

## **New Zealanders' travel patterns: trends in trip chaining and tours**

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### **Abstract**

In 2008, we reformulated the 2004-07 Ongoing New Zealand Household Travel Survey trips dataset into trip chains and tours. We based this on our previous reformulation of the 1997/98 New Zealand Household Travel Survey dataset. Trip chains and tours are combinations of the basic unit of these surveys, the trip leg. For example, if I drive home from work but stop briefly twice (e.g., to get a newspaper, and later to pick up children), that travel comprises three trip legs but only one trip chain.

Using the reformulated datasets, we made comparisons between New Zealanders' travel patterns in 1997/98 and the four-year period of 2004-07 and commented on the emergence of some trends in New Zealand travel behaviour.

Among other things, in comparing 2004-07 with the earlier 1997/98 dataset, we found that:

- The mean number of trip chains per day (2.3) and the mean number of tours per day (1.3) were essentially unchanged.
- Both trip chains and tours showed an increasing propensity to have fewer segments.
- Vehicle-driver-only trip chains increased significantly to 53% from 48% of all trip chains. Vehicle driver only tours increased significantly to 50% from 47%.
- The vast majority of trip chains and tours are 'non-work/non-education' tours (e.g. personal business; social welfare; social; recreational).
- Walk-only trip chains declined to 11% from 13%.

### **Background**

In 2003/04, Pinnacle Research (now Pinnacle Research & Policy Ltd) and Capital Research reformulated the 1997/98 New Zealand Household Travel Survey (NZHTS) database into two datasets, one comprising what are known as 'trip chains' and the other as 'tours.' The results of this work were published as a Land Transport New Zealand Research Report (O'Fallon and Sullivan 2005a), as well as being presented at the Sustainable Land Transport Conference in Wellington (November 2004) and the ATRF in Sydney (O'Fallon and Sullivan 2005b).

When we completed the analysis, we noted that the NZHTS database was reasonably 'old' (being compiled in 1997/98), but that the survey was established as a continuous survey (ONZHTS) in 2003. The continuous survey provided the opportunity reformulate the new datasets into trip chains and tours and conduct a trend analysis, which was published in early 2009 (O'Fallon and Sullivan 2009b).

Within the continuous survey, people in approximately 2200 households in 280 meshblocks<sup>1</sup> throughout New Zealand are invited to participate in the survey each year. Each person in the household is then visited and interviewed about all their travel for two consecutive days specified by the interviewer. As has been the case for the 1989/90 and 1997/98 surveys, surveying takes place throughout the year, and every day of the year is included in the sampling, thus addressing potential seasonal bias. Day 1 begins at 4 am and Day 2 ends at 3.59 am. In the continuous survey, a 'complete' dataset representing all of New Zealand is compiled every four years.<sup>2</sup>

To enable comparison with the results of the earlier travel surveys, essentially the same questionnaire and response coding was used in the continuous survey as in the 1997/98 and 1989/90 surveys. Minor changes were made to update wording and response categories. One improvement made for the 2004–07<sup>3</sup> survey is that laptop computers were used by interviewers to improve data quality and reduce the time required for the interviews.

Because the ONZHTS does use largely the same questions and response coding as the 1997/98 survey, we were able to modify and apply our programming to the updated database fairly easily. The basic programming process is described in our earlier report (O'Fallon and Sullivan 2005a), while additional information regarding the treatment of 'professional drivers' and trip segment lengths with respect to the 2004-07 survey are contained in O'Fallon and Sullivan (2009b).

To avoid the inherent difficulties in trying to establish what any one individual regarded as their 'day' (as opposed to how a 'day' was defined within the NZHTS/ONZHTS datasets), we simply applied our definitions for trip chains and tours across both travel days recorded by the respondent.

To gain some perspective on the results from different units (segments, chains, tours), it may be useful to know just how many of each unit is typical:

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<sup>1</sup> The meshblock is the smallest geographic unit for which statistical data is collected and processed by Statistics New Zealand. A meshblock is a defined geographic area, varying in size from part of a city block to large areas of rural land. Each meshblock abuts against another to form a network covering all of New Zealand ([www2.stats.govt.nz](http://www2.stats.govt.nz)).

<sup>2</sup> Further detailed information about the continuous survey can be obtained from the Ministry of Transport website [www.transport.govt.nz/ongoing-travel-survey-index/](http://www.transport.govt.nz/ongoing-travel-survey-index/). Information about the 1997/98 NZHTS is recorded in Land Transport Safety Authority (2000).

<sup>3</sup> We have labelled the dataset collected between 1 July 2003 and 30 June 2007 as the '2004/07 dataset', referring to the *end* of the data collection year (which matches the New Zealand Government's financial year, 1 July – 30 June).

- On average, respondents reported **4.3 segments (trip legs) per day** in the 2004–07 dataset; 4.4 segments in the 1997/98 dataset.
- Tours are a distinctly broader unit of measurement and people often complete only one in a day. The average was **1.3 tours per day** in both the 1997/98 and 2004–07 datasets.
- Trip chains, as we defined them using a 90 minute cut-off, provide an alternative unit that is usefully intermediate in scope between segments and tours. Respondents averaged **2.4 trip chains per day** in the 2004–07 dataset (2.3 trip chains in the 1997/98 dataset).

The analysis of changes over a period of time (trend analysis) is useful to detect travel patterns that could lead to future quality or infrastructure provision problems (e.g. creating pressures or bottlenecks in infrastructure use) as well as to forecast future demand periods. Understanding the trends in New Zealanders' travel behaviour is also helpful to decision- and policy-makers wanting to select and target travel demand management programmes designed to encourage more sustainable transport use. For example, we are able to provide the evidence to answer questions such as:

- Are New Zealanders' travel patterns becoming more complex?
- Are walking and cycling trip chains and tours increasing relative to car-based tours and trip chains?
- Have the types of people making different types of trip chains or tours changed at all?
- Are work-based trip chains and tours increasing or decreasing relative to tours and trip chains for other purposes?
- Are New Zealanders making longer or shorter trip chains and tours relative to 1997/98?

Formal recognition of the importance of our alternative units (trip chains and tours) for monitoring trends has come recently in the Ministry of Transport's Transport Monitoring Indicator Framework ([www.transport.govt.nz/tmif/](http://www.transport.govt.nz/tmif/)). Two of the travel behaviour indicators in the framework will be based on trip chains.

## **Key definitions**

The key terms used in our research – 'segment', 'trip chain', 'tour', 'main mode' and 'main purpose' – are defined below. The definitions are abbreviated from our previous work with the 1997/98 NZHTS (O'Fallon and Sullivan 2005a and 2005b).

### **Segment**

A **segment** is a row (trip leg) in the trips database of the 1997/98 NZHTS or the 2004–07 ONZHTS. For example, if you drive from home to work but stop for 30 seconds to drop off a passenger, that travel is counted as two segments (but as one 'trip chain' in our reformulation of the datasets).

## **Trip chain**

Our definition of a **trip chain** is generally anchored at home or at work (i.e. when an individual is departing from home or departing from work, this begins a new chain).

More precisely, a trip chain is a series of one or more segments defined by starting a new chain whenever:

- the segment is the first one recorded in the respondent's travel diary (any segments by plane were excluded because our focus is on land transport);
- the starting point of the segment is their home or their workplace;
- the origin of the trip is neither home nor work, but the respondent has been at that location for more than 90 minutes (and the purpose of the immediately preceding segment was not to change mode); and/or
- plane was the mode used for the previous segment (and plane is not the mode for the current segment).

Thus, a new trip chain starts when a person leaves from home or work, or from a location where they remained for 90 minutes or longer (or, in a very few cases, ended travel by plane). Similarly, the current trip chain ends when the person arrives at work or at home, or when they stay at one location for 90 minutes or longer (or, in a very few cases, begin to travel by plane).

## **Tour**

A **tour** is a series of segments that starts from home and ends at home. Note that this definition leaves some segments not classified into any tour (e.g. segments recorded at the start of the travel diary where the respondent is not starting from home). In contrast, all segments are classified into a chain.

## **Main mode**

The **main mode** for a trip chain or tour is the one used for the greatest distance, because the distance (except for walking) can be reliably computed using geo-coding (as opposed to the respondent's best estimate). Where a trip chain or tour contained trip segments that did not have geo-coded lengths (namely: train, ferry, taxi, mobility scooter or 'other' segments), we assigned it to the category 'main mode not defined'.

## **Main purpose**

Our rule categorises the **main purpose** of the chain or tour by creating a hierarchy based on the assumed strength of the activity or purpose to shape the individual's movement. Hence, we have a classification with six categories:

- Subsistence – work (including main job, other job and employer’s business) or education (education meaning the education of the individual undertaking the trip);
- Maintenance – personal business/services, medical/dental, social welfare, shopping;
- Discretionary – social and recreational;
- Accompanying Someone Else – this delineates situations where an individual is travelling somewhere for a purpose other than their own: for example:
  - a child is accompanying a parent/caregiver to do the family shopping or for the parent’s visit to the doctor;
  - a parent is accompanying a child on a trip to or from school (including walking them to school) or to take their child to an activity that the child is participating in;
  - someone is taking their mum to the doctor, and so on.
  - If an individual drives to work but goes out of their way to drop off a partner at their workplace, the first segment will be coded as Accompanying Someone Else;
- Home – where the purpose is to return home;
- Change mode – where the only purpose of the chain/tour appeared to be changing from one mode to another.

These reasons are used hierarchically; that is, a chain or tour with any segment having the purpose ‘work’ is classified as Subsistence, regardless of the other purposes found within the chain or tour.

## **Precision and statistical significance of results**

At the time of our analysis, the Ministry of Transport was reviewing margin of error estimates for the ONZHTS in general, and we see extending such complex statistical analysis to all results in a report such as this one as beyond the scope of this project. Hence we developed a pragmatic rule of thumb for checking on differences highlighted in the text of this report. We compared the published margin of error estimates for trip segments in the 1997/98 NZHTS with simplistic margin of error estimates that ignore the complex sample design of the survey (ie, by assuming a simple random sample). In short, these comparisons led us to multiply such simplistic estimates by a design factor of 2 (for both 1997/98 and 2004–07 results) as a tolerably conservative<sup>4</sup> way of deciding which differences to highlight as statistically significant. Where we describe a difference as ‘significant’, this indicates that we have examined the relevant confidence interval or carried out a formal hypothesis test (using the conventional 95% confidence level). We have also reported a few differences without comment – ie, as if they are

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<sup>4</sup> Design factors (ie, the ratio of observed standard errors for a variable to the standard errors that would be obtained from a simple random sample of the same size) can vary quite a lot between results within the same survey. In the comparisons we made, the design factors ranged from 1.0 to 2.1 with an average of 1.5; this justifies our description of using 2 as conservative. (Some readers may be more familiar with the closely related term ‘design effect’ rather than ‘design factor’; the design factor is simply the square root of the design effect.)

significant – that fall slightly below this level (but no lower than a design factor of 1.2) where the difference is supported by other evidence (eg similar patterns in related age groups or similar Statistics NZ (2000 and 2007) results).

## Trends in trip chaining

### Overall number of trip chains and segments per day were unchanged – but males and females were different

The mean number of chains and segments per day remained virtually unchanged from 1997/98 to 2004–07, when respondents completed an average of 2.4 chains per day and 4.3 segments per day (Table 1). The differences ( $\pm 0.1$  chain or segment per day) noted here are small enough to be explained by the changes in recording methodology between the two surveys. Similarly, the change in data collection (from paper- to computer-based) is likely responsible for the discrepancy in the maximum number of trip chains within two travel days (25 compared with 59).

**Table 1 Comparing the mean number of trip chains and segments (1997/98 and 2004-07)**

Statistic	1997/98	2004–07
<i>Chains (unweighted count)</i>	<i>N=64719</i>	<i>N=67084</i>
Mean number of chains per person per day	2.3	2.4
Mean number of trip segments per person per day	4.4	4.3
Mean number of trip segments per trip chain	1.9	1.7
Maximum number of trip chains within two travel days	25	59

While the mean number of chains per day for all New Zealanders did not change between 1997/98 and 2004-07, there were some notable differences between males and females. Males significantly increased their mean number of trip chains from 4.8 to 5.2 *over two days* ( $t=3.1$ ,  $p<.001$ ). Males complete significantly more trip chains: they more commonly make six or more trip chains *over two days* than females do (37% compared with 32% in 2004–07); their mean number of trip chains *over two days* is significantly higher than the female mean (5.2 compared with 4.6 in 2004–07;  $t=5.6$ ,  $p<.001$ ).

### Trip chains were less complex

The mean number of segments *within* a trip chain declined significantly from 1.9 to 1.7<sup>5</sup> (refer Table 1), a relative decline of 10%. Other evidence suggested less linking of travel: a 7 percentage point increase in the number of one-segment trip chains (from 48% to 55%), in conjunction with a 4 percentage point decrease in two-segment trip chains. The proportions of trip

<sup>5</sup> Although this difference may look small in absolute terms, it is clearly significant statistically. To two decimal places, the averages are 1.91 and 1.75, giving a difference of 0.16. The confidence interval estimate around each of  $\pm 0.03$  (using Equation 2.47 for ratios from Cochran (1977) is very narrow, despite it having been doubled by the design factor discussed above.

chains with 3, 4 and 5 or more segments also declined by 3 percentage points.

This change is quite pronounced when considering vehicle driver trip chains: in 1997/98, 47% of all vehicle driver trip chains were one segment only, compared with 58% in 2004–07.

### Vehicle driver trip chains were more common

In 2004–07, 92% of all trip chains used a single mode. This compares with 90% of all trip chains in 1997/98. ‘Vehicle driver’ remains the most frequent single mode used by New Zealanders in a trip chain, growing significantly from 48% mode share<sup>6</sup> in 1997/98, to 53% in 2004–07, an absolute increase of 5%. This represents a relative increase of 11% between 1997/98 and 2004–07.

By contrast, the number of ‘walk only’ trip chains has decreased significantly from 13% of all trip chains undertaken in New Zealand in 1997/98 to just over 11% of all trip chains in 2004–07 – a relative decline of 15% in less than ten years. Relatedly, the number of trip chains with some walking within them has decreased markedly: from 22% in 1997/98 (including walk only) to 18% in 2004–07 (but this change may be sensitive to the extent of probing by interviewers about short walks at the end of car trips, etc.).

### More short trip chains (<2 km) by vehicle drivers – fewer by walking

We calculated the lengths of trip chains<sup>7</sup> as part of the reformulated dataset. This is particularly relevant where the chain has more than one segment. Leaving aside any other factors that could affect the choice of travel mode, knowing the length of the chain allows us to refine our expectations of the volume of ‘short trips’ currently made by private car that are potentially suitable for encouraging travel behaviour change. We contend that the chain-based and tour-based results are more relevant than using trip segment lengths for quantifying the potential for mode shift away from short car driver trips.

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<sup>6</sup> Significance tests of mode share percentages cannot use the simple calculations routinely used for opinion polls etc. For significance testing of these (and other later results based on the ratio of two estimates), we have approximated the standard error (SE) through use of the relative standard error (RSE). The RSE expresses the standard error as a percentage of the estimate:  $RSE\% = (SE/estimate) \times 100$ . The formula to approximate the RSE of a percentage formed from the ratio of two estimates is:  $RSE(x/y) =$

$\sqrt{\frac{[RSE(x)]^2 - [RSE(y)]^2}{[RSE(x)]^2 + [RSE(y)]^2}}$ . Australian Bureau of Statistics (2007) provides further details and a worked example of this method.

<sup>7</sup> The length of trip chains is calculated only for those chains which have values for all segments within the chain. Vehicle driver, vehicle passenger, cycle, taxi and bus trip segments generally have geo-coded distances, and we have imputed distances for walk segments. If a trip segment length is missing (e.g. for train, ferry, mobility scooter or other), then the chain has been excluded from any analysis involving trip chain length.

Generally speaking, it is accepted in New Zealand that trip segments and/or trip chains less than 2 km long are 'walkable' while those less than 6 km long are 'cyclable'. Support for these suppositions is shown by the fact that 72% of walk trip chains were less than 2 km and 82% of cycling trip chains were less than 6 km in 2004–07.

In 2004–07, one-half (50%) of trip chains (by all modes) were less than 6 km in total length and 21% were less than 2 km in total. This is virtually unchanged from 1997/98.

However, when we examined the mode split for trip chains of particular trip chain lengths (up to 1.99 km, 2.00 to 4.99 km and 5.00 km or more), there are some significant changes in the balance of mode use for short trip chains. These are shown in Table 2.

**Table 2 Main mode of trip chains by total chain length in three categories (1997/98 and 2004–07)**

Main mode of trip chains (reduced categories)	Total chain length							
	Total		up to 1.99 km		2.00–4.99 km		5.00 km or more	
	1997/98	2004-07	1997/98	2004-07	1997/98	2004-07	1997/98	2004-07
<i>Chains (unweighted count)</i>	<i>N=63862</i>	<i>N=66023</i>	<i>N=14419</i>	<i>N=14904</i>	<i>N=15754</i>	<i>N=16456</i>	<i>N=33689</i>	<i>N=34663</i>
Vehicle driver	52.6%	56.8%	30.3%	38.0%	51.9%	56.1%	61.7%	64.4%
Vehicle passenger	28.5%	26.8%	20.2%	18.9%	29.8%	27.3%	31.3%	29.8%
Walk*	13.2%	11.7%	44.9%	39.2%	12.0%	11.4%	1.1%	.9%
Cycle	2.4%	1.5%	4.5%	3.2%	4.1%	2.1%	.8%	.6%
Bus	3.3%	3.2%	.2%	.7%	2.1%	3.2%	5.0%	4.1%
<b>Total**</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

\* Walk distances have been imputed.

\*\* Excluding trip chains where the main mode was not defined.

As can be seen, proportionately fewer walk trip chains were less than 2 km and between 2 and 5 km in length in 2004–07 compared with 1997/98. At the same time, the share of short vehicle driver trip chains increased. For example, in the case of trip chains less than 2 km long, vehicle drivers' share increased significantly from 30% in 1997/98 to 38% of all modes in 2004–07, while the walk share fell significantly, from 45% to 39%, in the same timeframe.

## Trends in tours

### Tour types

We used two classification schemes for tours for both of our analyses (O'Fallon and Sullivan 2005a; 2009a). One classification scheme was the 'main purpose' one described above, where the purpose was assigned on a hierarchical basis.

The second classification scheme recognised the complexity of tours and incorporated time of day, tour purpose and the structure of tours. The structure of tours considered whether they were:

- ‘multi-part’ tours – consisting of two or more segments (e.g. several work-related segments), all for the same purpose; or
- ‘composite’ tours – comprising segments with differing purposes (e.g. a work-related segment with one or more non-work segments).

Hence, we created a tour classification scheme comprising ten tour types (see Table 3).

**Table 3 Classification of tours by complexity and purpose (source: adapted from O’Fallon and Sullivan 2005)**

Tour description	Sequence <sup>a</sup>
Simple work	h-w-h
Multi-part work	h-w-(w) <sup>b</sup> -w-h
Composite to work	h-psl/e-(psl/w/e)-w-h
Composite from work	h-w-(psl/w/e)-psl/e-h
Composite to and from work	h-psl/e-(psl/w/e)-w-(psl/w/e)-psl/e-h
Composite at work	h-w-(psl/w/e)-psl/e-(psl/w/e)-w-h
Simple / multi-part education <sup>c</sup>	h-e-(e)-h
Composite education & non-work	h-psl-e-(psl)-h <b>and</b> h-(psl)-e-psl-h
Simple non-work/non-education	h-psl-h
Multi-part non-work/non-education	h-psl-psl-(psl)-h

Notes:

a: h = home; w = work, e = education, psl = personal (includes personal business/services, medical/dental, social welfare); shopping, and leisure (includes social, leisure and recreational purposes), i.e. neither work nor education).

b The bracketed terms represent additional segments that may be in the tour.

c Multi-part education tours form less than 0.5% of all tours within the database, hence they are combined with the ‘simple education’ tour category.

## Overall mean number of tours and segments per day were unchanged

Essentially, the mean number of tours per New Zealander per day (1.3 tours per day) has not changed between 1997/98 and 2004–07, and neither has the mean number of segments per tour (3.1), the maximum number of tours over two days (13) or the number of segments in a tour (approximately 56% have two segments; 5-6% have seven or more).

**Table 4 Comparing basic tour characteristics (1997/98 and 2004-07)**

Statistics	1997/98	2004-07
<i>Tours (unweighted count)</i>	<i>N=37446</i>	<i>N=36367</i>
Mean number of tours per person per day	1.3	1.3
Mean number of trip segments per tour	3.1	3.1
Maximum number of tours within two travel days	13	13
Maximum number of segments per tour	28	23

In 1997/98, men were slightly (but significantly) more likely to complete two-segment tours (58% of their tours were two segments, compared with 54% of women’s tours). This gap was essentially the same (58% compared with 55%) in the 2004–07 dataset.

## The mix of tours (type and complexity) showed signs of change

The vast majority of tours are ‘non-work/non-education’ tours: in 2004–07, these formed 64% of all tours. However, this may be a 2% decrease since 1997/98, where 66% of all tours were non-work/non-education (the change

verges on significance at the conventional 5% level). Table 5 shows how tour type and complexity have changed between the two datasets.

**Table 5 Types of tours (1997/98 and 2004-07)**

<b>Tour type</b>	<b>1997/98 (%)</b>	<b>2004-07 (%)</b>	<b>Absolute change (%)</b>
Simple non-work/non-education tour	41.3	40.0	-1.3
Multi-part non-work/non-education tour	24.9	23.9	-1.0
Simple work tour	10.6	12.7	2.1
Multi-part work tour	3.2	3.2	0.0
Composite to work tour	2.0	2.2	0.2
Composite from work tour	4.0	4.3	0.3
Composite to and from work tour	1.7	1.9	0.2
Composite at work tour	2.0	1.8	-0.2
Simple/multi-part own-education tour	6.8	6.7	-0.1
Composite own-education & non-work tour	3.6	3.4	-0.2
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>-</b>

Comparing 1997/98 and 2004–07, we found that simple work tours, where the respondent travelled from home to work and then back home again with no intermediate stops, remained fairly constant at just over 1 in 10 tours.

In 1997/98, the 3–17 year olds undertook the vast majority of education-related tours: 84% of the simple/multi-part education tours and 74% of the composite education tours. However, reflecting the rapid growth in tertiary education participation rates between 1998 and 2005 (Ministry of Education 2008), we found that 3–17 year olds completed less than 80% of simple/multi-part own-education tours in 2004–07.

Older people were much more likely to complete simple and multi-part non-work/non-education tours than any other kind of tour. In 1997/98, 91% of the 60+ age group's tours were of this type; in 2004–07, this had decreased to 85%, with a corresponding increase in work-related tours (particularly simple work tours, rising from 4% to 8%). This reflects the trend for older people to stay in the work force longer than previously (Statistics NZ 2007).

### Vehicle driver tours were more common

In 2004–07, 86% of all tours used a single mode, similar to the 84% of all tours in 1997/98. As is to be expected, this is lower than the 92% of trip chains (in 2004–07) that used one mode. The share of vehicle driver only tours has increased slightly but significantly from 47% (1997/98) to 50% (2004-07), while the share of vehicle passenger only tours remains unchanged (23%).<sup>8</sup>

Given that vehicle driver continued to dominate as the main mode for the majority of all tours, it is not surprising to find that vehicle driver was also the

<sup>8</sup> The Ministry of Transport has noted that some under-reporting of walk/vehicle combinations is expected. To minimise this, interviewers are trained to probe for walk segments with questions like 'Where did you park?' or 'How did you get to the shop from there?' etc.

most common main mode for a number of different tour types, such as simple and multi-part non-work/non-education tours (50% and 54% respectively – in 1997/98, the corresponding figures were 49% and 52%). Vehicle driver continued to be overwhelmingly the mode of choice for all types of work tours: simple (77%), multi-part (88%) and composite work tours (81%). The vehicle driver share of work-based tours in 1997/98 was 75%, 85% and 80%, respectively.

As was the case in 1997/98, we found that men were more likely than women to complete tours as a vehicle driver (54% compared with 46%), and women were more likely to be vehicle passengers (59% compared with 41%). These rates are within 1% of what they were in 1997/98.

### Older people (60+) were making more tours as vehicle drivers

While the main part of the adult population (18–59 year olds) showed no change in its mode share for vehicle drivers between 1997/98 and 2004–07, older people (aged 60+) increased their vehicle driver tours as a proportion of all their tours from 60% to 65% (this difference does not quite reach statistical significance when applying the rule of thumb introduced earlier, but the trend is consistent with other results such as increased driver licence-holding among older people). As Table 6 shows, this appears to have been at the expense of walk and vehicle passenger tours. The increased driver tours and decreased walk and passenger tours in the older age group is not totally surprising, given the increased proportion of older women holding drivers' licences: in the 1997/98 NZHTS, 75% of women aged 65–74 and 52% of women aged 75+ held drivers' licences. In 2004–07, the licence-holding rate of women in these two groups had increased to 83% and 61% respectively. Further analysis of older people's travel patterns is found in O'Fallon and Sullivan (2009a).

**Table 6 Main tour mode by New Zealanders aged 60+ (1997/98 and 2004-07)**

Main mode of tours	Age 60+	
	1997/98	2004-07
<i>Tours (unweighted count)</i>	<i>N=4709</i>	<i>N=6268</i>
Vehicle driver	59.9%	65.2%
Vehicle passenger	18.9%	16.4%
Walk	17.8%	15.3%
Cycle	1.6%	0.8%
Passenger transport	1.3%	1.4%
Not defined	0.5%	0.9%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>

### Tour lengths were unchanged

We considered total tour length; the relationship between tour length and tour type (e.g. education-based tours are typically shorter than work-based tours); and the relationship between vehicle driver tour length and tour type and found no changes between 1997/98 and 2004-07. In particular, the proportions of short tours completed were relatively similar: about 26–27% of

all tours were less than 4 km long in both datasets. Just over half (52–53%) were under 10 km.

## Residents in New Zealand's three main centres made more simple work tours

We briefly analysed the tours dataset to determine if any notable differences in tour-making patterns were obvious between Auckland (the four cities of North Shore, Waitakere, Auckland and Manukau including Papakura and part of Rodney District), Wellington (the four cities of Porirua, Upper Hutt, Lower Hutt and Wellington) and Christchurch.

Table 7 shows that simple work tours increased in all three cities (the increase of 2.5 percentage points for the three cities combined is clearly significant statistically).

**Table 7 Comparison of tour types in the three major cities (1997/98 and 2004–07)**

Tour type	All cities combined		Auckland		Wellington		Christchurch	
	1997/98	2004–07	1997/98	2004–07	1997/98	2004–07	1997/98	2004–07
<i>Tours (unweighted count)</i>	<i>N=12132</i>	<i>N=11589</i>	<i>N=6316</i>	<i>N=5225</i>	<i>N=3528</i>	<i>N=3116</i>	<i>N=2288</i>	<i>N=3248</i>
Simple work tour	9.0%	11.5%	9.1%	11.9%	9.1%	10.9%	8.2%	10.8%
Multi-part work tour	3.1%	2.8%	3.1%	3.0%	2.4%	3.4%	3.9%	1.8%
Composite work tours (all types)	11.2%	10.8%	10.7%	10.2%	10.4%	13.7%	13.7%	10.4%
Simple/multi-part education tour	7.0%	7.3%	8.1%	8.1%	4.4%	4.5%	6.2%	6.6%
Composite education & non-work tour	3.7%	4.0%	4.1%	4.3%	2.9%	3.3%	3.3%	3.9%
Simple non-work/non-education tour	41.1%	40.0%	40.4%	39.6%	43.7%	38.8%	40.7%	42.6%
Multi-part non-work/non-education tour	25.0%	23.5%	24.6%	23.0%	27.2%	25.4%	23.9%	23.9%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

## The proportion of vehicle driver tours in New Zealand's three main centres was unchanged

When the three major cities are considered together, the proportion of tours completed as a vehicle driver (including vehicle driver and walk) has been stable (50% in 1997/98 and 51% in 2004–07). This is distinctly different than when New Zealand as a whole is considered. The proportion of tours completed as a vehicle driver (including vehicle driver and walk) within the whole New Zealand population grew from 51% in 1997/98 to 54% in 2004–07.

## Summary and discussion of findings

In 2008, we reformulated the 2004-07 Ongoing New Zealand Household Travel Survey trips dataset into trip chains and tours, based on our previous reformulation of the 1997/98 New Zealand Household Travel Survey dataset.

Using the reformulated datasets, we made comparisons between New Zealanders' travel patterns in 1997/98 and the four-year period of 2004-07. Among other things, in comparing 2004-07 with the earlier 1997/98 dataset, we found that:

- The mean number of trip chains per day (2.3) and the mean number of tours per day (1.3) were essentially unchanged.
- Both trip chains and tours showed an increasing propensity to have fewer segments. In particular, the mean number of segments *within* a trip chain declined significantly from 1.9 to 1.7, a relative decline of 10%.
- Males significantly increased their mean number of trip chains from 4.8 to 5.2 per day, while females remained virtually unchanged (4.4 compared with 4.6 per day)
- Vehicle-driver-only trip chains increased significantly to 53% from 48% of all trip chains.
- Vehicle driver only tours increased significantly to 50% from 47%.
- Older people (aged 60+) increased their vehicle driver tours as a proportion of all their tours from 60% to 65% (not quite statistically significant, but consistent with other results such as increased driver licence-holding among older people).
- Vehicle drivers' share of trip chains less than 2 km long increased significantly from 30% in 1997/98 to 38% of all modes in 2004–07, while the walk share fell significantly, from 45% to 39%, in the same timeframe.
- In the three metropolitan centres (Auckland, Wellington and Christchurch), the proportion of tours completed as a vehicle driver (including vehicle driver and walk) has been stable (about 50%) while proportion of tours completed as a vehicle driver (including vehicle driver and walk) within the whole New Zealand population grew from 51% in 1997/98 to 54% in 2004–07.
- Walk-only trip chains declined to 11% from 13%.

Since at least 2003, the New Zealand Government has invested considerable resources (e.g. providing more passenger transport services and infrastructure; school travel and workplace travel planning) to increase passenger transport use and to encourage walking and cycling. The impact of such 'travel behaviour change' initiatives is clearly not showing up among the general New Zealand population yet, as driving trip chains and tours, of various descriptions, notably trip chains less than 2 km long, have shown significant increases, generally at the expense of walking, cycling and passenger transport use.

That said, in the three main centres where the majority of the initiatives and investment has occurred, there appears to have been a break from the more general New Zealand trend for increasing proportion of tours completed as a vehicle driver (including vehicle driver and walk). It will be interesting to see view the on-going trends, as the ONZHTS data is available as a 4-year moving average.

Changes in the characteristics of the New Zealand's older population (e.g. increased driver license holding rates, involvement in the work force until older ages) mean that there are more older drivers on the roads. This has safety implications, as well as implications for changes in the overall travel patterns of the New Zealand population, as older drivers tend to make shorter trips in the off-peak periods compared with other adult drivers (aged 25-59).

### **Potential for further research**

Partly to demonstrate some of the kinds of analysis that can be undertaken using the trip chains and/or tour datasets, the full report (O'Fallon and Sullivan 2009b) contains additional analyses not included in this paper, such as a newly created tour classification which specifically distinguishes shopping as an activity within a tour, or even as the basis of a tour (the 'multi-part shopping tour' and the 'simple shopping tour'). Using the 2004–07 dataset, we found that simple and complex shopping tours together form 22% of all tours undertaken by New Zealanders. Most (61%) simple and complex shopping tours were completed as vehicle driver (including vehicle driver plus walk); simple shopping tours were more likely than tours including work or education to be less than 2 km long. Our full report also estimates three transport monitoring indicators identified in the Government's Transport Monitoring Indicator Framework.

The NZ Transport Agency funded Capital Research and Pinnacle Research & Policy Ltd to undertake a research project that will deliver (in late 2009), among other things, an up-to-date and detailed analysis of vehicle occupancy, which is based on vehicle driver and passenger trip chains. To the extent allowed by improvements in the Ongoing New Zealand Household Travel Survey data collection since 1997/98 that affect comparability, we will consider changes/trends since 1997/98.

Pinnacle Research & Policy Ltd has recently completed a project (O'Fallon and Sullivan, 2009a) analysing changes in older people's travel patterns between 1997/98 and 2004–07, although this work primarily draws on the original 'trip legs' (segments) datasets rather than the reformulated trip chains and tours datasets.

It is essential to realise that many other applications for the reformulated ONZHTS trip chain and trip tour datasets are possible. The programming we have developed can be readily applied to future datasets, such that ongoing trends can be monitored. Other modifications to highlight different activities (such as the work we did with shopping tours), demographics, etc. are also

feasible. Hence, the most important output from the overall research project is probably the programming that goes with these rather than the initial reports.

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