# Car passenger valuations of quantity and quality of time savings
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# Abbreviations and acronyms

| | |
|---|---|
| BCHF | Beca Carter Hollings & Ferner |
| CV | contingent valuation method: a method of establishing willingness-to-pay (WTP), using a 'stated preference' direct approach, by asking people directly about their WTP for a benefit or willingness to accept (WTA) a loss |
| DfT | Department for Transport (UK) |
| driver-km | driver-kilometre(s) |
| EEM | NZ Transport Agency's *Economic evaluation manual* |
| HCG | Hague Consulting Group |
| HOV | high-occupancy vehicle (lanes) |
| ITS | Institute for Transport Studies |
| IVT | in-vehicle time |
| NZHTS | New Zealand Household Travel Survey: a continuous sample survey of household travel patterns in New Zealand |
| passenger-km | passenger-kilometre(s) |
| person-km | person-kilometre(s) |
| PT | public transport |
| RP | revealed preference: a market research approach to establishing willingness-to-pay by observing people's behaviour in 'real world' situations and inferring their preferences |
| SC | stated choice: a method of establishing willingness-to-pay using a stated preference indirect approach by asking people to choose between or rank option 'packages' |
| SP | stated preference: a market research approach to establishing willingness-to-pay, using a surrogate market approach or experimental techniques |
| TP | transfer price: similar to CV, a method that examines choices between the current situation and a hypothetical situation |
| vehicle-km | vehicle-kilometre(s) |
| VoT | value of time (savings) |
| WTP | willingness-to-pay: represents the (maximum) amount of income individuals would be prepared to sacrifice in order to consume the resources required to satisfy their demands |

# Contents

# Executive summary

**Research objective:** The objective of this research, which was conducted from 2010 to 2013, was to undertake primary market research in New Zealand, at an exploratory level, to gain greater understanding of car passengers' valuations of time savings (VoT). While there is extensive international literature on car drivers' valuations, there is little international research on car passengers' valuations of travel time savings. Car passengers account for the second-largest mode share of person travel in New Zealand and knowledge of how car passengers value time savings is important for both transport demand modelling/forecasting (particularly route choice, including for toll road forecasts) and for the economic evaluation of road system improvements.

**International review:** A review of the international literature, research and practice showed the following:

- Most surveys of motorists' VoT have focused on values for the driver; a few have also assessed passenger values, but none appear to have assessed car occupants as a group (the 'car' value).
- It has generally been assumed (but without clear evidence) that driver values derived from willingness-to-pay (WTP) surveys are 'selfish' (ie take little or no account of passenger views).
- Driver values may be affected by the presence of passengers (adults or children) in the car.
- The very limited evidence on passenger values suggests that they are generally lower (typically by 25–40%) than driver values – however, these relativities can differ substantially by trip purpose.
- No studies of car passengers appear to have explicitly addressed the different impacts on their valuations (eg relative to driver valuations) of (i) person effects (eg income); and (ii) preference effects (eg 'control', relaxation/comfort, alternative uses of travel time).

**Exploratory market research:** The exploratory market research involved interviews with adults in 10 car-owning households, to explore their attitudes and preferences to travelling by car as a driver or passenger, including indications of their WTP to save time in a variety of car travel situations. Key issues examined, using an iterative contingent valuation approach, included: how an individual's valuations differed according to whether they were travelling as driver or passenger, and according to the presence of other passengers (particularly children); and the extent to which the valuations expressed by each (adult) person in the car were consistent with any 'group' valuation for the 'car'.

Our key findings in this area were as follows:

- In most cases, an individual's valuations were broadly similar whether they were driver or passenger.
- Respondents often found it difficult to place values on time savings, especially in hypothetical situations, and particularly for car passengers (as they were not usually paying the costs).
- Valuations expressed by an individual were often sensitive to specific trip characteristics and situations (eg trip duration, trip frequency, extent of time saving, time constraints on the trip).
- It seemed that car driver and car passenger valuations given in response to WTP questions were not simply additive (ie a combined valuation arrived at by the group of people on the trip could be less than the sum of the valuations of the individuals on that trip).
- There were clear indications that the presence of children on a trip (particularly young children on longer trips) could significantly increase the VoT for the adults in the car.

**2001 car driver survey:** The car driver VoT that was derived in a stated preference (SP) survey undertaken by Beca Carter Hollings & Ferner in 2001 has been the basis of the car driver VoT in the NZ Transport

Agency's *Economic evaluation manual* (EEM) since 2002. It was based on SP pair-wise comparisons, which required car drivers to express preferences between two alternative routes with different travel times and cost levels. Key points of that survey that are relevant to this research were as follows:

- In the great majority of cases, the car driver owned the car, paid for the trip and was the main decision maker (eg on route choice) on behalf of the group of car occupants. Given this, the driver should be in the best position to make realistic trade-offs between time savings and trip costs.
- The survey analyses (and hence the current EEM car driver VoT) assumed that the preferences expressed by the driver respondents took no account of any values that passengers might have; however, no guidance was given to the surveyed drivers in this regard. While this assumption is commonly adopted in such research, it does not appear to have a strong evidential basis.
- Almost half the survey trips involved passengers (one or more) as well as the driver. While the survey collected data on car occupancy (by adults/children), no analyses of any effects of car occupancy on driver VoT were attempted at the time.
- The survey covered only drivers and not passengers; thus, no information on car passenger VoT could be deduced from the data collected.

**Options for future market research:** For the next stage of market research to establish VoT for car passengers and for 'cars' with multiple occupancy, we consider the three options below (which are not mutually exclusive) as the most promising approaches, in terms of value for money.

***Option A – Household-based (in-depth) interviews:*** This would involve expansion of our exploratory survey approach to encompass a larger sample, within a more formal survey structure and with emphasis on establishing WTP for car passengers and car groups (relative to solo car drivers) in a range of situations. Emphasis would be given to the following aspects:

- How the valuations of individuals vary according to whether they are travelling as (i) a solo car driver; (ii) a driver with accompanying passengers; or (iii) a passenger (with/without other passengers).
- How the valuations of adults (drivers or passengers) are affected by the presence of children.
- To what extent the sum of car driver and car passenger (adult) individual values is consistent with a 'total car' value.

This option would involve household-based interviews lasting up to 60 minutes, preferably with all car licence holders in the household. Interviews would focus on selected (recent) trips undertaken by household members, and would assess their WTP for reducing travel time, as either driver or passenger. (An alternative method, involving trade-offs between time spent in two different situations, such as car driver alone or with children, would also be considered.) Quotas would be adopted, if appropriate, to cover a minimum number of trips by duration category (eg short/medium/long) and trip purpose (eg commuting, shopping/personal business, social/recreational; but excluding business travel). Data on income (personal and household, including household budget arrangements), age and gender would also be collected and used in the stratification of results.

Within a constrained budget, it is unlikely that a large and sufficiently random sample could be covered to provide rigorous valuations that could replace those in the current EEM. However, this option would provide much-improved information on valuations for car passengers and for the 'car' group (relative to solo car drivers). If successful, the method could be extended to larger samples.

***Option B1 – Analysis of car driver valuations by occupancy (using 2001 survey data):*** This would involve further analysis of the data collected in the 2001 car driver survey (see above), to assess how

driver VoT varies with car occupancy (adults/ children), assuming (as in the original analysis) that the survey values reflect driver ('selfish') valuations only.

This task would be relatively straightforward and low cost, with low risk. However, it is possible that it would not find significant relationships: ie its conclusion might be that driver values, on average, are unaffected by the presence of either adult or child passengers (note that this would be a useful result in itself), although the values for particular individuals and circumstances may be strongly affected.

***Option B2 – Car passenger survey, using 2001 driver survey methodology:*** This would involve a survey of WTP by people travelling as car passengers. The methodology would be based closely on the 2001 driver (SP) survey, but focusing on trips made as car passengers. If the 2001 survey requirement for strictly random sampling were to be relaxed, the original survey delivery (random household interview) approach could be varied so as to substantially reduce the survey costs for a given sample size.

A potential difficulty with this option is that a substantial proportion of people travelling as car passengers would be likely to have difficulty in imagining themselves as being responsible for paying for the trip in question and making trade-off decisions relating to travel time (through route choice) relative to trip costs. The extent of these difficulties could be established fairly rapidly through a pilot survey. At this stage, we have significant doubts regarding the likely realism of the responses that would be obtained.

This approach would also not address the major unresolved issue; ie whether driver and passenger individual valuations are sensibly additive, to provide a 'car' value.

**Recommendations:** The table below summarises the three options; their key outputs/benefits and potential shortcomings/risks; their costs, and our recommendations for future research. We consider that option B2 should not be pursued (certainly not without piloting), for the reasons noted above.

**Table Options and recommendations relating to future research**

| Option | Outputs/benefits | Risks/shortcomings | Indicative costs[a] | Recommendation |
|---|---|---|---|---|
| A: Household (in-depth) interviews | • Valuations for individuals as driver/passenger in a range of roles<br>• Understanding of any differences between individual and 'group' values | • Will not give definitive values that are sufficient for direct inclusion in the EEM (unless larger samples at higher costs) | $45–80k (100–150 households) | Proceed (subject to piloting) |
| B1: Car driver valuations by occupancy (2001 survey) | • Variation in driver values with adult/child passengers (assuming 'selfish' behaviour)<br>• May lead to adjustment of car driver values in EEM | • No information on individual values (only overall distributions)<br>• No information on passenger values<br>• May not give significant results (although occupancy effects may be substantial for some drivers)<br>• Low risk (data already available, in suitable form for analyses) | $10–15k | Proceed |
| B2: Car passenger survey (using 2001 driver methodology) | • Valuations for passengers (mean, median and distribution, but not by individuals) – should be consistent with car driver values from 2001 survey<br>• May lead to adjustment of car passenger (behavioural) values in EEM | • No information on group ('car') values<br>• No information on how individual's values vary with role, occupancy<br>• Substantial risks relating to the realism of the results (may be mitigated through a piloting stage) | $50k (c.1000 completed interviews) – but considerably greater cost if strict random sampling | Not proceed (if there is interest in proceeding, careful piloting would be required before making a decision) |

a) NZ$2012, based on the assumption that the work would be undertaken by the same consultants involved in this report.

# Abstract

The objective of this research project was to undertake primary market research in New Zealand, at an exploratory level, to gain greater understanding of car passengers' valuations of travel time savings in a range of situations (including passenger valuations relative to when driving, and relative to car occupants as a group). Based on this exploratory research, the project assessed the priorities for a more extensive (quantitative) research programme, which will derive a new set of car passenger values for demand modelling and economic evaluation applications in New Zealand.

The research methodology focused on:

- Assessment of international (including New Zealand) literature, research and practice relating to valuations of car passenger travel time savings (in particular relative to the equivalent driver valuations).
- Exploratory (primary) market research with a small sample of New Zealand adults, to explore their attitudes and preferences to travelling as a car driver or passenger, including indications of their willingness-to-pay to save time in a variety of car travel situations (including as a solo driver, as a driver with adult/child passengers, as a passenger, and as one member of a car 'group').
- Development and comparative assessment of options for further New Zealand-based market research to establish willingness-to-pay valuations by car passengers (and drivers) in a range of car travel situations.

# 1 Introduction

## 1.1 Background and research context

in terms of the market for person travel in New Zealand (as in many other developed countries), the 'car driver mode' accounts for the largest single share of total travel, measured in terms of person-kilometres (person-km). The 'car passenger mode' accounts for the next largest mode share of New Zealand travel, by a considerable margin – nearly 60% of the level of car driver travel, and over 33% of total person travel on a national basis.[1]

The benefits associated with time savings account for the majority of the total economic benefits of most initiatives (in New Zealand and elsewhere) that aim to improve the performance of the transport system. The values placed on time savings are similarly an important component in demand modelling/forecasting methods used to assess the demand impacts of transport initiatives, which are then used as inputs to the economic evaluation process.

Despite the importance of the topic for both transport demand modelling and economic evaluation, remarkably little evidence is available, in New Zealand and internationally, about the values (on a willingness-to-pay basis) that car passengers place on travel time savings. Internationally, very few of the major studies undertaken into the valuation of travel time savings have involved market research with car passengers; and a large proportion of the limited research that has been undertaken has not reached clear conclusions (eg on how passenger valuations compare with driver valuations). In New Zealand, the major market research project undertaken for Transfund NZ in 2001 excluded any research into car passenger valuations. In the absence of research on the topic, the Transfund Board decided (in 2002) to retain the previous practice of valuing car passenger time savings at 75% of the car driver rate; this practice has continued to be adopted up to the present day.[2] This proportionate assumption is similar to that adopted in some other leading countries – but the international evidence base for this assumption is flimsy.

A 2007 project conducted by Ian Wallis Associates Ltd (IWA) for Land Transport NZ reviewed international evidence on car passenger values of time savings, and concluded:

> *There is a strong need for further research internationally – which could be applied in New Zealand, even if not undertaken in New Zealand – on the values of time for multi-occupant car travel, and how these should be applied to time v cost trade-offs and in economic evaluation. This is a challenging research area and any such research programme would need to be very carefully designed.*

Car passenger values of time savings cannot be considered in isolation from car driver values: for many purposes (eg motorists' response to toll charges, economic evaluation of projects), the issue to be addressed might be expressed as how values of time per vehicle vary with vehicle occupancy.

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1 Figures taken from the NZ Household Travel Survey (NZHTS). (The mean number of passengers accompanying car drivers who participated in the Beca Carter Hollings & Ferner (BCHF) 2001 car driver stated preference survey for Transfund NZ was 0.70.)

2 During the course of this research, the NZ Transport Agency modified its policy on the valuation of time savings more generally, with the adoption of a multimodal ('equal-value') basis across all modes and user types (including car drivers and car passengers) for economic evaluation purposes, but retaining separate behavioural values by mode and user type for demand estimation.

This research project was designed to fill this critical gap in knowledge, both in New Zealand and internationally.

## 1.2 Project objective and scope

The objective of the research project, which was conducted from 2010 to 2013, was as follows:[3]

> *To undertake primary market research in New Zealand, at an exploratory level, to gain greater understanding of car passengers' valuations of travel time savings in a range of situations (including passenger valuations relative to when driving, and relative to car occupants as a group). The valuation information resulting from this research is expected to shed light on the preferred market research methodology, value structure and indicative values of time savings; but is likely to need to be followed by more extensive surveys (with larger, random samples) in order to provide a new set of car passenger values for future demand modelling and economic evaluation (EEM) applications.*

The project, as originally defined, was to involve two main market research phases:

- an exploratory/qualitative phase, including an exploratory survey with a limited sample of car users
- a quantitative research phase, involving surveys that would be designed in the light of the experience gained from the exploratory phase.

At the end of the first phase, it was realised that the second phase could not be successfully delivered within the original time and resource allocation. It was therefore decided to finish the research at the end of the first (exploratory/qualitative) phase, document the findings and produce a set of recommendations on research priorities for a second (quantitative) phase, which could be considered for further research.

The members of the research team were Ian Wallis (IWA), Dr Neil Douglas (Douglas Economics) and Dr Charles Sullivan (Capital Research).

## 1.3 Report structure

The remainder of this report is structured as follows:

- Chapter 2 provides our review of international (including New Zealand) literature, research and practice on the valuation of car passenger time savings.
- Chapter 3 describes our initial market investigations, in two components:
  - analysis of the New Zealand Household Travel Survey (NZHTS) dataset, to provide an understanding of the car passenger (and driver) travel market in New Zealand
  - exploratory interviews with a small number of New Zealand households, to explore the perspectives of New Zealand adults regarding travel as a car passenger, including the values they place on time savings as a passenger and/or driver.
- Chapter 4 defines and assesses candidate research options for future quantitative market research on this topic.

3 The objective that was set out in the original consultant research proposal was modified, following discussions with the Transport Agency project coordinator and the project Steering Group members.

- Chapter 5 sets out our conclusions and recommendations, focusing on our recommended tasks, methodologies and associated costs for the quantitative research phase of the project.
- Appendix A contains the NZHTS analyses of passenger travel.
- Appendix B contains the interview guide for the household-based interviews.
- Appendix C contains key features and comments regarding the Beca Carter Hollings & Ferner (BCHF) 2001 travel time (stated preference) survey.

# 2 Review of international literature, research and practice

This chapter summarises the international (including New Zealand) research evidence on value of time (VoT) as it relates to car/light vehicle passengers: in effect, it addresses the evidence on how the total 'vehicle' VoT varies with car occupancy, which may be divided into two components:

- the impacts of car passengers on the car driver (as sole occupant) VoT
- the VoT for the passengers (one or more) themselves.

We found there was little international market research on this topic (compared with that for car drivers and public transport – passengers). Most major international VoT studies did not survey car passengers at all; and for many of these, it was unclear whether the values obtained for car drivers should be interpreted as also covering passengers.

## 2.1 New Zealand research and practice

### 2.1.1 New Zealand market research

The previous New Zealand market research undertaken relevant to car passenger VoT has been very limited, and may be summarised as follows:

- **Steer Davies Gleave (SDG) (1992)**

  This study included SP (stated preference) surveys in the Wellington region in order to assess the likely willingness-to-pay (WTP) of motorists to use the proposed Transmission Gully toll route. The study report commented 'Our survey found no evidence for car passengers to have significantly higher value of time than car drivers ...'

- **Booz Allen Hamilton (BAH) (2001)**

  This market research study focused on car driver VoT only, but recorded car occupancy. Supplementary analyses were therefore undertaken to assess the impacts of car occupancy on driver VoT, but were inconclusive, finding that:

  - driver VoT values with one passenger were higher than for a solo driver for two market segments, but lower for the other two segments
  - driver VoT values with two passengers were higher than for one or no passengers for three market segments, but lower for the other segment.

- **Richardson (2004a, b, c) New Zealand tolling market research**

  This research involved SP 'transfer price' surveys of car drivers in relation to three proposed New Zealand toll route projects. The surveys were undertaken by the Urban Transport Institute (Professor Tony Richardson) for Transit NZ. The surveys covered car drivers only and focused on their stated WTP to use an enhanced (toll) route rather than the existing (free) route.

  While car occupancy data was recorded for the trip in question, no attempt was made to analyse how the driver VoT varied with the occupancy level. For the purposes of forecasting the toll route demand, it appears to have been assumed that the route choice would be governed by the driver's valuation only.

### 2.1.2 Transfund/BCHF review and market research (BCHF et al 2002)

A major project on the benefit parameter values for economic evaluation was undertaken for Transfund NZ by a consultant team over the period 1999–2002; the main market research phase took place in 2001, as reported in *Review of parameter values for economic evaluation: final report* (BCHF et al 2002). Details of this review and its market research are given in appendix C.

Prior to that review, Transfund's evaluation practice was to value car passenger VoT at 75% of driver time, based on Hensher (1989).

The 2001 SP surveys undertaken for the BCHF review covered car drivers but not car passengers. The car driver survey included questions on the number of people (adults, children) in the car for the trip in question, but this data was never analysed (it is noted in the BCHF report that '... this may allow an analysis on occupancy, subject to sample size limitations').

The BCHF report commented on the issue of VoT for car passengers as follows:

> *The SP surveys are of car drivers. However, application of the results will be for car drivers and car passengers. This raises the question of whether or not car passengers should be weighted equally to car drivers and, if not, what basis should be used for such a difference.*
>
> *Inclusion of passenger time values at all assumes that the car driver does not fully take account (or take account at all) of the VoT of passengers when making travel choice decisions. There are three issues:*
>
> - *to what extent do car drivers take account of car passenger VoT?*
> - *how does car passenger VoT vary from driver VoT?*
> - *does the presence of passengers affect the VoT of a car driver for other reasons?*
>
> *The first and third are somewhat inextricably linked. SP surveys that segment VoT by number of car occupants are needed for a combined valuation. SP surveys of car passengers allow the second to be determined.*
>
> *In practice, the application of VoT in evaluation either assume a uniform VoT over all car occupants and factor this by car occupancy, or recognise a different value for car passengers and apply this similarly. The assumption is always made that car drivers do not include passenger time values in their travel choice* (BCHF et al 2002, s2.2.5).

The BCHF work also included a review of international empirical evidence and practices relating to car passenger VoT. Taking into account that review and the above considerations, its conclusions were as follows:

> *The evidence for differentiating between driver time and passenger time is not strong but recent overseas findings are consistent with current practice for non-commuting trips (70% in HCG (1999) versus 75% used in the PEM). For commuting trips there appears to be less reason to make a distinction, and our preliminary recommendation is that current practice be changed so that the passenger value is assumed to equal the driver value for work commuting. Evidence for different driver VoT by vehicle occupancy is somewhat contradictory and, in the absence of other evidence, our preliminary recommendation is that a mean driver VoT be used over all vehicle occupancy rates* (BCHF et al 2002, s2.2.5).

However, the Transfund Board subsequently decided, based on a submission from Transfund management, that the previous practice of valuing car passenger time at 75% of the car driver rate should be continued. This remained as the Transport Agency's policy until very recently (see below).

### 2.1.3 Current New Zealand practice

The long-standing Transfund NZ (now the NZ Transport Agency) policy, which was reaffirmed following the 2002 BCHF review, continued to be adopted until July 2013.

At that time, the Transport Agency modified its policy on the valuation of time savings more generally, with the adoption of a multimodal ('equal-value') basis across all modes and user types for economic evaluation purposes (while retaining behavioural values by mode and user type for demand estimation). Under this policy, the 'base' VoT for car passengers and for car drivers (and for other mode users) are all set to the same value for economic evaluation purposes (NZ Transport Agency 2013).

## 2.2 UK research

Two major UK national research studies into VoT have been undertaken over the last 25 years, largely using SP survey methods:

- MVA Consultancy et al (1987) study – including surveys of car drivers, stratified by vehicle occupancy
- Hague Consulting Group (HCG) and Accent Marketing and Research (1999) study – including a survey of car drivers by vehicle occupancy and a separate survey of car passengers.

The findings from these two studies, plus a subsequent review/re-analysis of the HCG study results (by ITS Leeds) are summarised below.

### 2.2.1 MVA (1987) study

This research study included two surveys that assessed the valuations of car drivers having regard to the presence of passengers (no surveys of car passengers were undertaken):

- The *long-distance* survey found that the driver VoT increased by around 40% with between one and three passengers, and by 65% with four or more passengers (ie broadly by 15–20% for each additional passenger).
- The *Tyne Crossing* survey found that driver time values for cars with more than one occupant were about 5% lower for commuting than for cars with a single occupant, but unchanged for 'other' (non-work) purposes.

The report commented that greater weight should be put on the long-distance survey than the Tyne Crossing survey.

The report discussed alternative possible interpretations of car driver values when passengers were being carried, which it summarised as:

- driver VoT assuming passenger contributions
- vehicle VoT as perceived by the driver
- driver VoT reflecting the value of the passengers' company.

It noted the difficulties in interpretation and application of values for multi-occupant vehicles, commenting that:

> *If evaluations are to be based on market (willingness-to-pay) principles, then it is the behavioural values for the vehicle that are the appropriate measure.*
>
> *However, if equity values are to be used, then a single per person value should be derived, and multiplied by the vehicle occupancy rate. (But in the absence of any knowledge on passenger values, it is suggested that the occupancy factor might be omitted.)*

## 2.2.2 Hague Consulting Group (HCG) (1999) study

This major UK (national) study used SP/CV (contingent valuation) methods to examine:

- how car driver values varied with car occupancy
- values of car passengers.

The study report noted (s8.4) the following:

- The earlier UK study (MVA 1987) had focused only on driver values, finding that vehicle occupancy had little effect on these, and hence (by implication) concluded that passenger values were close to zero.
- To the knowledge of the study authors, their study was the first concerted effort to research passenger values.

The SP surveys covered 4000 car driver interviews, stratified by trip purpose (4), urban/inter-urban roads, road type (3) and distance band (4). However, there were only 400 car passenger interviews, thus somewhat limiting the extent of stratification that could sensibly be applied in analyses for passengers.

#### 2.2.2.1 SP survey results

- For *drivers*, it was found that a single passenger in the car apparently increased the value of (driver) time savings by 9% for commuter trips, but reduced the value by 15% for 'other' (non-business) trips. (It is hypothesised that the latter outcome may be because those trips with higher car occupancy may be for leisure or recreational purposes.) There was no change for business travel.
- For *passengers*, values were equal to driver values for commuter trips, 11% lower for 'other' (non-business trips), and 36% higher for business trips.[4]
- Overall average values were derived as follows (pence/km):
  - Driver value – drive alone Commute 5.5, Other 4.3
  - Driver value – with one passenger Commute 5.2, Other 4.2
  - Passenger value Commute 6.0, Other 3.1.
- It concluded that 'It is evident that the drivers are not taking full account of their passengers' values when making their choice.'

#### 2.2.2.2 Transfer price survey results

- The following mean values (pence/minute) for drivers' and passengers' VoT were found from the transfer price survey (questions re trade-offs between travel time and costs):
  - Business: Driver 9.0, Passenger 7.0 (ratio 78%)

4 The higher passenger value than driver value for business trips may well reflect the 'chauffeur' effect.

- Commuting: Driver 7.8, Passenger 4.9 (ratio 63%)
- Other: Driver 7.5, Passenger 5.6 (ratio 75%).

#### 2.2.2.3 Conclusions and recommendations

- A key conclusion was that drivers appear to take little account of passenger values, and hence the need to survey passengers separately.
- Recommended values (pence/km) for evaluation purposes were:
  - Driver 5.4 commuting, 4.4 Other
  - Passenger 6.0 commuting, 3.1 Other.
- It was also recommended (but based on no direct evidence), that half of the passenger 'other' value should be adopted for passengers under 17 years of age.
- Note that these recommendations were not adopted by the Department for Transport (DfT): the study results were subject to further review by ITS Leeds, on behalf of the DfT, as described below.

### 2.2.3 ITS Leeds UK 2001-2003 review (Mackie et al 2003)

The purpose of this review was to reappraise the HCG 1994 surveys, analyses and conclusions (above), in order to arrive at a set of recommendations for adoption by the DfT.

In relation to car passengers, the Institute for Transport Studies (ITS) expressed concerns regarding the interpretation of the car passenger SP responses, and in particular, whether passengers had really responded as passengers rather than (in some cases) as drivers.

Apart from this reservation, the ITS found that passenger values were consistently around 20-25% lower than driver values, for both commuting and other (non-work) purposes. They considered that this result was plausible.

The ITS conclusions and recommendations included the following:

- The HCG results suggest car passenger values are some 20% below car driver values. However, 'we are not completely convinced of the validity of this result and do not recommend its implementation'.
- Larger groups should probably be assigned lower values per person than solo drivers.
- Further targeted research would be desirable to address the variations in values between drivers, passengers and for larger groups.

## 2.3 Australian research

Over the last 30 years, Professor David Hensher has undertaken a number of studies of VoT for car users in the Sydney metropolitan area, including at least two SP-based studies that have examined VoT, either for drivers and passengers separately, or for drivers by level of car occupancy. Two of the key studies are summarised here.

### 2.3.1 1981-1982 Sydney commuter study (Hensher 1984)

This study focused on commuter travel by all modes in the Sydney metropolitan area. SP surveys were undertaken, covering a sample of 1455 commuter trips. A series of multinomial logit and nested logit models were estimated, and time values derived for in-vehicle and out-of-vehicle time for car (driver, passenger) and public transport (PT) (train, bus).

The values from this study are summarised in table 2.1. Interesting results included the following:

- For in-vehicle time (IVT), car passenger values were about 75% of car driver values, but greater than PT user values (the train IVT was surprisingly low, which may have reflected the ability for train passengers to utilise their travelling time most effectively).
- For access/egress time, car passenger VoT was higher than for drivers for walk time, on a par with drivers for wait time.

In addition, we would note the following:

- No evidence was readily available on the income distributions and averages for each mode, so it was not possible to assess the extent to which the VoT differences by mode reflected person differences rather than modal differences.
- The study results appear to relate to perceived VoT for (i) drivers only, ignoring any passenger valuation; and (ii) passengers only, ignoring any driver valuation. For economic evaluation purposes, it would therefore most likely be assumed that the values may be added in the case of multi-occupant cars; however, this may not be valid in terms of behavioural responses to tolls, etc.

**Table 2.1 Sydney commuter study – behavioural values of time savings (A$1982 per person hour)**

| Mode | In-vehicle time (ivt) | | Walk time (wkt) | | Wait time (wtt) | | Ratio of values | |
|---|---|---|---|---|---|---|---|---|
| | Value | % av gross wage rate | Value | % av gross wage rate | Value | % av gross wage rate | Wkt/invt | Wtt/invt |
| Car driver | 4.30 | 46 | 13.40 | 144 | 7.90 | 84 | 3.1 | 1.8 |
| Car passenger | 3.25 | 35 | 16.90 | 181 | 7.90 | 85 | 5.2 | 2.4 |
| Train | 1.80 | 19 | 6.95 | 74 | 13.00 | 139 | 3.9 | 7.2 |
| Bus | 3.00 | 32 | 3.20 | 34 | 8.75 | 94 | 1.1 | 2.9 |
| All modes | 2.60 | 28 | 7.60 | 81 | 12.25 | 131 | 2.9 | 4.7 |

### 2.3.2 2004 Sydney non-commuter study (Hensher 2008)

This SP survey of car drivers on non-commuter (ie recreational, leisure, etc) trips was designed to address whether and to what extent car occupancy, through the presence of car passengers, influences the time vs cost trade-offs of car drivers in choosing between alternative route scenarios.

The survey focused on a stated choice (SC) experiment that gave travellers the opportunity to choose between one existing route offering and two hypothetical route offerings with varying packages of trip attributes – these attributes were free-flow time, slowed-down time, travel time variability/uncertainty, running costs and toll costs. The survey involved 222 effective driver interviews, each responding to 16 choice sets, resulting in 3552 observations for model estimation purposes.

Table 2.2 presents a summary of the key results in terms of car driver VoT according to car occupancy. The key results may be summarised as follows:

- For 'free-flow' travel, car driver values were effectively independent of the number of car passengers.
- For 'slowed-down' travel, car driver values reduced significantly with increased occupancy (the data suggested that the major reduction was when moving from two to three persons per car, where in most cases the additional passenger was a child).
- Hence, driver values for the typical trip reduced with increasing occupancy, from around A$20/hour (driver alone) to around A$14/hour (driver plus three or more passengers).

These results appear intuitively plausible, because:

- in 'free-flow' conditions, the driver focuses on the driving task and is largely indifferent to the other occupants of the car
- in 'slowed-down' conditions, solo drivers are likely to be frustrated by the delays; but this frustration (and hence the driver VoT) is significantly reduced if s/he is able to talk with and be entertained by other occupants, perhaps particularly children.

These results were seen to have significant implications for policies relating to high-occupancy vehicle (HOV) lanes, toll roads, etc. However, the paper noted that the results related to drivers only, and did not address values for passengers and hence for the vehicle overall: further research was intended to address car passenger values.

**Table 2.2 Car driver values of time savings, by car occupancy**

| Car occupancy | No. of interviews[a] | Value of driver time – A$/hr | | | | | |
|---|---|---|---|---|---|---|---|
| | | Free-flow time | | Slowed-down time | | Weighted average | |
| | | Value | % av gross wage rate | Value | % av gross wage rate | Value | % av gross wage rate |
| 1 | 83 | 8.82 | 5.7 | 33.67 | 17.4 | 19.99 | 11.7 |
| 2 | 80 | 8.46 | 6.2 | 34.00 | 17.4 | 18.04 | 10.1 |
| 3 | 28 | 8.50 | 6.4 | 24.59 | 17.5 | 14.44 | 9.5 |
| 4 | 23 | 8.39 | 11.0 | 24.10 | 22.8 | 14.72 | 12.3 |
| 5 | 8 | 8.98 | 7.7 | 21.28 | 17.1 | 13.22 | 8.5 |
| All | 222 | 8.62 | 6.2 | 31.88 | 17.8 | 18.07 | 10.8 |

a) 16 observations per interview.

## 2.4 Other international research

Apart from the UK and Australia, the other main countries that have addressed car passenger VoT aspects are in north-west Europe, mainly through national VoT studies. The research findings for the UK, Australia and these countries are summarised in table 3.1.

Two of the north-west European countries surveyed car passengers directly – ie Sweden (1994) and Denmark (2007); in the other national studies, the research covered only the effects of car passengers on car driver values.

The Spanish research (Roman et al 2007) (a combined RP – revealed preference/SP study), while not a national study, also warrants mention. It was concerned with mode choice for long-distance travel (Madrid–Barcelona), including the alternatives of car driver, car passenger, high-speed train and air. While car passenger values were on average significantly lower than car driver values, it is notable that the average incomes of car passengers were only about half those for car drivers.

## 2.5 Summary of research evidence

Our review found that the international research evidence on appropriate VoT for car passengers (or for cars with more than one occupant) was surprisingly sparse, given that:

- in many developed world countries (including New Zealand), the second-largest mode share (after car driver) is car passenger
- it is a very significant issue in forecasting the impacts of road pricing/tolling policies.

The key findings of this research review are summarised/interpreted in the following sections.

### 2.5.1 Overall

- All market surveys undertaken to date appear to have taken the perspective of either the driver (recognising the presence of passengers) or the passenger separately – there appear to have been no surveys of car occupants as a group.
- All the survey evidence appears to suggest that the valuations given by drivers take little (if any) account of passenger values (ie the driver essentially acts selfishly) – although this issue is not generally made explicit in the survey specification. It is surmised that in most cases, the driver is the prime decision maker in the car, and thus the driver values effectively become the 'car values' in any trade-off decisions between time and costs (eg use of a tolled vs untolled route) – although this important supposition is yet to be proven.
- The survey data available is not disaggregated in such a way as to be able to separate out the person effects (income, age, etc) from the modal effects (eg pleasure/stress of driving vs being a passenger). However, there is strong evidence available that average (personal) incomes of car passengers are substantially lower than those for car drivers, suggesting that the person effects are likely to be an important factor in any VoT differences.
- Given the limited research available and the variety of circumstances (eg trip purpose, trip length) to which this relates, there are major difficulties in drawing robust conclusions.

### 2.5.2 Car driver

- The evidence is conflicting as to whether, and to what extent (and in what circumstances), the presence of passengers results in an increase or reduction in car driver VoT.
- We consider that the most robust evidence is likely to be that from the Hensher (2008) study, relating to non-commuter (recreational, etc) travel in the Sydney area. This finds that driver VoT with three or more passengers was c.30% lower than for solo drivers. An interesting (and plausible) finding was that the overall VoT reduction applied almost solely to 'slowed-down' (congested) time, not to 'free-flow' time.
- The UK 1999 (HCG) study gave results not inconsistent with those of Hensher (2008) for 'other' travel purposes, the driver VoT with a single passenger was 15% lower than that for solo drivers.
- The UK 1987 (MVA) surveys gave rather different results. The Tyne Crossing survey (medium-distance trips) indicated that driver VoT for 'other' trips was unaffected by the presence of passengers but it would reduce by about 5% for commuter trips. The long-distance driver survey (trip purposes unspecified) indicated that driver VoT increases substantially with the number of passengers.

- It is possible that all these results may be not inconsistent – the effects of passengers on car driver VoT could well be dependent on trip purpose, trip length and extent of congestion (as well as whether the passengers are adults or children, family members, business associates, friends, etc).

### 2.5.3 Car passenger

- Only two of the studies provided useful information on car passenger VoT, relative to car driver.
- The UK 1999 (HCG) study appeared to be the more comprehensive of the two. Its TP (transfer price) surveys provided strong indications of passenger VoT being in the range of 60–80% of driver VoT, for all trip purposes. Its SP surveys presented more of a mixed pattern, with passenger VoT being lower than driver VoT for 'other' travel, similar for commuter travel, and higher for business travel (this latter result may well reflect income effects – the lower income driver drives the higher income passenger).
- As noted above, the data available (for car passengers) did not enable us to distinguish person effects (eg income) from modal effects. It is unclear whether people in general prefer to travel (and therefore have a lower VoT) as a car driver rather than as a car passenger; in practice, a considerable degree of self-selection is likely to take place, such that most people would have lower VoT in their chosen mode (whether driver or passenger) than their alternative mode.[5]

This research review confirmed the following two suppositions, which we had formulated prior to the start of this project:

- There is a strong need for further research internationally – which could be applied in New Zealand, even if not undertaken in New Zealand – on the values of time for multi-occupant car travel, and how these should be applied to travel behaviour (time vs cost trade-offs) and in economic evaluation.
- This is a challenging research area and any such market research programme would need to be very carefully designed and implemented.

5 This comment reflects that when people perceive their disutility as being greater in situation A than situation B (ie they prefer time spent in situation B), they will place a higher value on saving time in situation A.

**Table 2.3 Summary of international market research – car passenger VoT**

| Country/year | Author[a] | Survey type/modes[b] | Results, comments |
|---|---|---|---|
| UK – 1987 | MVA 1987 | Long distance – driver<br>Tyne Crossing – driver | • Driver VoT increases with occupancy – by about 40% with 1–3 passengers, 65% with 4+ passengers.<br>• Driver (car) VoT reduces by about 5% with passengers for commuter trips, unchanged for other (non-work) trips. |
| UK – 1994–1996 | HCG 1999 | SP – Driver & passenger<br><br><br><br><br><br><br>TP – Driver & passenger | • Driver survey – Effects of a single passenger on driver VoT were:<br>- commuter travel +9%<br>- other travel 15%<br>- business travel no change.<br>• Passenger survey – Passenger values relative to driver values were:<br>- commuter travel similar<br>- other travel -11%<br>- business travel +36%.<br>• Mean ratios for passenger VoT relative to driver VoT were:<br>- commuter 63%<br>- other 75%<br>- business 78%.<br>• A key conclusion of this work was that driver valuations appear to take little account of passenger values, and hence the need for separate surveys of passengers. |
| Australia – 1982 | Hensher 1984 | SP – Driver & passenger (Sydney commuter travel) | • Car passenger (in vehicle) VoT c.75% of driver value, and somewhat higher than PT values.<br>• Unclear to what extent these differences reflect person (income, etc) differences rather than modal differences. |
| Australia – 2004 | Hensher 2008 | SP – Driver (Sydney non-commuter travel) | • Driver VoT reduces significantly with number of passengers: values with 3+ passengers c.30% lower than for solo driver.<br>• Reduction in value with passengers applies primarily to 'slowed-down' time – driver values for 'free-flow' time largely unaffected. |
| Norway –1997 | Ramjerdi et al 1997 | SP/TP – Car drivers, private travel (commuters) | *Local (urban) trips*<br>• Commuting: Driver VoT increases slightly with single passenger, reduces c.25% with 2+ passengers.<br>• Other purposes: Driver VoT slightly lower with 1 or 2 passengers than for alone. |

| | | | |
|---|---|---|---|
| | | | *Car driver long-distance (inter-urban) trips*<br>• Commuting/work: Driver VoT reduces by c.75% with 1 passenger, by c.40% with 2+ passengers.<br>• Other purposes: Driver VoT almost unchanged with 1 passenger, increases c.40% with 2+ passengers.<br>• Noted that results may be affected by income differences (eg solo drivers vs car-sharing drivers).<br>*Comments*<br>• Stated 'These results suggest that the driver does not take into account the VoT of the passengers'.<br>• Car passenger values not addressed. |
| Sweden – 1994 | M Borjesson, pers comm, 30 April 2012 | DT/TP – Car drivers, car passengers | • Passenger VoT almost identical to driver VoT.<br>• Driver VoT not significantly affected by presence of passengers (adults or children). |
| Sweden – 2008 | M Borjesson, pers comm, 30 April 2012 | SP/TP – Car drivers | • Driver VoT not significantly affected by presence of passengers (adults or children).<br>• Car passenger values not addressed. |
| Denmark – 2007 | Fosgerau et al 2007 | Data collected for c.6000 respondents, including c.500 car passengers. Four SP experiments were carried out with this sample. The main ones analysed were: (i) Time vs cost trade-off exercise to derive mean IVT values; (ii) Disaggregated time components, to estimate component values relative to IVT (car and PT) values | • Found, on average, over all trip purposes:<br>- car passenger VoT averaged 67% of driver VoT<br>- after correction for person differences (using income elasticities estimated by mode), car passenger VoT average 82% of driver VoT<br>- income-adjusted VoT (driver and passenger) do not vary substantially by trip purpose (excludes business travel). |
| Spain – 2004 | Roman et al 2007 | RP/SP studies into mode choices for travel between Madrid and Barcelona. Includes sample of c.200 drivers and 110 passengers | • Found that, for overall sample, the passenger VoT averaged 82% of driver value for work/education, 69% for other trip purposes. However, average income/capita for car passenger was 49% of the level for driver. |

a) Full reference details given in chapter 6.

b) SP = stated preference survey; TP = transfer price survey.

# 3 Initial market investigations

This chapter summarises the initial New Zealand-based market research and investigations undertaken within this research project. This involved two main components:

- analysis of the NZHTS dataset to provide an understanding of the car passenger (and driver) travel market in New Zealand (see section 3.1 below and appendix A)
- exploratory interviews with a small number of New Zealand households and/or individuals, to explore the perspectives of New Zealand adults (as individuals and within a household context) regarding travel as a car passenger, including the weight they place on potential time savings as a passenger and/or driver (see section 3.2 and appendix B).

Section 3.3 then outlines the key issues identified relating to the estimation of VoT savings for car passengers, and provides a set of guidelines to assist in the development of approaches to future market research that will address these issues.

## 3.1 The New Zealand car passenger market – analyses of the New Zealand Household Travel survey

### 3.1.1 The New Zealand Household Travel Survey (NZHTS)

The New Zealand Household Travel Survey (NZHTS) has been in existence since 1989/1990. The first two survey 'waves' were undertaken in 1989/1990 and 1997/1998, and the survey has operated as a continuous survey (sampling annually) since 2003. The survey covers details of all travel (on two consecutive days) by household members, broken down by trip 'legs': for each 'leg', information is collected on detailed origin and destination, mode used, number in party, etc. Additional information is collected on the characteristics of the sampled households; eg numbers of household members and age groups, number of vehicles available, licence holding, etc.

For this project, use was made of the NZHTS data for years 2008–2011 (inclusive), which covered some 25,000 respondents.[6]

### 3.1.2 Analysis purpose and scope

The purpose of our NZHTS analyses was, as precursor to the formulation of any qualitative market research, to provide an overview of the New Zealand car (light vehicle) travel market, with particular focus on car passengers (ie travel involving more than one car occupant).

These analyses:

- covered travel by light 4-wheeled vehicles (including cars, vans, utes, SUVs; but excluding motorcycles, taxis, trucks, buses)
- segmented the passenger market (by passenger numbers, characteristics, etc), in order to inform decisions on which market segments should be included in any subsequent quantitative market research work.

6 At the time of undertaking the analyses for this project, the NZHTS results for 2012 were not yet available.

The analyses undertaken and their findings are set out in detail in appendix A. A summary of findings and their implications for the project are given in the following sections.

### 3.1.3 Summary of findings

#### 3.1.3.1 Market overview (see appendix A.2)

- 33% of total vehicle trip legs and 37% of total vehicle-km travelled involved passengers (ie more than one occupant per car).
- 63% of total person-km were travelled as drivers (40% alone, 23% with passengers) and 37% as passengers.
- Car passenger-km were split fairly evenly between those travelled as sole passengers, those with two passengers, and those with three or more passengers.
- Overall, the amount of travel (person-km) undertaken as a car passenger was 59% of that travelled as car driver.

#### 3.1.3.2 Market shares by trip purpose (see appendix A.3)

- The split of person-km between drivers and passengers varied greatly by trip purpose:
  - work: driver alone 77%, driver with passenger 10%, passenger 13%
  - social/recreational: driver alone 24%, driver with passenger 28%, passenger 48%
  - 'serve passenger': driver alone 12%, driver with passenger 34%, passenger 54%.

#### 3.1.3.3 Market characteristics (see appendix A.4)

- Overall:
  - Of total travel (vehicle-km) involving car passengers, about two-thirds involved carrying household passengers, one-third carrying non-household passengers.
- For household passengers:
  - Males were much more likely than females to carry another adult in the household as the only passenger (reflecting the propensity for males to drive when travelling with a female adult).
  - Males were much less likely than females to carry household children as the only passengers.
- For non-household passengers:
  - Overall, around 10% of vehicle travel involved carrying non-household passengers only (which exceeded the proportions carrying both household adults only and household children only).
  - As a proportion of their travel as drivers, females carried non-household passengers more frequently than male drivers.

#### 3.1.3.4 Licence holding (see appendix A.5)

- Proportions of adults (aged 15+yrs) without a car/motorbike licence:
  - *overall*: 12%
  - young: 15–19yrs 43%, 20–24yrs 14%
  - middle: 30–60yrs 5%
  - older: 75–84yrs 20%, 85+yrs 42%.

- Those without licences tended to travel more as passengers – but still only accounted for 16% of passenger-km by those aged 15+yrs.

### 3.1.4 Implications for quantitative research

In making the following comments, it was assumed that:

- any quantitative survey would focus on licence-holding adults in car-owning households
- it would be desirable for any such survey to be stratified into key market segments with differing travel behaviour patterns, so that potentially weighted average responses, representative of the total car passenger market, could be estimated.

We comment on the implications of the NZHTS analyses as follows:

- The NZHTS indicates that three major segments account for a large proportion of all passengers: (a) household adults; (b) household children; (c) non-household members.
- The survey interviews will potentially capture segments (a) and (c) if they are licence holders. Segment (b) plus non-licence holders in segments (a) and (c) would not be captured through interview, but their effects as car passengers on the values of those interviewed would be covered.
- The patterns of multi-occupant car travel vary substantially by gender and trip purpose. It would thus be desirable to stratify the quantitative survey responses by these dimensions. Further thought would be needed if/when overall passenger valuations (eg by trip purpose, peak/off-peak, etc) need to be estimated from the survey findings.
- The NZHTS gives no segmented information on either informal or 'formal' car-pooling arrangements (typically involving some form of cost sharing).

## 3.2 Exploratory survey

### 3.2.1 Purpose of survey

This was an exploratory (qualitative) market research task, designed to assist in the development of the preferred methodology and specification for a subsequent (quantitative) survey.

Its purpose was defined as being 'to explore the perceptions of New Zealand adults regarding travel as a car passenger – in particular their perceptions of costs, their time vs cost trade-offs, and their perspectives relative to travel as a car driver'.

### 3.2.2 Survey approach

At the initial (proposal) stage of the project, two alternative survey approaches were listed for consideration:

- focus groups – likely to be two or three groups
- individual/household-based exploratory interviews – likely to be 5–10 interviews.

We preferred the individual/household-based interview approach, which we believed would be more effective for exploring the concepts involved (eg time vs cost trade-offs, perceptions as a driver vs passenger, etc), including exploring the interactions between household members. (Note: Focus groups might have been undertaken first, followed by a set of exploratory interviews, but budget constraints precluded this.)

### 3.2.3 Interview planning and delivery

Key aspects were as follows:

#### 3.2.3.1 Interview unit

- Households with at least one car and at least one licensed driver.

#### 3.2.3.2 Sample selection

- Adults in 10 households, selected from among friends/acquaintances of the researchers.
- All participants drawn from the Wellington region (including Wairarapa), for convenience.

#### 3.2.3.3 Interview style

- Face-to face interview – in home, at cafes, etc.[7]
- Typical duration c.45 minutes.
- Where practicable, the preferred method was to explore the views of each household driver separately, and then bring them together to attempt to reconcile their views and establish household WTP valuations for typical trips involving two or more adults from the household.

### 3.2.4 Interview guide

Box 3.1 provides an outline of the guide used by the interviewers (members of the project team): appendix B provides the full version of this guide.

Key features of the interview included the following:

- Each adult in the household was interviewed separately, then they were brought together to explore (and reconcile) 'household' WTP values relative to the sum of the individual values.
- The focus was on establishing individual WTP for saving time on car trips, for a range of typical trips undertaken (but excluding commute or work-related trips), with a range of roles (travelling as driver and passenger) and a range of occupancy situations (eg driver alone, driver with adult passenger, driver with child passengers, etc).
- WTP values were established through the CV approach (ie through an iterative procedure, establishing maximum WTP to save a specified amount of travelling time).
- Interviews would test WTP against:
  - extent of time saved (eg 5min/10min on a 30-min trip)
  - numeraire (in terms of toll charges, fuel charges, supermarket cost savings).
- The interview included an exploration, for drivers, of whether the values stated related to the interviewee only or were intended to represent all occupants together.

(Note that in the exploratory interviews, typically no more than two trips were covered, and alternative levels of time savings and numeraire types were not always covered. In the case of a quantitative survey, the range of options for testing in any one interview would need to be restricted, to avoid having an excessively long interview time; it may be appropriate to segment the interview sample, such that particular subsamples focus on particular aspects; eg extent of time savings, numeraire, etc.)

7 Some of the interviews were undertaken by phone. While this was reasonably satisfactory for individuals, it was less satisfactory for exploring the interactions between the individuals in a household.

**Box 3.1 Interview guide (outline)**

| | |
|---|---|
| **A. Introduction/context**<br>• Purpose of interview<br>• Sample – adult + licence<br>**B. General**<br>• Household numbers/composition<br>• Car ownership<br>• Licence holding<br>• Household income group (but not asked)<br>**C. Attitudes to car travel**<br>• Extent of car sharing, types of shared trips<br>• Preferences – driver alone vs with passenger – driver or passenger<br>• Use of travel time | **D1.Typical trips**<br>• Purpose<br>• Duration<br>• Trip frequency<br>• Occupants (adults/children)<br>• Which adults in household<br>**D2. Selected trips – WTP**<br>• WTP to save time (CV method used WTP to save X mins) – as driver alone, driver with adult pax, driver with child pax, passenger<br>• Basis of valuations – self only, or whole car (altruistic?)<br>• Alternative numeraires for testing – tolls, petrol, supermarket price savings |

### 3.2.5 Summary of exploratory survey findings and implications

We considered that the exploratory survey was largely effective and met its stated purpose (see section 3.2.1). However, it needs to be recognised that the circumstances for the survey were relatively favourable (friends of the project team members were interviewed), and it may be more difficult to elicit such good responses from a random sample of the public.

Table 3.1 presents a summary of the findings from the exploratory survey; but note that these findings are based on very small samples and should be regarded as no more than tentative.

**Table 3.1 Exploratory survey – summary of findings**

| Aspects | Findings, comments |
|---|---|
| **Attitudes and preferences** | |
| A1 Driver vs passenger roles | • Driver role generally preferred<br>• Strong self-selection effects (most people take their preferred role)<br>• In most cases, WTP values did not seem to be sensitive to driver vs passenger roles |
| A2 Driver alone vs with adult passenger | • Most common preference was to drive alone<br>• Driver WTP values were significantly higher (up to 50%) with adult passenger(s) |
| A3 Driver alone vs with child passengers | • Most common preference was to drive without children, especially on longer trips<br>• Driver WTP values in some cases were 'a lot higher' with children – but dependent on child age, trip duration, etc |
| **WTP valuation aspects** | |
| B1 Difficulties in estimation | • Respondents often had difficulty in valuing time savings<br>• It was particularly difficult to get good responses to hypothetical situations (eg usual driver asked to give value as passenger) |
| B2 'Car' values based on driver views | • Typically, the driver was the car 'owner' and main funder (running costs, etc), hence main decision maker (on behalf of the group)<br>• Need to make clear in questioning that the respondent would be paying for any costs involved<br>• However, in typical family cases, WTP values were commonly related to the overall household budget |

| Aspects | Findings, comments |
|---|---|
| B3 'Selfish' vs altruistic valuations | • Important to make it clear, in eliciting WTP (especially from drivers), whether the value was related to driver only (selfish) or on behalf of all occupants (altruistic)<br>• From an analysis perspective, it was more helpful to get 'selfish' views |
| B4 Effects of children | • It was not possible to elicit values for children directly<br>• However, there was evidence that the presence of young children (in particular) significantly increased adult values |
| B5 Additivity of occupant values | • There were strong indications that the WTP values of occupants were not simply additive – typically, values for two (family) adults sharing a car were not much greater than for driver value alone<br>• This is a key aspect to be examined in further work (results may be sensitive to the wording/explanation of the questions asked) |
| B6 Effects of trip characteristics | • Unit WTP values were often sensitive to trip characteristics and situations, including:<br>- extent of time savings – indications of low (unit) values on small time savings<br>- trip duration – not clear on relative WTP values for longer vs shorter trips<br>- trip frequency – WTP values higher for occasional (vs regular) trips (may be compounded with trip duration)<br>- 'quality' of time savings – higher values in congested conditions<br>- trip purpose<br>- time pressures – eg may be lower WTP for weekends, when there are fewer time constraints |
| B7 Effects of incomes and payment sources | • Important to understand payment sources for valuations<br>• Need to establish relevant income measure (typically the overall household budget)<br>• Desirable to explore how values relate to household/personal income, employment status, gender, role in household, etc |
| B8 Choice of numeraire | • Need for an exploration on the effects of choice of numeraire (tolls, fuel costs, supermarket bills, time, etc) in valuations<br>• Also explore the preferred numeraire (SDG 2001 surveys used a 'generic' cost variable) |

We note the following learnings and implications for any more-extensive (quantitative) surveys that are based on a similar approach to our exploratory survey:

- A more structured approach will be needed for a quantitative survey.
- Various detailed survey design aspects still need to be resolved, and one or more pilot surveys will be required.
- The preferred interview method is face-to-face, in the home, and involving all adult drivers (separately and together) in the household.
- The typical interview length would most likely be 40–60 minutes.
- Relatively skilled interviewers would be required, thus resulting in high costs per interview.

## 3.3 Issues and guidelines in establishing VoT for car passengers

In the light of our review of international research and practice (chapter 2), our analysis of the New Zealand car passenger market (section 3.1) and particularly our exploratory market research (section 3.2), this section outlines *key issues* relating to the estimation of VoT savings for car passengers (or more correctly, for cars carrying more than one occupant). These key issues will be critical in the development of a more extensive programme of future market research, which is discussed in chapter 4.

Values of non-working time (savings) for car drivers are well established from numerous market research studies internationally; these generally show a strong consistency between different (developed) countries when expressed as a proportion of average wage rates. While most of the international (including New Zealand) research is not explicit on this point, the published values can be taken, to a reasonable approximation, as representing solo car drivers (ie drivers without passengers).

For future research into 'car' values, we would propose taking the relevant solo car driver values as our baseline, and expressing valuations with multiple car occupants in terms of factors on these baseline values. Thus, future research should collect evidence on solo car driver values as well as on passenger and 'group' (driver with passengers) values.

Our exploratory research highlighted the deficiency in the common approach adopted internationally (including in New Zealand), for both behavioural modelling and economic evaluation, of having a single base value (by trip purpose) for car drivers and a single value for car passengers, and assuming these are simply additive for multi-occupant cars. The following main considerations in the exploratory research indicated the deficiency in this approach:

- evidence that an individual's (adult) WTP (ie their marginal disutility of travel) differed according to whether they were travelling as a driver or a passenger
- evidence that an individual's valuation, whether travelling as a driver or passenger, could be strongly affected by the presence (and behaviour) of other car occupants
- evidence on maximum WTP ('package') effects. A large proportion of trips with passengers involved two or more members of the same household, with any costs for the trip being funded out of a single common household budget. In such cases, it appeared that adult WTP values were influenced by a 'package' effect; eg each of two adults could be separately willing to pay $10 to save 30 minutes on a trip, but when travelling together they could jointly be willing to pay only $15 in total.

It is commonly assumed in surveys of driver VoT that the values expressed are essentially 'selfish'; ie they relate to the driver only, taking account of effects of the passengers (if any) on driver WTP, but not taking any (altruistic) account of the (implicit or explicit) WTP values held by passengers. However, this point rarely seems to be addressed explicitly in car driver VoT surveys, so it is not clear whether this assumption is valid. In any future research, we suggest making it clear to individual respondents (whether drivers or passengers) that they should take the 'selfish' approach in making trade-offs to derive valuations. Apart from possibly when considering child passengers, the 'selfish' approach should minimise any dangers of double counting WTP for multi-occupant cars.

The above discussion of issues leads us to suggest the following guidelines in formulating the approach and scope for any future research on this topic:

- The primary, but not sole, focus in future research on car passenger VoT should be on individual/group values in within-household multiple-occupant situations. (These are the most common situations for cars with passengers, and appear to be the most challenging to address.)
- It would be desirable to relate all values (for an individual or car 'group') to the 'baseline' of the individual's valuation as a solo driver.
- WTP valuations should be explicitly based on a 'selfish' approach (ie respondents should provide valuations that reflect only their own personal (dis)utility, not taking into account the possible valuations of others in the car.
- The research should address the variations in WTP valuations of an individual in different multiple-occupant situations (whether driver or passenger, with different passenger situations).
- The research should also address combined values for the 'group' of car occupants, to investigate any non-additive effects. These seem likely to be of particular importance in situations where more than one family member expects to source payments for costs from a common family budget pool.
- Surveys should collect both household and personal income information. They should also clarify the funding source from which each respondent would expect to source any proposed payments.
- SP, rather than RP, methods will generally need to be used for establishing WTP values. While there may be some 'revealed' situations from which RP evidence may be derived (eg from route choice studies), these are likely to be the exception rather than the norm; in general, the available RP evidence will be insufficient to address most of the valuation aspects of relevance to car passenger VoT research.
- The preferred SP approach is contingent valuation (CV, as in the exploratory research), involving iterative questioning to establish a respondent's maximum WTP to save a defined amount of time. (One significant advantage of this CV approach over SC (pair-wise comparison) methods is that the CV approach can establish WTP values for an individual in different situations, whereas the SC approach establishes the distribution function of values for a sample population, but not for each individual. This advantage is particularly important in this case, where there is a focus on investigating differences in values for individuals over a range of situations.)
- Further consideration will need to be given to the best choice of cost numeraire in WTP trade-offs between time savings and costs. International experience on this question will be of value here. An approach similar to that used in the Transfund/BCHF 2001 survey (BCHF et al 2002), using a generic cost measure (developed to combine car running costs and parking charges) may be appropriate. The alternative approach of using a time, rather than cost, numeraire should also be considered (eg assessing the point of indifference between X minutes travelling as a car passenger and 30 minutes as a car driver).
- The approach to assessing valuations for children will need further consideration (and may warrant a separate subproject). It may be possible to address this through asking adults (parents) to give two sets of WTP values; ie one explicitly selfish, the other explicitly altruistic and taking into account their estimates of WTP for children's time savings (typically sourced from the household budget). (An alternative would be to assume that the WTP of children is (close to) zero, as in most cases their personal income is minimal.)

# 4 Potential approaches to future research

This chapter outlines and assesses potential approaches for a future quantitative research project, formulated in the light of the literature review and exploratory (qualitative) market research covered in the two previous chapters. Several options (not generally mutually exclusive) could be considered for the quantitative market research:

- Option A Household-based (CV) interviews (extending the approach of the exploratory surveys)
- Option B1 Reanalysing the Transfund/BCHF 2001 survey data, to estimate the impacts of car occupancy on driver VoT
- Option B2 Car passenger VoT survey (possibly also including car drivers), using similar methodology to the Transfund/BCHF 2001 survey.

These options are described in detail in the following sections. Our conclusions on these options, and their implications for a quantitative research project, then follow in chapter 5.

## 4.1 Option A – Household-based (CV) interviews

### 4.1.1 Research approach

Given the findings from the exploratory survey part of this project (see section 3.3), one logical research option is to check whether or not the key findings from those exploratory interviews are confirmed with a larger sample and a more structured interview approach. The larger sample and structured approach would enable the quantification of some of the findings suggested by the exploratory work.

The following method proposed in this option would be somewhere in between conventional qualitative and quantitative approaches:

- It would be quantitative by involving a structured interview process with at least 100 respondents.
- It would still resemble the qualitative approach in some ways (including some open-ended probing of apparent inconsistencies in responses, which is important for the interpretation of the results).
- It would deliver indicative quantitative findings on car passenger VoT – which could subsequently be extended with larger samples to provide definitive updated car passenger VoT (for use in any update of the Transport Agency's EEM).
- It would focus on the largest segment of trips involving car passengers; ie when all car passengers (adults or children) and the driver are members of the same household (this segment accounts for some two-thirds of all car passenger travel).

### 4.1.2 Rationale

The exploratory research suggested various apparent inconsistencies that may occur, which undermine the validity of more conventional approaches for valuing car passenger time. For example:

- *Non-additivity of driver and passenger values:* Despite passenger WTP values appearing to be broadly similar to driver WTP values, respondents suggested that WTP for cars with a driver plus an adult passenger may be little or no different from values for the driver alone (in cases where both the driver and passenger were members of the same household, and generally regarded their trips as being funded from a common household budget).

- *Children having strong effects on the reported pleasantness of adult trips, yet little or no effect on WTP values:* Despite compelling mentions of preference for driving without children (perhaps particularly on long trips), WTP values for driver + child passenger trips were often (although not in all cases) little different from solo driver values.

An obvious approach to valuing passenger time savings is to measure these and simply assume that they can be added to existing driver values; ie adopting the 'conventional' assumption that car drivers do not include passenger time values in their travel choice (BCHF et al 2002, pp2-8). Indeed, the current EEM approach involves such additivity. Rather than making such an assumption, this research option would probe these issues in detail. For example, this option would involve asking the same household for driver, passenger, and 'car' values (where the car contains one adult passenger) and then directly probing about any apparent non-additivity.

In this way, this research option would aim to gain data directly relevant to each of the three issues mentioned in the Transfund/BCHF research underlying current EEM passenger values of time (ibid), as set out in table 4.1. These issues were assumed away in the BCHF research, rather than being a topic for further exploration and data collection.

### 4.1.3 Research methods

Grappling directly with such difficult issues, which have been deliberately sidestepped in previous research, places unusual demands on the data collection methods. In particular, it is important to gain a good number of responses with a driver and an adult passenger from the same household, who can ideally each give three VoT assessments for the same trip: driver, passenger and 'car' (meaning the household WTP for both the driver and passenger).

Such joint interviews are distinctly more difficult to arrange than the usual household interviews with only one household member. Not only do the interviews need to be arranged for a time when both household members are available, but some social and practical awkwardness may result from the need to have each provide their individual VoT independently (ie preferably without being influenced by overhearing the responses from the other person), before bringing them together to give their combined views on values.

**Table 4.1 Passenger-related valuation issues (BCHF et al 2002)**

| Valuation issue | How this research option would address the issue |
|---|---|
| How does car passenger VoT differ from driver VoT? | • By asking drivers to value their time savings for the same trip if they were a passenger rather than the driver (note: this informs us about relative VoT for adult passengers only).<br>• Similarly, by asking drivers to value their time savings for the same trip if they were the driver (this is only likely to be worthwhile for passengers who have significant driving experience).<br>• Where possible, by asking a car passenger and car driver in the same household for their VoT for the same trip. Given the non-additivity problem suggested by qualitative interviews, also crosscheck consistency between joint views on WTP (by the household) for the 'car' (ie driver + passenger) and the sum of the driver and passenger values. |
| Does the presence of passengers affect the VOT of a car driver for other reasons? | • By asking drivers to value their time for the same trip with and without a passenger (the qualitative research having suggested that the presence of passengers can affect the VoT of the driver). This can include questions about the effect of having children as passengers. |

| Valuation issue | How this research option would address the issue |
|---|---|
| To what extent does the VoT expressed by car drivers take account of car passenger values? | • The distinction between a personal VoT for drivers and the driver's valuations for the car (including passengers) would be made explicit by asking for each separately.<br>• However, this would not directly inform us about the extent to which car drivers in earlier research may have been taking at least some account of car passenger VoT (noting that previous research analyses and applications have assumed that drivers were not considering passenger values). |

#### 4.1.3.1 Sampling

Given that this option would be a methodological exploration that would be intermediate in approach between qualitative and quantitative methods, a random sample should not be pursued because that would greatly increase costs. Rather, households should be recruited by using methods that are more common to qualitative research; eg by getting a market research company to recruit from a panel who have already agreed to participate in such research, and paying them (around $60 per person) to both be in attendance at an agreed time. In this way, the unusual requirements to have people from the household being available, and one of them being prepared to move to another room in order to facilitate independent responses, can be agreed in advance of the interview, and the payment would assist the acceptance of these requirements. Sufficient households would need to be recruited to allow sensible calculations of averages and comparisons between average VoT.

The objectives would not justify seeking valuations from multiple regions – any regional differences would be small, relative to the expected spread of results within a single region. The research could be conducted in, at most, two major cities: Auckland and Wellington. Given the complexity of the interviews and the desirability of face-to-face briefing of interviewers by the researchers, our recommendation would be to interview in one centre only (Wellington).

#### 4.1.3.2 Questionnaire design

The questionnaire would start by grounding responses in an actual trip that had involved the two respondents from the household as a driver and a passenger. The questions would then move to establishing VoT for the trip and the hypothetical variants of it.

In order that the interviewer and the respondents could both immediately understand VoT responses, the values would need to be elicited fairly directly so that any potential inconsistencies between driver, passenger and car VoT would be readily apparent. An iterative choice CV approach could be used; eg asking if they would prefer the trip they had actually had, or one with a quicker route but extra costs of (for example) $10. Depending on their response, the same choice could then be offered with a higher or lower value for the extra costs, with this iterative process easing the participants' way into expressing a maximum dollar value for the time saved. To minimise any anchoring bias effects associated with the initial values in iterative bidding, the levels of initial values provided for choices should be varied.

The same process would be repeated to elicit driver, passenger, and car (for driver + passenger) values for the trip from each respondent. Drivers would also provide a valuation for the same trip, imagining they no longer had a passenger. Note that for one respondent, the driver trip would be actual and the passenger trip hypothetical (and vice versa). Table 4.2 presents a summary of the valuations to be sought for a typical driver plus (adult) passenger trip.

**Table 4.2 Overview of VoT required for one shared trip**

| Actual driver | Actual passenger |
|---|---|
| Driver | Passenger |
| Driver (imagining the same trip but with no passenger) | |
| Passenger (hypothetical – imagining the same trip but with roles reversed) | Driver (hypothetical – imagining the same trip but with roles reversed) |
| Car (individual view of household VoT) | Car (individual view of household VoT) |
| Car (joint decision about household VoT) | |

Some respondents could find it difficult to express the valuations when their role is hypothetical. Solutions for this could be to:

- ask for the *actual* rather than the *hypothetical* valuations first
- 'warm up' for the hypothetical role by using some of the questions about the differences between the roles used in the qualitative research, and if appropriate, briefly discuss a recent trip where they were in that role.

However, in the case of any (adult) passengers who do not have driving experience, it would seem unlikely that they would be able to give realistic valuation estimates as drivers: adult non-drivers form a relatively small proportion of the adult population, and it may be best to exclude them from the sample selection.

To control for possible 'order effects', sometimes the car value would be elicited last and sometimes first (and the difference between such values elicited first and last would be tested statistically). Given the results from the exploratory research that suggested non-additivity, any revised values resulting from asking respondents about consistency between the 'car' value and the sum of the driver and passenger values should also be explicitly recorded. More qualitatively, the reasons the participants give for revising their values, or justifying apparently inconsistent values, could also be recorded.

Furthermore, note that the driver VoT would be elicited twice: once for an actual trip with a passenger, and then for the same trip (hypothetically) as a solo driver.

Having elicited such values separately from both adults in the household, they could then be asked to jointly arrive at 'car' values for the same trip (or trips). The joint VoT should be recorded, as well as the reasons given for any differences between the joint VoT and sum of car values provided earlier (particularly any reasons relating to apparent non-additivity, or that shed light on the different perspectives being used during joint decision making compared with individual decision making). For example, it is theoretically possible that apparent non-additivity could result from entirely logical and additive valuations (eg because the driver VoT in the presence of a passenger reduces by roughly the same amount as the passenger VoT).[8]

Respondents would be asked about the funding source for any WTP amounts: the experience from the exploratory phase was that any 'payments' towards the hypothesised costs most commonly came from the joint household budget pool rather than from an individual's separate income. Therefore, both household and personal incomes for the adults interviewed should be established: then, at the analysis stage, one aspect to test would be whether valuations are primarily a function of household or personal income.

8 We have encountered situations where the combined WTP of two people travelling together is less than either of their individual values travelling alone: this would reflect that they each perceived less disutility (ie gained greater pleasure) when travelling together.

To the extent that tolerable interview length and budget allow, the following extensions of the approach (in the same interview) could be considered:

- Repeat the questions for at least two different trip purposes and/or trip lengths (eg up to 30 minutes local, and two hours or more between cities/regions). In terms of trip purposes, the focus should be on 'other' trips (excluding in-work trips and commuting).
- Explore the effects of having child passengers on the valuations of adults (drivers or passengers).

Because interview length and budget would probably not allow an exploration of all of these potentially relevant combinations, let alone the intersection of such combinations with all trip lengths of interest, the interviews could focus on two very common cases: (i) driver + adult passenger (from the same household), and (ii) driver + child passenger (from the same household). Note that the age of the child may make a clear difference to VoT (particularly with longer journeys). To get good values related to the presence of children, some care regarding the recruitment of respondents would be required.

#### 4.1.3.3 Analysis

The adoption of the CV approach (with iterative choices) approach would enable valuations to be derived for each household surveyed (and for each adult within the household). This would be a substantial advantage over the SC (pair-wise comparisons) approach often used in VoT research, which only provides averages rather than individual results – particularly where, as in this case, understanding the range of responses as to how individuals value their time savings in different circumstances is important.

The analyses would provide several comparisons relevant to issues typically ignored in VoT research to date (eg as reflected in the issues/assumptions around car passenger VoT in table 4.1 above); for example:

- driver VoT compared with passenger VoT for the same person on the same trip (one of the roles being hypothetical)
- passenger VoT for an actual adult passenger compared with hypothetical responses from a driver from the same household (eg because passenger VoT may be lower because of the personal income and/or gender differences typical of adult passengers from the same household)
- driver VoT with a passenger (adult or child) compared with the same driver without a passenger for the same trip (the driver-alone valuation being hypothetical). This directly explores the impact on driver VoT of the presence of passengers
- interactions of such results with trip length (ie significantly different patterns in the comparisons listed above for long vs short trips).

Statistically, such paired comparisons should be relatively sensitive in their ability to detect differences. That is, even a relatively small sample should be sufficient to see whether drivers systematically give lower values when they consider the same trip but without the passenger, because each driver's responses would be compared with their own answers, rather than simply averaging the results from independent samples.

Interpretation of results would not rely purely on statistical analysis of the responses. Rather, somewhat qualitatively, consideration would be given to open-ended comments by respondents about reasons for their valuations – in particular, any valuations they subsequently regarded as misguided or based on misunderstanding; systematic patterns of revision to valuations in response to later questions (eg because of apparent inconsistency between car valuations and separate valuations for driver and passenger); and discussions between respondents during joint decision making over car valuations.

### 4.1.4 Indicative costs

The complexity of issues covered means that pre-testing and piloting would need to be more extended than usual and two pilots could be required. The costs could be adjusted by varying the number of interviews undertaken, and (to some extent) the length of the interviews.

Indicative cost estimates for this option are estimated as follows:

- Design, pre-testing, interviewer instructions by researchers: $10,000–$20,000.
- Fieldwork – subcontract to a reputable market research firm, including recruitment of households with (at least) two adult drivers (at least one of whom is regularly a passenger with the other), incentive payments to respondents, interviewing by experienced interviewers, data entry: $24,000–$38,000. This would fund around 110 to 150 household interviews with around 260 respondents, assuming $6000 for set-up costs and $160–$210 per interview (including incentive payments).
- Fieldwork – management and liaison, including attendance at interviewer briefing: around $2000–$3000.
- Analysis and reporting: range $10,000–$20,000.
- Total cost: range $46,000–$81,000.

## 4.2 Option B1 – re-analysis of the Transfund/BCHF 2001 car driver survey

### 4.2.1 Research approach

This option would involve re-analysis of the Transfund/BCHF 2001 SP survey of car driver VoT, to establish how driver values are affected by the presence of other car occupants (adults and/or children). The original survey analyses and their interpretations assumed that the values given by drivers in the 2001 survey represented their own ('selfish') values; while these may have been affected by the presence of passengers, it was assumed that they did not take account of passengers' own valuations or preferences.

This approach would provide *no information* on the valuations of car passengers (in their own right).

### 4.2.2 Rationale

The key features of the Transfund/BCHF survey of car driver VoT are described in appendix C (BCHF et al 2002). This survey covered car drivers only, using a set of pair-wise SC games to examine drivers' trade-offs between time and cost, and hence to estimate VoT for the pooled data (not for individual respondents). While the survey collected information for the specified trip on the number of car occupants (adults/children), no use was made of this information in the analyses of VoT.

It could be expected that a car driver's own valuations would be affected (positively or negatively) by the presence of others in the car – our exploratory survey indicated that these effects could be quite significant, especially with child passengers on longer trips).

In the 2001 car driver survey, it was found that 23% of commuter trips and 64% of other-purpose trips carried one or more passengers (44% of trips overall). This suggests that re-analysis of the survey data including variables for car occupancy (adults/children) should identify any effects of occupancy on driver VoT.

### 4.2.3 Research methods

The research process proposed for this option is as follows:

1 Obtain the 2001 car driver SP survey database. (We have already done this.)

2 Inspect the database to check whether the data is in an appropriate form to enable the required re-analysis. (We have already done this – it appears the data is in an appropriate form.)

3 Re-specify the original BCHF logit model formulation, with additional variables for (a) the number of car passengers; and (b) how many of these were children.

4 Re-run (a) the original model formulation, to check the original model parameters; and (b) the adjusted model formulation, to derive adjusted model parameters, in particular those that reflect the effects of other (adult/child) car occupants on driver VoT.

5 Document the results in a working paper that includes the findings and their implications.

On the assumption (as in the BCHF analyses) that the original survey responses represented the driver's own (selfish) valuations rather than (altruistic) valuations that took account of passenger values/ preferences, the adjusted model would continue to reflect driver values only.[9] However, it would show how these values are affected by the presence of passengers. It is, of course, quite possible that these effects may not be statistically significant for the overall sample.[10]

Assuming the effects prove to be significant, this option could potentially lead to a reformulation of driver VoT values (as in the EEM) varying with car occupancy (maybe separately by adults/children).

### 4.2.4 Indicative costs

Indicative costs for undertaking, and reporting on, the re-analyses of the 2001 SP survey, as summarised above, are estimated at $10,000–$15,000[11].

## 4.3 Option B2 – car passenger survey, using the Transfund/BCHF 2001 SP methodology

### 4.3.1 Research approach

This option would use essentially the same survey design as for the 2001 car driver (SP) survey, but apply this to derive VoT for car passengers.

This option could be extended, using the same survey design/analysis methodology, to also cover car drivers. This would provide updated car driver VoT values, consistent with those obtained for car passengers.

9 While this assumption appears to have been adopted in most VoT studies internationally, the evidential support for it appears weak.

10 The effects might be very significant (positive or negative) for individual drivers, but may 'get lost' in the pooled dataset.

11 This estimate assumes the work is undertaken by the consultant team that has undertaken the work in this report.

### 4.3.2 Rationale

There are several advantages in estimating car passenger VoT by using a similar survey design (and analysis methodology) to that used in the 2001 VoT SP survey for car drivers. These advantages, described below, would be strengthened if car drivers were also to be covered in the new survey:

- The SC pair-wide comparison method is a common, simple, well-proven method of eliciting time vs cost trade-offs (eg for alternative routes) and hence establishing VoT estimates.
- The specific methodology applied in the 2001 survey is tried, tested and peer reviewed, and has been applied in deriving the car driver VoT currently used in the EEM.
- The method uses a standard set of questions, but tailored to respondent's actual trip, thus helping to achieve realistic responses.
- Essentially the same survey design and analysis methodology can be used with drivers and passengers, thus ensuring comparability and consistency in the results (but refer to table 4.3).

Table 4.3 summarises the strengths and weaknesses of the 2001 SC pair-wise comparison methodology, for passengers and also potentially for car drivers.

**Table 4.3 SP pair-wise comparison game approach for car passenger VoT – strengths and weaknesses**

| Aspect | Strengths | Weaknesses |
|---|---|---|
| Task | • An easy task for respondents to do.<br>• Respondents compare two journeys in terms of time and cost and are not required to calculate their VoT or even know about the concept of VoT. | • The method does not elicit a VoT for an individual at the time of the interview.<br>• Responses to the difference questions could be inconsistent, pointing to low/high VoT. |
| Standard set of questions | • Standardised framework used with all respondents but tailored to actual trips.<br>• Costs and times can be chosen to cover likely range in VoT. | • Repetitive in that the same type of question is asked nine times.<br>• Some respondents may not trade-off; ie they always prefer the cheaper (or quicker) alternative, or they may give inconsistent responses. |
| Values of time | • VoT are 'revealed' during analysis (as a ratio of the time- and cost-sensitivity parameters) for market segments. | • Average value for an individual is rarely reported, although in theory a design could enable the individual's VoT to be narrowed down. |
| Subsidiary SPs | • SDG also developed SPs for congestion, road roughness, bendiness and safety. The same questions could be asked of passengers to see if they have similar preferences. | • Lengthens the questionnaire if subsidiary SPs adopted (not advisable, given the additional complexity and costs involved). |
| Risks | • SP pair-wise route/journey choices are a tried-and-tested method of 'simulating' likely behaviour and estimating values of time. | • Choice of route may not be an appropriate behavioural choice for passengers if route choice is determined by driver, although passengers would most likely have preferences.<br>• May be difficult (too hypothetical) for many passengers to put themselves in the position of paying for the trip (despite best efforts in survey design) (see below). |
| Basis of the EEM | • The BCHF design has been used successfully and the values form the basis of the EEM values.<br>• Interviewing drivers as well as passengers would provide an opportunity to update the driver values of time (but beyond the option's scope as defined). | • The BCHF design is now 12+ years old –cost parameters would need updating for inflation. |

| Aspect | Strengths | Weaknesses |
|---|---|---|
| Effects of occupancy on VoT | • The BCHF asked for occupancy data but did not report the effect on driver WTP. Therefore the original SDG data could be re-analysed to estimate the effect of passengers on driver VoT (without surveying costs). | |
| Different trips for passengers and drivers? | • VoT are context-specific; therefore values need to be estimated with context at the forefront ie in the context of an actual recent trip.<br>• Values that are based on general questioning do not have a firm foundation. | • For an individual, the most recent trip made as a driver will differ from that made as a passenger, including the number and age of other passengers. These context differences will affect VoT. The best approach would most likely be to interview both driver and passenger about the same trip, in both their actual and alternative roles. |
| Self-selectivity | • Can potentially derive valuations for car drivers and car passengers separately, but on a consistent basis. | • Self-selectivity will tend to mean that respondents will have lower values in their selected role than in their alternative role – the implications need to be considered carefully in deriving appraisal values. |
| Who pays for the trip? | • The BCHF approach involved a route choice based on the assumption that the respondent paid (even when they didn't, or when costs were shared). This is a reasonable assumption for the great majority of drivers.<br>• The same design could be given to groups to decide (driver + passenger). | • This is a less reasonable assumption for passengers, so asking passengers to assume they paid (when they didn't) would make the results problematic. This would be an important aspect to address during the piloting stage. |
| Self-completion? | • The SP is so simple that the questionnaire could potentially be completed using an internet survey. | • Having interviewers may still be desirable, to ensure each and every set of choices is considered by the respondent (though this is still not guaranteed). |

### 4.3.3 Research methods

The starting point for the methodology would be that used in the 2001 car driver survey: this is set out in some detail in appendix C.

For the survey of car passengers, the 'base' methodology would be essentially identical to that used in the 2001 survey; ie:

- Random households would be sampled, with the selection of one individual within each sampled household.
- The survey would focus on a specific trip undertaken recently by that individual, as a car passenger.
- For the specified trip, information would be collected on trip purpose, travel time, numbers/ages of passengers, etc. Other information would be collected on the individual and household (income, who pays for trips, etc).
- Each 'game' would involve a choice between two alternative routes, characterised by different travel times and costs (fuel plus parking).

A major difficulty, which could affect the success of the methodology, would be in asking passengers to respond as if they were paying for the trip in question. The 2001 car driver survey confirmed that car passengers paid for either fuel or parking costs in only a very small proportion (c.3%) of trips surveyed. Similarly, passengers could be expected to take primary responsibility for choice of route in only a small

proportion of cases. Therefore it could be very problematic for many/most passengers to give realistic responses to what they will regard as very hypothetical questions on time vs cost trade-offs. A small pre-pilot survey or focus groups could be used to check whether this would be a major issue with this method.

### 4.3.4 Indicative costs

For the 2001 car driver SP survey, a high priority was put on obtaining random samples of New Zealand motorists. Given this priority, a decision was taken in favour of household-based interviews, with the selection of a random (clustered) sample of households and of a single individual within each selected household. The length (duration) of the survey also tended to favour in-house delivery (as distinct from phone or postal methods).[12] As a result of the approach adopted, the survey was comparatively expensive to administer.

The following methods could reduce the survey costs, while covering essentially the same questions:

- *Sampling basis:* If the 2001 requirement for rigorous random sampling were to be relaxed, then an intercept sample selection methodology could be adopted, with substantial cost savings for a given sample size.
- *Survey delivery:* Assuming an intercept methodology is adopted, it may well be possible to simplify/shorten the questionnaire somewhat, so that it could be administered on-street or at local activity centres (shopping malls, etc) and take only in the order of 10 minutes, using either laptops/tablets or paper/show cards.
- *Surveyors:* In such a case, students could most likely be recruited and trained as surveyors. Checks could be made regarding interviewer quality (eg by recording respondents' first names and mobile phone numbers).
- *Internet-based delivery:* A simplified questionnaire could probably be delivered successfully through the internet. Respondents could either be drawn from one of the established internet panels (eg Smile City, Automobile Association), or recruited on-street and given a web link to access the questionnaire.

Assuming administration by student surveyors, broad costs for around 1000 completed interviews with car passengers would be in the order of $50,000. These costs include questionnaire design, piloting, data analysis, etc.

Costs for internet delivery are likely to be somewhat lower than this, and the incremental costs (per additional respondent) would also be very low. Thus, larger samples may be affordable, within a given budget constraint. .

12 The full survey covered congestion/reliability aspects and safety aspects, as well as time-saving aspects.

# 5 Conclusions and recommendations

This chapter provides a summary of the findings of this research and the recommended priorities for future research.

## 5.1 Transfund/BCHF 2001 car driver value of travel time (SP) survey (BCHF et al 2002)

This survey has provided the basis for the car driver values of time (savings) (VoT) applied in the EEM since 2002. It was based on stated preference (SP) pair-wise comparisons, which required car drivers to express preferences between two alternative routes with different travel times and cost (fuel plus parking) levels.

Key points relating to the survey, in the context of this research, were as follows:

- In the great majority of cases, the car driver owned the car, paid for the trip and was the main decision maker (eg on route choice) on behalf of the group of car occupants. Given this, the driver should have been in a good position to make realistic trade-offs between time savings and trip costs.
- The survey analyses (and hence the current EEM car driver VoT) assumed that the preferences expressed by the survey respondents took no account of any values that passengers might have; however, no guidance was given to the drivers in this regard. While this assumption is commonly adopted in such research, it does not appear to have any strong evidential basis.
- Almost half the survey trips involved passengers (one or more) as well as the driver. While the survey collected data on car occupancy (by adults/children), no analyses of any effects of car occupancy on driver VoT were attempted at the time.
- The survey covered only drivers and not passengers; no information on car passenger VoT can be deduced from the data collected.

## 5.2 Exploratory market research

Exploratory interviews with adults in 10 car-owning households explored their attitudes and preferences regarding travelling by car as a driver or passenger, including indications of their willingness-to-pay (WTP) to save time in a variety of car travel situations. Key issues examined, using an iterative contingent valuation (CV) approach, included: how an individual's valuations differed according to whether they were travelling as driver or passenger, and according to the presence of other passengers (particularly children); and the extent to which the valuations expressed by each (adult) person in the car were consistent with any 'group' valuation for the 'car'.

Key findings from the exploratory research that are relevant to future market research were as follows:

- In most cases, individuals' valuations when travelling as a driver or passenger were broadly similar (most of the adults interviewed preferred to drive, indicating that their VoT as a driver would tend to be somewhat lower than their VoT as a passenger).
- Respondents often found it difficult to place values on time savings. This difficulty was particularly pronounced in hypothetical situations: it applied particularly to car passengers, as generally they were not involved in paying the costs involved in the trip.

- Valuations expressed by an individual were often sensitive to specific trip characteristics and situations (eg trip duration, trip frequency, extent of time saving, congested vs open road travel, specific time constraints on the trip).
- Indications were that car driver and car passenger valuations given in response to WTP questions were not simply additive (ie a combined valuation arrived at by the group of people on the trip could be less than the sum of the valuations of the individuals on the trip). This could have been because the individual valuations implicitly made some allowance for the preferences of other people in the group (recognising that the trip costs often came from a common family budget).
- Nothing was known directly about the WTP of children: given their generally low incomes, it could be surmised that their valuations would be very low. However, there were clear indications that the presence of children on a trip (particularly young children, on longer trips) could significantly increase the VoT for the adults in the car.

## 5.3 The case for further research – knowledge gap, potential applications and benefits

### 5.3.1 Problem and knowledge gap

The New Zealand car passenger 'market' accounts for over one-third of all (land) person travel in New Zealand, approaching 60% of the level of car driver travel, and over 10 times the level of public transport (PT) travel. Given the size of this 'market', it is remarkable that (virtually) no research has been undertaken in New Zealand relating to car passenger behaviour and the potential car passenger benefits from roading investments.

Unfortunately, this paucity of research is generally repeated in other developed countries that are widely seen as international leaders in transport modelling and evaluation practice. The extent of international research on car passenger VoT is very sparse, and no clear consensus has been reached on car passenger valuations (and 'total car' valuations) relative to driver valuations (which have been extensively researched).

Our exploratory research in this project suggests that current valuations used for car passenger VoT, both in New Zealand and internationally (typically taken, for behavioural purposes, as 75% of driver values), may be unrealistic, and that the combined valuation for a group of people in a car may often differ substantially from the sum of the valuations of the group members individually.

Hence, one of our conclusions is that there is a serious knowledge gap relating to this topic, both in New Zealand and internationally.

### 5.3.2 Potential applications and benefits from further research

Further research into how car passengers value time savings would therefore appear to warrant very high priority (relative to other potential topics relating to transport demand modelling/forecasting and economic appraisal/evaluation), although it should be recognised that such research will be challenging. *Prima facie*, New Zealand research into car passenger valuations should take higher priority than further research on car driver valuations in any future research programme on appraisal parameter values, given the dearth of evidence, in New Zealand and internationally, and the potential pay-offs involved.

A well-designed research programme into the VoT for car passengers (and for car 'groups') would potentially bring benefits in two main areas:

- *Behavioural modelling/forecasting*, principally in the area of route choice, and particularly in the context of response to direct road-use charging (including network-wide pricing and selected road tolling). This will be important to urban transport modellers/forecasters and to potential commercial investors in toll road schemes.
- *Economic appraisal (evaluation),* as a significant input to providing better and more credible estimates of user benefits from roading projects generally.

## 5.4 Options for future market research

Three options (which are not mutually exclusive) have been developed as the most promising approaches, in terms of value for money, for future market research to establish VoT for car passengers and for cars with multiple occupancy. These options were described in chapter 4, and their key features that are relevant to future research are summarised below.

### 5.4.1 Option A: household-based (in-depth) interviews

This option would involve expansion of the exploratory survey approach to a larger sample, within a more formal survey structure and with greater emphasis on establishing WTP for car passengers and car groups (relative to solo car drivers) in a range of situations. Particular emphasis would be given to the following aspects:

- How do the valuations of individuals vary according to whether they are travelling (i) as a solo car driver; (ii) as a driver with accompanying passengers; (iii) as a passenger (with/without other passengers)?
- How are the valuations of adults (drivers or passengers) affected by the presence of children?
- To what extent is the sum of car driver and car passenger (adult) individual values consistent with a 'total car' value?

This option would involve household-based interviews, preferably with all car licence holders in the household. Interviews would be expected to last up to 60 minutes. It would therefore be unlikely that a large and sufficiently random sample could be covered, within a constrained budget, in order to provide rigorous valuations that could replace those in the current EEM. However, this option would provide much-improved information on valuations for car passengers and for the 'car' group (relative to solo car drivers): essentially this would be the quantitative research phase envisaged within the original objectives of this project. If successful, the method could subsequently be applied to larger samples.

### 5.4.2 Option B1: analysis of car driver valuations by occupancy (using 2001 survey data)

This option would involve further analysis of the data collected in the BCHF 2001 car driver survey (see section 5.1), to assess how driver VoT varies with car occupancy (adults/ children). Consistent with the original survey analyses, this analysis would assume that the survey values reflect driver ('selfish') valuations only.

This task would be relatively straightforward, with relatively low cost and low risk. However, it may not find significant relationships; ie its conclusion may be that driver values on average are largely unaffected

by the presence of either adult or child passengers (note that this would be a useful result in itself), while the values for particular individuals and circumstances may be strongly affected.

### 5.4.3 Option B2: car passenger survey, using the BCHF 2001 driver survey methodology

This option would involve a survey of WTP by people travelling as car passengers: the methodology would be based closely on the BCHF 2001 driver (SP) survey, but focusing on trips made as car passengers. As outlined earlier (section 4.4), if the 2001 survey requirement for strictly random sampling was to be relaxed, the original survey delivery (random household interview) approach could be varied so as to substantially reduce the survey costs for a given sample size.

A potentially fatal flaw with this option is that most people travelling as car passengers would be likely to have difficulty in imagining themselves as being responsible for paying for the trip in question and making trade-off decisions relating to travel time (through route choice) and trip costs. The extent of these difficulties could be established relatively rapidly through a pilot survey (or focus groups). At this stage, we have significant doubts regarding the likely realism of the responses that would be obtained.

This approach would also not address the major unresolved issue; ie whether driver and passenger individual valuations are sensibly additive, to provide a 'car' value.

Given these two likely deficiencies, this option is not recommended: in comparison with the other options, the risks appear too great relative to the likely benefits.

## 5.5 Future research recommendations

Table 5.1 summarises each of the options outlined above, including their key outputs/benefits and their potential shortcomings/risks. It also provides indicative costs (for options A and B2 – clearly, these would be dependent on sample sizes selected). In the light of this appraisal, the last column provides our recommendations regarding the best options for future research.

We recommend that priority should be given to proceeding with *option A* (subject to satisfactory piloting) and *option B1*. Given our current state of knowledge, we consider that *option B2* should not be proceeded with, primarily due to concerns as to whether most car passengers would be able to make realistic time vs money trade-offs. If required, this issue could be clarified through pilot interviews with a small number of passengers, following which a better-informed decision on whether or not to proceed could be taken.

**Table 5.1 Recommendations relating to future research**

| Option | Outputs/benefits | Risks/shortcomings | Indicative costs | Recommendation |
|---|---|---|---|---|
| A: Household (in-depth) interviews | • Valuations for individuals as driver/passenger in a range of roles<br>• Understanding of any differences between individual and 'group' values | • Will not give definitive values that are sufficient for direct inclusion in the EEM (unless larger samples at higher costs) | $45–80k (100–150 households) | Proceed (subject to piloting) |
| B1: Car driver valuations by occupancy (2001 survey) | • Variation in driver values with adult/child passengers (assuming 'selfish' behaviour) | • No information on individual values (only overall distributions)<br>• No information on passenger values | $10–15k | Proceed |

| Option | Outputs/benefits | Risks/shortcomings | Indicative costs | Recommendation |
|---|---|---|---|---|
| | | • May not give significant results (although occupancy effects may be substantial for some drivers)<br>• Low risk (data already available, in suitable form for analyses) | | |
| B2: Car passenger survey (using 2001 driver methodology) | • Valuations for passengers (mean, median and distribution, but not by individuals) – should be consistent with car driver values from 2001 survey | • No information on group ('car') values<br>• No information on how individual's values vary with role, occupancy<br>• Substantial risks relating to the realism of the results (may be mitigated through a piloting stage) | $50k (c.1000 completed interviews) – but considerably greater cost if strict random sampling | Not proceed (if there is interest in proceeding, careful piloting would be required before making a decision) |

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# Appendix A New Zealand Household Travel Survey analyses of passenger travel

This appendix provides the detailed analyses of the New Zealand Household Travel survey (NZHTS) that we undertook, which have been summarised in section 3.2 of the report.

## A.1 Introduction

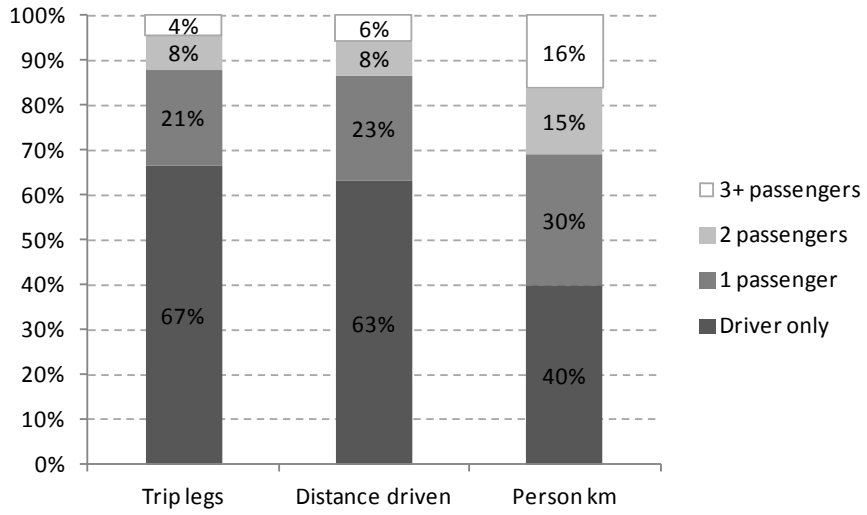
The following results are from the 2008–2011 NZHTS, for which substantial background information is readily available (MoT 2010).[13] Analysis here was restricted to 'light 4-wheeled vehicles'; this includes cars, vans, utes and SUVs but excludes motorcycles, trucks, buses and 'professional driver' trips (such as taxis). The unweighted base number of respondents in the survey over this time period was 25,559 (some of whom made no trips in light 4-wheeled vehicles).

## A.2 Passenger share of travel in light 4-wheeled vehicles

The base unit of travel in the NZHTS is the 'trip leg'. For example, if someone drives to work and drops a child off to school on the way, then this will be recorded as two trip legs. The findings for 2008–2011 showed that around two-thirds of trip legs in light 4-wheeled vehicles were made by the driver alone (see figure A.1).

However, passengers were included more often on longer trips than shorter ones. Hence, travel by drivers alone accounted for a slightly lower proportion of the distance driven (vehicle-km) in light 4-wheeled vehicles (63%) than of trip legs (67%). Furthermore, if travel was measured in terms of total person-km, then naturally the share involving passengers was substantially larger: driver-alone travel dropped to 40%, and the share with one passenger was a substantial 30%. In terms of overall person-km of travel by light vehicle, passenger-km were 59% of the level of driver-km.

**Figure A.1 Passenger share of trip legs, distance driven, and person-km (NZHTS 2008–2011)**

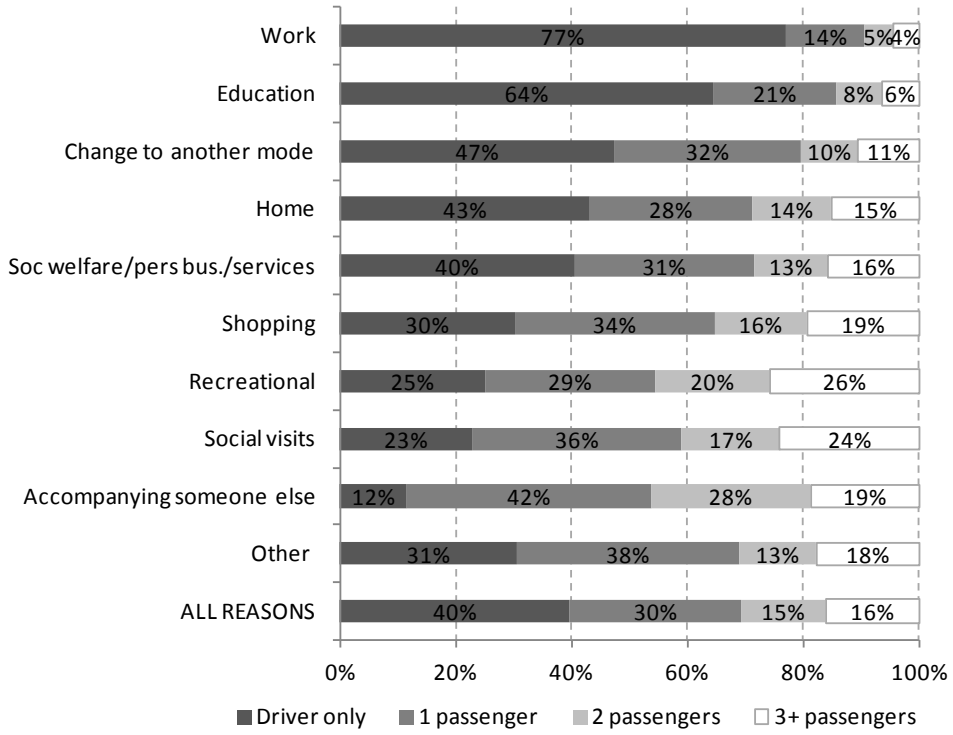



13 At the time of undertaking these analyses, the NZHTS results for 2012 were not yet available; however, the 2012 results are likely to make only marginal changes to the figures given in this appendix.

# A.3 Passenger numbers vary markedly by trip purpose

The NZHTS records the reason for stopping at the end of each trip leg. Some trip reasons (as measured by the reason given by driver) involve passengers much more often than others (see figure A.2). In particular, travel (in light 4-wheeled vehicles) to work is mainly by the driver alone (around three-quarters of person-km). In contrast, travel for recreational and social visits generally involves passengers (around one-quarter of person-km are by the driver alone for those trips). Note that the reason 'home' is not particularly informative here; it accurately shows the driver's reason for stopping at the end of the trip leg but does not tell us what they might have done previously.

**Figure A.2 Driver's reason for trip leg, split by number of passengers (share of person-km, NZHTS 2008–2011)**




Another way of looking at the same data is to consider the share of kilometres travelled for each number of passengers, by reason (see table A.1). Driving to work is a large share (31%) of travel (in light 4-wheeled vehicles) while driving alone, but a much lower share of the travel with passengers (from 7% of distance travelled with one passenger down to 4% with three or more passengers). The driver's reason is *Accompanying someone else* for 9% of person-km overall. This reason is valid even for some driver-only trips, because drivers travelling alone to pick someone up can choose to record that reason for the trip leg.

**Table A.1 Number of passengers, split by driver's reason for trip leg (share of person-km, NZHTS 2008–2011)**

| | Driver only | 1 passenger | 2 passengers | 3+ passengers | All |
|---|---|---|---|---|---|
| Home | 36% | 31% | 31% | 31% | 33% |
| Work | 31% | 7% | 5% | 4% | 16% |
| Shopping | 9% | 13% | 12% | 14% | 11% |
| Social visit | 8% | 18% | 17% | 22% | 15% |
| Social welfare/personal business/services | 5% | 6% | 5% | 5% | 5% |
| Recreational | 4% | 6% | 8% | 9% | 6% |
| Accompanying someone else | 3% | 13% | 18% | 11% | 9% |
| Change to another mode | 2% | 2% | 1% | 1% | 1% |
| Education | 1% | 0% | 0% | 0% | 1% |
| Other (incl. leaving the country and overnight lodgings) | 2% | 4% | 3% | 3% | 3% |
| *All reasons* | *100%* | *100%* | *100%* | *100%* | *100%* |

a) Due to rounding, the figures may not add up to exactly 100%.

# A.4 Passenger characteristics differ between drivers

The next analyses come from a different underlying base: the NZHTS in 1997/1998 for key urban centres only (Auckland cities, Wellington cities, Christchurch), with trip legs longer than 60km removed (Sullivan and O'Fallon 2003). The strong patterns shown in that research seem almost certain to remain relevant now, and so we present it because the similar data is not available for more recent years, nor is there any nationwide data. The analyses below are presented separately for weekdays and weekends because of the substantially higher vehicle occupancy figures for weekends.

There were some large differences in the types of passengers typically carried by male and female drivers. (Therefore, there may be gender differences between drivers regarding their valuations of time savings and thus overall valuations are likely to be sensitive to the male/female balance in the sample). Specifically, table A.2 shows that male drivers had other household adults as passengers more often than female drivers (10% of their distance driven, compared with 4% for females), but female drivers had children as passengers much more often (12% of the distance they drove, compared with 3% for males).

On weekdays, the ratio of travel (vehicle-km) undertaken carrying household passengers to that carrying non-household passengers was about 1.60–1.65, for both female and male drivers. At weekends, this ratio was rather lower for female drivers, at around 1.40, but was much higher for male drivers, at around 4.60. Over the week as a whole, the ratios were 1.56 for females and 2.47 for males, giving an overall average close to 2.0. Thus, overall, of the total vehicle-km involving carrying passengers, about two-thirds involved carrying household passengers and one-third carrying non-household passengers.[14]

If we assumed that these same patterns extended to all driving nationwide, this resulted in some very different splits between genders for each category of passenger type (see table A.3). For example, during weekdays, male drivers accounted for around three-quarters (76%) of the distance driven with household

14 These analyses ignored the relatively small proportion of travel that involved both household and non-household passengers.

adult passengers but only about one-quarter (27%) of the distance driven with household children as passengers. The indicative estimates in table A.3 combine total distances driven, by gender, from the 2008–2011 NZHTS, together with the 1997–1998 data on passenger characteristics in table A.2. Obviously, these results are indicative only as regards nationwide patterns; nevertheless, they are useful for planning the sampling of passenger trip types in surveys.

**Table A.2 Gender differences in passengers carried (NZHTS 1997/98, Auckland/Wellington/Christchurch urban areas only)[a]**

| | Gender of driver | |
|---|---|---|
| | **Female** | **Male** |
| Weekdays | | |
| Lone driver | 68.3% | 73.4% |
| Household adult passengers only | 4.4% | 9.6% |
| Household children (under 18yrs) passengers only | 11.8% | 2.9% |
| Household passengers only, both adults & children | 0.5% | 1.7% |
| Non-household passengers only | 10.4% | 8.6% |
| Undefined; driver did not specify number of occupants | 1.0% | 2.1% |
| Other | 3.5% | 1.8% |
| Total | 100.0% | 100.0% |
| *Base number of trip legs (unweighted)* | *6757* | *7081* |
| Saturdays | | |
| Lone driver | 50.9% | 47.4% |
| Household adult passengers only | 5.5% | 21.9% |
| Household children (under 18yrs) passengers only | 14.3% | 7.1% |
| Household passengers only, both adults & children | 2.5% | 8.7% |
| Non-household passengers only | 14.5% | 10.5% |
| Undefined; driver did not specify number of occupants | 3.0% | 1.7% |
| Other | 9.3% | 2.8% |
| Total | 100.0% | 100.0% |
| *Base number of trip legs (unweighted)* | *911* | *1550* |
| Sundays | | |
| Lone driver | 50.5% | 34.0% |
| Household adult passengers only | 6.8% | 28.0% |
| Household children (under 18yrs) passengers only | 10.5% | 4.7% |
| Household passengers only, both adults & children | 5.3% | 15.9% |
| Non-household passengers only | 19.1% | 8.2% |
| Undefined; driver did not specify number of occupants | 0.5% | 1.2% |
| Other | 7.4% | 7.8% |
| Total | 100.0% | 100.0% |
| *Base number of trip legs (unweighted)* | *611* | *1160* |

a) Due to rounding, the figures may not add up to exactly 100%.

**Table A.3 Indicative splits, by driver gender, for each passenger category (NZHTS 1997–1998 patterns for each passenger category from major urban areas combined with NZHTS 2008–2011 nationwide distances)**

| | Gender of driver | | |
|---|---|---|---|
| | **Female** | **Male** | **All** |
| Weekdays | | | |
| Lone driver | 39% | 61% | 100% |
| Household adult passengers only | 24% | 76% | 100% |
| Household children (under 18yrs) passengers only | 73% | 27% | 100% |
| Household passengers only, both adults & children | 17% | 83% | 100% |
| Non-household passengers only | 45% | 55% | 100% |
| Undefined; driver did not specify number of occupants | 24% | 76% | 100% |
| Other | 57% | 43% | 100% |
| Saturdays | | | |
| Lone driver | 39% | 61% | 100% |
| Household adult passengers only | 13% | 87% | 100% |
| Household children (under 18yrs) passengers only | 55% | 45% | 100% |
| Household passengers only, both adults & children | 15% | 85% | 100% |
| Non-household passengers only | 45% | 55% | 100% |
| Undefined; driver did not specify number of occupants | 51% | 49% | 100% |
| Other | 67% | 33% | 100% |
| Sundays | | | |
| Lone driver | 43% | 57% | 100% |
| Household adult passengers only | 11% | 89% | 100% |
| Household children (under 18yrs) passengers only | 53% | 47% | 100% |
| Household passengers only, both adults & children | 15% | 85% | 100% |
| Non-household passengers only | 54% | 46% | 100% |
| Undefined; driver did not specify number of occupants | 18% | 82% | 100% |
| Other | 33% | 67% | 100% |

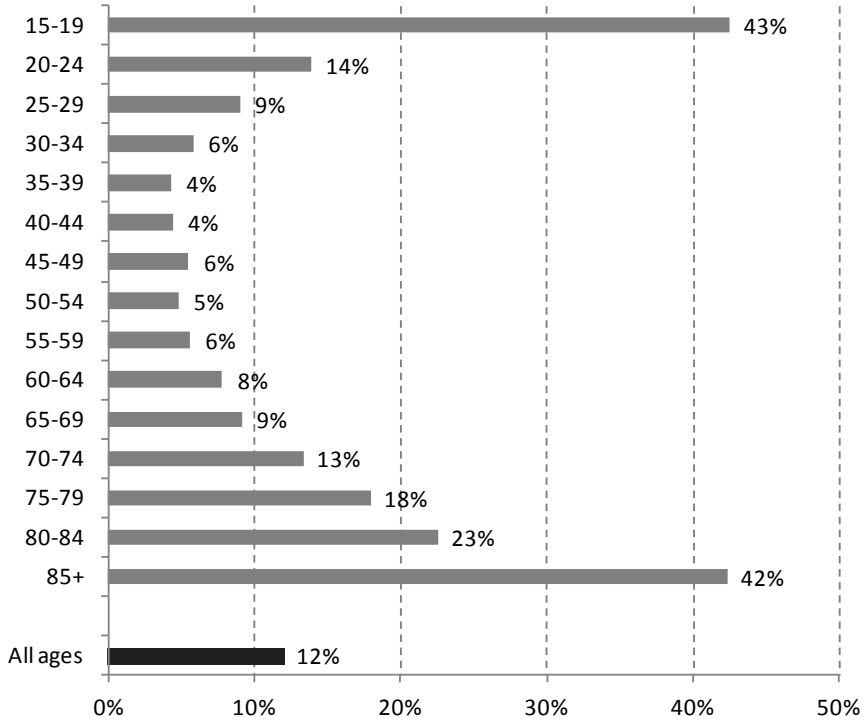
## A.5 Adults without a driver licence

Some preliminary quantitative analysis concerning adults without a driver licence was prudent because they would not be able to answer questions about their views while driving and they could be more likely to travel as passengers than other comparable adults.

Only 12% of those aged 15 years or more, particularly the young and the old, lacked a driver licence (see figure A.3). This showed they could be relatively expensive to recruit as a focus group in the qualitative pre-research phase. However, as non-drivers are a substantial proportion of the young and old, this may well affect recruitment for future quantitative research and whether the questionnaire is designed to ensure that all questions are also relevant to those without licences.

Not surprisingly, those without licences tended to travel more as passengers, but this did not result in them dominating adult passenger travel: they accounted for around 16% of kilometres travelled as a passenger in light 4-wheeled vehicles by those aged 15 years or older.

**Figure A.3 Adults without car or motorbike licence, proportion by age (NZHTS 2008–2011)**

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# Appendix B Household-based interviews – interview guide

**A Interview basis:**

- Adults (preferably all) in household, age >15yrs.
- Preferably face-to-face – phone may be OK for people you know.
- Preferably in home – other locations (cafe, etc) acceptable.
- Payment/gift – small token (bottle of wine) or cash.

**B General aspects:**

- Household numbers and composition:
  - age group/gender [not asked directly, but relevant information noted]
  - children's ages
- Licence holding
- Car ownership/availability – shared or 'individual' ownership
- Household and/or personal income group [not asked directly, but relevant information noted]
- Extent of car sharing and types of trips – within household:
  - 2(+) adults
  - adult(s) + child(ren)
  - typical trips undertaken (purpose/frequency/travel time/driver).
- Extent of car sharing and types of trips – beyond household:
  - number/type in car (adults/children, friends/relatives, etc)
  - typical trips undertaken (purpose/frequency/travel time/car owner/driver)
  - financial arrangements.
- Driver vs passenger choice
  - preferences (by trip duration, day/night, alternative driver, etc)
  - who decides, and how?
- Select trips for more detailed questions, preferably:
  - 3 trip types – long (1 hour +), medium (30–45mins), short (10–20mins)
  - within/beyond household.

**C Specific household trip questions:**

[Interview each adult driver separately, regarding their experience as both driver and passenger. Cover the following for each relevant trip.]

- Trip characteristics:
  - origin and destination
  - frequency
  - approximate travel time
  - which people in the car
  - as driver vs passenger.
- Attitude towards travel time (i) as driver alone:
  - use of travel time
  - would you prefer longer or shorter?
  - would you value travel time saving?
  - would you be prepared to pay more (eg petrol, tolls) to reduce travel time?
  - max. WTP to save Xmins (say 30% of travel time)
  - max. WTP to save X/2mins.
- Attitude towards travel time (ii) as driver with adult passengers:
  - similar to (i) above
  - explore whether/how driving behaviour is affected by presence/absence of adult passenger(s)
  - WTP to save travel time, relative to as driver alone, etc
  - explore whether/how allowing for views of passengers.
- Attitudes towards travel time (iii) as driver with child passenger(s) (maybe also adult):
  - similar to (i) above
  - explore whether/how driving behaviour is affected by presence/absence of child passenger(s)
  - WTP to save travel time, relative to as driver alone, etc
  - explore whether/how allowing for views of passengers.
- Attitudes towards travel time (iv) as passenger (with adult driver only):
  - similar to (i) above
  - WTP to save travel time, relative to as driver alone, etc
  - explore whether/how allowing for views of driver.

**D Hypothetical trip questions:**

*D1 Shopping trip:*

Think about driving to a supermarket that is identical to the one you normally use and is offering exactly the same products that you buy now.

- Would you consider driving there if it would take you half an hour longer to drive there and back (15mins each way) but saved you $10 (after allowing for the cost of petrol)?
  - If it saved you 30mins and was $10 cheaper?
  - If it saved you 15mins and was $10 cheaper?
  - If it saved you 15mins and was $20 cheaper?
- Do you normally shop by yourself or with others?
- Do you think the length of the drive would affect your decision about shopping alone or with others?

*D2 Toll road:*

Think about making a one-hour trip to the Kapiti Coast to visit a friend.

- Would you choose a toll road, offering a 15-minute travel time saving (one way), if the toll was $5, rather than the free normal route?
- How much (maximum) would you be willing to pay?
- How much (maximum) would you be willing to pay if travelling with others and you were the driver?
- What if you were the passenger – would it affect how much you'd be prepared to pay? Would this change if the driver was someone from outside your family?

**E Close:**

- Do you have any follow-up queries (relating to this interview)?
- Would you be willing to participate in a quantitative survey?
- Do you have any feedback?

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**Additional notes/queries – for consideration in survey development**

Choice of cost numeraire in time vs cost trade-offs:

- Toll (route choice)
- Petrol costs (route choice)
- Parking charges (destination choice?)
- Grocery bill (destination choice).

# Appendix C BCHF/SDG 2001 travel time (SP) survey – key features and comments

## C.1 Overview

The project on *Review of benefit parameter values for economic evaluation* was undertaken for Transfund New Zealand by a consultant team led by BCHF over the period 1999–2002, with the main market research phase taking place in 2001 (BCHF et al 2002).

The centre-piece of the market research phase was a multipart stated preference (SP) survey, covering:

- car drivers, to elicit information on values of (i) time savings; (ii) congestion and reliability changes; and (iii) perceived safety benefits
- PT users
- commercial vehicle operators.

This appendix focuses on the SP research (survey and analyses) undertaken to establish car drivers' VoT, from the following two main viewpoints:

- Does the previous survey and its analysis shed any light on VoT associated with car passengers; or could the survey data shed such light with supplementary analyses?
- Does the previous survey/analysis provide guidance on the design of any survey to establish VoT associated with car passengers (or varying car occupancy levels)? In particular, could economies be achieved in future market research into the variation of 'car' VoT with occupancy levels by making use of the previous survey analyses of car driver VoT in conjunction with a new survey/analysis of car passenger VoT?

## C.2 Key features of the 2001 survey

Table C.1 sets out the key features of the 2001 SP survey of car drivers, regarding the aspects relating to establishing VoT.

The SP survey focused on a set of pair-wise comparisons of alternative routes, each defined in terms of drive time and trip cost (petrol plus car parking). Figure C.1 sets out the instructions that were given to the respondents. Figure C.2 gives a typical 'game', in which the respondent was asked to give preferences between the two alternatives. (Laptop computers were used to present the questionnaire and to tailor the SP 'games' to a specified recent trip made by the respondent. However, a booklet of paper questionnaires could be used as an alternative.)

The SP experimental design specified 18 'games' in which drive time differences took one of three levels, and cost differences one of six levels. These incremental times and costs were chosen to accord with reasonable 'boundary values of time' (ie additional cost/time saved), based on 'an expected average VoT of 12 cents/minute and a fairly long tail to the distribution'. Table C.2 shows the experimental design used.

In practice, the design was applied in two halves, with each respondent being asked to play nine choice 'games'. An example of the SP game is shown in figure C.2.

## C.3 The survey treatment of car passengers and implications for future car passenger (occupancy) VoT research

The SP survey covered *car drivers only*, although information was collected on the number of car occupants, including the number of children. In this regard, the BCHF report (2002) stated:

> *Given the sample size and the large number of topics to be covered it was considered unwise to try to cover passengers as well as drivers. The risk was that if they did have different preferences they could introduce enough variance in the sample to weaken all the estimates. It was thought better to get good estimates for drivers, and take a view, based on experience and practice elsewhere, on the values to use for passengers* (s3.2.4).

In the case of multi-occupant car trips surveyed, it was implicit (although not specified) that the car occupancy for the trip in question was unchanged throughout all the SP choices. However, no guidance was given on whether the trade-offs made by the respondents were expected to take any account of passenger valuations/preferences. The BCHF report (BCHF 2002, s3.2.5) stated that 'The assumption is always made that car drivers do *not* include passenger time values in their travel choice'. While it is debatable whether this is a reasonable assumption, it was adopted in the analyses of the SP results (ie it was assumed that the VoT estimates related to drivers only).

While (arguably) car drivers did not allow for any passenger valuations/preferences in responding to the SP games, the presence of car passengers may have affected their own VoT. The survey analysis undertaken has not examined the effects of occupancy on car driver valuations, although the data collected should enable this to be done (table C.1 notes that 44% of the surveyed trips involved one or more passengers).

We investigated whether such a re-analysis of the original data would be feasible in practice and make the following points:

- We have obtained the original survey database.
- Inspection of this database indicates that the required re-analysis should be possible.
- This will involve re-running the original analyses with additional variables for (i) the number of car passengers; and (ii) how many of these were children (<15yrs).
- This is likely to involve approximately one consultant week's work.

The output of such a re-analysis would be information on how the car driver VoT varied with the number of (adult/child) passengers carried. It would *not* provide any information on:

- whether the driver VoT include any allowance for passengers' values/preferences (the BCHF analyses assumed the driver took no account of these values)
- the valuations of car passengers (or whether driver and passenger valuations are simply additive).

## C.4 Other issues relating to the 2001 (SP) survey

We note in table C.3 a number of other issues relating to the 2001 car driver SP survey/analyses, which may be relevant to interpretation of the survey results or to any future survey (eg of car passengers) for which it is desired to compare the results with the 2001 survey.

**Table C.1 Key features of the 2001 VoT survey (Source: BCHF et al 2002)**

| Heading | Features |
|---|---|
| Overview | • Random sample of New Zealand car drivers, to establish trade-offs between in-vehicle travel time and trip costs, and hence VoT |
| Consultants | • BCHF with SDG (survey design) and Forsyte (survey admin. and delivery)<br>• Peer review by David Ashley and John Bates |
| Survey method | • Considered relative merits of door-to-door household survey vs an intercept/hall approach – decided on household survey<br>• Used multistage cluster sampling of selected households, (up to 2 call-backs) with initial 'screening' questionnaire to identify households within scope<br>• Computer-assisted personal interviews (CAPI) – although could do similarly with show-cards or web-based responses<br>• Found an average of 6.0 door-knocks per completed interview<br>• Two pilot surveys (c.60 interviews) undertaken prior to main survey |
| Population and sampling basis | • In the selected households, eligible respondents were those that, within the previous two weeks, had made a trip of >10mins duration as a car driver<br>• One eligible (with next birthday) respondent per household was then selected for interview [this gives a bias against households with more adults]<br>• For the selected respondent, interview then focused on a single selected recent trip (categorised into commuter/non-commuter, urban/rural)<br>• Business trips were excluded<br>• Trips <10mins duration were excluded. [This was seen as overcoming the potential difficulty for respondents in trading-off very small time and cost changes for such short trips; however, it may result in significant bias in terms of reflecting the total New Zealand car travel market, especially in terms of trip numbers]<br>• Sample was to comprise 1200 completed interviews across 11 interview areas (predominantly urban) in New Zealand<br>• Minimum or indicative quotas were set by: (i) centre; (ii) trip purpose (split 50% commuter: 50% other); (iii) minimum 40% mainly rural trips; (iv) gender and age group |
| Questionnaire | • Also focused on the recent trip identified through the 'screening' interview<br>• Covered (for the one-way trip):<br>- journey origin, destination, distance, driving time<br>- road types (urban vs rural, motorways vs other)<br>- trip purpose<br>- number of vehicle occupants (adult vs child)<br>- parking details (type of parking place, time parked, cost, who paid)<br>- time between parking location and main destination<br>- car characteristics – type of car, type of fuel, engine capacity<br>- who owns the car (driver, other family member, employer, etc)<br>- who paid for fuel costs<br>- various stated preference 'games' (see below)<br>- demographic, etc, aspects (age, sex, personal income, household structure) |
| Time vs cost (SP) 'games' | • SP 'games' involving two alternative routes and sets of costs, one representing the actual trip, and asking for respondent preferences (definitely A, probably A, cannot choose, probably B, definitely B)<br>• 'Base' cost was fuel cost (estimated based on engine capacity and distance) plus parking costs. 'Base' time was driving time plus(?) parking access, etc, time<br>• Defined 18 'games' (for trips <1hr), with time savings 5/10/15mins, additional costs in range \$0.15–\$4.50 (together encompassing 'boundary' VoT in range 3–30c/min)<br>• For trips taking 1–2 hours, all these increments were doubled; tripled for trips taking 2–3 hours, etc |

| Heading | Features |
|---|---|
| | • Each respondent was asked to complete 9 of the 18 games<br>• Respondents were asked to play the game as if they were paying the costs themselves<br>• Figure C.1 shows the introductory screen and a typical game screen for the SP survey |
| Respondent characteristics | • *Group size:* Overall, 44% of the surveyed trips involved carrying one or more passengers (average c.1.7 passengers for these trips). For commuter trips, only 23% carried passengers; for other trips, 64% carried passengers<br>• *Trip duration:* Average drive time 23mins for commuter trips, 51mins for other trips<br>• *Car ownership:* About 80% of respondents owned the car they were driving; for 9% the car was owned by someone else in the household; for 6% it was owned by the respondent's employer<br>• *Fuel costs:* 83% of respondents bore the fuel costs themselves<br>• *Parking costs:* Only 10% of trips (12% urban, 6% rural) involved any parking costs. For such trips, in 85% of cases the costs were borne by the driver<br>• *Total trip costs:* The average reported cost (fuel + parking) was $5, with around 60% of trips having costs in the range $0–$2.50. (Total [1-way] trip costs were stated to be calculated as 1-way fuel costs + total parking costs: this appears to be an error – half the parking costs should be used) |
| Analysis approach | • The analysis involved fitting logit models to the choice data.<br>• The logit model formulation is:<br>$P_i = \mathrm{Exp}(V_i)/\sum \exp(V_j)$<br>where $P_i$ is the probability of option $i$ being chosen and $V_i$ is the utility of option $j$. This utility is a function of the attributes of that option (in this case cost and time)<br>• The simplest expression for the utilities is then a linear combination of cost and time, as in:<br>$V_i = a_1 \cdot \textit{In-vehicle time}_i + a_2 \cdot \textit{Cost}_i$<br>where the parameters $a_1$ and $a_2$ are parameters to be estimated. An estimate of the 'value of time' is then given by the ratio $a_1/a_2$<br>• In practice, a more complex formulation was applied to estimate the variation of the VoT with income and trip distance |

**Figure C.1 Introduction to VoT SP**

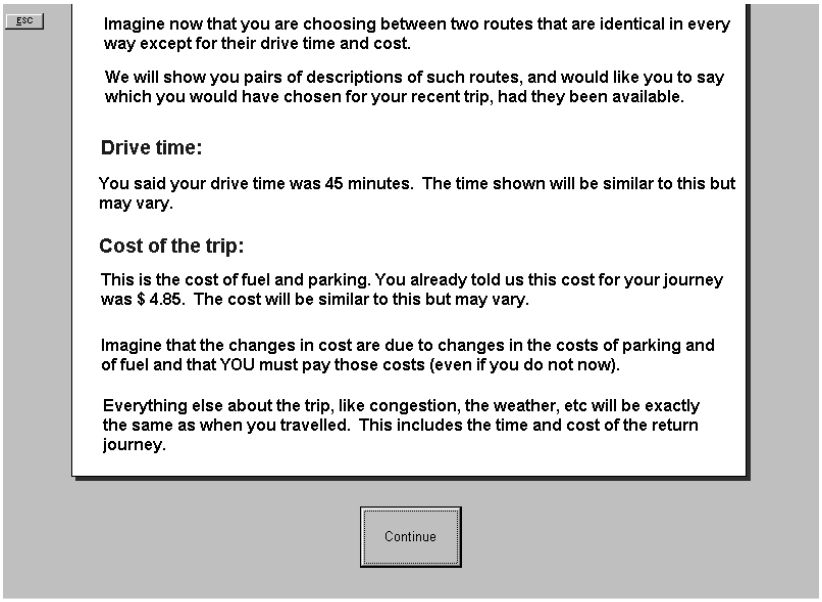


**Figure C.2 Example of VoT SP screen**

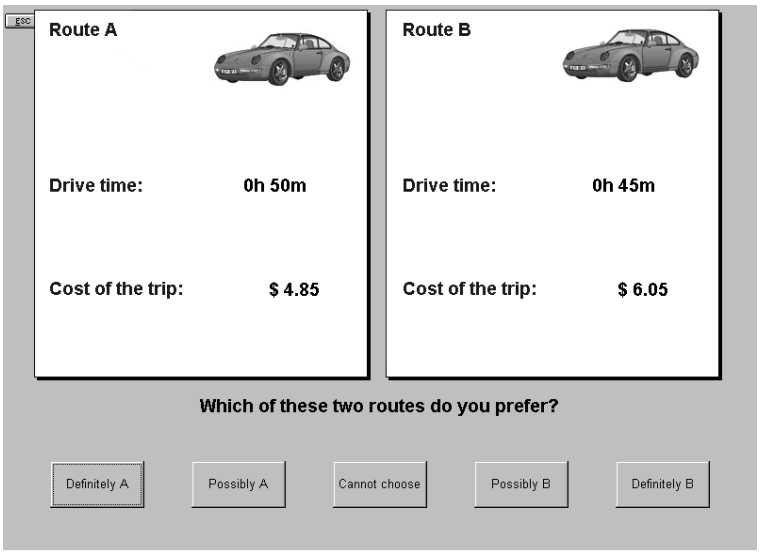


**Table C.2 Design for VoT**

| Case | Time saved (mins) | Additional cost (cents) | Boundary VoT (cents/min) | Design allocation |
|---|---|---|---|---|
| 1 | 5 | 15 | 3 | 1 |
| 2 | 5 | 30 | 6 | 2 |
| 3 | 5 | 60 | 12 | 1 |
| 4 | 5 | 90 | 18 | 2 |
| 5 | 5 | 120 | 24 | 1 |
| 6 | 5 | 150 | 30 | 2 |
| 7 | 10 | 30 | 3 | 2 |

| Case | Time saved (mins) | Additional cost (cents) | Boundary VoT (cents/min) | Design allocation |
|---|---|---|---|---|
| 8 | 10 | 60 | 6 | 1 |
| 9 | 10 | 120 | 12 | 2 |
| 10 | 10 | 180 | 18 | 1 |
| 11 | 10 | 240 | 24 | 2 |
| 12 | 10 | 300 | 30 | 1 |
| 13 | 15 | 45 | 3 | 1 |
| 14 | 15 | 90 | 6 | 2 |
| 15 | 15 | 180 | 12 | 1 |
| 16 | 15 | 270 | 18 | 2 |
| 17 | 15 | 360 | 24 | 1 |
| 18 | 15 | 450 | 30 | 2 |

**Table C3 2001 car driver SP survey – 'other' issues**

| Issue | Comments |
|---|---|
| Short trips | • Trips of <10mins duration excluded from survey.<br>• This seems likely to comprise a quite substantial proportion of all car driver trips (a much lower proportion of driver hours and driver-km).<br>• Omission of these trips reduces the ability to examine values for small time savings/shorter-duration trips. |
| Business trips | • 'Employer business' trips excluded from survey/analysis – not necessarily a problem, but these should be covered somewhere if a full suite of VoT is to be established. |
| Sample selection | • While the BCHF report (2002, s5.1.1) states that 'The sample is thus designed to provide a representative sample of the resident driving population', we consider that biases are likely to result from sampling being based on only one respondent per household. For example, this will tend to result in undersampling of households with more adult drivers, which may lead to underestimates of average car occupancy rates.<br>• It does not appear that any tests or sample adjustments have been made for this effect. |
| Urban vs rural trips | • The report finds that VoT do not differ significantly between urban and rural trips, once account is taken of the other model variables (distance, income, etc).<br>• This suggests that it may not be necessary to set urban vs rural quotas in any future related research. |
| Treatment of parking charges | • While the SP games were based on one-way trips, the total cost calculation for the trip appears to have been based on (i) fuel costs for the one-way trip; plus (ii) total cost of parking associated with the 2-way trip (refer to BCHF et al 2002, s5.1.26). This is an inconsistency: only half the total parking costs should have been included for the one-way trip.<br>• The effects on the results of this inconsistency appear likely to be small, as parking costs were incurred in only c.10% of the surveyed trips (BCHF et al 2002, table 5.1.15). |

## C.5 Appendix C references

Beca Carter Hollings & Ferner (BCHF) with Steer Davies Gleave, Forsyte Research and Brown Copeland & Co (2002) *Review of benefit parameter values for economic evaluation: final report*. Report to Transfund NZ. 393pp.