

# ‘Transit Faithfuls’ or ‘Transit Leavers’? Understanding mobility trajectories of new parents

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## ABSTRACT

First-time parenthood is typically associated with an increase in car orientated travel behaviour. As cities face increasing pressure to reduce growing levels of private car use, understanding the ways in which to prevent the adoption of car-based mobility during this period is becoming increasingly important. However, while much is known about aggregate changes in travel behaviour following parenthood, less is understood about differences that may exist at the individual level. Understanding these differences will help planners and policymakers to introduce more targeted policy interventions for new parents, assisting to curb the tendency towards car orientation.

A latent class analysis is conducted using data from a survey of new parents in Melbourne, Australia. The results reveal five distinct mobility patterns following parenthood. These range from a marked decline in public transit use – *Transit Leavers* – through to remarkably consistent travel behaviour prior to and following parenthood – *Transit Faithfuls*. The findings show that not all parents adopt car orientated travel behaviour following parenthood. Caregiving and employment status, as well as car ownership changes, are shown to be crucial in determining the extent to which travel behaviour changes and new car orientated travel behaviour is adopted. Moreover, each group display distinct characteristics and constraints on their travel choices. This suggests targeted interventions specific to individual groups are necessary to curb the tendency towards car-based mobility among new parents.

## 1. Introduction

Parenthood is a life stage in which travel behaviour typically becomes more car orientated (Ryley, 2006; Kitamura, 2009). Among first-time parents, car ownership and use typically increase, while the use of public transit and cycling decrease (Zwerts et al., 2007; Scheiner and Holz-Rau, 2013). As cities face increasing pressure to reduce growing levels of private car use, understanding ways to curb these unsustainable travel patterns requires attention. This is becoming increasingly urgent as many millennials, a large cohort comprising over a third of the global population, enter this life stage. If millennials follow previous generations and adopt car orientated travel behaviour as they transition into parenthood, it will have a significant long-term impact on the sustainability of the transport system (McDonald, 2015; Delbosc, 2016).

However, while much is known about aggregate changes in travel behaviour following parenthood, less is understood about differences that may exist at the individual level. Not all parents adopt car orientated travel behaviour following the birth of their child. So, which attitudinal or demographic characteristics are associated with adopting less car orientated travel behaviour? Understanding these differences will help planners and policymakers to introduce more relevant and targeted policy interventions for new parents. This, in turn, may assist to curb the tendency towards car orientation following parenthood and

increase the sustainability of transportation systems.

Using the results from a survey of new parents in Melbourne, Australia, this paper seeks to identify typical mobility trajectories following parenthood. It does this by conducting a market segmentation analysis, to identify groups of parents sharing similar travel mode changes following parenthood. Each group is then profiled to understand their associated demographic and attitudinal characteristics. The value of market segmentation approaches lies in formulating relevant policy interventions for specific groups and identifying those groups more primed to change their travel behaviour (Anable, 2005; Haustein and Hunecke, 2013). As such, the profiles are followed by specific policy interventions proposed for each group.

After discussing the relevant literature and describing the study methodology, this paper outlines the results from the market segmentation. Five distinct groups are profiled and described. The paper concludes with a discussion of the implication of these findings and possible policy interventions relevant for each group.

## 2. Literature review

### 2.1. Travel behaviour changes following parenthood

Two strands of transportation research have revealed important

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findings regarding the way in which travel behaviour changes following parenthood. First, studies within the life course perspective examining the effect of childbirth on travel behaviour show that car use and ownership tends to increase in anticipation of parenthood (Prillwitz et al., 2006; Oakil et al., 2016), particularly among formerly carless households (Clark et al., 2016). Following the birth of a child, public transit and cycling typically decrease, while walking increases (Scheiner and Holz-Rau, 2013; de Haas et al., 2018).

Transportation research examining differences in travel behaviour by life stage shows car orientated travel behaviour adopted during the transition to parenthood endures as the household ages. Households with children generally display more car-dependent travel behaviour compared with other household groups (Ryley, 2006; Scheiner and Holz-Rau, 2007). This group is typically less multimodal (Scheiner, 2014) and use public transit and active travel less (Zwerts et al., 2007). The growth in car orientated travel behaviour is attributed to a multitude of psychosocial and structural factors which tend to encourage car-use and ownership whilst discouraging the use of alternative modes (McCarthy et al., 2017).

Although these bodies of literature underscore the highly car orientated nature of travel among families with children at the aggregate level, not all new parents are likely to shift towards car-based mobility. Market segmentation, discussed below, is one approach that helps identify relevant groups that would otherwise not be visible when making observations at the aggregate level.

## 2.2. Market segmentation examining individuals with children

Market segmentation, used widely in both consumer marketing and research, creates groups, or segments, within a population who share similar characteristics. Studies using market segmentation approaches have been widely used in travel behaviour research. The extent of these studies reflects the usefulness of market segmentation as a powerful means to identify groups within a population who can then be targeted in a meaningful and relevant way, that may more likely result in travel behaviour changes (Anable, 2005). Moreover, it allows interventions to be focused on those groups within the population who are more likely to change their travel choices (Haustein and Hunecke, 2013). Within transportation research, groups are often defined based on a combination of travel behaviour, socio-demographic and attitude characteristics (Haustein and Hunecke, 2013).

Segmentation approaches including the presence of children as a variable show that individuals with children are typically, but not always, associated with more car orientated segments. Ryley (2006), conducted a cluster analysis based on life stage, using the results of a large Scottish travel survey. One of the major study findings was that households with children present were considerably more car-dependent than other household groups (Ryley, 2006). Anable (2005), in her seminal work incorporating attitudes towards travel in segmentation analysis, profiled six groups based on their likelihood of changing to more sustainable travel modes. Among the only two non-car owning groups, respondents with children were significantly underrepresented, whereas they were relatively evenly dispersed among the four car-owning groups (Anable, 2005). While recent research from de Haas et al. (2018), examining the impact of life events on changes between segments over time, show that increasing car dependency is evident following the birth of a child, among all segments (de Haas et al., 2018).

Interestingly, however, several studies demonstrate that individuals with children are not always associated with car-dependent traveller segments. Molin (2016), identifying groups of multimodal travellers in the Netherlands, showed that respondents with children were over-represented in the group associated with most frequent car-use but also among the group using a combination of bike and car (Molin et al., 2016). Likewise, Priwltz (2011) conducted a cluster analysis to identify segments based on individuals' daily travel patterns. This revealed that households with children were most likely to be part of the 'consistent

green travellers group' (characterised by higher combined use of cycling and public transit) followed by the 'frequent car users' group (Prillwitz and Barr, 2011). It should be noted that these studies were undertaken in differing transport contexts, had differing objectives and used different segmentation approaches and analysis variables. However, this finding, that parents with children are not always associated with car orientated groups, supports the notion that while travel patterns of families with children may often be car orientated, this is not always the case.

Numerous market segmentation analyses have been undertaken in transport research. However, to the authors' knowledge, none have specifically examined travel pattern changes following parenthood. As this is a crucial period in which car orientated travel behaviour is adopted, understanding segments that may be more primed to retain or adopt less car orientated travel behaviour is important for the formation of effective car reduction policies. This paper seeks to address this gap.

## 3. Method

### 3.1. Questionnaire and sample

The data used in this analysis comes from an online survey of new parents, conducted during 2018, in Melbourne, Australia. Participants were recruited through posting a survey link on social media and a smaller number through the researchers' personal networks. While the survey was open to parents with at least one child aged five years and younger ( $n = 903$ ), respondents who only had children aged five years and younger were used in this analysis ( $n = 758$ ). This was to ensure the timeframe to examine mode changes (between one and six years) was relatively comparable among respondents.

The survey recruited individuals rather than households as our earlier work highlighted notable differences in the extent of mobility changes by individual characteristics such as gender, attitudes and caregiving status. The sample aimed to be broadly representative of parents with young children in Greater Melbourne in terms of age, partnership status, location, household income and gender. A non-probability purposive sampling method was adopted. As shown in Table 1, the final sample was representative across most characteristics identified. However, male respondents were significantly under-represented (17% of respondents) and respondents on low-incomes were notably under-represented. To address the gender imbalance, we applied gender weights to the dataset. Each male response was weighted by 2.96, while each female response was weighted by 0.61. The results presented in this paper, unless otherwise stated, are based on the weighted dataset.

The survey questionnaire was structured into the following six sections: travel habits; current and preparenthood mode use; life events; travel and housing attitudes; barriers to public transit use; and, demographic characteristics. To identify different mobility trajectories following parenthood, the sections regarding current and preparenthood mode use, attitudes and demographic characteristics, were used.

Travel mode changes between the year prior to becoming a parent for the first-time (pre-parenthood status) and currently were derived from two questions. Firstly, respondents were asked the frequency in which they currently travelled by car (driver or passenger), public transit, cycling and walking. Respondents were provided with 8 options: 'Practically everyday', '4–6 days per week', '1–3 days per week', '1–3 days per month', '6–11 days per year', '1–5 days per year', 'less than 1 day per year', and 'never'. The next question again asked about mode use frequency, but for the period one year prior to becoming a parent for the first time. In the second question, respondents were also provided with a further option for 'Don't know/can't recall'.

The inclusion of a large number of categories in each indicator increases the number of possible patterns which poses problems for classification. As such, we reduced the number of categories in each of the six indicators from eight to three, as follows: 'frequent' = four or

**Table 1**  
Survey respondent characteristics.

Characteristic	Variable	Survey respondents		2016 Census, Greater Melbourne	
		Unweighted	Weighted	HH with children aged 0-4	All HH
Gender	Male	17%	50%	50%	49%
	Female	83%	50%	50%	51%
Household composition	Dual parent family household	92%	93%	84%	34%
	Single parent family household	8%	7%	10%	10%
	Other	–	–	6%	56%
Household car ownership	No car	3%	3%	2%	9%
	1 car	32%	32%	24%	33%
	2 or more cars	65%	65%	74%	55%
Household* income	Less than \$499 per week	4%	5%	17%	13%
	\$500 - \$999 per week	11%	11%	19%	17%
	\$1000 - \$1499 per week	17%	17%	17%	16%
	\$1500 - \$1999 per week	21%	20%	13%	12%
	\$2000 - \$2499 per week	14%	13%	11%	18%
	More than \$2500 per week	34%	34%	23%	24%
Household location	Inner urban	12%	14%	–	–
	Middle urban	44%	43%	–	–
	Outer urban	38%	37%	–	–
	Regional	6%	6%	–	–
Children*	Children per household (mean)	1.5	1.5	1.8	0.8

Notes: '–' indicates data is not available; '\*' indicates Census data based on households with dependent children aged 15 years and younger.

more days per week; 'occasional' = between 1 and 12 days a month; and, 'rare' = less than twelve days per year. Walking was excluded from the analysis as even with the reduction in categories for each indicator the number of possible patterns was still very high.

Most of the attitudinal questions included in the questionnaire were sourced from the Netherlands Mobility Panel (Hoogendoorn-Lanser et al., 2015). The questions aimed to test car reliance, social norms, pro-environmental attitudes and attitudes to travelling by car and public transit. Questions were asked on a five-point scale ranging from 'strongly disagree' to 'strongly agree'.

The final questions regarding respondents' demographics. Respondents were asked about their individual characteristics (gender, age-group, partnership status, caregiving status) and their household (income, postcode, current vehicle ownership, vehicle ownership one-year prior to becoming a parent, number and age of children).

### 3.2. Analysis methods

The objective of this analysis was to identify different groups that share similar changes in travel mode use following parenthood. Moreover, it aimed to understand the attitudes and socio-demographic characteristics associated with each group. In order to understand this, we conducted a latent class analysis (LCA) using Latent Gold software. LCA is a subset of structural equation modelling. However, in contrast to cluster-based modelling techniques, LCA probabilistically assigns individuals to classes or groups. Statistical criteria are used to determine the least number of classes which can sufficiently explain the association between the indicators. The technique is becoming increasingly common in travel behaviour research. For a succinct summary of the advantages of LCA, see Araghi et al. (2017).

Six indicator variables with three categories each were used to determine the class membership. These were derived from the questions regarding current and preparenthood mode use. Specifically, current and preparenthood frequency of car (driver or passenger), public transit and cycling use. Mode use frequency for each indicator was categorised as follows: 'frequent' = four or more days per week; 'occasional' = between 1 and 12 days a month; and, 'rare' = less than twelve days per year.

In addition, socio-demographic and attitudinal variables were included, all as active covariates predicting the class membership. Specifically, the following attitudinal variables were included in the analysis: 'I only use a car if it is really necessary'; 'I could not manage

without a car'; 'With the environment in mind, in the past year I have consciously tried to drive a car less'; 'It is pointless to worry about the environment, because there is nothing you can do about it on your own'; 'Due to costs, I opt to travel by public transport instead of by car'; 'I feel safe using public transport'; 'Using public transport is a satisfying experience'. Three other questions testing social norms, attitudes to the cost of car travel and the extent to which a car provides freedom were not significant in predicting class membership and not included in the final model.

## 4. Results

### 4.1. Model fit

After running a series of models with between 2 and 10 classes, a five-class solution was selected as the optimal number of classes. As shown in Table 2, the five-class solution had the lowest Bayesian Information Criterion (BIC). The BIC is commonly used to determine, amongst a series of models, the optimal number of classes. Generally, when selecting the preferred model amongst a series of models, the model with the lowest BIC is chosen. Moreover, the models with more than five classes included classes with very small sizes, making interpretation problematic.

### 4.2. Class profiles

Profiles of the indicators used to predict class membership are displayed in Figs. 2–6 while the active covariates used in the model are

**Table 2**  
Model fit statistics.

Number of clusters	Log-likelihood	BIC(LL)	No. of parameters	Class errors
2-Cluster	–2045	4379	46	0.02
3-Cluster	–1905	4313	80	0.04
4-Cluster	–1787	4289	114	0.01
5-Cluster	–1661	4252	148	0.01
6-Cluster	–1587	4317	182	0.01
7-Cluster	–1569	4494	216	0.04
8-Cluster	–1486	4541	250	0.02
9-Cluster	–1438	4660	284	0.01
10-Cluster	–1379	4756	318	0.01

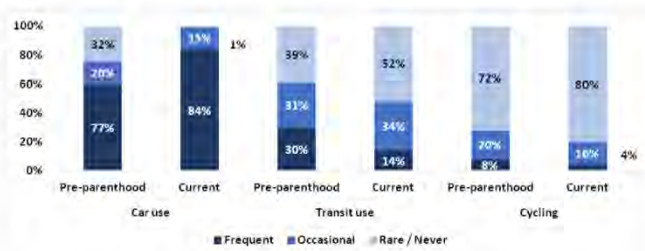


Fig. 1. Overall sample pre-parenthood and current (parenthood) mode use.

shown in Table 3. The five groups, described below, are referred to as *Transit Leavers* (Group 1), *Consistent Drivers* (Group 2), *Committed Multimodals* (Group 3), *Transit Faithfuls* (Group 4) and *Devoted Cyclists* (Group 5).

As shown in Fig. 1, among the overall sample, public transit shows the most notable decline in mode use frequency, followed by cycling. Travel by car is the only mode to exhibit an increase in use. In the year prior to parenthood, 39% of respondents used public transit rarely or not at all increasing to over half of respondents (52%) currently. In contrast, the proportion of respondents rarely or never using the car decreased from nearly a third (32%) pre-parenthood to less than 1% currently.

Overall, the most notable mode use changes following parenthood are apparent in Group 1, *Transit Leavers*, and Group 5, *Devoted Cyclists*. The remaining three groups (*Consistent Drivers*, *Committed Multimodals*, *Transit Faithfuls*) are characterised by minimal changes in mode use. Among the *Transit Leavers* members were most likely to be the primary caregiver and to work part-time. Accommodating childcare responsibilities and differing employment patterns is likely to explain the growth in car-based travel and reduced use of alternative modes among this group. As females are more likely to be the primary caregiver in this sample, this likely explains the gendered differences between the *Transit Leavers* and the other groups. In contrast, the mode-use changes apparent among the *Devoted Cyclists* can be attributed to an increase in car ownership.

#### 4.2.1. Transit Leavers

The largest Group (39% of respondents), termed *Transit Leavers* due to the significant decline in public transit use following parenthood, is the only group to contain predominantly women (82%). The *Transit Leavers* also have the highest proportion of respondents who were the primary caregiver (68%), a stay-at-home parent (28%) and employed part-time (38%). As shown in Fig. 2, in the year prior to parenthood, half the members of this group used public transit frequently and a further 38% occasionally. This reduces to just 10% of members frequently using public transit and 58% occasionally using public transit, currently. The decline in public transit use is replaced by an increase in private vehicle use with the proportion of frequent users increasing from 69% pre-parenthood to 89% currently.

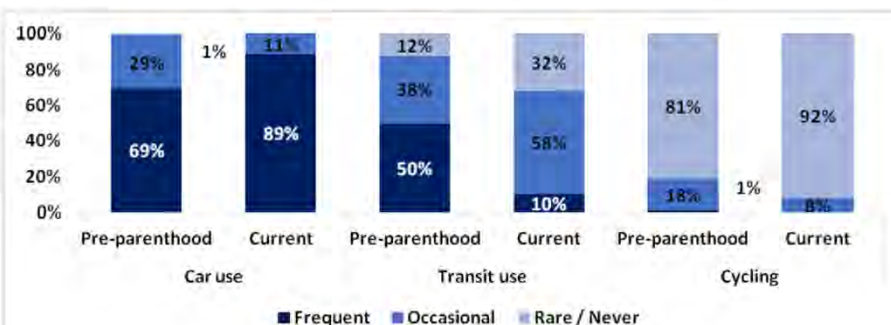


Fig. 2. Transit Leavers pre-parenthood and current (parenthood) mode use.

Overall, the *Transit Leavers* show pragmatic but reliant attitudes towards car-use (Table 2). The group scored highly in terms of “could not manage without a car” but slightly higher than average with regards to “using the car only when necessary”. Interestingly, despite this group being characterised by a decline in public transit use, attitudes regarding public transit satisfaction are highest among all the groups. Similarly, scores regarding safety on public transit are higher than both groups 2 and 3. This suggests that while public transit may currently not meet the needs of this group when their circumstances change, they may return.

#### 4.2.2. Consistent Drivers

*Consistent Drivers* are the second largest group, comprising a quarter of respondents. Members of the *Consistent Drivers* continued to use cars frequently both prior to parenthood and presently (Fig. 3). Of note, while a large majority of members used public transit rarely prior to parenthood (78%), this increased to nearly all of the members (98%) currently. Like the *Transit Leavers*, the *Consistent Drivers* have a high proportion of members who are the primary caregiver (48%). Interestingly though, this group has the evenest gender split out of all groups with males comprising 52% of members. Out of all the five groups, the *Consistent Drivers* are most likely to live in Outer Melbourne (67%) and regional areas (10%) and most likely to be in the lowest income group (21%). Car ownership among this group is high, with 83% residing in a household with two or more vehicles. This clustering of characteristics suggests the group may be experiencing “forced car ownership”. This a concept applied to households, often living in urban periphery areas and experiencing aspects of social disadvantage, who are “forced” into car ownership due to a lack of transport alternatives (Currie and Senbergs, 2007).

Analogous to the *Transit Leavers*, this group shows strong attitudes regarding reliance on a private vehicle. However, the *Consistent Drivers* are the least likely to attempt to reduce their car use due to environmental reasons and most likely to agree with the statement regarding ‘It is pointless to worry about the environment, because there is nothing you can do about it on your own’. This group also has the lowest satisfaction with public transit, both in terms of safety and overall satisfaction. The high levels of car-use among this group are likely to be attributed to their location and household circumstances as well as their attitudes which are predisposed to car-use.

#### 4.2.3. Committed Multimodals

Like the *Consistent Drivers*, the *Committed Multimodals* (17% of respondents) are characterised by minimal changes in mode use following parenthood. Members also share similar attitudes towards transport and the environment as the *Consistent Drivers*, which tend to favour car-use. However, as shown in Fig. 4, while they are frequent car-users, most members of this group are also likely to use public transit and cycle occasionally. Compared with the *Consistent Drivers*, a larger share of this group lives in middle urban areas, better serviced by public transit. Moreover, the *Committed Multimodals* have a considerably higher share

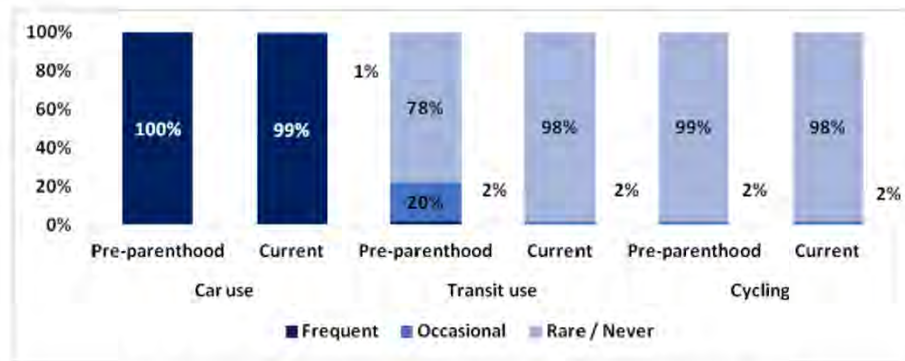


Fig. 3. Consistent Drivers pre-parenthood and current (parenthood) mode use.

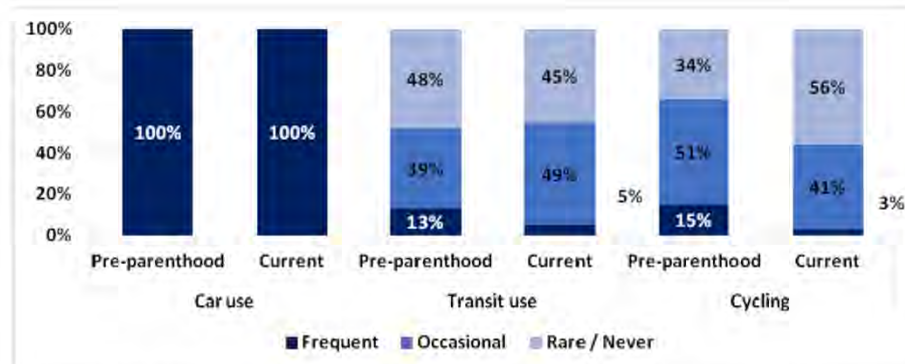


Fig. 4. Committed Multimodals pre-parenthood and current (parenthood) mode use.

of male members (82%) and those who are the non-primary caregiver. The differences between location and caregiving responsibilities could explain the greater use of public transit and cycling among the *Committed Multimodals* compared with the *Consistent Drivers*.

#### 4.2.4. Transit Faithfuls

*Transit Faithfuls*, comprising 11% of respondents, are described as such given the comparatively high frequency of public transit use, both prior to parenthood and currently. As shown in Figs. 5 and 84% of *Transit Faithfuls* used public transit frequently and 15% occasionally, prior to parenthood. This drops to 64% of members using public transit frequently currently, with the remainder shifting to occasional use (35%). While this represents a decline in public transit use, the group has the highest rates of public transit usage, both prior to and following parenthood compared with the other groups. The high frequency of transit use coupled with the low frequency of car-use and cycling, as well as the higher than average employment rates, suggests that members of this group primarily use transit for commuting purposes.

Members of the *Transit Faithfuls* are most likely male (72%), employed full-time (72%) and live in Middle urban areas (62%). They are also typically from the highest income bracket (71%) and have comparatively low rates of household vehicle ownership, with most members residing in a single-vehicle household (48%) and 10% of respondents residing in a carless household. This group shows favourable attitudes towards public transit with variables regarding using public transit due to cost, safety on public transit and satisfaction with public transit all scoring higher than average.

#### 4.2.5. Devoted Cyclists

The final group, comprising just 8% of respondents, are characterised by their comparatively high cycling rates and notable change

in vehicle ownership following parenthood.<sup>1</sup> Nearly half of members (46%) were carless prior to parenthood but this drops to just 1% following parenthood. However, car ownership remains the lowest of all groups following parenthood with 62% residing in a single-vehicle household. Moreover, overall vehicle use is relatively low, with just 41% of members using the vehicle frequently, and 56% occasionally.

Like the *Transit Faithfuls*, the *Devoted Cyclists* have favourable attitudes towards public transit. However, this group also shows strong pro-environmental attitudes that are likely to influence their car use. Moreover, this group scored strongly on only using the car when necessary. These attitudes coupled with notably low pre-parenthood car-ownership levels and low frequency of car use presently (Fig. 6), suggests that members of this group transitioned to car ownership with some reluctance.

Overall, current car-use is highest among the *Transit Leavers*, *Consistent Drivers* and *Committed Multimodals*, while the lowest among the *Transit Faithfuls* and *Devoted Cyclists*. Group 1 is characterised by a high proportion of part-time workers and primary caregivers, while Group 2 has the highest proportion of members living in outer urban areas, likely to be less well served by transit. In contrast, groups 4 and 5 are more likely to live in inner or middle urban areas, from the highest income group and employed full-time. Differences in household location and income as well as in caregiving and employment practices among the groups suggest different travel constraints exist. Respondents with primary caregiving responsibilities are likely to have

<sup>1</sup> We note this class exhibits more multi-modal travel behaviour than the *Committed Multimodals*. However, the most striking transport characteristic of this group is their continual frequent use of cycling and, as such, this is reflected in the group's title.

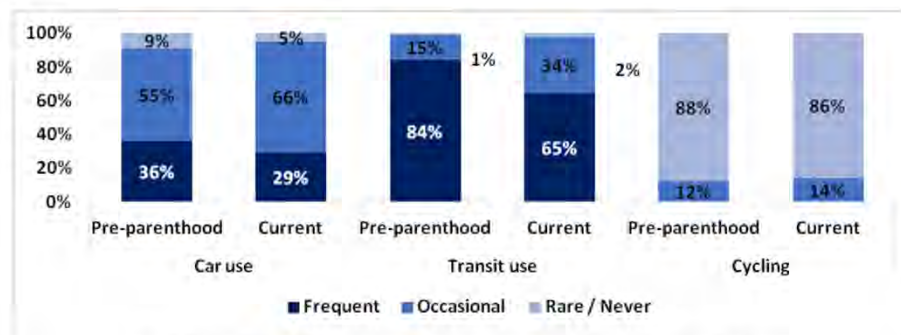


Fig. 5. Transit Faithfuls pre-parenthood and current (parenthood) mode use.

more complex travel routines as they accommodate the travel needs of their young children. Similarly, housing location and income can constrain travel choices. This suggests different policy implications for each group, discussed in the following section, are appropriate.

## 5. Discussion and conclusion

This analysis aimed to identify separate groups sharing similar mobility trajectories following parenthood. In doing so the findings provided two important contributions. First, in contrast to the well-established literature regarding increasing car-orientation following parenthood at the household level, the results of the latent class analysis show a range of travel mode changes are evident. While car use did indeed increase for most groups, for other groups displaying more sustainable travel patterns, minimal changes were observed. Characteristics apparent among the two groups showing shifts towards car-based mobility include a higher likelihood of being the primary caregiver, employed part-time and a stay-at-home-parent (*Transit Leavers*) as well as an increase in car ownership, specifically from zero to one car (*Devoted Cyclists*). The second notable finding is that each of these groups represents five distinct patterns of mode-use changes. This suggests that to reduce the adoption of car-based mobility following parenthood, policy interventions should be tailored for different groups of new parents.

### 5.1. Policy implications

Generally, travel behaviour interventions targeting segments with more favourable attitudes towards alternative modes will be more successful than attempting to convert those with less favourable attitudes towards public or active transit (Anable, 2005). As such, policy attention should be focussed on the groups which show a higher

likelihood of mode switching. Table 4 presents an overview of the type of interventions appropriate for each group.

The largest group, *Transit Leavers*, show favourable attitudes towards public transit and yet they have the most pronounced decline in public transit use. Higher than average scores for car reliance suggest that due to current constraints, their travel mode preferences favour the car. The characteristics strongly associated with this group, namely primary caregiver status and part-time employment, could explain why their travel mode preferences have become more car orientated. Accommodating a child's travel needs as well as their own is likely to increase the complexity of travel and introduce constraints regarding the new destinations and activities they need to reach within existing time travel budgets. Moreover, part-time employment is more likely to involve off-peak commutes when transit services may be less frequent and harder to accommodate day-care pickup times.

Nonetheless, while the reasons for the decline in public transit use are readily explainable, it does raise several other questions. Favourable attitudes towards public transit are typically predicated on the frequent ongoing use of this mode (Beirão and Sarsfield Cabral, 2007; Kroesen et al., 2017). If public transit is no longer meeting the current needs of these former users, how long are they likely to retain their favourable attitudes towards public transit? When the current constraints to travelling on public transit are no longer in place, will they return to public transit or will new car orientated attitudes and behaviours have formed? The answers to these questions will have significant implications for justifying funding to better accommodate new parents on public transit systems. If these users are lost permanently, investing in public transit systems in order to retain these users, seems considerably more important. Small-scale improvements, such as increasing the provision for caregiver parking at park and ride stations, have been suggested in Table 4. However, further research examining the longer-term implications of declining public transit use among this group will

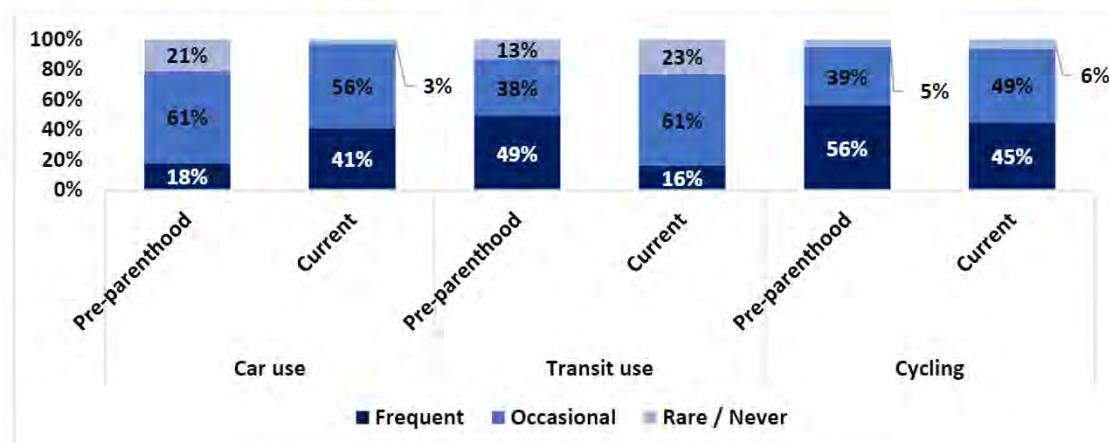


Fig. 6. Devoted Cyclists pre-parenthood and current (parenthood) mode use.

**Table 3**  
Active covariates.

Active Covariates		TL	CD	CM	TF	DC	Sample
Class size		39%	25%	17%	11%	8%	
Gender	Male	0.22	0.53	0.82	0.72	0.76	0.50
	Female	0.78	0.47	0.18	0.28	0.24	0.50
Primary caregiver	Non-primary caregiver	0.37	0.52	0.64	0.69	0.65	0.52
	Primary caregiver	0.63	0.48	0.36	0.31	0.35	0.48
Relationship status	Single	0.09	0.07	0.10	0.06	0.00	0.07
	Couple (Married or de facto)	0.91	0.93	0.90	0.94	1.00	0.93
Full licence status	Does not have full licence	0.11	0.01	0.00	0.04	0.18	0.07
	Has full licence	0.89	0.99	1.00	0.96	0.82	0.93
Employment status	Full-time employment	0.30	0.49	0.61	0.72	0.75	0.48
	Part-time employment	0.36	0.21	0.25	0.21	0.19	0.27
	Student	0.05	0.01	0.03	0.01	0.00	0.03
	Unemployed/Job seeker	0.01	0.02	0.04	0.01	0.00	0.02
	Stay at home parent	0.28	0.26	0.05	0.05	0.06	0.20
	Unable to work	0.00	0.00	0.02	0.00	0.00	0.00
Region	Inner urban	0.15	0.01	0.12	0.22	0.34	0.14
	Middle urban	0.51	0.22	0.51	0.62	0.52	0.43
	Outer urban	0.30	0.67	0.32	0.16	0.08	0.37
	Regional	0.03	0.10	0.04	0.00	0.06	0.06
Household income	Less than \$999 per week (pw)	0.14	0.21	0.16	0.07	0.13	0.16
	Between \$1000 - \$1999 pw	0.43	0.43	0.35	0.21	0.17	0.37
	More than \$2000 pw	0.43	0.37	0.49	0.71	0.71	0.47
Pre-parenthood household vehicle ownership	None	0.02	0.00	0.06	0.20	0.46	0.08
	1	0.44	0.15	0.33	0.53	0.26	0.34
	2	0.45	0.71	0.58	0.28	0.28	0.51
	3 or more	0.08	0.14	0.03	0.00	0.00	0.07
Current household vehicle ownership	None	0.01	0.02	0.00	0.10	0.01	0.03
	1	0.44	0.15	0.18	0.48	0.62	0.32
	2	0.45	0.67	0.79	0.41	0.35	0.56
	3 or more	0.11	0.16	0.03	0.00	0.01	0.09
Age group	29 years or younger	0.13	0.31	0.24	0.01	0.01	0.17
	30–39 years	0.70	0.64	0.47	0.79	0.65	0.66
	40 years or older	0.17	0.05	0.29	0.20	0.34	0.17
Number of children per household (mean)		1.61	1.36	1.35	1.41	1.40	1.45
Attitudes [Mean – A scale of 1 (Strongly disagree) to 5 (Strongly agree)]	Car used only when necessary	2.88	2.34	2.13	3.25	3.79	2.77
	Could not manage without a car	4.21	4.29	3.93	3.04	3.31	3.98
	Pro-environmental	2.60	2.14	2.65	2.87	3.46	2.58
	Inaction towards environment	2.00	2.61	2.24	2.22	1.86	2.21
	Due to costs, use public transit	2.19	1.62	2.30	3.48	2.42	2.27
	Feel safe using public transit	3.76	2.52	2.78	4.30	3.87	3.27
	Satisfaction with public transit	3.03	2.33	2.63	2.82	2.81	2.72

**Note:** TL: Transit Leavers; CD: Consistent Drivers; CM: Committed Multimodals; TF: Transit Faithfuls; DC: Devoted Cyclists.

be worthwhile in order to justify more substantive investment in public transit to ensure it meets new parents' travel needs.

*Committed Multimodals* display promising characteristics predisposed to travel behaviour changes. While they are all frequent car users, nearly half also cycle (44%) and use public transit (54%) at least occasionally. They experienced minimal changes in travel behaviour following parenthood and are the least likely to be the primary caregiver. This suggests that parenthood has had a minimal effect on their travel choices and so more general policies encouraging an uptake in the use of public transit and active travel would be effective. As car ownership is high among this group, encouraging the use of alternate modes, such as car sharing, may assist in reducing car ownership levels which, in turn, will assist to reduce car use. However, in order for alternative modes to be utilised among this group, they must accommodate the specific needs of families with children. For example, most car sharing fleets do not include child seats, creating a barrier to using this mode when travelling with young children.

Likewise, *Transit Faithfuls* are less likely to be encumbered with childcare responsibilities and so face fewer constraints on their travel choices. However, the majority of this group use cars frequently (29%) or occasionally (66%). As they already have favourable attitudes towards public transit and the vast majority are frequent (65%) or occasional (34%) users, this suggests there is scope to convert some of these car trips to public transit trips. This could be achieved by

promoting public transit for recreational trips. Moreover, as this group signalled cost was an important factor in travelling by public transit, promoting seasonal public transit passes may be effective.

Finally, while a small group, the *Devoted Cyclists* experienced a notable shift towards car-based mobility following parenthood. While the group continued to display comparatively high rates of cycling following parenthood, a significant increase in household vehicle ownership and a moderate increase in car use was observed. Among the group, less than a third were likely to be the primary caregiver. This suggests that the car may have been purchased for the primary caregiver in the household as the majority of users only use the car occasionally (56%). However, the group show strong pro-environmental attitudes and generally lower levels of car reliance. This suggests that interventions *prior* to parenthood may be effective in preventing a rise in car ownership and a commensurate increase in car use. Moreover, promoting the environmental benefits associated with public transit and alternative modes may also be productive.

Overall, the five groups show distinct constraints on their travel choices and general attitudes towards travel. This is reflected in the differences to which their travel modes change following parenthood. Moreover, it calls for differing policy interventions, as outlined above. The research also suggests several areas of future research. Obtaining more granular location data as well as including questions to garner preferences regarding residential neighbourhoods would allow the

**Table 4**  
Policy interventions by segment.

Group	Typical characteristics	Drivers to using alternate modes	Constraints to using alternate modes	Policy interventions	Likelihood of switching
Transit Leavers	Female; Primary caregiver; Employed part-time; Middle urban areas; Middle/high income; High car reliance	Positive attitudes towards transit; Familiarity with transit use	Caregiving responsibilities; Car reliant attitudes.	Increase off-peak service frequency; Improve transit network connectivity and density; Dedicated 'caregiver parking' at stations; Provide information about travelling with children using alternate modes	Medium
Consistent Drivers	Outer/regional urban areas; Low/middle income; High car ownership; Young; High car reliance	None	Caregiving responsibilities; High car ownership; Car reliant attitudes; Transit poor location	Promote transit as a fun activity with children	Low
Committed Multimodals	Male; Employed full-time; Non-primary caregiver; Middle/high income; Middle/Outer urban areas	Occasional cyclist and transit user	High car ownership	Promote car sharing as an alternative to a second vehicle	Medium
Transit Faithfuls	Male; Employed full-time; Non-primary caregiver; Middle urban; High-income; Positive public transit attitudes; Lowest levels of car reliance	Low car ownership; Transit-rich location; Lower levels of car reliance	Moderate level of car reliance	Promote public transit for recreational travel; Promote public transit passes	High
Devoted Cyclists	Male; Employed full-time; Non-primary caregiver; Inner/middle urban; High-income; Positive public transit attitudes; Lower levels of car reliance; Strong pro-environmental attitudes	Pro-environmental attitudes and positive transit attitudes; Low car ownership; High rates of cycling	Moderate level of car reliance	Reinforce environmental benefits of public transit and active travel; Promote car sharing as an alternative to car ownership; Cycling infrastructure improvements.	High

Source: Adapted from Anable (2005).

impact of proximity to public transit and role of residential self-selection in influencing declining public transit usage to be investigated. In addition, further research examining the long-term implications of declining public transit use among new parents would be beneficial. This would help justify greater investment to ensure public transit and active travel networks meet the needs of new parents, particularly those who are primary caregivers for their children. This, in turn, would assist to curb the tendency towards car orientation among new parents, with long-term benefits for the sustainability of transportation systems.

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## References

- Anable, J., 2005. 'Complacent Car Addicts' or 'Aspiring Environmentalists'? Identifying travel behaviour segments using attitude theory. *Transport Pol.* 12 (1), 65–78.
- Araghi, Y., Kroesen, M., van Wee, B., 2017. Identifying reasons for historic car ownership and use and policy implications: an explorative latent class analysis. *Transport Pol.* 56, 12–18.
- Beirão, G., Sarsfield Cabral, J.A., 2007. Understanding attitudes towards public transport and private car: a qualitative study. *Transport Pol.* 14 (6), 478–489.
- Clark, B., Chatterjee, K., Melia, S., 2016. Changes in level of household car ownership: the role of life events and spatial context. *Transportation* 43, 565–599.
- Currie, G., Senbergs, Z., 2007. Exploring forced car ownership in metropolitan Melbourne. In: 30th Australasian Transport Research Forum.
- de Haas, M.C., Scheepers, C.E., Harms, L.W.J., Kroesen, M., 2018. Travel pattern transitions: applying latent transition analysis within the mobility biographies framework. *Transport. Res. Pol. Pract.* 107, 140–151.
- Delbosc, A., 2016. Delay or forgo? A closer look at youth driver licensing trends in the United States and Australia. *Transportation* 1–8.
- Haustein, S., Hunecke, M., 2013. Identifying target groups for environmentally sustainable transport: assessment of different segmentation approaches. *Curr. Opin. Environ. Sustain.* 5 (2), 197–204.
- Hoogendoorn-Lanser, S., Schaap, N.T.W., OldeKalter, M.-J., 2015. The Netherlands mobility Panel: an innovative design approach for web-based longitudinal travel data collection. *Transp. Res. Procedia* 11, 311–329.
- Kitamura, R., 2009. Life-style and travel demand. *Transportation* 36 (6), 679–710.
- Kroesen, M., Handy, S., Chorus, C., 2017. Do attitudes cause behavior or vice versa? An alternative conceptualization of the attitude-behavior relationship in travel behavior modeling. *Transport. Res. Pol. Pract.* 101, 190–202.
- McCarthy, L., Delbosc, A., Currie, G., Molloy, A., 2017. Factors influencing travel mode choice among families with young children (aged 0–4): a review of the literature. *Transport Rev.* 37 (6), 767–781.
- McDonald, N.C., 2015. Are millennials really the "Go-Nowhere" generation? *J. Am. Plan. Assoc.* 81 (2), 90–103.
- Molin, E., Mokhtarian, P., Kroesen, M., 2016. Multimodal travel groups and attitudes: a latent class cluster analysis of Dutch travelers. *Transport. Res. Pol. Pract.* 83, 14–29.
- Oakil, A.T.M., Manting, D., Nijland, H., 2016. Dynamics in Car Ownership: the Role of Entry into Parenthood, vol 16. pp. 661–673 4.
- Prillwitz, J., Barr, S., 2011. Moving towards sustainability? Mobility styles, attitudes and individual travel behaviour. *J. Transp. Geogr.* 19 (6), 1590–1600.
- Prillwitz, J., Harms, S., Lanzendorf, M., 2006. Impact of life-course events on car ownership. *Transport. Res. Rec.* 71–77.
- Ryley, T., 2006. Use of non-motorised modes and life stage in Edinburgh. *J. Transp. Geogr.* 14 (5), 367–375.
- Scheiner, J., 2014. Gendered key events in the life course: effects on changes in travel mode choice over time. *J. Transp. Geogr.* 37, 47–60.
- Scheiner, J., Holz-Rau, C., 2007. Travel mode choice: affected by objective or subjective determinants? *Transportation* 34 (4), 487–511.
- Scheiner, J., Holz-Rau, C., 2013. A comprehensive study of life course, cohort, and period effects on changes in travel mode use. *Transport. Res. Pol. Pract.* 47, 167–181.
- Zwerts, E., Janssens, D., Wets, G., 2007. How the Presence of Children Affects Parents' Travel Behavior Transportation Research Board 86th Annual Meeting. Washington DC, USA.