UNDERSTANDING AND VALUING JOURNEY TIME VARIABILITY

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1. INTRODUCTION

Congestion is an increasingly important issue for road users and the Highways Agency has a specific objective *to 'take action to reduce congestion and increase the reliability of journey times'.*

Reducing travel times is a key issue in economic appraisal. Reducing the variability in travel times has not been treated with the same importance despite evidence from earlier studies that variability in journey times is valued more highly by some people than reductions in travel time itself.

Valuing travel time variability is difficult given the complexity of the subject. This study has undertaken a detailed qualitative assessment of what travel time variability means to people in order to understand the most meaningful method of presenting journey time information to people. Its methodology has been novel and innovative, including optimisation of departure time choice in the SP experiment.

The study had two key objectives:

- Explore using qualitative research, what travel time variability means to people and to gain an understanding of the best methods of representing it.
- Measure the value that people place on journey time variability using stated preference techniques.

2. BACKGROUND

In commissioning this study, there was recognition by the Highways Agency (HA) that Journey Time Variability (JTV) is an important factor in influencing travel behaviour and that there is a need to take it into account for future highway investment planning. JTV has two dimensions – a frequency dimension – how often delays occur, and a magnitude dimension – how big the delay is when it occurs. It is important to the HA that the economic value of JTV is defined.

Early research used the concept of 'reliability ratio' – the relationship between travel time and the standard deviation of travel time. More recent research

carried out in the US has adopted a more behavioural activity scheduling approach.

FaberMaunsell have conducted an initial phase of qualitative research and the design and pilot of quantitative Stated Preference (SP) analysis.

3. QUALITATIVE RESEARCH

3.1 Introduction

The qualitative research phase was in two stages, involving depth interviews and focus groups.

The main purpose of Stage 1 was to get an understanding of what journey time variability means to people and to explore how it impacts on journey planning. Stage 2 concentrated on exploring different types of presentational techniques to derive a preferred method of presentation for the stated preference experiment that would be used in the quantitative phase of research. How respondents made decisions when faced with a choice between two journey time distributions with different characteristics was explored.

3.2 Stage 1 Depth Interviews and Focus Groups

Stage 1 involved 3 focus groups and 6 depth interviews, in north and south England, with a range of traveller types making a range of trips.

Firstly, a series of cards was presented to respondents in the focus groups which showed different journey time distributions in the form of simple bar graphs. There were sets of cards representing different journey lengths relevant to respondent's typical journeys. Respondents were asked to group similar distributions, explain their rationale and provide a description for each distribution and its cause. Respondents were also asked to select the 3 distributions that were most attractive.

Respondents were shown a series of paired journey choices with same mean and different standard deviations, or ranges, see example in Figure 3.1. The majority preferred the options where standard deviations were lower as they felt that it meant they could plan better and the maximum journey time was lower. A minority preferred the option that presented the lowest minimum, ie the higher standard deviation.

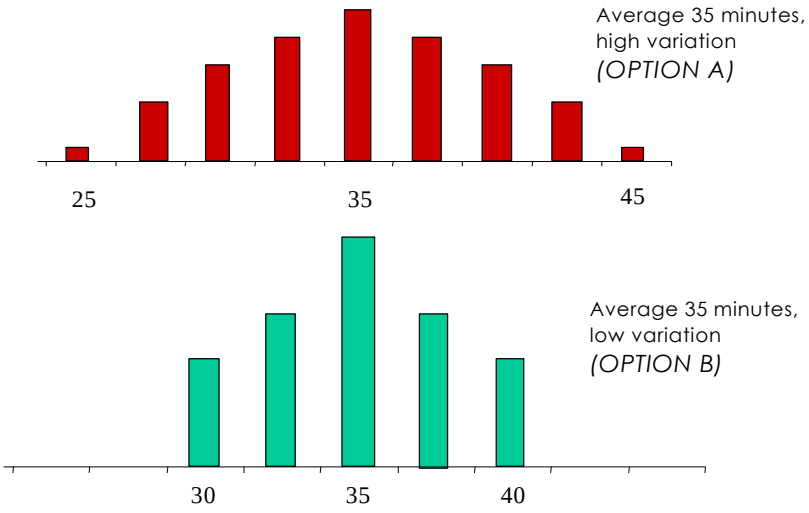


Figure 3.1 Distributions with same mean, different standard deviation

Respondents then compared low mean, high variation versus high mean, low variation. Some respondents still preferred predictability over variability.

> *"I'd go for OPTION B because there's less uncertainty… otherwise you could end up on a good day arriving 20 minutes early"*

> *"OPTION B…it's likely to take you longer but there's less variability in the time"*

When the mean time was increased by the moderator for option B, by moving the histogram to the right, some respondents started switching their choices between the options presented, thus trading off mean journey time with the standard deviation. Respondents also took account of mean journey time, and the shortest and longest journey times to make their decision.

> *"I would go for OPTION A now because on average, this journey [OPTION B] is taking you 10 minutes longer near enough every day…the average does play a part to a degree. Where your average isn't much different it doesn't matter but when you start getting the average being a reasonable amount more, then I think sometimes it would be worth taking the risk"*

Respondents were looking at different information to make their choice. Some looked at the 'spread' which they referred to as the 'time span' or the difference between the minimum and the maximum time.

> *"It's the spread…if you tell someone you're going to be there in 40 minutes…with OPTION B it's more likely to happen. There's more danger of slippage on the red one [OPTION A]"*

Some were considering the mean, the minimum and the maximum.

> *"I look at the average first of all but I'm on the spread, the best and the worst case."*

Some just considered the maximum.

> *"I look at the end point".*

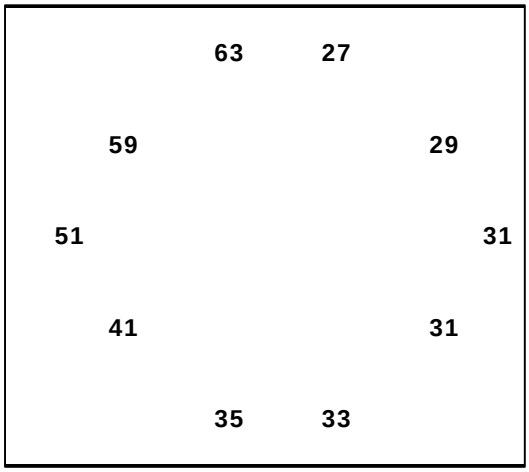
The discussions included testing the ability of individuals to understand and use a range of information regarding journey times presented differently. The aim of the exercise was to find out positives and negatives for each method of presentation and to investigate respondent suggested improvements. A series of cards were shown to respondents, representing different ways of presenting JTV;

- Linear presentation of journey time data;
- Clock face presentation of journey time data;
- Clock face presentation of how early or late each journey arrival time was; and
- Graphical presentation of journey time data.

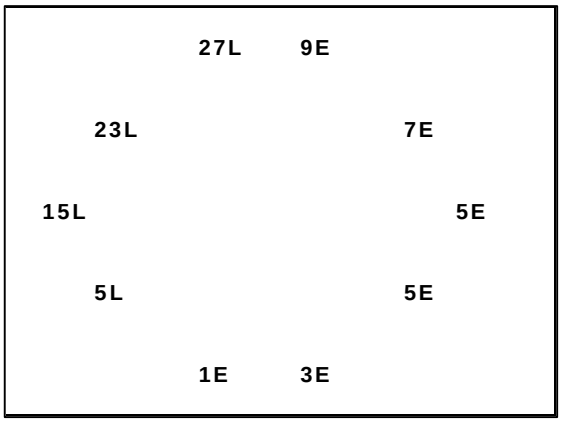
1. Linear Presentation – This shows the number of minutes taken for the last 10 journeys made, in ascending order.

Journey Time Minutes									
26	**28**	**30**	**30**	**32**	**34**	**40**	**50**	**58**	**62**

2. Clockface presentation of journey time – this also shows the number of minutes taken for the last ten journeys but arranged in a circle.



3. Clockface presentation of how early or late each journey arrival time was.



4. Bar Charts showing the last 10 journeys made.

The methods of presentation which generated the most positive comments, were a linear arrangement of raw data and the graph (bar chart).

Some respondents preferred the linear data over the graphical format because they considered the key data easier to see (minimum, maximum, outliers) but others felt that it took longer to understand the data than from the graph. It was also felt that the linear data could not be 'abused'/misrepresented, but that graphs could be.

Respondents were looking for something which allowed them to make a fully informed decision. People also indicated that they did not think of lateness in terms of a few minutes, but significant lateness of say half an hour.

Stage 1 Qualitative Research Summary

Respondents were asked to describe their experience of and response to journey time variability (JTV). This revealed little that was unexpected.

Respondents thought that regular journeys by car, which were made at the same time of day, using the same route, varied little. This is likely to be because respondents have found the best route (i.e. most reliable and

quickest). Business travellers were more likely to say that all journeys were unreliable.

Causes of journey time variation were perceived to be time of day, day of week, weather, school starting and finishing times, and extreme events. Incidents, such as major road works, accidents, wide loads, were not planned for and were frustrating, particularly where journeys are being made for meetings/appointments.

Many business appointments are now made with a degree of flexibility (the 'ish'). This appears to be an acknowledgement by the business community that it is difficult to accurately predict journey times.

Buffer/safety margins are added to most journeys with fixed appointments. The level of the buffer varied according to journey distance, how important the appointment is, and how familiar the traveller is with the journey. The buffer covers known road conditions (traffic lights, roundabouts), known road works/delays and expected levels of congestion. Incidents are not allowed for in the buffer. Some respondents claimed that they had sometimes planned journeys to avoid major traffic delays, even though it meant travelling greater distance and increased journey time.

Personality traits strongly influence attitudes to arriving early or late. Some people always plan to arrive early and are very distressed if they arrive late. Other people would gamble the possibility of being late if it meant that journey time was shorter.

Quality of journey (i.e. ability to travel at constant speed versus stop/start) plays a key role in route choice decisions). A journey involving travel at constant speed was less stressful than one with a considerable amount of stopping and starting.

Respondents appeared to understand the concept of JTV and graphical and linear representation of JTV data. They were willing to trade increased mean journey time for reduced JTV.

There was variability between respondents in the factors that they took into account when making their choice decisions – some looked at the maximum journey time, some looked at the range of journey times, some looked at the mean journey time and the range, and others looked at the distribution/standard deviation.

Respondents were split in their preferences for the method of presenting JTV data between a linear presentation of data and a graphical presentation. Graphs were preferred for being easier and quicker to interpret because they

were visual. Conversely not all might be able to understand them and there was some mistrust of graphical data.

3.3 Stage 2 Qualitative Research - Presentational Issues

Objectives
The objectives were to understand through qualitative research how the different presentations of JTV data were interpreted and how choices were determined.

Procedure
The methodology applied was to conduct four mini-groups, with up to four people, to explore different methods of presenting journey times to respondents. Before taking part in the group discussion, respondents were asked to complete a travel diary for 5 working days to record their journey details to work, how long it took, departure and arrival times, incidence of extreme events, etc. The purpose of this was to focus respondents on journey time and to provide evidence for the degree to which their journey time to work varies.

A more structured and less open approach than the previous exploratory qualitative research was developed to ensure more control. A range of tasks in each group were carried out to provide a measure of the level of understanding.

Journey scenarios were presented to respondents in four different ways, as for the Stage 1 research;

- Linear presentation of journey time data;
- Clock face presentation of journey time data;
- Clock face presentation of how early or late each journey arrival time was; and
- Graphical presentation of journey time data.

The graphical presentations were enhanced such that the data represented 100 journeys. This enabled a rich amount of information to be presented from which respondents could make their decisions.

Scenarios were designed to represent the journeys of fictional people, each being given a name, as shown in Table 3.1 below. Naming the distributions helped respondents to think about the journeys as being made by people, rather than in an abstract way, hence they could assign reasons those people might give for choosing their routes.

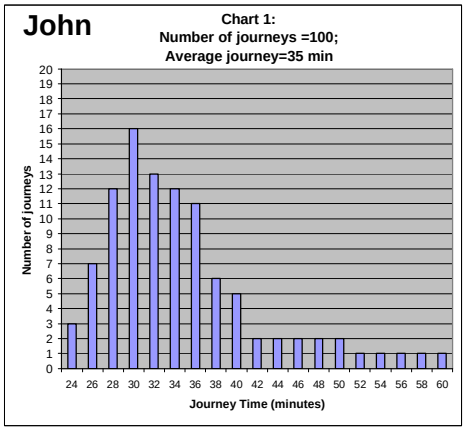
Table 3.1 Distribution Types

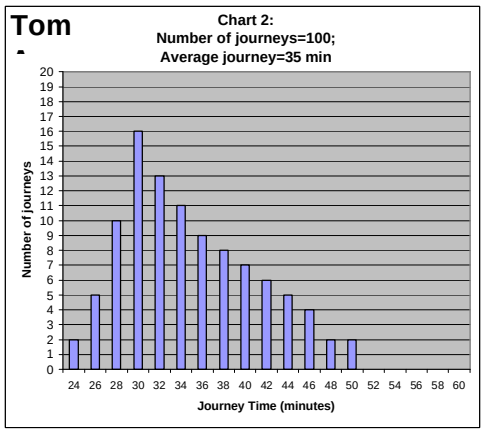
John/Audrey/Gilly	Wide distribution of times, low mean time
Tom	Narrow distribution of times, low mean time
Graham	Narrow distribution of times, with one outlier
Mark	Narrow distribution of times, high mean time

The first scenario compared the journeys of two fictional people named John and Tom, see examples in Figures 3.2 to 3.5. Other scenarios compared the journeys of Graham and Audrey and of Gilly and Mark. Each person represented a particular pattern of journey times.

John and Tom travel by car from Warrington to Chester every day at the same time. They always travel by the same route, but they use different routes from each other. Both of them make their journeys at the same time of day.

Chart 1 shows how long John's journey took the last 100 times that he made it and chart 2 shows the same information for Tom. On average both journeys take 35 minutes but the journey time does vary as shown in the charts.





Q1 Imagine that you wanted to make the journey from Warrington to Chester and had to use either John or Tom's route. Given the information presented, which route would you prefer to take?

Figure 3.2 Scenario based on Bar Chart

John and Tom travel by car from Warrington to St. Helen's every day at the same time. John always uses the same route, as does Tom, but they use different routes from each other. Both of them are making their journeys at the same time of day. Figure 1 shows how long John's journey took the last 10 times that he made it and figure 2 shows the same information for Tom. On average, their journeys take 35 minutes, bu the journey time varies as shown in the figures.

Figure 1

Average Journey Time = 35 min

John's journeys:

Journey Time Minutes
26 28 30 30 32 34 40 50 58 62

Figure 2

Average Journey Time = 35 min

Tom's journeys:

Journey Time Minutes
26 30 30 32 34 36 42 46 50 52

Q1 Imagine that you wanted to make the journey from Warrington to St. Helen's and had to use either John or Tom's route. Given the information presented, which route would you prefer to take?

Figure 3.3 Scenario based on Time Line

John and Tom travel by car from Warrington to Altrincham every day at the same time. John always uses the same route, as does Tom, but they use different routes from each other. Both of them are making their journeys at the same time of day. Figure 1 shows how long John's journey took the last 10 times that he made it and figure 2 shows the same information for Tom. On average, the journeys take 36 minutes, but the journey time varies as shown in the figures.

Figure 1

Average Journey Time = 36 min

John's journeys:

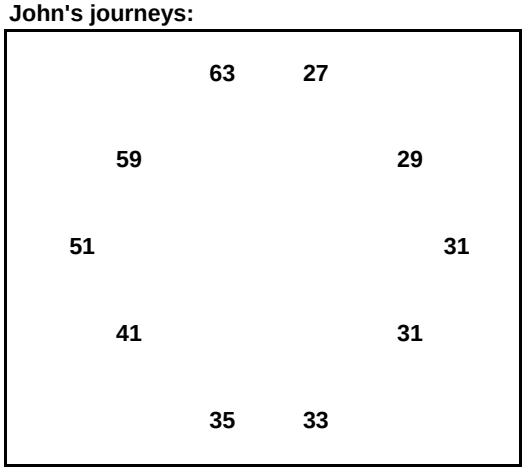
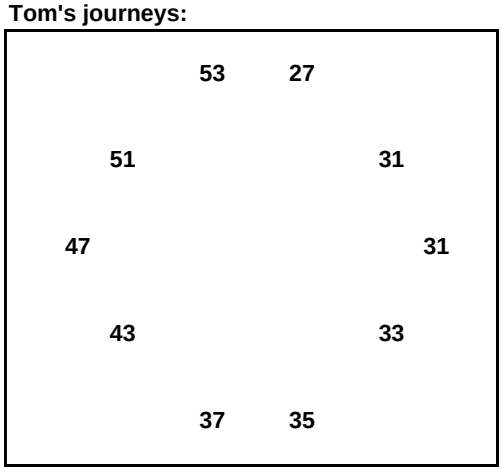


Figure 2

Average Journey Time = 36 min

Tom's journeys:



Q1 Imagine that you wanted to make the journey from Warrington to Altrincham and had to use either John or Tom's route. Given the information presented, which route would you prefer to take?

Figure 3.4 Scenario based on Clock face presentation

John and Tom travel by car from Warrington to Widnes every day at the same time. John always uses the same route, as does Tom, but they use different routes from each other. Both of them are making their journeys at the same time of day. Figure 1 shows how long John's journey took the last 10 times that he made it and figure 2 shows the same information for Tom. On average both journeys take 33 minutes but the journey time does vary as shown in the figures. N.B. In the figures below, E= Early, L=Late e.g. 12 E means that John arrived 12 minutes early.

Figure 1

Average Journey Time = 33 min

John's journeys:

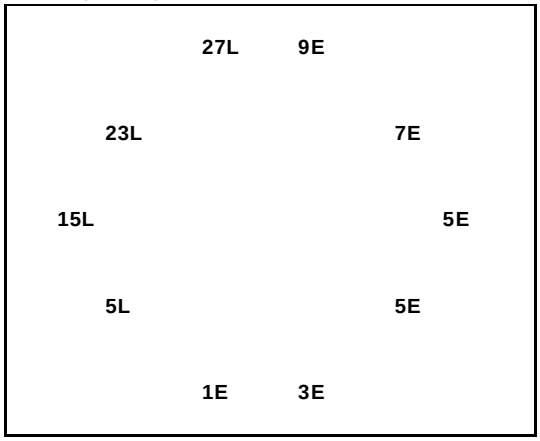
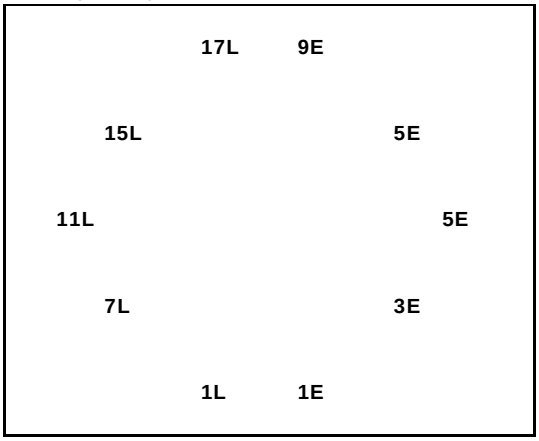


Figure 2

Average Journey Time = 33 min

Tom's journeys:



Q1 Imagine that you wanted to make the journey from Warrington to Widnes and had to use either John's or Tom's route. Given the information presented, which route would you prefer to take?

Figure 3.5 Scenario based on Early/Late times

The average journey time for each journey was stated. This average journey time was used to calculate the times for the early vs. late clocks.

Although the patterns of the journeys made by John, Audrey and Gilly were the same, the actual times were adjusted slightly by a minute or two in order to minimise the chance of respondents realising the journeys were identical.

For each person, the data shown on the timeline and the clocks was identical. The data shown in the charts followed the same pattern but could not be identical because of the larger number of journeys represented. Each comparison was labelled so it appeared to be showing a different route each time. For example, each of John and Tom's journeys began in either St. Albans or Warrington, but finished in four different locations (one for each means of showing the data).

Each group was given the stimulus material in a different order from the other groups to minimise order bias and to reduce the effect of respondent fatigue.

Respondents were asked to identify what aspect(s) of the distribution they were using to make their decision on which route they would choose and justify their decisions, whether it was the mean journey time, the range etc. No values of standard deviation were presented. They were also asked to

state how long they would leave for each fictional person's journeys in order to arrive on time and why. As the stimulus material essentially shows the same journeys being made by each person, the purpose of the exercise was to see if respondents were consistent in their answers or if the different ways of presenting the data altered their perceptions. Where respondents had switched between possible choices (for example between John and Tom) this was discussed and their reasons explored.

Stage 2 Qualitative Research Summary

The research shows that the concept of JTV and the graphical and linear representation of JTV data is understood with little training.

Respondents were asked to identify what they had based their final decision on and were asked to indicate which factor(s) they used to decide which route to choose. The factors were:

- the quickest time that the journey takes
- the longest time that the journey takes
- the spread of journey times between the shortest and the longest
- the most frequently occurring journey time
- the mean journey time
- Other

Figure 3.6 shows the frequency with which each factor was used.

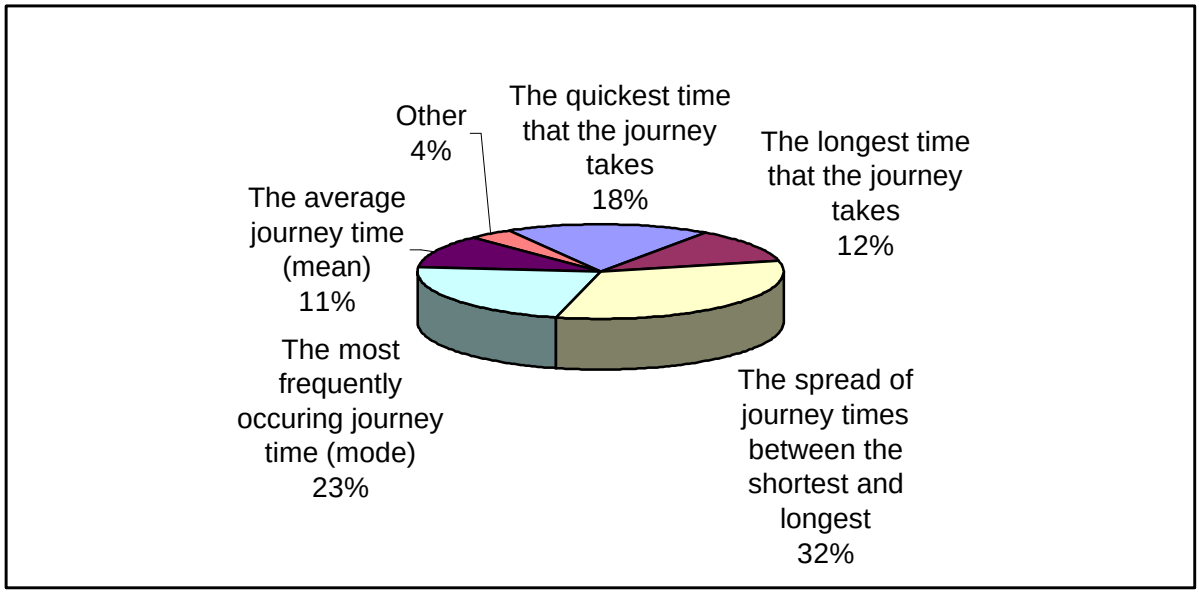


Figure 3.6 Factors Determining Choice in use of Presentation Material

This shows that the spread is the most commonly used factor, followed by the most frequently occurring journey time.

This exercise also showed that the way the information was presented to respondents did affect their choice of preferred route. Some respondents did not stay with the same route choices throughout the exercise, but their decisions do not appear to be random. For the majority of cases respondents did choose the route that was 'better' (lower mean, least chance of being late). It seems that the more factors that a respondent took into consideration when making their choices, the more likely they were to pick the 'better' route.

Respondents seem to be able to understand the histogram, timeline and simple clockface presentation of data. The findings show, however, that including the concept of ‘early’ and ‘late’ times creates an ‘emotive’ response. People did not seem to like being told they would be late.

There seemed to be limited consistency between choices by respondent, by the method of presentation used. Where possible, respondents find ways of simplifying the task. The sample size is small, therefore these findings may not definitive, however, respondents appeared to be able to grasp the idea of distributions and to translate this concept into more simple ideas which relate to real journey choices with little training.

The research has established that:

- travel diary information is useful for providing ‘context’ to journey choice options;
- most respondents can cope with the task of comparing data relating to journey choices and do understand the information presented.
- people are able to understand journey time information presented as a distribution histogram based on a large amount of data with no training.

4. QUANTITATIVE RESEARCH

4.1 Introduction

The traditional method for modelling travel time variability is referred to as the Mean Variance Approach. It measures the relative valuation of travel time variability compared with mean journey time and is expressed as a ratio.

The reliability ratio measures the ratio of the travel time parameter and standard deviation of travel time parameter in the following utility function (β/α):

$U = \alpha TT + \beta SDTT$

Where

U=Utility

TT=Travel Time

SDTT= Standard Deviation of Travel Time

α, β are parameters to be estimated.

An alternative to the Mean Variance Approach is the Activity Approach for examining how travellers schedule their activities, for example Noland and Small (1995). Underlying this approach is an assumption that the traveller has an ideal time for arriving for a particular activity. Any departure from this imposes so called scheduling costs on the traveller.

The following utility function is estimated:

$E(U) = \gamma cE(T) + \delta E(SDE) + \varepsilon E(SDL) + \eta PL$

Where Expected utility E(U) is dependent on expected (or mean) travel time E(T), expected schedule delay-early, E(SDE), expected schedule delay-late E(SDL) and the probability of late arrival PL.

γ, δ, ε and η are parameters to be estimated.

Scheduled Delay Early Time (SDE) and Scheduled Delay Late Time (SDL) relate to the average number of minutes early or late that a person will experience given a particular journey time distribution. This is in relation to their Preferred Arrival Time (PAT), the time they are aiming to arrive. Probability of being late is the number of times they will be late in relation to their PAT.

For the purposes of this study we have adopted an approach which is capable of being modelled in both ways so that it is possible to estimate the value of the standard deviation and hence obtain a reliability ratio but also estimate scheduling costs, although it was recognised, on the basis of previous work, eg Noland et al (1998) that it may not be possible to estimate both in a single model.

The standard deviation of travel time will be approximately a linear function of the scheduled delay parameters but only if departure time is optimised.

4.2 Stated Preference Survey Design

Following the qualitative phase, it was decided that the SP experiment would:

- be based on the histogram method of presentation; and
- designed to be capable of estimating both standard deviation and scheduling costs – early and late
- not include monetary costs of car travel.

The histogram method of presentation was chosen because this approach seemed capable of presenting a large volume of information to people, which on the basis of the qualitative research, they seemed to be able to understand with little training. Presenting journey time data in this form had not been attempted before.

The inclusion of monetary costs of car travel in the design was carefully considered, however it was decided to omit them because of the problem of getting a big enough variation without introducing emotive concepts such as tolls.

The SP design and Computer Aided Personal Interviewing (CAPI) program were developed and built in Excel. This allowed the respondent's actual travel times to be input at the start of the interview. This data was then used in selecting scenarios and thus the scenarios presented could be highly customised.

4.3 Computer Aided Personal Interviewing (CAPI) Program

Twenty-six histograms were created, representing a range of journeys with a spread of maximum and minimum journey times, and standard deviations ranging from 0.8 to 6.8 minutes. An example is shown in Figure 4.1.

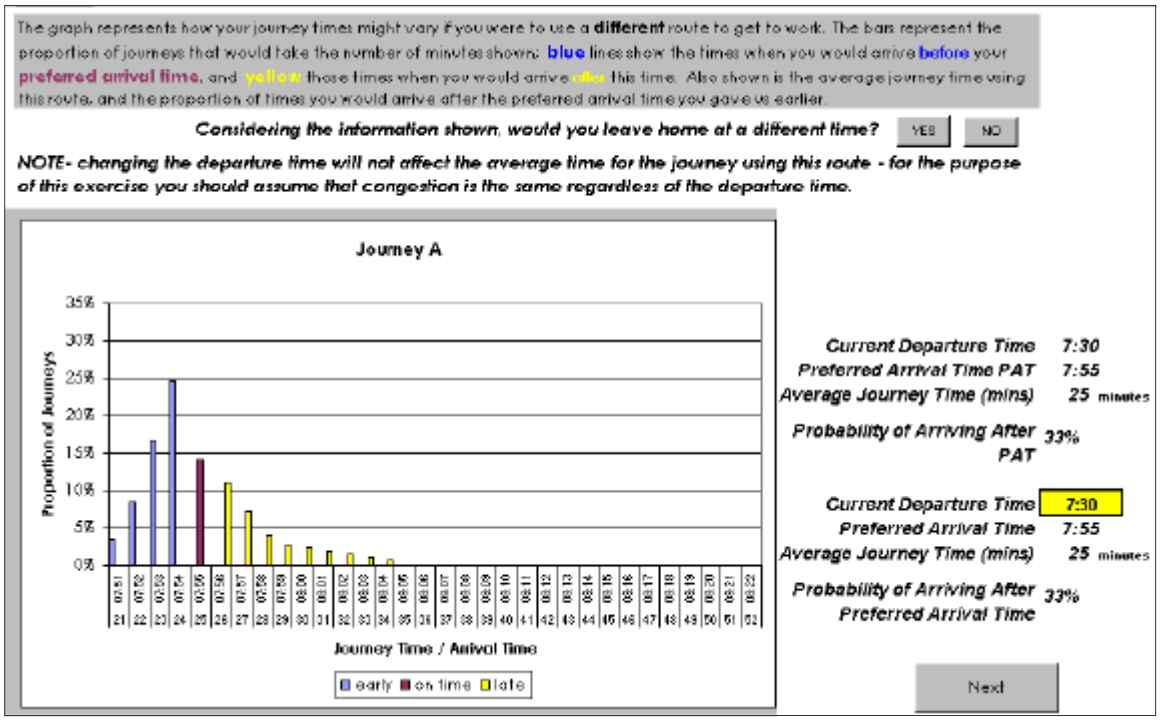


Figure 4.1 Journey A

The respondent was shown ‘Journey A’, which was not referred to as actual, even though the range of journey times is similar to that experienced, and the average matches that of the respondent. The arrival times and journey times were shown, based on the value of Current Departure Time (CDT) given by the respondent, and the distribution uses colour coding to indicate where the arrival times are on or after the Preferred Arrival Time (PAT) given by the respondent. Also shown is the Probability of Arriving after the PAT as a proportion.

The respondent was then invited to consider whether they would change (optimise) their departure time in response to the information shown. For example if the respondent wanted to reduce the number of journeys that arrive late he could choose an earlier the departure time. The computer then generated the same graph (same average Journey Time, shape of distribution) but based on the revised departure time. Some of the bars changed colour, and the Probability of Arriving late will change. The respondent can continue to adjust the departure time as many times as he wishes until he is satisfied, ie the departure time is optimised.

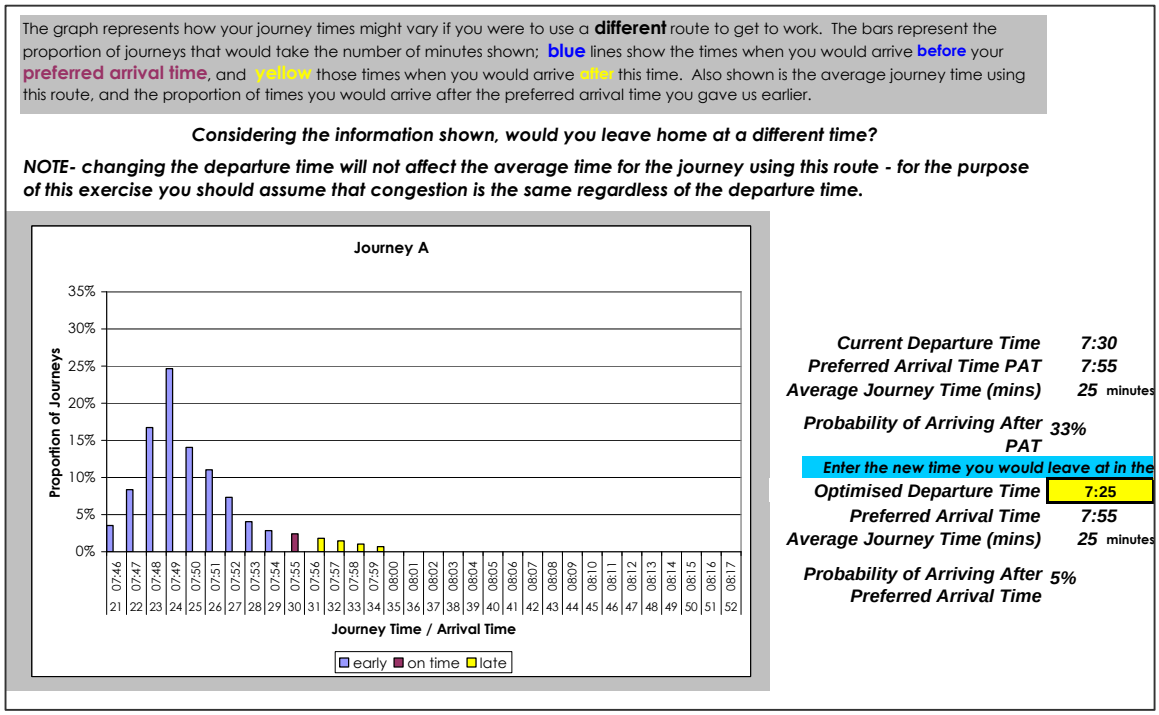


Figure 4.2 Journey A Optimised

The interviewers were specifically instructed to allow the respondents plenty of time to grasp the concepts, and question any illogical decisions, to ensure that the respondents fully understood before making decisions.

The values of Standard Deviation (SD), Scheduling Delay Early E(SDE), and Scheduling Delay Late E(SDL) are not presented to the respondent but are calculated for the distribution based on the PAT, and both CDT and Optimised Departure Time (ODT).

The program then presented the respondent with Journey B. This distribution was selected such that its standard deviation was different to that for Journey A. If the SD was higher, the Average Journey Time for the distribution was lower than that for A, and vice versa, in order to ensure there was a trade off between SD and Average Journey time. This distribution was then presented in the same format as described for Journey A, and again the optimisation process was carried out.

The next stage was to present Journeys A and B together for the respondent to choose which they would prefer.

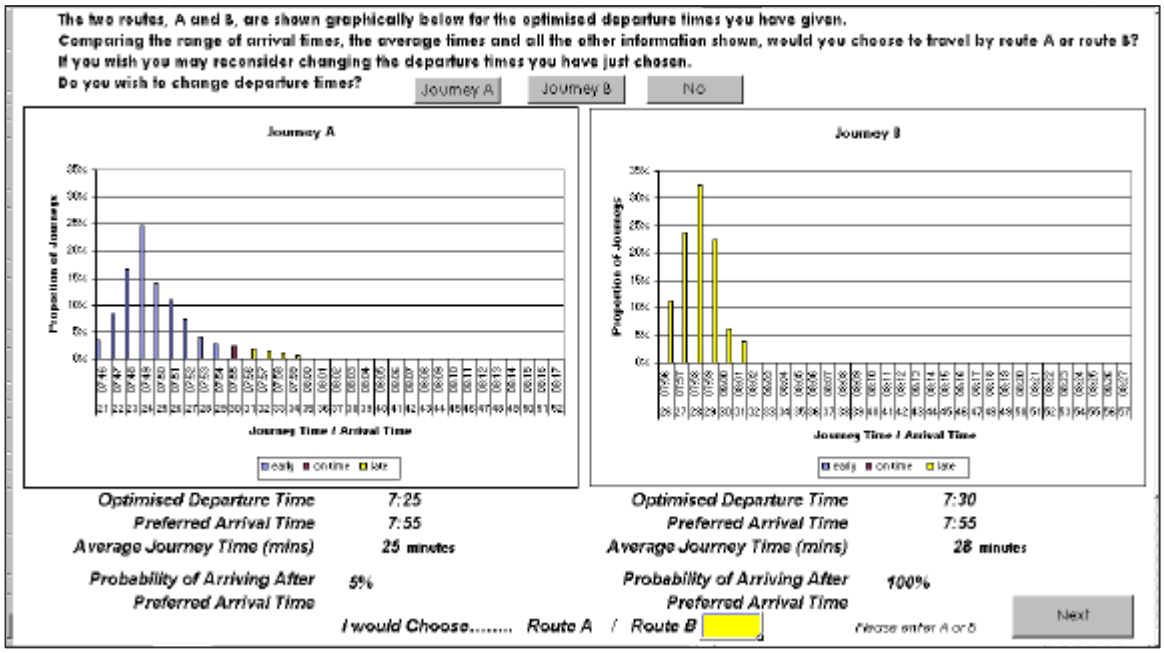


Figure 4.3 Pair wise Choice

Respondents had the option to go back and further revise their departure times at this stage, before choosing between scenarios A and B.

Two further distributions were then selected by the computer, C and D, and again the standard deviations for each would be different and the average journey times relatively longer or shorter. The optimisation procedure is repeated for each and all four distributions then presented pair wise, such that six pair wise scenarios are presented to the respondent. It was felt that this was as many as realistically possible, given the nature of the task.

In the event, while some respondents found the exercise difficult, most found it straightforward once the concepts had been sufficiently explained. People who currently had no choice of route at all sometimes found it difficult initially to imagine the possibility of an alternative. The number of pair wise choices did not appear to prove onerous.

4.4 Simulations And Design Pre Piloting

Simulations of the SP design proved difficult as the values for SDE, SDL and PLate could not be determined in advance of knowing the respondent's CDT and PAT and were therefore NOT design values. No method was found in the time available to go through the optimisation procedure in the simulations. As a consequence it was not possible to carry out the usual simulation exercise using synthetic choice data.

However in order to provide evidence that our methodology would work, a pilot survey was carried out internally with FaberMaunsell staff who drive to work. From the 34 interviews recorded, which was carried out on a self

completion basis, there was evidence of trading long/short journey times for low/high standard deviations, and it was possible to produce a plausible model.

4.5 Survey Fieldwork

The quantitative survey was in two stages. The first stage involved the recording of a travel diary over a two-week period and this was followed by the CAPI SP interview, early in 2002.

People who were eligible for the survey were recruited and invited to complete a two-week travel diary and then attend for an interview to be conducted on computer at the Manchester City Centre offices of the fieldwork company. The recruitment questionnaire was designed to screen people who were in employment, commuted to work by car as the driver, travelled alone, departed for work within a 15 minute time band on most days, and journeyed to the same destination on most days. Data was recorded for 188 interviews, with 167 respondents completing the diaries.

The other information taken from the diary which were entered onto the CAPI were the key journey variables:

At what time do you normally set off for work?	CDT
And at what time do you normally aim to be at work for?	PAT
What is the LATEST time you could arrive at work, on a regular basis, without it having an impact on your job status or take home pay?	LAT

For the journeys to work, the departure and arrival times from the diary were input, to allow the average, minimum and maximum journey times to be calculated.

The CAPI data was checked, and some extreme data rejected. The travel diary was examined to determine the types of traveller and types of journey in the sample. Over two thirds were male, and a range of age groups were represented. The job titles given by respondents were converted into Socio Economic Group (SEG) categories according to the MRS Occupation Coding Dictionary. The survey sample was not representative of the general population; there was a very high proportion of white-collar workers, 85% B/C1, compared with population average of 40%. This is a consequence of the recruitment being carried out in Manchester City Centre. However, the sample did comprise a range of people with different constraints on their arrival time, as shown in Table 4.1.

Table 4.1 Flexibility in Arrival Time at Work

Flexibility	Proportion
I can arrive at any time I choose - complete flexibility	9%
I can arrive when I like, as long as I make my hours up	20%
I am expected to be in within 30 minutes of the start time	19%
I am expected to be in within 5 minutes of the start time	35%
I cannot be late	17%
Total	100%

Travel Diary Analysis

Respondents recorded information for up to 12 journeys to work. Analysis showed that very few people departed for work at exactly the same time each day, with only 3% varying their departure time by less than 5 minutes, and almost half the sample departing within a twenty minute time band.

The travel diary data shows that people currently experience quite large variations in their journeys to work over a typical fortnight, with values of standard deviation of 6-7 minutes over a 45 minute journey being typical. 'Extreme' events such as accidents affected 2% of journeys, but did not affect the timing of subsequent journeys.

The average journey times recorded were in general 4-5 minutes shorter than the time people allowed themselves between setting off and arriving. The variation in both departure times and journey times means that there is a range of times over which people arrive at their destinations, with the majority of journeys arriving in advance of the time given as the preferred arrival times, but rarely later than their 'Latest Time'. The average times in advance of the LAT at which people choose to arrive at work vary according to the socio-economic grouping from 9 minutes early for SEG D workers to 47-48 minutes for SEG A and B workers.

Stated Preference Experiment

Respondents appear to have understood the SP experiment, and the method of presentation very well. What may have been less well understood are the definitions of LAT, as these produced buffer times much larger than expected.

4.6 QUANTITATIVE RESEARCH CONCLUSIONS

The modelling of the data was carried using ALOGIT.

Modelling of the data to date has shown that the standard deviation of journey time is valued 30% more highly than journey time, which produces a reliability ratio of 1.3.

However, using the 'scheduling modelling approach' in which parameters for Scheduled Delay Early (SDE), Scheduled Delay Late (SDL) and Probability of being late (Plate) have so far produced unexpected results. While SDL time is valued more highly than SDE, both are valued less than journey time.

These results seem inconsistent with those obtained from the Reliability Ratio approach using the same respondents. So whereas the Reliability Ratio approach suggests that travellers value journey time variability highly, this is not supported when converted into SDE and SDL time. This apparent discrepancy is currently being investigated, although to date no analysis problems have been highlighted.

It is suspected that respondents isolate key characteristics of the distribution and base their decision on that subset. On the basis of the qualitative research, it appears that respondents concentrated on the distribution spread rather than the degree of early/ lateness, as in these tasks people tend to concentrate on one or two variables rather than a balancing of four or five.

5. CONCLUSIONS

The study had two key objectives:

- Explore using qualitative research, what travel time variability means to people and to gain an understanding of the best methods of representing it, and
- Measure the value that people place on journey time variability using stated preference (SP) techniques.

The qualitative research produced a wealth of information about how people think about journey time variability. The key findings were that journey planning does not allow for extreme incidents, for example accidents and vehicle breakdowns. Travellers, especially for journeys with fixed appointments, value predictability of journey time. Where journey time variability exists considerable buffers are built into schedules in order to avoid being late, by some people. Many business appointments are made with a degree of flexibility – the 'ish', which recognises that travel time variability exists and is difficult to predict and being late is acceptable for particular appointments.

The research also identified a method of presentation that most people were capable of understanding which was applied in the quantitative SP stage. The pilot survey undertaken has produced a relatively small dataset for

modelling and has produced some initial findings. An apparent inconsistency has been identified between the reliability ratio approach and the scheduling modelling approach which requires further investigation.

The authors would particularly like to thank Dr John Bates and Dr Ian Black for their valued contribution and guidance in trying to get an understanding of the different results produced by the two modelling approaches.

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Understanding and Valuing Journey Time Variability

Presentation to
European Transport Conference 2002

Geoff Copley & Paul Murphy (FaberMaunsell)
David Pearce (Highways Agency)

FABER MAUNSELL

Background

- Study carried out for HA under Managing Travel Demand portfolio. Overseen by DfT.

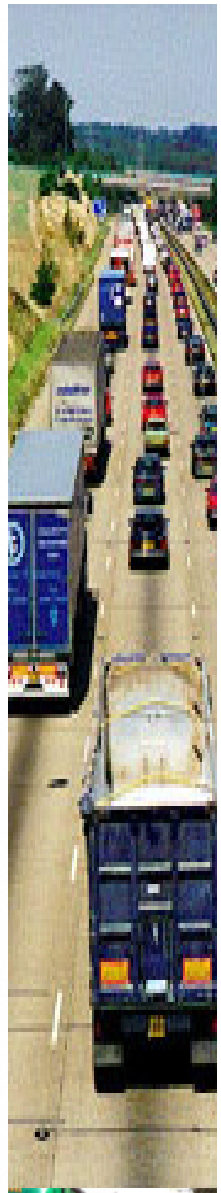
Context

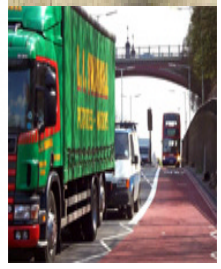
- Congestion and variability of travel times increasingly important as an issue

- Highways Agency – specific objective

'to take action to reduce congestion and increase the reliability of journey times'

- Important for Economic Appraisal





Study Objectives

- Qualitative research,
  - what travel time variability means to people
  - gain an understanding of the best methods of representing it

- Quantitative - SP
  - Measure the value that people place on journey time variability

Study Content

Qualitative Research

Stage 1 Depth Interviews and Focus Groups
Stage 2 Qualitative Research - Presentational Issues

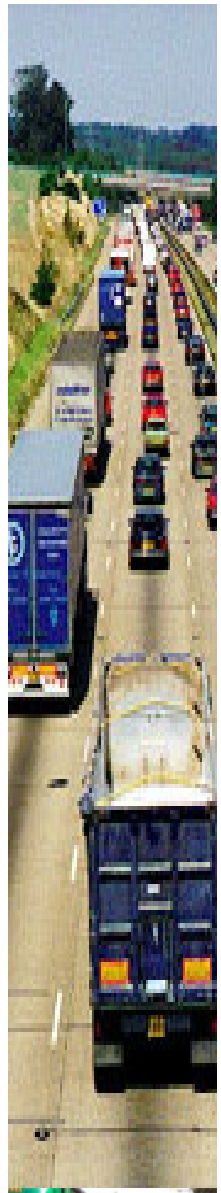
Quantitative Research

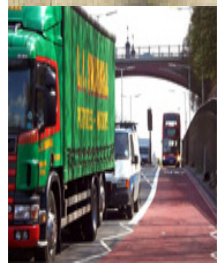
Stated Preference Survey

Qual Stage 1

- Objective:
  - to understand what journey time variability means to people
  - explore how it impacts on journey planning.

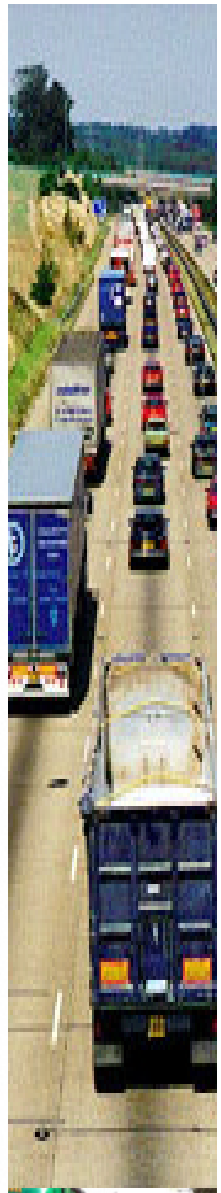
- Involved three focus groups and 6 depth interviews
  - north and south England
  - range of traveller types
  - range of trips.

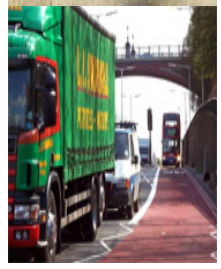




Qual Stage 1- What is Journey Time Variability?

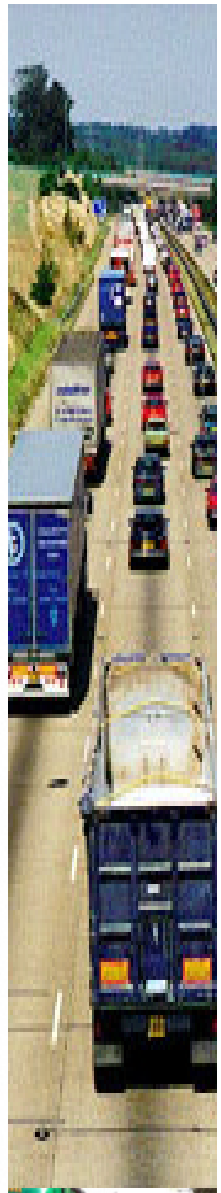
- JTV – viewed as unpredictability or unreliability of journeys
- Most perceived car to be more predictable than public transport
- Regular car journeys made at same time of day using same route – journey time varied little
- Perceived causes of journey time variability:
  - Time of day/Day of week
  - Weather
  - School holidays
  - Extreme events

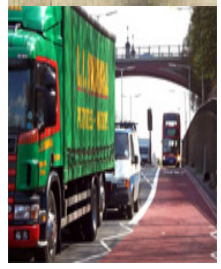




Qual Stage 1 Journey Planning

- People do not allow for extreme events in journey planning
- Predictability of journey time is valued by respondents – particularly for fixed appointments
- People build in buffers into most journeys with fixed appointments – work/non work
- Increasingly business appointments made with degree of flexibility – the ‘ish’
- Personality strongly influenced attitudes towards arriving early or late
- Preference for longer continuous journey over shorter stop start journey





Qual Stage 1 – Data Presentation 1

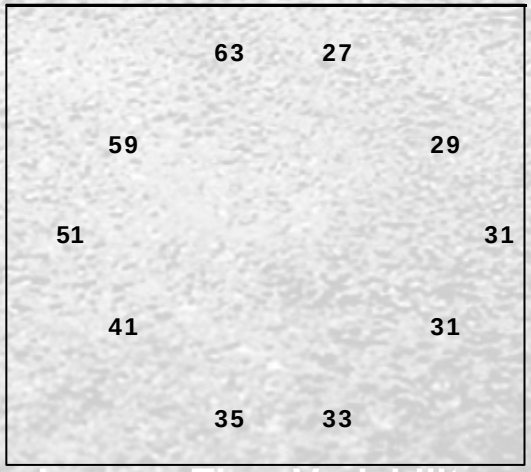
Tested the ability of individuals to understand and use a range of information regarding journey times presented differently.

Data showing number of minutes taken for the last 10 journeys

- A) Linear presentation of journey time data

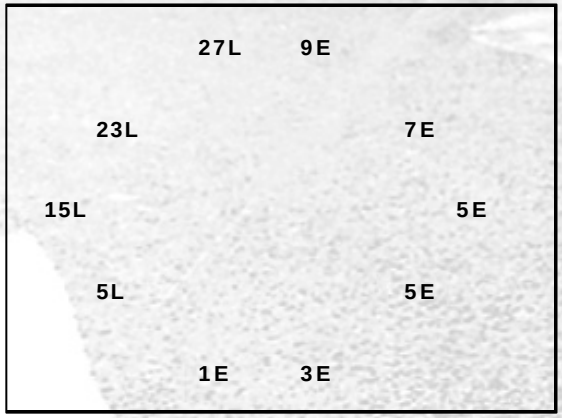
Journey Time Minutes
26 28 30 30 32 34 40 50 58 62

- B) Clock face presentation of journey time data;

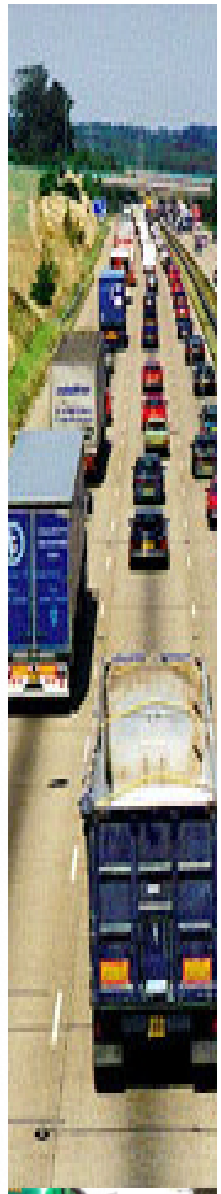


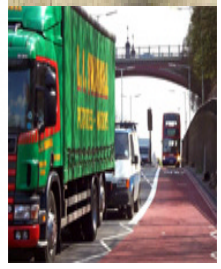
Qual Stage 1 – Data Presentation 2

- C) Clock face presentation of how early or late each journey arrival time was; and



- D) Graphical presentation of journey time data.





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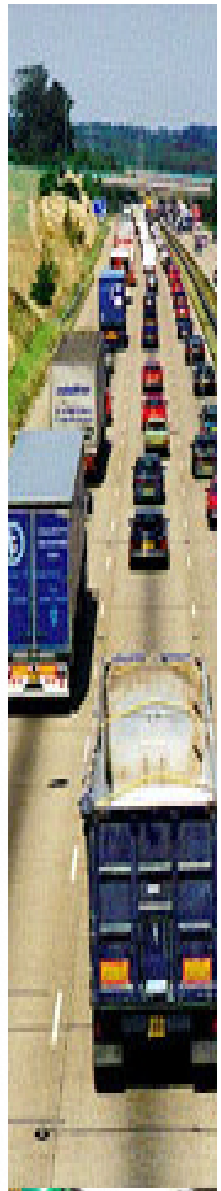
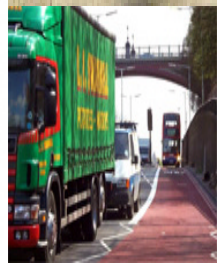
Understanding Journey Time Variability

Qual Stage 1- Findings

- Respondents appeared to understand concept of JTV and graphical and linear representation of JTV data
- Willing to trade increased mean journey time for reduced JTV.
- Variability between respondents in factors taken into account when making choice decisions
  - maximum journey time
  - range of journey times
  - mean journey time and the range
  - distribution/standard deviation.
- Split in preferences for the method of presentation between linear and graphical
  - Graphs easier and quicker to interpret
  - not all might be able to understand them
  - some mistrust of graphical data.





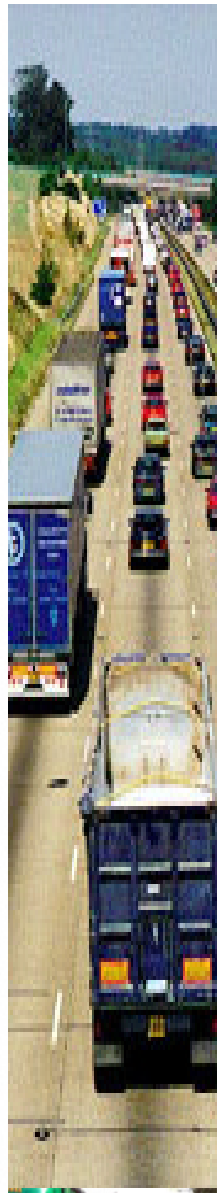
Qual Stage 2 - Objectives

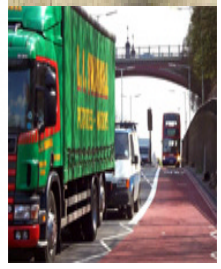
- Explore different types of presentational techniques to derive a preferred method of presentation for the stated preference experiment
- Explore how respondents made decisions when faced with a choice between two journey time distributions with different characteristics

Qual Stage 2 - Method

- Four mini-groups, (up to 4 people)

- Preceded by travel diary for 5 working days to record journey to work
  - how long it took,
  - departure and arrival times,
  - incidence of extreme events, etc.
- Purpose to focus respondents on journeys made
- Collect evidence on variability of journey time - Very little variation found





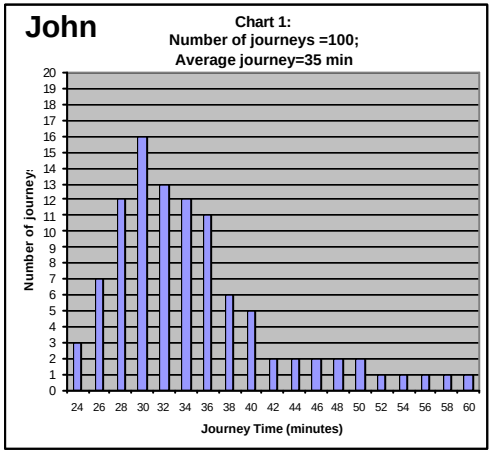
Qual Stage 2 – Route Choice Game

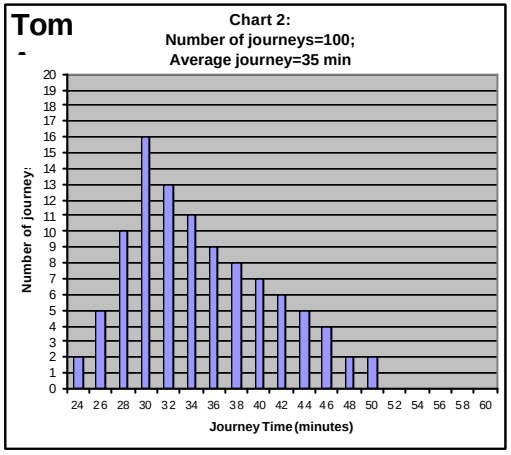
- Scenarios represent journeys of fictional people – abstract ie not themselves
- Distributions had different features - some with outliers
- Same journey time information presented in different formats
- Journey scenarios presented 4 different ways (Linear, Clock face journey time data, Clock face early or late, Graphical) as shown earlier
- Respondents shown the four different methods in different order
- Asked to choose Person A or Person B's route
- Asked to identify what aspect(s) of the distribution they were using in making their decision

Qual Stage 2 – Example of Choice using graphical method

John and Tom travel by car from Warrington to Chester every day at the same time. They always travel by the same route, but they use different routes from each other. Both of them make their journeys at the same time of day.

Chart 1 shows how long John's journey took the last 100 times that he made it and chart 2 shows the same information for Tom. On average both journeys take 35 minutes but the journey time does vary as shown in the charts.





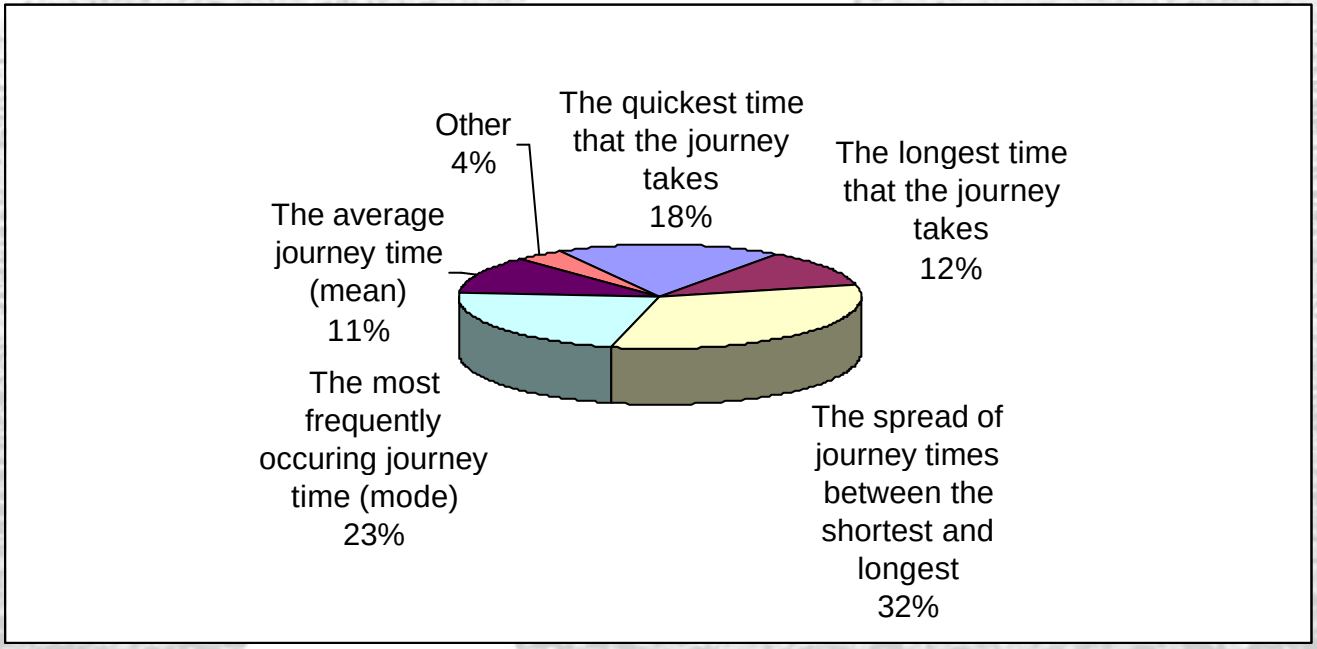
Q1 Imagine that you wanted to make the journey from Warrington to Chester and had to use either John or Tom's route. Given the information presented, which route would you prefer to take?

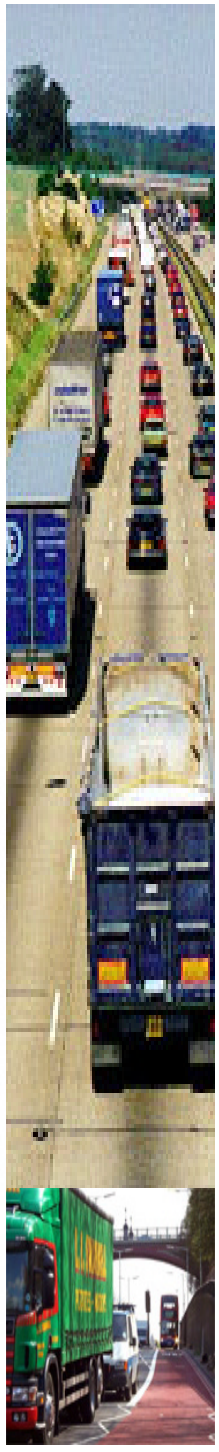
Qual Stage 2 - Results

- Concept of JTV and the graphical and linear representation of JTV data is understood with little training
- Way information presented did affect choices made
- Use of Early/ Late sometimes created emotive response – people did not seem to like being told they would be late
- Travel Diary useful for providing context to route choice exercise

Qual Stage 2 - Results

- Factor(s) used to decide which route to choose:
- Most respondents concentrated on 1 or 2 aspects





Quantitative Research- Modelling Journey Time Variability - Background

Traditional method - Mean Variance Approach

- Relative valuation of travel time variability compared with mean journey time
- expressed as a ratio (reliability ratio)

$U = \alpha TT + \beta SDTT$

Where
U=Utility,
TT=Travel Time,
SDTT= Standard Deviation of Travel Time

Alternative- Activity Approach

- how travellers schedule their activities
- assumption that traveller has ideal time for arriving for a particular activity. Any departure from this imposes 'scheduling costs' on the traveller

$E(U) = \gamma E(T) + \delta E(SDE) + \varepsilon E(SDL) + \eta pL$

Where
Expected utility E(U) is dependent on expected (or mean) travel time E(T), expected schedule delay-early, E(SDE), expected schedule delay-late E(SDL) and the probability of late arrival pL

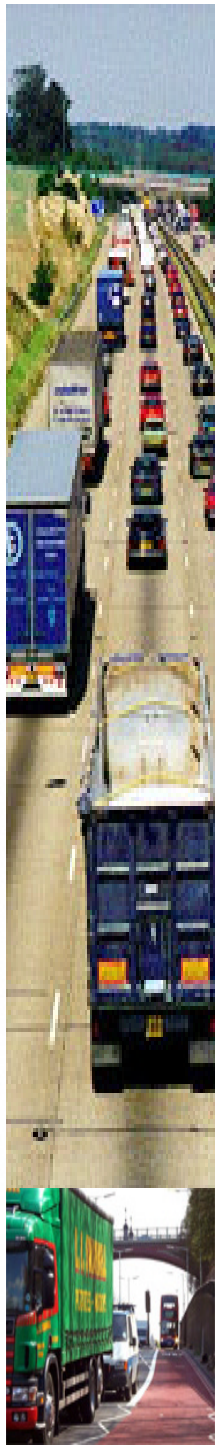
SP Design

- SP experiment:
  - Based on histogram method of presentation;
    - capable of presenting a large volume of information with little training (on the basis of qualitative research)
  - Designed to be capable of estimating
    - Mean
    - Standard Deviation
    - Scheduling Costs – Early and Late
    - Probability of being Late
  - Excluded monetary costs of car travel –
    - Omitted because of the problem of getting a big enough variation without introducing emotive concepts such as tolls.

Survey Procedure

- SP design and Computer Aided Personal Interviewing (CAPI) program developed and built in Excel
- allowed respondent's actual travel times to be input at the start of the interview (from two week travel diary)
- Diary Data used in selecting scenarios - highly customised
- Twenty-six histograms, representing a range of journeys with a spread of maximum and minimum journey times, and wide range of standard deviations

- Piloted with Faber Maunsell staff (37) in different offices - self complete
- Main Survey200 Respondents recruited;
  - Car commuters to central Manchester
  - Range of journey times
  - Interviewer administered



CAPI – Input Travel Diary Data

RECORD INFORMATION FROM TRAVEL DIARY
If no travel diary information is available, ask respondent for this information from memory

To start, we will enter the data you have collected in your travel diary for the journeys made to work. This will only take a few minutes

At what time do you normally set off for work?	07:30	*enter time in 24 hour format, eg 8:00*
And at what time do you normally aim to be at work for?	07:55	*enter time in 24 hour format, eg 9:00*

You have indicated that you normally allow 25 minutes to make this journey.

What is the LATEST time you could arrive at work, on a regular basis, without it having an impact on your job status or take home pay?	08:05	*enter time in 24 hour format, eg 9:00*
And what would be the least time you could make this journey in if there was no traffic congestion?	15	minutes

Refer to Travel Diary - Home to Work Journeys Only

Journey Number	1	2	3	4	5	6	7	8	9	10	11	12
Time Left Home (24 hour format)	07:30	07:35	07:25	07:30	07:28							
Time Arrived At Work (24 hour format)	07:54	07:55	07:55	07:56	07:55							
Journey Time (in minutes)	24	20	30	26	27							
Significant Delay? (enter Y or N)	n	n	n	n	n							

Leave blank where information incomplete

If there is no Travel Diary…..

In an average week, what do you estimate the AVERAGE journey time to be?	25	minutes
In an average week, what is the shortest time your journey to work might take you?	20	minutes
In an average week, what is the longest time your journey to work might take you?	30	minutes

Next

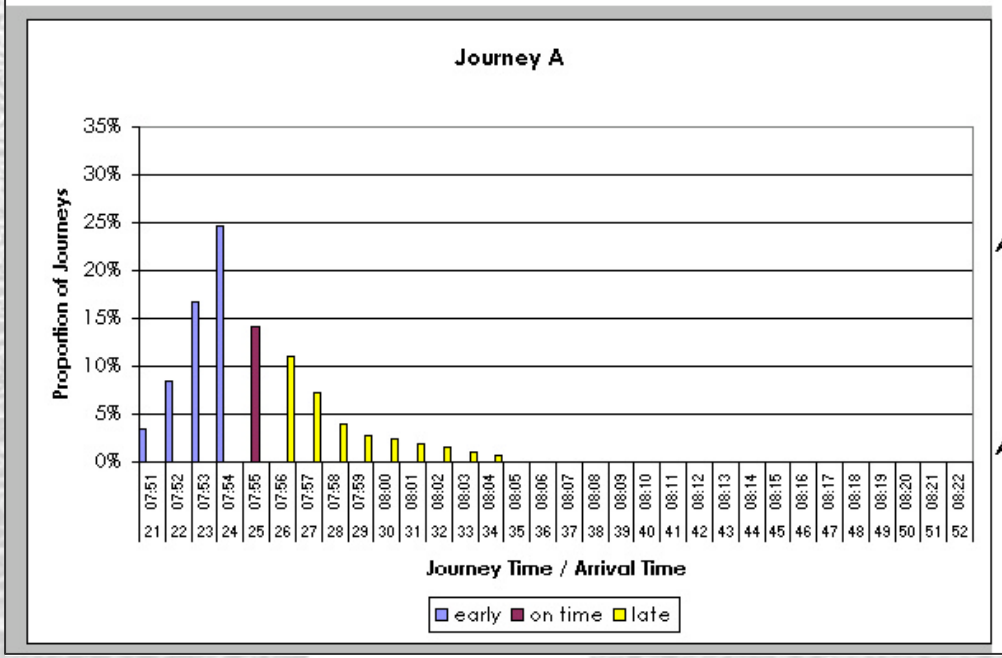
CAPI – Journey A

'Journey A' - not referred to as actual, though range of journey times is similar to that experienced, and the average matches that of the respondent.

The graph represents how your journey times might vary if you were to use a **different** route to get to work. The bars represent the proportion of journeys that would take the number of minutes shown; **blue** lines show the times when you would arrive **before** your **preferred arrival time**, and **yellow** those times when you would arrive **after** this time. Also shown is the average journey time using this route, and the proportion of times you would arrive after the preferred arrival time you gave us earlier.

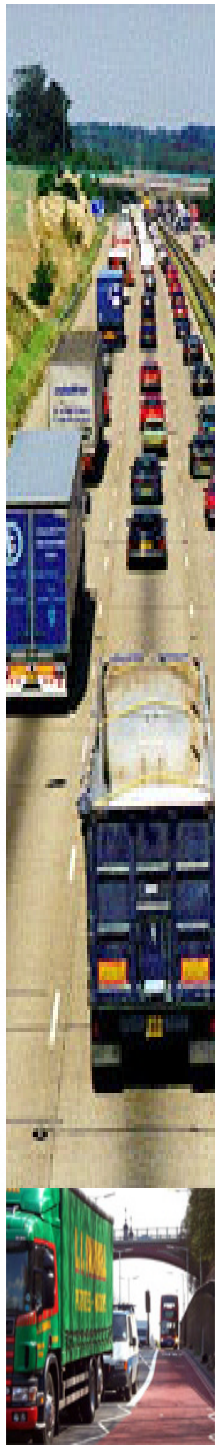
Considering the information shown, would you leave home at a different time? YES NO

NOTE- changing the departure time will not affect the average time for the journey using this route - for the purpose of this exercise you should assume that congestion is the same regardless of the departure time.



Current Departure Time	*7:30*
Preferred Arrival Time PAT	*7:55*
Average Journey Time (mins)	*25* minutes
Probability of Arriving After PAT	*33%*
Current Departure Time	7:30
Preferred Arrival Time	*7:55*
Average Journey Time (mins)	*25* minutes
Probability of Arriving After Preferred Arrival Time	*33%*

Next



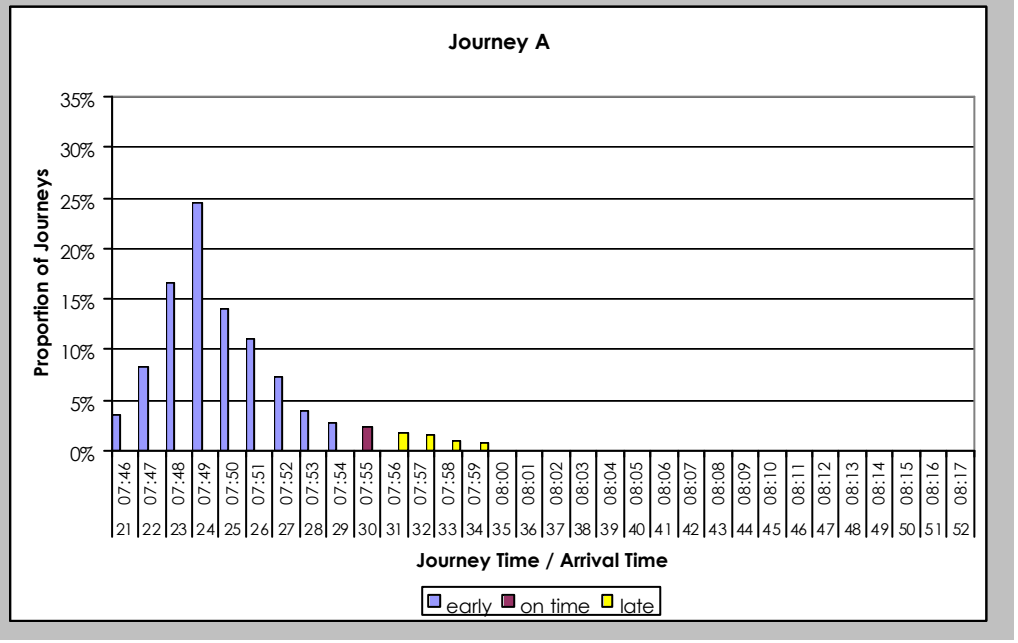
CAPI – Journey A Optimised

Respondent then invited to change (optimise) departure time in response to the information shown

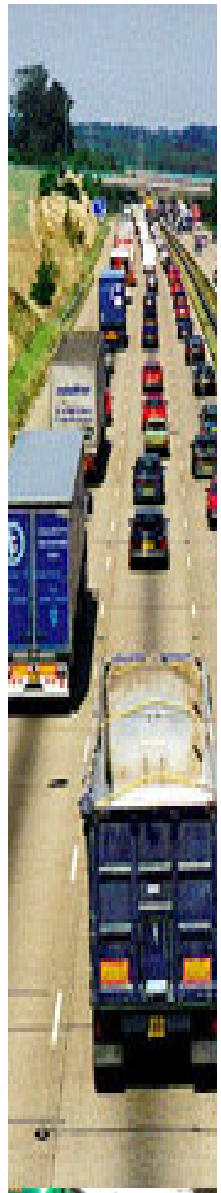
The graph represents how your journey times might vary if you were to use a **different** route to get to work. The bars represent the proportion of journeys that would take the number of minutes shown; **blue** lines show the times when you would arrive **before** your **preferred arrival time**, and **yellow** those times when you would arrive **after** this time. Also shown is the average journey time using this route, and the proportion of times you would arrive after the preferred arrival time you gave us earlier.

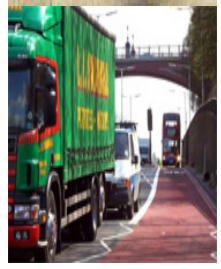
Considering the information shown, would you leave home at a different time?

NOTE- changing the departure time will not affect the average time for the journey using this route - for the purpose of this exercise you should assume that congestion is the same regardless of the departure time.



Current Departure Time	***7:30***
Preferred Arrival Time PAT	***7:55***
Average Journey Time (mins)	***25*** minutes
Probability of Arriving After PAT	***33%***
Enter the new time you would leave at in the	
Optimised Departure Time	***7:25***
Preferred Arrival Time	***7:55***
Average Journey Time (mins)	***25*** minutes
Probability of Arriving After Preferred Arrival Time	***5%***





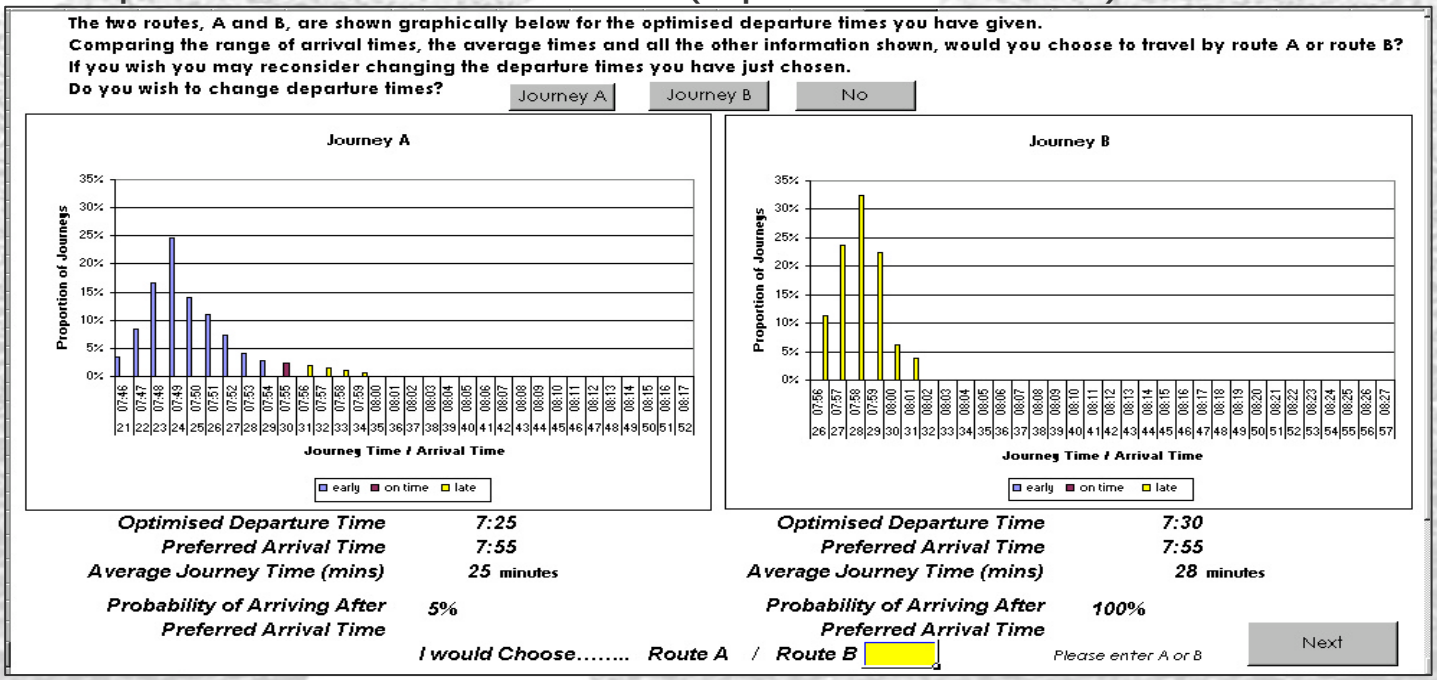
CAPI – Journeys A and B

Journey B distribution selected such that standard deviation different to that for Journey A, eg SD lower, Average Journey Time higher

Journey B distribution presented in the same format as for Journey A, and optimisation process carried out

Next stage presents Journeys A and B together for the respondent to choose which they would prefer.

Repeated for Scenarios C, D (6 pair wise choices)

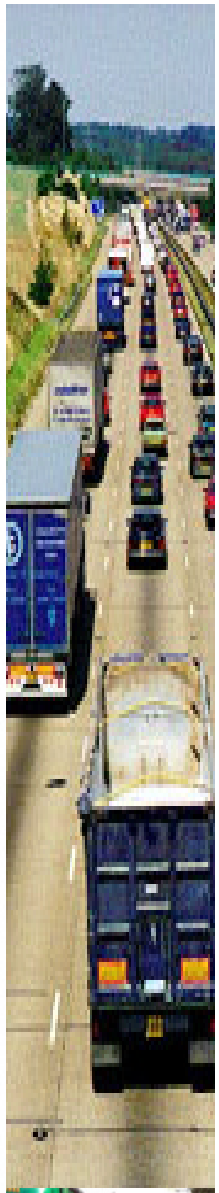


Travel Diary Data Analysis

- Sample comprised high proportion white collar staff

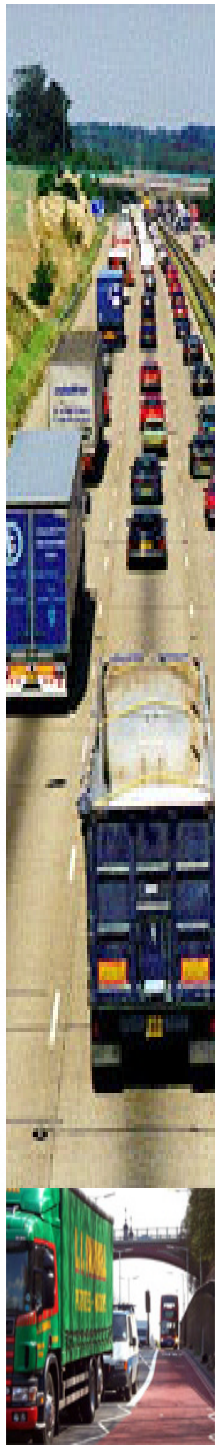
  Flexibility Variable

  - complete flexibility 9%
  - 'Flexitime' 20%
  - +/- 30 minutes of the start time 19%
  - +/- 5 minutes of the start time 35%
  - 'I cannot be late' 17%
- Information collected for up to 12 journeys to work
  - only 3% vary departure time by less than 5 minutes
  - Large variations in journeys to work (typical SD of 6-7 minutes over a 45 minute journey) (Different from qual but this was for journeys to Central Manchester)
- 'Extreme' events eg accidents affected 2% of journeys- did not affect timing of subsequent journeys



SP Data Analysis

- Standard Deviation of journey time is valued 30% more highly than journey time - reliability ratio of 1.3.
- 'scheduling modelling approach' in which parameters for Scheduled Delay Early (SDE), Scheduled Delay Late (SDL) and Probability of being late (Plate) produced less expected results. While SDL time is valued more highly than SDE, both are valued less than journey time.
- People are making sensible trade offs – lower mean journey time or lower sd of journey time
- Was task too difficult?Suspicion that respondents isolate key characteristics of the distribution and base decision on that subset - qualitative research – concentrate on distribution spread rather than the degree of early/ lateness
- Further analysis needed to bottom this out



CONCLUSIONS

- Qualitative Research key findings;
  - Journey planning does not allow for extreme incidents
  - Travellers with fixed appointments value predictability of journey time
  - Buffers built into schedules in order to avoid being late, (by some people)
  - Many business appointments are made with a degree of flexibility – the ‘ish’
  - Identified a method of presentation that most people seemed capable of understanding
- Quantitative SP stage
  - small dataset for modelling
  - initial findings show apparent inconsistency between reliability ratio approach and scheduling modelling approach
  - further investigation required