***] Significant at the 1% level

[a] Reference case is car tours for all purposes, i.e., $\beta_{N\_Acts} = \beta_{MPSD} = 0$

[b] The traditional approach is a special case of the proposed approach when activities undertaking at different places are constrained to have the same effect as activities sharing a destination with others

4 Conclusions

Tours undertaken by car and public transport are found to be different. Public transport tours are more likely to be MPSD with activities chained into a tour being close together and reachable by walking. On the other hand, car tours are more likely to be MPMD. The modelling results show the spatial distribution of activities chained into tours significantly affected the relative utility of public transport, depending on whether activities take place at single or multiple destinations. Additionally, the effect appeared to be different across travel purposes, although less significantly within each subgroup of activities than between them.

These findings, together with an investigation on the types of activities that people have tended to chain into a single destination have important policy and planning implications for increasing public transport ridership. A cluster of activity centres in close proximity where people can engage in multiple activities could promote public transport use through travel as MPSD.

References

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