ROAD USER CHARGING
- PRICING STRUCTURES

Final Report

for

The Department for Transport

on

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Prepared by a team from

The University of Leeds

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Executive Summary

Background

This project considers the extent to which the public could cope with complex price or tariff structures such as those that might be considered in the context of a national congestion pricing scheme. The key elements of the brief were:

- to review existing studies of road pricing schemes to assess what information and evidence already exists on the key issues;
- to identify what can be learned about pricing structures from other transport modes and other industries and in particular what issues and conclusions might be transferable;
- to improve the general understanding of the relationship between information and people's ability to respond; and
- to recommend what further research would be most valuable to fill evidence gaps and enable conclusions to be drawn about an effective structure.

Content of Report

This report summarises our approach to the brief, presents the evidence that we have found on the issue and draws attention to the implications that this might have for policy on the structure of road charging tariffs.

The evidence has been presented under nine headings:

- People's ability to cope with complexity/uncertainty
- The extent of complexity/uncertainty that people can deal with
- The coping strategies used when full evaluation of options is not possible or not justified
- People's readiness to rely on approximations
- The stage at which people need/want to know the price
- The likely behavioural response to complex/uncertain charges
- The effect of familiarity, experience and the passage of time
- Whether complex charges might be more acceptable in the public or private sector, and
- Lessons from case studies involving variable or complex road charges**.**

The conclusions have been presented under three headings:

- General issues relating to individual decision making
- Findings from case studies
- Other findings of particular relevance to congestion charging

The implications are considered, with some inevitable duplication, under four headings

- Implications for the system specification
- Implications for the communication of price signals
- Implications for the implementation strategy
- Expectations of response

Methodology

The project was substantially completed in six weeks beginning in early May 2004. The evidence was drawn primarily from our existing knowledge of the field, interviews with key actors and a comprehensive search of published literature. Twenty-one key individuals took part in interviews or less formal enquiries. Seventy-six papers or reports have been examined and their content entered into a database. The papers have come from four main sources; studies within the utility and transport industries, studies of road pricing, work on traveller behaviour, and work on human judgement and decision making. In drawing lessons from other modes, sectors and countries, consideration has been given to issues of transferability.

Main conclusions from available evidence

General Issues Relating to Individual Decision Making

People's ability to respond to price signals is constrained, not only by their circumstances and commitments, but by their access to the necessary information and by their ability and preparedness to access, understand and process that information.

People's ability to access, understand and process information is limited by their mental capacity and experience but also by situational factors such as the time available to complete the task.

People's preparedness to access, understand and process information depends partly on their personality, and partly on their engagement with the task. This in turn will depend on their perception of: its importance, the motives of the body providing the information and their perception of the effort required to complete the task. The structure and presentation of information can have a great influence on people's ability or preparedness to process it. People show a strong tendency to rely on the most easily accessed information.

When people cannot derive an analytical solution, or choose not to, they will resort to a heuristic or will seek to avoid having to make the choice. Most decisions in daily life are based on heuristics. The accuracy of heuristics is increased when their underlying logic is consistent with the decision situation; however, when this is not the case their use can lead to inappropriate and in some instances very poor decisions.

People's motivation to understand price signals, and their responses to them, are influenced by their attitude to the fairness and appropriateness of the price. This has implications for the transferability of findings from situations in which prices are well established to situations, such as road user charging, where consumption has traditionally been free at the point of use.

Findings from Case Studies

People have a clear preference for simple price structures. The commercial sector, notably in the telecommunications industry, recognises this preference and companies have sought to simplify their structures wherever possible – even where this reduces their control over the pattern of demand. Monopolistic suppliers, in the private or public sectors, are able to make greater use of differential prices to influence the

pattern of demand than are suppliers in a competitive market even though competition may lead to greater price differentiation in the context of niche marketing.

The variety of prices and tariff structures available in the telecommunications market reflects a desire to provide tariffs which will appeal to niche markets and should not be taken as evidence that the suppliers think that consumers welcome complex tariffs.

Evidence on the acceptability of highly differentiated charges designed to influence patterns of demand in the transport sector is mixed;

- The low cost (low frills) airlines have prospered with an extremely complex pricing structure which, for the customer, means that they never know the price of the ticket until they come to purchase it; prices can vary even during a booking transaction. The public are apparently willing to accept this uncertainty in the belief that they are getting a bargain. There is a widespread understanding that the price for a particular flight will be a function of demand.
- The US experience of HOT lanes suggests that if differentiated charges can yield more reliable journey times, the unpredictability of the charge is not much of an issue for individual motorists but is regarded as a problem by some companies.
- The Singapore experience with road pricing suggests that differentiated charges, and periodic well-advertised adjustments to them, are accepted as a sensible way to reduce peak period congestion and that the resulting variability in prices does not seem to have been a serious issue. Singapore's experience with a market for car ownership permits similarly suggests that the principle of using price to manage demand, and the resulting price volatility, is accepted and understood (of course, in seeking to transfer this experience to the UK, allowance needs to be made for the two countries' quite different political cultures and traditions of public acceptance of government regulations).
- The German rail operator (Deutsche Bahn)'s abortive attempt to introduce a fairly complicated system of limited availability discounts designed to divert demand from the busiest services onto those with spare capacity suggests that, if the public regard price differentiation as unfair they will object very strongly and that, against this background, any perceived complexity will be one of the targets of criticism (it is, in fact, difficult to defend some of the more obscure restrictions which were placed on the availability of discounts).
- Deutsche Bahn's experience may be contrasted with that of Virgin Rail whose introduction of a similar system of discounts has apparently been welcomed by regular customers as part of a revised pricing structure which offers more straightforward opportunities to customers to save money by booking in advance and by using off-peak trains.

Three high-profile attempts to introduce variable pricing in the transport sector (the variable tolls introduced by the French motorway company Cofiroute, the capacity related discounts introduced by Deutsche Bahn, and the yield management pricing introduced by SNCF the French rail operator) have been defeated by adverse public opinion. The public objection was, in each case based on the supposed unfairness of the new pricing regime and its failure to achieve the desired effects. This failure was linked to accusations that the pricing structure was too complicated (even though, in the case of Cofiroute, the system was in fact very simple) and was broadened to include wider accusations of management failure (Cofiroute's supposed failure to publicise its tariffs and to predict the behavioural consequences of its new price

structure, DB's supposed failure to operate its trains to timetable, and SNCF's spectacular problems with its booking software).

Potential complexity has often been a concern prior to implementation of differential pricing and generally attracts media criticism in the early stages of the implementation, whether warranted or not. However, given good publicity for the charges, and a clear logic to the price structure, these concerns have usually faded soon after launch.

The idea that the public expect differential pricing from the private sector but not from the public sector persists but we have not found any evidence to prove the proposition; there are always alternative explanations. It does appear, however, that people will object to price differentiation if it appears unfair, unjustified or ineffective.

Other Findings of Particular Relevance to Congestion Charging

Most people have difficulty estimating distance. Estimates of distance are often derived indirectly from estimates of journey duration – but these too are subject to bias and error.

Many people have difficulty with spatial data. Few people are familiar with road names or categories – even in areas where they travel quite frequently (the one exception being the motorway/non-motorway distinction).

The idea that prices should be highest at times of heavy demand has been established by pricing policies in the airline, rail, bus and holiday industries. People seem to have no difficulty accepting this principle and it may provide the basis for a heuristic which people find easier to deal with than detailed information requiring network knowledge and good perception of distance.

It is widely expected that advice systems will emerge to assist drivers to plan their routes in the light of congestion charges. Such systems are seen as playing a major role, particularly during the early stages of implementation.

Implications of these findings

Assumptions

Given that people's ability and preparedness to respond to price signals is conditioned by their perception of their effectiveness, certain assumptions had to be made about the impact of the scheme. Briefly, we assumed that, for the motorist who always uses the same route at the same time of day, the introduction of congestion charges will reduce the unpredictability of the journey time, but for the motorist planning a new journey, it will introduce an extra dimension of uncertainty.

Implications for the System Specification

The clarity of the pricing signal is fundamental to the success of congestion charging. However, it is not realistic to expect drivers to be able, or willing, to calculate the precise charges that they would incur for each of the routes and departure times available to them. The best that can be hoped for is that, *if they understand the structure of the charges*, they will be in a position to predict whether one option

would be cheaper or more expensive than another and, perhaps, to make a reasonable estimate of the likely cost. Their ability to understand the structure of the charges will depend on the strength of the logic that underlies it. We assume, in what follows, that the structure provides for higher charges on the busiest roads at the busiest times and that the logic is that this will help to reduce congestion.

The charge structure should reflect the fact that most people estimate distance via time and so perceive journeys made in congested traffic to be longer (in distance) than those made in free-flowing traffic. We argue that, in the context of distance-based charges, the price differential required to cause a given degree of diversion from congested routes need not be as great as would be required if distance were estimated directly.

Different drivers will have different abilities to estimate prices from numeric or spatial data. This raises the possibility that drivers might be allowed to elect a degree of tariff complexity appropriate to their needs and abilities but, on balance we see more problems than advantages in offering people the choice of a range of tariffs.

Even though people could find out about the latest charges before setting off (e.g. by accessing an internet site) it is not realistic to expect ordinary motorists to do this and conclude that, unless, a la HOT lane, notice can be given upstream of a diversion point, it is not realistic to try to use charges to influence traffic in anything approaching real time.

Implications for the Communication of Price Signals

The prime requirement is that the logic of the charge structure, and the necessity of a degree of complexity, is capable of being communicated and is seen to reflect the objectives of the scheme. The logic should be capable of being summed up in a relatively simple expression such as *"Charges will be highest when and where traffic is expected to be busiest"*. The logic of such a charge structure would be reinforced by replacing fixed costs (such as the annual vehicle excise duty, VED) by usage-based charges and by allowing rates to vary according to seasonal or incident-related demand and by imposing higher charges on larger vehicles. Communication of the underlying logic is more difficult if it is intended that the charges should also seek to achieve environmental goals (e.g. by discouraging rat-running or the use of other environmentally sensitive roads), and a shift of taxation from fuel tax to distance-related charges could send a distinctly confusing message.

Whatever the clarity of the underlying rationale, information about the price structure may need to be communicated in a variety of ways (e.g. in both summary and detailed formats) in order to meet the needs and abilities of different types of driver.

People would welcome assistance in predicting charges and the efficiency of the overall network would be improved if it were readily available. Internet-based aids could be used prior to one-off journeys and, via internet-enabled phones or PDAs, would make it theoretically possible to divert en-route in response to near real-time changes in charges. However, it seems unlikely that people would consult such tools for their regular journeys. Although introduction of charges would probably be enough to stimulate development of commercial services government has a role in facilitating this development while staying alert to the equity implications of the best advice being available only to those equipped with the latest technological aids.

In-car meters and/or post-trip logs identifying the incidence of charges could help people to monitor charges and so learn to predict them and to have trust in the correctness of charges being levied. However, even with such aids, it is inevitable that people's experience will be incomplete and distorted by misperceptions and selective recall.

The form in which information is presented (e.g. structure, content and amount) is likely to be crucial in determining the decisions strategies that people use, and hence the choices that they make. Map-based information about charges might be useful for some people but would be of little use to others. Colour coding would probably be more universally useful but it would be inequitable to rely exclusively on any one form of display or communication.

Implications for the Implementation Strategy

Significant effort would be required, prior to launch, to explain the reasons for the scheme and the logic of the charging structure and the system should be trialled with no actual charging to help people become familiar with the charge structure.

In the early stages of implementation it is likely that people will think quite carefully, perhaps even logically, about the likely cost of using different routes at different times but, unless the price differentials are significant, they will in time begin to take less care about optimising their behaviour. Thus, to maintain a given response, the strength of the price signal may need to be increased over time.

To the extent that complexity brings unpredictability, it may be best to limit the impact of complexity (by restricting the differences between the different rates) until users are familiar with the basic concept of charging and the operators have built up their knowledge of the response elasticities.

Expectations of Response

If road pricing induces strong task engagement people will make an effort to predict accurately; if not, they will resort to simple rules and heuristics (e.g. "try to avoid town centres and peak traffic") or may make no effort to adjust their behaviour in the light of the charges. We believe that people would have strong task engagement in the early stages of implementation but that, unless the financial sums involved are significant, this engagement would diminish as familiarity increases. Levels of engagement will undoubtedly vary from person to person and from situation to situation.

Even though they might wish to choose routes and journey timings so as to minimise charges, some people will not be equipped to do so – either because they lack the analytical skills or because they do not have access to the requisite information. Such people will make estimates based on rough guesses, personal experience and the advice of friends and colleagues. They are bound to make mistakes! However, the efficiency with which they respond to the intended price signals could be increased if they are supplied with good feedback and advice from trip-planning services.

Some people will respond to perceived complexity of charges by reducing their use of the roads about whose charges they are uncertain. Although this response might be welcomed in as much as it tends to reduce use of congested roads (assuming that

these are the ones with, for example, the greatest peak/off-peak differential), this response would be imprecisely aligned to the intended price signal and the loss of individual welfare could cause the entire scheme to be viewed in a worse light than necessary.

Although public acceptance of a scheme might be increased if it were portrayed as a means by which drivers can save money (e.g. by electing to join the scheme instead of paying VED) and although acceptance of a degree of price differentiation might be increased if it were portrayed as a system of "discounts" available to people who choose to use lower priced roads and cheaper times of day, the effect on usage patterns might be compromised.

Even if a majority of travellers are employing inaccurate heuristics, or ignoring the pricing signal altogether, considerable efficiency gains may be achieved provided that a sufficient number of drivers are reacting to the signals in the manner intended. Efficiency gains would arise not only from changes in journey timing, route and mode on particular journeys but also from the re-arrangement of travel plans, rescheduling of activities, and even from decisions on choice of home or job location which would affect travel patterns in the longer term.

Research on people's ability to understand complex prices, and on their behavioural responses when faced with such prices, stresses that their response, *and their ability to understand* the price signals depends on their emotional reaction to the price regime – particularly their perception of its fairness and rationale. It is thus impossible entirely to separate the question of people's acceptance of the concept of road pricing from their ability to respond to the price signals which it seeks to send. However, recognising that the question of the public acceptability of road pricing has been the subject of a separate study, we have not attempted to fully explore its implications. We do, however, conclude that every effort must be made to explain the reason for introducing congestion charging and the necessity for a degree of complexity in the tariff structure; to ensure that charges always reflect the published rationale and that any overcharging is corrected immediately and without quibble; and to encourage an initial positive reaction to the scheme by, for example, introducing it initially as a voluntary scheme to which people can sign up in exchange for being excused their annual VED payment, and offering free equipment and reduced tariff rates to the first few thousand subscribers.

Knowledge Gaps

We see a particular need for research on:

1. The accuracy with which people can predict journey distances, costs and durations.
2. The accuracy with which people can predict the complex or imprecisely defined charges which they meet in everyday life and the implications this has for their behaviour.
3. The ease with which people can understand the kinds of logic likely to be used to define the structure of road charges.
4. The accuracy with which people (and would) predict hypothesised road charges.
5. The loss of efficiency and welfare that would be attributable to individuals' inability to estimate charges correctly or to avoid imprecisely priced options.
6. The most effective ways to convey the kind of quantitative information that would be involved in a national implementation of distance-based road user charges.

Contents

1. Background

1.1 Project Brief

The project was designed to inform the work of the Road Pricing Feasibility Study (RPFS) and is concerned with the practicality of options for the design and implementation of a new system for charging for road use in the UK.

The project takes as given the fact that, in the light of variations in demand, capacity, vehicle characteristics, atmospheric conditions and ability to pay, the "first-best" solution might suggest a pricing structure that might be impractical, unpopular or too complex for road users to understand or respond to. This implies a trade-off between complexity and simplicity in the structure of tariffs for road user charges. The current project was designed to help the RPFS to come to a view on this trade-off by identifying evidence on the ability, or otherwise, of the public to understand and respond to complex charge structures.

The original brief is attached as Annex 1 but the objectives are set out here for convenience. They were:

- to identify the key issues to be explored;
- to review existing studies of road pricing schemes to assess what information and evidence already exists on the key issues;
- to identify what can be learned about pricing structures from other transport modes and other industries and in particular what issues and conclusions might be transferable;
- to improve the general understanding of the relationship between information and people's ability to respond; and
- to recommend what further research would be most valuable to fill evidence gaps and enable conclusions to be drawn about an effective structure.

It should be noted that this report does not seek to address the public acceptability of road charging (except in so far as this affects people's response to its complexity). This issue was addressed in two other research briefs whose reports can be found at: www.dft.gov.uk/roads/roadpricing.

1.2 Scope of this Report

This report documents our approach to the brief, summarises the evidence collected, presents our findings on the key issues and identifies knowledge gaps which might benefit from further research.

2 Methodology

2.1 Study Method

The project was conducted, and substantially completed, over a period of six weeks from early May 2004. During this period a series of meetings were held, face to face or via video link, with the Project Steering Group and a number of progress reports were submitted.

The Leeds team comprised Professor Peter Bonsall (project leader), Jeremy Shires, Bryan Matthews and Jo Beale from the Institute for Transport Studies and Dr John Maule from the Centre for Decision Research. The project was constructed to capitalise on the range of specialist knowledge, expertise and experience which this team was able to bring from a number of disciplines.

The project was organised as a series of technical tasks:

1. Liaison with client
2. Identification of issues
3. Identification of sources
4. Specification of database
5. Literature review and assembly of database
6. Interviews and enquiries
7. Synthesis of findings
8. Report writing

Although the majority of the work on tasks 2 and 3 was concentrated in the opening weeks of the study, the project was structured to allow new issues to be incorporated, and new sources to be tapped, even if they had not been identified in the opening phase of the work. Thus, regular meetings of the team allowed the emerging findings from the literature review, interviews and enquiries to feed back into the identification of issues and sources.

2.2 Sources of Evidence

Four major sources of information, evidence and insight were identified in the Leeds proposal. The first was **the team's existing knowledge** of the field (derived from their past research into responses to road charging, responses to uncertainty, perception of modal attributes, and decision processes). The second was **interviews** with people likely to have knowledge or opinions on the issues involved. The third was published **literature and reports**, and the fourth was **comments from a network of fellow academics and researchers.**

Prior Knowledge

The team's prior knowledge was fed into the project via team meetings and discussions to identify issues and evidence, and via summaries of the relevant research findings in the database.

Interviews and Enquiries

A list of potential interviewees was drawn up and prioritised in discussion with the Project Steering Group. A proforma template for the interviews was agreed with the Project Steering Group and is appended as Annex 2.

Eighteen full interviews and three briefer enquiries were conducted (see Annex 3 for names and affiliations of interviewees). These include all but one of the interviews which were agreed by the Project Steering Group to be of the highest priority (one potential interviewee declined to participate due to pressure of work) and all but two of those identified and agreed as being of the second highest priority.

The interviews were generally extremely valuable; they identified a number of important issues and some useful sources of evidence. The interviewees were generally very keen to give their opinions and to discuss the issues but it was apparent that decisions to introduce or withdraw pricing structures are often based on market research which is commercially confidential.

Another general conclusion from the interviews was that decisions to introduce or withdraw pricing structures are generally based on a company's perception of the popularity of the structure rather than on their perception of the public's ability to understand it.

Literature Review

The literature search began with the identification of an initial list of keywords and criteria for inclusion/exclusion, and an initial list of papers, reports and other sources already known to the team. These lists were allowed to evolve as more issues emerged and as new leads were obtained. The reviews were entered into an Access database which was structured to facilitate later investigation of the material via keywords. A description of the search procedures and of the structure of the database is provided as Annex 4.

Seventy-six papers were identified, examined and entered into the database. Their titles are listed in Annex 5. Of these 76, 23 were found to be particularly useful and are shown in bold in Annex 5. Of the 76, 17 relate to pricing in the telecommunications or utility industries, 25 to pricing in the transport sector, and 34 more broadly to consumer choice and decision making.

Much of the literature in this final category refers to evidence derived from laboratory experiments which, typically, have used students as the experimental subjects. Taken individually, these studies might not be thought sufficiently robust or transferable to be relied on in the current context but, taken together, they provide a body of evidence which supports, to varying degrees, a set of theories and conclusions on how people make decisions when faced with complex information. In addition, there is an increasing body of research showing that these theories and conclusions are highly predictive of judgements and decisions taken by lay members of the public in more everyday-world settings. A selection of the experimental studies has been included in the database to give a sense of their content and orientation but it is the sheer number

of such studies, the degree of acceptance that they command from the decision theorists and the evidence showing that they are predictive of 'real-world' judgements and decisions, rather than the content of any individual study, which warrants their inclusion.

Input from Fellow Academics and Researchers

Input from fellow academics was to be sought at two stages; firstly by inviting comments on the initial list of issues and secondly by inviting comments on a draft final report. The invitees were drawn from a group of internationally respected academics and researchers known to be active in this field.

The first stage was conducted via email correspondence and, although it resulted in some useful leads, its main benefit came from confirming the completeness of the list of issues. The second stage, also conducted by email, resulted in a general endorsement of our findings and provided some very useful additional points and references. All comments received by 6th September have been considered for inclusion in this final draft.

3 Key Facts, Findings and Evidence

3.1 Preamble

We have focussed on what we believe to be the most robust evidence from the most reliable sources, and have drawn on evidence from other modes, sectors and countries where appropriate. The inclusion of evidence from a variety of different contexts obviously raises the question of inter-sectoral and inter-cultural transferability. We have sought to address this question as and when it arises but our general assumption has been that the fundamentals of decision-making are universal even though different cultural and commercial traditions are likely to influence people's acceptance of different pricing regimes.

The facts and findings presented in this section have been themed to provide some structure to what is, in reality, a large mass of interconnected issues. This inevitably results in some duplication.

Much of the "evidence" drawn on in this section is accepted as fact within the discipline, or is logically derived from known facts, and it would be invidious to quote a specific source for such evidence. However, where the evidence is particularly new or compelling, or where an item of literature in our database, or an interview transcript, throws particular light on an issue, we have provided a cross reference to that source via codes in parentheses. The alphabetic codes indicate an interview (see Annex 3), the numeric codes refer to the literature database (see Annex 5) and the italicised numeric codes refer to other literature (see Annex 6).

3.2 On people's ability to cope with complexity/uncertainty

1. Most travel decisions, indeed most decisions per se, have to be made using incomplete information (*302*). Drivers' journey times are a function of traffic flow, network capacity and random events. The traffic flow in turn varies as a function of time, place, day and special events. Their petrol costs are a function of the car they drive, the traffic conditions, their driving style, the ambient temperature and the prevailing petrol price. Drivers have to make judgements based on incomplete information and, to the extent they are aware of the incompleteness of their information, they accept this and try to act as best they can with the information available (D, E, F, G, H, K, O and Q).
2. There is a significant body of evidence to suggest that drivers tend to underestimate fuel costs. The evidence on other components of journey cost is more mixed; some shows a tendency to under-predict (e.g. urban journey times), and some shows a tendency to over-predict (e.g. inter-urban journey times). (007,*303*) The fact that tolerably accurate aggregate travel forecasts have been based on the calculation of time and distance coefficients does not prove that individuals can estimate or perceive time or distance accurately (O).
3. People have to deal with uncertainties over price in many/most situations. Interesting example include:

- *Phone calls*, where, depending on the tariff chosen, the price will be a function of call duration, time of day, number being called (local/national, network supplier, premium or other non-location specific number). Telecoms industry research suggests that the majority of phone-callers do not know the cost of each call that they make. When asked how much a particular call is likely to cost overestimations by a factor of three are apparently not uncommon (102).
- *Electricity bills*, where, depending on the tariff chosen, the price will be a function of consumption and time of day or night. Consumption will in turn be a function of weather conditions, thermostat settings, etc. We understand that the industry believe that most people make only very approximate estimates of their bills though there is some uptake of software that enables people to make predictions using their own past data (105 and 106).
- *Taxi fares*, which will be a function of whether the taxi is regulated, whether it is a private hire vehicle, time of day or night, whether it is in or out of zone, traffic conditions, route taken and 'extras' charged. Anecdotal evidence suggests that, except in the case of regular journeys, people have only a very approximate idea of what a taxi journey is likely to cost them. Where there is no meter, people will sometimes ask for an estimate from the driver, but where there is a meter people generally seem content to trust that the cost will be fair (though there is also anecdotal evidence that people dislike the fact that they don't know how long the journey will take and, hence, how much it will cost (L)).
- *Cheap airline tickets*, though, unlike the previous examples, the purchaser generally knows the price before committing to the purchase. This is a very interesting and relevant example because prices are a function of busyness and capacity available. Anecdotal evidence suggests that people understand this and have come to accept it. Despite the availability of some very low fares, airline travel still tends to be a 'big ticket' purchase, motivating the customer to undertake pre-planning and to seek to gain an understanding of how the tariffs work (F, I, N, Q and R).
- *Holiday bookings*, where it is accepted that the headline brochure price is likely to exclude inescapable items such as insurance and surcharges but that better prices are likely to be obtained by shopping around or waiting for last minute offers. People have apparently come to accept that other people on the same holiday are likely to have paid a different price and this is no longer a major source of contention.

4. The lesson from the I-15 San Diego HOT lane is apparently that people are prepared to accept considerable price-uncertainty provided that it is resolved prior to their having to make an irrevocable decision (B, C and D). [The I-15 facility was introduced in 1996 as two tidal toll lanes running for 8 miles alongside an existing toll-free highway. Since 1998 the tolls have varied dynamically according to the expected level of congestion (being kept just high enough to dissuade sufficient users to ensure that the lanes are kept free of congestion). Although the toll lanes have not been entirely free of congestion (according to www.valuepricing.org), the success of this regime has led to it being expanded to 4 lanes extending over 22 miles]
5. Price complexity does not seem to have been an issue on the SR91 HOT (High Occupancy Toll) lane facility although its tolls are quite complex (with charges varying, in multiples of 5 cents, by time of day, day of week and direction of travel and currently having up to 11 different charge bands on a given day). This

level of complexity has been phased in, but this was not out of fear about user reactions – rather it is because the operators have, over time, learned how best to vary prices (D). [The SR91 HOT lanes opened in December 1995 as a privately built and operated HOT lane facility comprising 4 lanes in the median of an existing 8-lane highway in Orange County California. The tolls vary according to a published schedule reflecting expected congestion levels. Access to the facility is restricted to vehicles equipped with a transponder for electronic funds transfer. Vehicles with at least 3 occupants, zero-emission vehicles, motorcycles and certain disabled drivers travel free except on weekday pm peaks when they pay 50% of the published toll].

6. The lesson from Singapore, where the road charges vary over time and may be revised at regular intervals, is that the public do not have difficulty with the structure or with the idea that there may be periodic revisions. Most drivers apparently know that they will have to pay more in the peaks and less in the off-peaks but not necessarily how much more or less (E and 202). Singapore's strong tradition of government regulation will, of course, affect people's readiness to accept such a system.
7. The work leading up to the proposed road pricing scheme in Hong Kong included market research which looked at the response to complexity. Although the sheer number of cordons and screen-lines, each with different charges for crossings inbound and outbound, and the inclusion of up to six different tariffs during a 24 hour period, resulted in quite a complex charging regime, the proposed complexity did not appear to be much of an issue. It is suggested that this was because, for all its complexity, it could be presented as a simple system (higher charges at busier times and in the busiest directions) (T). We cannot know, however, whether the complexity would have become an issue if the scheme had actually been implemented or if concerns about privacy had not been so dominant (219).

3.3 On the extent of complexity/uncertainty that people can deal with

1. It is well established that people have limited capacity to store and process information, that they use relatively simple rules to overcome these limitations and that, consequently, their decisions are only boundedly rational (211, *310*, and *311*)
2. Research has suggested that most people can deal with no more than 7 (plus or minus 1) items of numeric or abstract data at any one time (*310*). If people can detect a structure in the data they are much better able to handle complex information. A number of our interviewees expressed the view that people are quite happy to deal with prices varying according to two or three parameters, but that people do not want to deal with systems where there is a larger number of 'price points'. They report that common responses to more complex systems are to disengage (by switching out of the product or brand in question or by simply paying whatever price is charged) or to try to identify the parameters which are most important to them and then decide according to those (A, D, E, F, J, N, P, Q and R).
3. People differ in terms of their ability to deal with complex or abstract information. This is partly due to differences in education and experience (104), and partly to mental ability, mental and emotional state (with stress and emotions such as anger

not only changing people's ability to process complex information, but also which aspects of the information they focus on). Some research also points to age and gender-related differences. The influence of mental state is relevant because, if road pricing were to induce stress or anger, this would affect people's ability to respond to the pricing signals in a "rational" manner. (This in turn means that the whole question of the acceptability of road pricing is relevant to consideration of people's ability to respond to it).

4. The complexity of phone tariffs is particularly confusing for the elderly and people in lower social classes and for first time users. Many people do not realise that they are making a wrong choice (103). There is strong evidence that this is also the case in the electricity and gas sectors (105 and 106).
5. Perception of distance is generally rather poor, most people are unable to estimate the distance of even a regularly undertaken journey with any degree of precision (O and P)
6. Distance is often estimated via journey time (007). Time is more readily remembered because it is the dimension in which activities are organised, because day-to-day life involves schedules and appointments and because people carry watches. Estimates of time are converted into distance via a notional speed or, more simply, via simple arithmetic based on experience: *"I know that it is about 100 miles to Bristol, the journey to Bristol takes about 2 hours. The journey to Birmingham takes about 3 hours so Birmingham must be about 150 miles away"*. In fact the estimation of time is also far from perfect (In a recent study in Leeds, most people over-estimated the duration of a journey to Manchester by about 30% (*303*). Research has established that the accuracy of time perception is influenced by the activities undertaken during the interval being assessed e.g. people consistently judge an interval as shorter if they are engaged in relatively complex activity during this interval as compared with relatively simple activity (e.g. a demanding rather than an undemanding driving experience).
7. Work on "mental mapping" has identified the circumstances which tend to lead to over/under estimation of time and distance; much of it has to do with unfamiliarity with the journey and perceived differences between the origin and destination – each of which lead to overestimation of time and distance.
8. Most people have quite limited knowledge of network topologies, road names and numbers (206). Knowledge of road names and numbers is poor even for roads in areas with which people are familiar (perhaps because they have never needed to know the names or numbers). Knowledge of road types is also poor – the only readily recognised distinctions being those between motorways, dual-carriageways and the rest.
9. Many people have difficulties interpreting maps (people who have difficulty with maps apparently have particular difficulties estimating distance but the ability to read maps does not guarantee an ability to estimate distance or vice-versa). Males generally perform better than females at map reading and tasks involving spatial reasoning (023). Using maps as a means of communicating messages about pricing structures can be confusing for many people (I).
10. The bus industry comment that significant proportion of their customers have difficulty with geographical/spatial/map-based information; they find the notion of zones and networks difficult to get their minds round. This has apparently led the industry to make less use of zonal fares than they used to. Indeed, one of the recent trends in bus fares has been towards much simpler structures, and even flat

fares across an area (204). There is some evidence that this simplification has lead to increases in demand (F and L).

11. Evidence from the utility sectors suggests that significant numbers of customers do not know how their bills are calculated (105, 106).
12. Similarly, in the financial sector, a significant number of customers did not understand the key differences between the many thousand different mortgage products available, citing the level of complexity and the use of technical language as the main factors causing confusion (107 and 108).
13. Two thirds of the individual customers consulted recently as part of the SRA's policy consultation on Fares Structure in the Rail Industry said that fare complexity was a major problem (214).

3.4 On the coping strategies used when full evaluation of options is not possible or not justified

1. Academic research on judgement and decision-making and applied research undertaken by industry show that the most prevalent coping strategy is to use a simplifying rule (a heuristic) to approximate the "true" value of the unknown factors. In the absence of information about the correct rule, a heuristic is likely to be derived from experience or hearsay (015). People generate expectations and heuristics by attempting to recognise patterns. They look for and apply relationships between variables (e.g. price and quality (003) or distance and time (007)) which may be more imagined than real.
2. Telecoms industry research (e.g. 102,103) suggests that, when estimating likely call charges, callers use heuristics such as:
    - calls made in the evenings or at weekends are cheaper than calls made during the working day.
    - 0800 numbers are free
    - 0875 numbers are at local call rates
    - 0900 numbers can be very expensive
    - calls to mobiles are generally more expensive (unless you are calling from the same network).
3. Other heuristics which we have come across in the travel sector include:
    - mid-week flights are cheaper than those on a Friday night or Monday morning
    - petrol costs about 15 p per mile
    - taxis cost about £2.50 and then £1 per mile.
4. Application of heuristics leads to incomplete appreciation of information and to anomalies in the ways in which choices are made. There is a considerable body of experimental data on this. For example, trivial changes in the format in which information is presented can induce people to use different rules and this can lead to anomalous and contradictory behaviour – one format may induce a rule that leads people to strongly prefer one option, but another format induces a different rule that leads people to prefer a different option, despite the fact that the same basic information is being presented (002, 004, 012 and 017).
5. Laboratory evidence suggests that people use one of two modes of thinking. *Type 1 intuitive* or *superficial* thinking (simple heuristic forms of thinking, based on very simple rules e.g. choose what I did last time, choose what I recognise, or rely on trusted sources of advice) is used for problems which they regard as

unimportant, routine, when they find the situation too complex to handle or when they are under pressure. Whereas they tend to employ *type 2 analytical evaluations* (involving conscious, analytical thought that takes account of most if not all the available information) for more important, one-off, decisions taken at leisure.

6. The type and precision of information that people require to enable them to come to a decision will vary with the type of thinking they are using (e.g. type 1 *vs* type 2)
7. The use of heuristics, or of analytical methods, which fail to take into account all the dimensions of a complex problem, need not lead to sub-optimal behaviour provided that the *relevant* dimensions are covered adequately. For example, if a driver's route choice is constrained he does not need to understand how charges vary over space and if his choice of departure time is constrained he does not need to understand how charges vary over time.
8. As mentioned above, our interviewees highlighted that, as the number of parameters on which price varies goes up, people quickly start to try to identify the most important parameters for them and use those to make their decisions.
9. In addition, one of our interviewees suggested that when someone has no idea what they might be charged for a service they would be less likely to use that service, and if there is a wide range of possible prices people are more likely to give greater weight to the upper bound than the lower (I).
10. People look for cues to assist their decision-making. They like to rely on trusted sources and the image of the supplier of the product or service can bring with it a perception of price or quality (013,105,106,108).
11. Most people avoid the issue of optimising their behaviour by falling into a habitual pattern in which state they are likely to pay little regard to relatively subtle differences in price (see *301,* or 030 for a discussion of the phenomenon of routineisation).
12. Some people, whilst not optimising their behaviour in any conventional sense of the term, appear constantly to be to be changing their behaviour. They may be seeking variety for variety's sake (014) or may be responding to changes in a subset of the option attributes. Depending on which attributes they are interested in, they may or may not be easily influenced by price differences.
13. Recent years have seen increasing reliance on technological aids to decision making – particularly web-based searches and advice systems (204 and 105). Research has shown that the presentation of options can have a significant impact on consumer choice (002, 004 and 012) and that the effectiveness of these advice systems depends crucially on how the information or advice is presented.
14. When faced with complex choices involving non-trivial sums of money, some people will seek advice (e.g. in purchase of financial products). There is considerable evidence that consumers welcome assistance when calculating the charges they are incurring (e.g. phone displays, price calculations on internet airline ticket sales sites, internet energy comparison sites). Consumers generally want to be aware of how much they are spending, or are likely to spend, but don't wish to devote too much additional effort to become informed (102, A, D, G, H, J, K, Q and R). OFGEM recently investigated the use of an Energy Cost Index (ECI) to help people compare prices between different suppliers. It was found very useful by customers who hadn't yet switched. However, it was considered too simplistic by many of those who had experience of switching between suppliers (105).

15. It is widely believed that, faced with the complexity of congestion charging, motorists will make considerable use of advice systems to help them plan routes so as to avoid excessive charges (S). In the freight sector, the need for an advice system when planning a journey which does not infringe driver's hours regulations, the working time directive and peak period road tariffs has been demonstrated to some effect (U).

3.5 On people's readiness to rely on approximations

1. People tend to be cognitive misers (005, 016, 021 and 211) – they will not waste effort on thinking about something that they consider not to warrant it. This means that they will be looking for ways to economise on their mental effort. Even when the task is within their capability, people may *choose* not to allocate all their resources to it. (019, 021, 102, A, D, E, F, G, H, I, J, K, O, P, Q and R).
2. People are more likely to rely on rough approximations or heuristics when they are in a hurry (005 and 010). Even when not under time pressure, people tend to rely most heavily on the most easily accessed information (005 and 011).
3. People are more likely to rely on heuristics when the task becomes more complex (relative to their ability) (019 and 021).
4. Increasing complexity makes people more likely to stick with the status quo (021) whilst the arrival of new information which seems to conflict with a previous impression causes people to engage in more systematic processing of the information (020).
5. There is a large body of research showing that information overload leads to a decrease in the quality of decisions made (017).
6. Evidence from the telecoms industry (102) and elsewhere suggests that most people are happy to make do with approximate estimates of cost when the sums involved are trivial or manifestly represent a bargain. But a minority of people find it disconcerting not to know the exact price before they commit themselves to a transaction whatever the sum involved (F, M, P, Q and R).
7. Experimental data is consistent with the supposition that people are more inclined to use approximations the greater the resource or effort required to complete an accurate calculation (019) and the more tired that they are. But, again, differences between individuals mean that, in any given case, some people will resort to approximations while others will seek to calculate the exact price even if that calculation is difficult (F, G, H, Q and R).
8. A person's readiness to rely on approximations will reflect their income or socio-economic group, their mental and emotional state as well as their mental ability, education and experience (211, D, E, F, H, O, P, Q and R).
9. A significant number of mobile phone users apparently tend to rely on word of mouth rather than thorough analysis when choosing a tariff package. The decision to think about changing from one package to another tends to be triggered by some external factor, most usually the need to buy a new handset, rather than something specifically to do with the price (J).
10. People are less likely to query the fairness of a price if they trust the provider of the product or service in question (008 and 013).
11. Complex charges can cause consumers to worry whether they are being over-charged – if the sums at stake are significant they may feel the need to work out the charge for themselves – but if they trust the organisation making the charge

they are less likely to feel the need to do so (105 and 106). Trust can be damaged when the customer makes an enquiry about a journey at one point in time and gets told one price, and then makes the same enquiry at another point in time and gets told a different price (G, K and Q).

12. Research in the telecoms industry suggests that people are generally much less concerned about knowing the charges being incurred if someone else is paying the bill! Our interviewees made similar comments in respect of air and rail journeys (G, H, I, Q and R).
13. The bus industry recognise two quite different markets; regular journeys and one-off journeys. People expect to be able to predict the cost of the former (and for it not to vary significantly from day to day) but appear happy to accept that they might not know the precise cost of a one-off journey until they actually make it (F and L).
14. The bus industry recognises two types of people; those who want to know the price in advance and are willing to go to some effort to research the prices in advance, and those who just turn up and pay. The distinction is NOT simply a function of income. The industry capitalise on this by offering discounts and special offers (and consequential complexity) to people who are prepared to take the effort to research them, while allowing the "standard" fare to increase (F).
15 Our interviewees (A, C, D, E, F, G, H, I, J, K, L, P, Q and R) identified different types of consumers who respond differently when faced with complex prices or product information. These may be summarised as:
    - those who are happy to make a quick decision based on the most easily accessible facts;
    - those who enjoy 'bargain-hunting' and are self-motivated to identify value;
    - those who, through frequent use or exposure, have become familiar with the attributes of the products on offer;
    - those who get confused and frustrated, either despite being a frequent user or because they are an infrequent user and are not among the relatively small number of bargain hunters.

    The relative sizes of these different groups are likely to differ depending on the context (e.g. type of product and frequency of purchase or, in our case, purpose and frequency of journey) and cultural factors.

3.6 On the stage at which people need/want to know the price

1. People differ as to what they want or need to know at a given stage (206). Most people prefer to know the price of an alternative before they have to decide whether or not to commit to the expenditure (e.g.203) and many people appreciate prior knowledge of prices even if they have no choice but to accept them. However, there are circumstances when they prefer not to know the price before they really need to and others where they prefer not to know at all and certainly not before it is too late to act on the information. The circumstances in which such seemingly irrational preferences prevail are generally those in which the individual is emotionally committed to one course of action and wants to avoid the cognitive dissonance which might be raised by the existence of facts that might show their course of action to be unwise. (In fact this behaviour need not be irrational; if the price is known to lie within a given range it may be that the

precise price would not alter the decision and so it could be quite logical not to overload one's mind with knowledge about the actual price).

2. Until recently, people accepted that the charges made by many professions and trades (lawyers, architects, surveyors, dentists, garages, builders, home maintenance, etc) could often not be predicted in advance of receiving the bill. Recent pressure from consumer groups has resulted in greater transparency and predictability in pricing for many of these services (I).
3. Although it is possible to know what bill is being built up when picking items in a supermarket or ordering a meal at a restaurant, it is widely held that most people do not make more than an approximate estimate at this stage (the main exception being people on a tight budget).
4. Market research on attitudes to road pricing conducted for the IMPRINT studies suggests that travellers would have a strong preference for knowing the charge before they travel (203, 219).
5. The clear lesson from the I-15 (San Diego) HOT lane is that, in the context of a scheme that offers them an almost guaranteed level of service, people are prepared to accept that they do not know the exact price until minutes before they have to make the decision (B, C and D).
6. The low cost (low frills) airlines have prospered with an extremely complex pricing structure based on the principles of yield management which, for the customer, means that they never know the price of the ticket until they come to purchase it; prices can vary even during a booking transaction. There is a widespread understanding that the price for a particular flight will be a function of demand and the public are apparently willing to accept this uncertainty in the belief that they are getting a bargain.
7. SNCF's attempt to introduce a similar pricing regime had to be withdrawn in response to public protests (and in the light of some spectacular own goals such as the occasion on which a train was sent out empty because no tickets had been sold due to a glitch in the software). The main public complaint was that uncertainty about the price and availability of tickets made it impossible to plan journeys effectively.

3.7 On the behavioural responses to complex/uncertain charges

1. Most people are risk averse (e.g. *308* and 028) and, other things being equal, will choose an option with a known price over one with an uncertain price. This result has been found over and over again in studies and experiments – including some in the context of road charges (203, 219 and 224). Notwithstanding this general finding, recent research, some of it in the context of imprecisely defined road charges (224), has suggested that, in certain circumstances, some people will deliberately choose the more uncertain option and it is suggested that this may be a benign manifestation of the game-playing mind-set which results in excessively complicated rat-running and speculative re-routing. Indeed some individuals may consistently take up the challenge of 'beating the system'.
2. Recent experience from the telecommunications industries (phone, TV and internet) suggests that, while most people may have a preference for fixed charges for unlimited use (102), different people make different choices (A and J). Fixed charges for unlimited use are particularly popular in the TV and Internet sectors

while pay-as-you-go contracts (e.g. with top up credit) have a particular following in the mobile phone industry.

3. Experience in the water industry also suggests that, despite the campaign to encourage people to adopt water meters, many consumers have stayed with a fixed charge.
4. Research from within the utility industries suggests that some of the preference for fixed charges reflects a belief that the fixed charge will be cheaper given their existing, or preferred, pattern of consumption and some of it reflects a desire to avoid uncertainty in the domestic budget. There is also a view, expressed by one of our interviewees, that people's willingness to pay more for a fixed price package than they would if they made the same pattern of usage on a pay-as-you-go basis, reflects the value they place on simplicity (A and 107)
5. Within the utility sectors there is a tendency for a significant number of customers to remain with the same supplier they have always had and not switch. One reason for this behaviour is that people find the different charges systems between companies too complex to understand and, even if they can understand, they are unwilling to spend the time making the necessary comparative calculations (105).
6. Despite some evidence of desire for change for change's sake (014), most research has shown that people have a strong tendency to stick to their previous decisions (the status quo bias) unless new options are perceived to be considerably better (e.g 021). A recent example of this phenomenon is provided by the California Statewide Pricing Pilot (SPP) project, which offers electricity consumers the option of switching to a tariff which, in return for a lower basic rate, is subject to critical-peak pricing announced just a day in advance in response to particularly tight supply conditions. It appears that, if flat rates are specified as the default, then few consumers volunteer to adopt time-varying rates. But if time-of-day rates are the default, then most consumers stay with them (*306*).
7. The trend in the bus industry has been towards simpler fare structures because the operators found that complexity was putting customers off and that communication of the fare structure got in the way of promoting the product (it was difficult to make the product sound attractive if its price is complicated) (204, F and L).
8. The UK bus industry claims some evidence of increased patronage following simplification of fare structures but it is difficult to be sure how much of the change in patronage is more properly associated with other changes (re-branding, service alterations etc) (F and L).
9. The lesson from attempts to introduce time-of-day pricing in the US transit industry has apparently been that, if it represents an additional degree of complexity, patronage is likely to fall. Thirty-three US transit agencies introduced time of day pricing between 1970 and 1983. Many of these pricing schemes were simplified versions of previous fare structures. However, eleven of the thirty-three schemes have been discontinued, nineteen have allowed inflation to reduce the real value of the time-of-day differential and only three have increased the differential. The main reasons for abandonment were, apparently (204), loss of revenue, fare disputes and failure to achieve the hoped-for shift in demand into the off peak
10. One lesson from the abortive attempt by Deutsche Bahn to manage demand via a complex system of discounts was that the increased complexity lead to reduced patronage and it seems that this was partly due to the fact that people did not fully

understand how to get best value from the discounts. (Fuller details of the story are provided in paragraph 3 of section 3.9).

11. Virgin Rail have introduced a new class of ticket whose price is based simply on whether the journey(s) are to be made on peak or off-peak services (conventional practice in the UK rail industry had allowed off-peak rates only in connection with two-way journeys). Virgin also offer a range of discounts for tickets purchased in advance (subject to availability), much as was the case in the ill-fated DB scheme. Regular customers have apparently welcomed these initiatives as providing a more logical basis for pricing and, crucially, more opportunities to save money on rail travel (G).
12. Transparency and predictability in pricing is now regarded as a selling point by many service providers, professions and trades. Confusion over phone tariff structures led firms to introduce tailor-made packages such as "free weekend calls" or "1000 free SMS". Leading mobile phone retailers tend to offer simple comparison boxes for networks with 'headline' figures. Pay-as-you go and monthly flat fees are both popular in the mobile and land line phone markets because, all be it in different ways, they allow people to budget more effectively. People on pay-as-you-go tariffs have welcomed displays which show the charges being accrued.
13. The fact that the phone industry offers an apparently bewildering array of tariffs should not be taken to indicate that people like to have this amount of choice. New tariffs are introduced by companies as a competitive tool to differentiate themselves from other providers and to appeal to niche markets (101). Far from welcoming the range of choice, recent research suggests that customers are off-put by too much choice and that commercial advantage may be gained by stressing the simplicity not only of each tariff but also by having only a few tariffs from which to choose There is an important distinction to be made between complexity of tariffs and breadth of product (and, hence, tariff) choice (204, A and J).
14. Suppliers' decisions (such as AOL's in the 1990s) to withdraw, or not to offer, fixed-price packages generally reflect operational problems (e.g. caused by excessive consumption) rather than because they are not popular with customers (027 and 117).
15. There is considerable evidence to suggest that, if people do not understand an option they will choose another that they do understand (even though it may be sub-optimal), (this is known as "Ambiguity avoidance" (028)). Preferences and choices may thus be driven by understandability rather than by utility (001, 005, 006 and 011). This has obvious relevance to the current study.
16. Surveys in the financial and utility sectors show that consumer switching between suppliers is highest in the insurance sector despite the complexity of the products on offer in that sector. The reason offered for this phenomenon, which seems to contradict the ambiguity avoidance axiom, are that people ignore most of the dimensions in which the products differ and fixate on the price and one or two other attributes. Against this background the ease of obtaining a firm quote (by phone or the web) makes the decision to switch relatively effortless (107).
17. Research (027, 031) suggests that the additional effort ("transaction cost") required to calculate prices may explain the popularity of fixed charges in lieu of usage pricing in a variety of markets (buffet meals, local telephone service in the US, flat fares throughout the New York City and Moscow subway systems, the Eurail pass, employer-provided family health care premiums that are independent of family size and amount consumed, Disneyland entry fees).

18. Responses to prices are context dependent and are strongly influenced by the consumer's perception of relevant reference prices (see for example *308* and 025). The response to a given price may be quite different in the context of a complex and varying price structure from what it would be if the price were simple and fixed. This obviously complicates the process of deriving or applying elasticities in the context of a complex price structure.
19. Research has suggested that, where prices vary over time, people's behaviour is more than proportionately influenced by the upper end of a price distribution (R). A particular example of this form of risk aversion is apparent from research in the telecoms industry which suggests that some people avoid making calls whose price is uncertain but may be very high.

3.8 On the Effect of Familiarity, Experience and the Passage of Time

1. In Singapore, the road charging system is now much more variable than its predecessor (there are 12 separate charge bands between 0730 and 0930), but this is put down to the possibility provided by the technology rather than to changes in the public's ability to deal with complexity (E). Great emphasis was placed on providing a lot of information on charging structures and advance warning is given of any changes to the structures. The system was trialled with no actual charging to help people "learn" how the system would work (E). The introduction of peak shoulder charging was initially regarded by some as a source of confusion but is apparently now welcomed by motorists There were initially some complaints when people at the time-boundary between two different charges found that the system-clock was not synchronised with their in-car clock, but people have now learned that it is the system clock which determines the time boundary and so they need to make sure that their in car clock is correctly synchronised to it (E).
2. A lesson from the I-15 (San Diego) HOT lane is that, despite some pre-launch opposition and scepticism about the scheme, the majority of users have, with experience, come to approve of it and that this favourable impression has also spread to non-users (B, 210, 212 and 213). (initial scepticism followed by acceptance seems, in fact to be the norm for road pricing schemes (219) but the San Diego experience is perhaps particularly relevant because of the complexity of the pricing in that scheme).
3. Another finding from the I-15 HOT lane is that, with experience, drivers have come to associate high prices in the toll lanes with congestion on the parallel-running highway and that some drivers, presumably those with high values of time and a disinclination to pay unnecessary tolls, are choosing to use the toll lanes only when their price is high (*305*).
4. Experience from the SR 91 HOT lane suggests that, over time, greater refinement or complexity can be incorporated into a charge structure as the users grow accustomed to the logic and as the operators develop greater understanding of the response elasticities (D).
5. Research within the telecommunications industry suggests that people on their second or subsequent phone package are better able to make decisions about which tariff to choose (103) (but note that the phone industry is simplifying its tariff structures). Similar findings have also been found in the energy sectors when investigating customers' switching behaviour between suppliers (105 and 106).

6. The trend towards simpler tariffs in several industries (notably in telecommunications and in the bus industry as noted in Section 3.7) suggests that even if, with experience, people become better able to deal with complex tariffs, the industry is aware that they retain a preference for simplicity (A, J, F and L).
7. The introduction of new, more complicated, arrangements and charges for Directory Enquiry Services was ridiculed by the media but the furore now seems to have died down. Similarly, although unfairness is often an issue when new charges are introduced, and may cloud people's reaction to the charge structure, the lesson from the introduction of charges for school milk, prescriptions and directory enquiries, is that the issue fades with the passage of time.

3.9 On whether complex charges might be more acceptable in the public or private sector

1. Research suggests that people expect private sector providers and suppliers to be motivated by profit and that prices charged will reflect what the market will bear (001). Anecdotal evidence suggests that people do not expect public sector providers to charge more than is reasonable. Some of our interviewees expressed the view that tax-payers do not expect government to engage in highly complex pricing (212, D, G, H, J, K and R). As a matter of historical fact, however, the public sector monopolies have been responsible for some quite complex price regimes designed to manage demand away from the peak. UK phone tariffs actually had more differentiation by time of day before privatisation than after. British Rail had introduced discounts for completing a return journey within a single day, for accepting a ticket that would not be valid at times, or on days, of high demand well before privatisation. The Electricity Boards similarly introduced an off peak tariff ("economy 7") well before privatisation. In a monopolistic environment, the public had little choice but to accept these price structures but it is widely believed that the public viewed them as providing incentives to use off peak services rather than as attempts to maximise profit. Post privatisation, the amount of price differentiation has been limited by regulation and by competition. Analysis of pricing in the communications industries suggests that highly differentiated prices feature more strongly among state monopolies than among private companies; suggesting that, in a competitive market, the consumers' preference for simple tariffs drives out highly differentiated tariffs (116). This does not mean that there will necessarily be less price dispersion is in competitive markets than in monopoly markets (see for example Borenstein and Rose's analysis of the US airline industry, *304*); as noted in Section 3.7, competition may lead to niche marketing and this may in turn lead to highly differentiated prices.
2. The SR91 (Orange County) toll facility has, as of early 2003, transferred from the private to the public sector but the trend in its tolls continues to be one of greater complexity. The complexity of prices appears to be no more, and no less, of an issue for users than it ever was (D).
3. In Germany, an attempt by the state owned rail company, Deutsche Bahn AG, to introduce a new rail tariff structure for its long distance services had to be radically revised in June 2003 after six months of bad publicity and falling revenues. The revised tariff structure replaced the traditional distance-based fare structure and a 50% discount for people who had purchased a *Bahncard 50* by a regime built around discounts for advance purchase of tickets on trains with spare

capacity. The discounts ranged from 10% to 40% depending on the degree of notice given but were subject to availability of spare seats and other restrictions and there was a penalty for cancellation of pre-purchased tickets. Further discounts included a 25% discount for *Bahncard 25* holders, a 50% discount for second and subsequent members of parties and free travel for young persons. In theory, the new system made it possible to obtain discounts of up to 75% on the basic fare but this was not fully understood by most people. The system was widely regarded as too complex and most travellers ended up paying significantly higher fares. The main objections came from long distance commuters and from businesses who said they had no alternative but to pay the increased prices. Their objections were taken up by the media which built a campaign stressing the unfairness of the price increases and the limited possibility of making use of the discounts on offer (225). The criticism broadened into an attack on the bureaucratic insensitivity of DB and their inability to run an efficient service (S). Government pressure eventually led to resignations from the DB Board and the withdrawal of the least popular aspects of the new tariff system. It should be noted that, although DB is a private company, it is wholly owned by the Government and the Government found it impossible to ignore the criticisms that were being levelled at it. It is difficult to judge whether the criticism would have been more or less vocal if DB had been a genuinely private company but it seems that the critical distinction is whether the consumer has a choice as to whether they consume a product or service not whether the service is provided by the public or private sector.

4. Nobel Laureate Daniel Kahneman (*308*) suggests that people's evaluation of choice options depends crucially on whether they model the situation as a gain (will the transaction bring me benefit?) or a loss (will I lose out?). Laboratory evidence, backed up by field evidence, clearly shows that responses to price signals depend crucially on whether the transaction is seen in a positive or a negative light. Thus we should expect the complexity of prices offered by, for example, low-cost airlines (where the dominant perception is that all the prices represent a bargain relative to those of the traditional airlines) to be viewed more favourably than an equivalent complexity of, for example, tax rates. We note that voluntary commercial transactions are, almost by definition, seen as gains whereas charges for 'public' services – particularly if the good in question was previously thought of as free and if the individual thinks he has no option but to continue consuming it – are likely to be viewed as a loss. This may reduce the relevance of experience from commercial transactions to the case of road charging.
5. The fact that SNCF's attempt to introduce yield management pricing was met with such opposition while the low cost airlines' use of similar principles is accepted as sound commercial practice, may suggest the existence of a double standard whereby public service authorities are not expected to behave in so commercial a manner. However, the comparison is complicated; firstly because the low cost airlines are offering a new product which is widely perceived as being good value for money while SNCF was acting in a market where people have preformed expectations and established patterns of demand, and secondly because SNCF's implementation of its new pricing regime was seen to be technically flawed.
6. The recent announcement by Royal Mail that, in order to more fully reflect the cost of processing different types of mail, it would be introducing charges based on the size of items (rather than simply their weight) was ridiculed in the media as an over-bureaucratic solution. Although it might be tempting to place this attack

in the tradition of media snipes at public sector organisations (over-complicated regulations, unintelligible forms, over-zealous traffic wardens, etc), there are numerous examples of similar criticisms of private companies (overbooking of flights, unfinished holiday hotels, uncaring banks, incompetent private security firms, unsafe cars, unreliable builders, leaky (private) water mains, endless waiting on automated phone services, …. the list is endless). It seems that excessive bureaucracy and poor service are targets wherever they appear.

3.10 Lessons from Case Studies Involving Variable or Complex Road Charges

1. The Singapore experience suggests that, despite some initial scepticism, time-varying tolls, and the periodic adjustment of these tolls, are now widely accepted by the public as a sensible response to the problem of congestion and that the issue of complexity is now scarcely mentioned. It is worth noting that considerable efforts were made to explain the logic of the scheme and the details of the charges, that Singapore has a strong tradition of government regulation, that its motorists have a long experience of road charges and that, with their unique system of a capacity-adjusted pool of car ownership permits available by auction to the highest bidder, they have become used to the idea that motoring costs reflect the amount of congestion.
2. The lesson from the I-15 (San Diego) HOT lane is that, again despite some initial pre-launch scepticism, most individual motorists are not now concerned by the fact that charges may vary from day to day and that, on balance they are pleased with a system that offers them a more reliable level of service. The unpredictability of HOT lane charges (and the complexity of the underlying formula) have not attracted widespread opposition from private motorists since the scheme was launched. It is suggested that the fact that the individual driver has a choice (to continue in the all-vehicle lane) has been an important factor in defusing criticism (201, 204, 205, 207, 208, 210, 212 and 213). The scheme organisers do, however, receive a lot of complaints if the billing system makes a mistake or if the expected level of service in the HOT lane fails to be provided (e.g. if, due to a system failure, the price is set too low or if drivers have been charged and then see traffic flowing quite freely on the parallel freeway) (B, C and D). Interestingly, there is evidence that drivers have come to associate high prices in the toll lanes with congestion on the parallel-running highway and that some drivers are choosing to use the toll lanes only when their price is high. Another interesting result is that, in contrast to private motorists, some businesses do not welcome the uncertainty of their monthly bill for HOT lane usage and express a preference for the previous system of fixed charge peak-period passes (B). This difference in attitude may reflect the fact that businesses cannot control their exposure to HOT lane charges as readily as individual motorists.
3. The lessons from the SR91 (Orange County) HOT lane are similar to those from the San Diego scheme. The fact that the lane offers a guaranteed level of service has apparently defused any criticism of the unpredictability of the charges. (There have been complaints about complexity of the procedures required to set up an account, but this is not directly relevant to the current investigation) (D).
4. In 1996 the French motorway toll company, Cofiroute, introduced time-differentiated tolls on its motorways near Paris. The charge structure, which was designed to help spread the peak flow of traffic back into Paris after weekends

away, included four different time bands between 1300 on Sundays and 1300 on Mondays. The system was not liked by the public who regarded it as unfair, ineffective and unnecessarily complicated (M). The accusation of complexity was made even though there were only 4 time bands which had been publicised in advance. The scheme was withdrawn following public protests and a concern about behavioural responses on the feeder roads (excessive speeding by drivers seeking to get there before the rate increase and cluttering up of toll plazas by drivers waiting for the cheaper rate period to begin).

5. The IMPRINT studies, and other work on attitudes to road charging suggest that, given a choice, travellers have a strong preference for predictable prices (203 and 219).

4 Main Conclusions from Available Evidence

4.1 General Issues Relating to Individual Decision Making

People's ability to respond to price signals is constrained, not only by their circumstances and commitments, but by their access to the necessary information and by their ability and preparedness to access, understand and process that information.

People's ability to access, understand and process information is limited by their mental capacity and experience but also by situational factors such as the time available to complete the task.

People's preparedness to access, understand and process information depends partly on their personality, and partly on their engagement with the task. This in turn will depend on:

- their perception of its importance (Cannot a previous decision be relied on? Is there really any need to make a new decision? Are the consequences of making a "wrong" decision of any significance - e.g. Are significant sums of money at stake?);
- their perception of the motives of the body providing the information (e.g. do they believe that, if they are not vigilant, they will be tricked);
- their perception of the effort required to complete the task (generally, if the task is seen as daunting, many people will not attempt it).

The structure and presentation of information can have a great influence on people's ability or preparedness to process it. People show a strong tendency to rely on the most easily accessed information.

When people cannot derive an analytical solution, or choose not to, they will resort to a heuristic or will seek to avoid having to make the choice. Most decisions in daily life are based on heuristics. Some heuristics are more accurate than others (in terms of their ability to reproduce an analytically-derived result) but their accuracy is generally increased when there is a clear underlying pattern or logic to the analytical result. Even in domains where the overwhelming majority of decisions are made using heuristics it is likely that some people will, in some circumstances, wish to derive the analytical solution and they will be distressed if this proves difficult.

4.2 Findings from Case Studies

People have a clear preference for simple price structures. Other things being equal they will choose the product or service whose price is most predictable. The commercial sector, notably in the telecommunications industry, recognises this preference and companies have sought to simplify their structures wherever possible – even where this means that they have less control over the pattern of demand. Monopolistic suppliers, in the private or public sectors, are able to make greater use of differential prices to influence the pattern of demand than are suppliers in a

competitive market but competition may lead to greater price differentiation in the context of niche marketing.

The variety of prices and tariff structures available in the telecommunications market reflects a desire to provide tariffs which will appeal to niche markets and should not be taken as evidence that the suppliers think that consumers welcome complex tariffs.

Evidence on the acceptability of highly differentiated charges designed to influence patterns of demand in the transport sector is mixed;

- The low cost (low frills) airlines have prospered with an extremely complex pricing structure which, for the customer, means that they never know the price of the ticket until they come to purchase it; prices can vary even during a booking transaction. The public are apparently willing to accept this uncertainty in the belief that they are getting a bargain. There is a widespread understanding that the price for a particular flight will be a function of demand.
- The US experience of HOT lanes suggests that if differentiated charges can yield more reliable journey times, the unpredictability of the charge is not much of an issue for individual motorists but is regarded as a problem by some companies.
- The Singapore experience with road pricing suggests that differentiated charges, and periodic well-advertised adjustments to them, are accepted as a sensible way to reduce peak period congestion and that the resulting variability in prices does not seem to have been a serious issue. Singapore's experience with a market for car ownership permits similarly suggests that the principle of using price to manage demand, and the resulting price volatility, is accepted and understood (of course, in seeking to transfer this experience to the UK, allowance needs to be made for the two countries' quite different political cultures and traditions of public acceptance of government regulations).
- Deutsche Bahn's abortive attempt to introduce a fairly complicated system of limited availability discounts designed to divert demand from the busiest services onto those with spare capacity suggests that, if the public regard price differentiation as unfair, they will object very strongly and that, against this background, any perceived complexity will be one of the targets of criticism (it is, in fact, difficult to defend some of the more obscure restrictions which DB placed on the availability of discounts).
- Deutsche Bahn's experience may be contrasted with that of Virgin Rail whose introduction of a similar system of discounts has apparently been welcomed by regular customers as part of a revised pricing structure which offers more straightforward opportunities to customers to save money by booking in advance and by using off-peak trains.

Three high-profile attempts to introduce variable pricing (Cofiroute's motorway charges, DB's system of discounts and SNCF's yield management pricing) have been defeated by adverse public opinion. The public objection was in each case based on the supposed unfairness of the new pricing regime and its failure to achieve the desired effects. This failure was linked to accusations that the pricing structure was too complicated (even though, in the case of Cofiroute, the system was in fact very simple) and was broadened to include wider accusations of management failure

(Cofiroute's supposed failure to publicise its tariffs and to predict the behavioural consequences of its new price structure, DB's supposed failure to operate its trains to timetable, and SNCF's spectacular problems with its booking software).

Potential complexity has often been a concern prior to implementation of differential pricing and generally attracts media criticism in the early stages of the implementation, whether warranted or not. However, given good publicity for the charges, and a clear logic to the price structure, these concerns have usually faded soon after launch.

The idea that the public expect differential pricing from the private sector but not from the public sector persists but we have not found any evidence that proves the proposition; there are always alternative explanations. People will object to price differentiation if it appears unfair, unjustified or ineffective and it so happens that these problems are more commonly perceived in the public sector (see for example *307*).

4.3 Other Findings of Particular Relevance to Congestion Charging

Most people have difficulty estimating distance. Estimates of distance are often derived indirectly from estimates of journey duration – but these too are subject to bias and error.

Many people have difficulty with spatial data. Few people are familiar with road names or categories – even in areas where they travel quite frequently (the one exception being the motorway/non-motorway distinction).

The idea that prices should be highest at times of heavy demand has been established by pricing policies in the airline, rail, bus and holiday industries. People seem to have no difficulty accepting this principle and it may provide the basis for a heuristic which people find easier to deal with than detailed information requiring network knowledge and good perception of distance.

It is widely expected that advice systems will emerge to assist drivers to plan their routes in the light of congestion charges. Such systems are seen as playing a major role, particularly during the early stages of implementation.

4.4 The Question of Transferability

This report has drawn on evidence from a variety of contexts. We have made reference to specific questions of transferability at various points during this investigation but it is perhaps useful to assemble the main arguments in one place. There are two main issues; firstly whether evidence from contexts in which people expect to pay for a product or service is applicable in the context of charges for the use of road space which has traditionally been free at the point of use, and secondly whether evidence from countries such as Singapore which has a strong tradition of government regulation and demand management is transferable to countries such as the UK with a more liberal tradition of individual choice.

On the first point we believe that behavioural responses to road charges will necessarily be conditioned by the fact that use of road space has traditionally been free at the point of use. For some people, the supposed unfairness of a new charge will completely dominate their response and it is clearly possible that, if this opinion is widespread, the attempt to introduce such charges will falter at an early stage. However, as the idea of a charge for road use (or perhaps more convincingly, a charge for use of popular road space) becomes more widely accepted, responses will become less emotionally charged and 'normal' consumer behaviour will come to the fore. Although transport is different from most other commodities in various respects (notably in being a derived demand), we see no reason to suppose that the decision making processes and general preferences observed in, say, the telecommunications market, should not be present in the (new) market for road space. Provided that appropriate allowance is made for factors such as captivity, we think it wholly appropriate to seek insights from these more established markets. The fact that similar findings have come from different sources supports this view.

Turning now to the question of cross-cultural transferability. This is an important issue because, although the report is intended to inform decisions on the possible implementation of road charges in the UK, much of the evidence on public response to complex road tolls or tariffs, and to the introduction of differentiated charges for public transport, comes from outside the UK. Having looked at the evidence we are struck by the fact that, although the public reaction to the *introduction* of differentiated charges may differ, once the new charges have been accepted as a fact of life the behavioural responses to the charges are broadly similar. We conclude that, while the findings on political acceptability may not be directly transferable, the evidence on medium to long term behavioural responses probably is transferable.

Having argued that the evidence on behavioural responses is broadly transferable, we must re-emphasise that the behavioural response to any given scheme will depend on local circumstances and design features.

5 Implications

5.1 Assumptions

Given that people's ability and preparedness to respond to price signals is conditioned by their attitude to the price regime and their perception of its effectiveness, we have had to make certain assumptions about the impact that the scheme might have on individuals.

It has been suggested that the introduction of congestion charges will make it easier for motorists to plan journeys than is currently the case because a major source of uncertainty (travel time) will have been reduced. This proposition requires that the motorist finds it easier to accept a variation in price than a variation in duration and also requires the congestion charges to have the kind of effect across a network as they have been seen to have on a single link (e.g. as has generally been achieved in the case of the I-15, San Diego, HOT lane). Such an outcome is possible only if the charges are allowed to change in response to unexpected congestion. If this is not to be the case the motorist will be faced with continued, all be it perhaps reduced, variation in journey times as well as with the fact that the cost of the journey will depend on when it is made and what route is taken.

We have assumed that, for the motorist who always uses the same route at the same time of day, the introduction of congestion charges will reduce the unpredictability of the journey time, but for the motorist planning a new journey, it will introduce an extra dimension of uncertainty.

Drawing on the evidence examined in Section 3 and summarised in Section 4 we now discuss how recognition of people's abilities to respond to complex price signals should affect the design of a national congestion charging scheme.

5.2 Implications for the System Specification

1. The clarity of the pricing signal is fundamental to the success of congestion charging. However, it is not realistic to expect drivers to be able, or willing, to calculate the precise charges that they would incur for each of the routes and departure times available to them. The best that can be hoped for is that, *if they understand the structure of the charges*, they will be in a position to predict whether one option would be cheaper or more expensive than another and, perhaps, to make a reasonable estimate of the likely cost. Their ability to understand the structure of the charges will depend on the strength of the logic that underlies it. We assume, in what follows, that the structure provides for higher charges on the busiest roads at the busiest times and that the logic is that this will help to reduce congestion. We address the question of how to communicate the logic of the charge structure in Section 5.3.
2. The charge structure should reflect the fact that most people estimate distance via time and so perceive journeys made in congested traffic to be longer (in distance) than those made in free-flowing traffic. In the context of distance-based charges they will *expect* such journeys to cost more than they actually do and so the price differential required to cause a given degree of diversion from

congested routes need not be as great as would be required if distance were estimated directly. Of course, if distance becomes an important metric (e.g. because non-trivial road charges depend on it) it is possible that people will begin to take more notice of it and become better able to estimate it.

3. Different drivers will have different abilities to estimate prices from numeric or spatial data. This raises the possibility that drivers might be allowed to select a degree of tariff complexity appropriate to their needs and abilities – varying perhaps from a fixed charge per day to a highly differentiated, dynamically varying, charge based on real time conditions. Provision of this degree of choice would probably increase public acceptance (although the initial choice of tariff might be daunting to some) but the consequences for system efficiency are far from straightforward. By allowing people to select a tariff that matches their ability to understand and respond to it, the incidence of confusion, frustration and mistakes should be reduced but, as outlined in Section 5.5 below, the continued availability of a fixed daily charge would remove the incentive on those drivers to avoid busy roads and peak times. The fact that different drivers have different abilities to understand and respond to complex pricing signals raises equity issues which would not really be overcome by offering people the choice of tariffs; the same issues would arise in respect of the choice of tariff – particularly if some tariffs were a better deal than others. On balance we see more problems than advantages in offering people the choice of a range of tariffs.
4. Even though people could find out about the latest charges before setting off (e.g. by accessing an internet site) it is not realistic to expect ordinary motorists to do this on a regular basis. Adjusting charges to reflect non-recurrent congestion might persuade people to make more effort to predict congestion (including that related to incidents) and adjust their behaviour accordingly but, again, the most likely outcome would be a lot of aggrieved motorists. We conclude that, unless, a la HOT lane, notice can be given upstream of a diversion point, it is not realistic to try to use charges to influence traffic in anything approaching real time. In order to retain the driver's trust it is probably undesirable to change charges with less than, say, a month's notice. This restriction would however, still allow the use of seasonal rates (e.g. increased charges in urban areas during school term time, on holiday routes on summer weekends and perhaps even during scheduled events such as Lord Mayor's parades or major maintenance). Provided that such special rates are kept within bounds, their existence would serve to reinforce the logic of the basic charge structure and so should not be discouraged.
5. The first best solution implies different tariffs for different vehicle types (e.g. higher tariffs for those taking up more road space or emitting more noise or fumes, lower tariffs for small and environmentally benign vehicles). The existence of different tariff structures would not seriously complicate the system (each person need only know the tariff applicable to his vehicle) and, given that it would reinforce the logic of the charge structure, we think that it would be a desirable feature.

5.3 Implications for the Communication of Price Signals

1. The prime requirement is that the logic of the charge structure, and the necessity of a degree of complexity, is capable of being communicated and is seen to reflect the objectives of the scheme. The logic should be capable of being summed up in a relatively simple expression such as *"Charges will be highest when and where traffic is expected to be busiest"* or *"Charges will be highest when and where congestion is expected to be most serious"*. Either of these are likely to be understood fairly readily because cheap airlines and holiday companies, and to a lesser extent the rail and bus industries, have already got the message across that it costs more to travel when it is busy. The logic of such a charge structure would be reinforced by replacing fixed costs (such as VED) by usage-based charges and, as outlined in paragraphs 4 and 5 of Section 5.2, by allowing rates to vary according to seasonal or incident-related demand and by imposing higher charges on larger vehicles (seen another way, if the system was supposed to help reduce congestion it would be difficult to defend charging a small car the same amount to use a holiday route in mid February as a large 4x4 towing a caravan is charged to use that same route on August bank holiday).
2. Communication of the underlying logic is more difficult if it is intended that the charges should also seek to achieve environmental goals (e.g. by discourage rat-running or the use of other environmentally sensitive roads). The explicative expression might be *"Charges will be highest when and where extra traffic is expected to be most unwelcome"* – an expression which, although more all-embracing than those offered in the previous paragraph, is likely to be less easily interpreted by travellers. Also, if the logic extends to cover environmental goals, a shift of taxation from fuel tax to distance-related charges could send a distinctly confusing message (it would appear that the cost of using a car with low fuel-efficiency was going down while that of using one with high fuel-efficiency was going up).
3. Whatever the clarity of the underlying rationale, information about the price structure may need to be communicated in a variety of ways (e.g. in both summary and detailed formats) in order to meet the needs and abilities of different types of driver. It would be wise to tap into the large body of research into people's ability to understand numerical information and on how to convey quantitative information effectively.
4. People would welcome assistance in predicting charges, and the efficiency of the overall network would be improved if it were easily available. Internet-based aids could be used prior to one-off journeys and, via internet-enabled phones or PDAs, would make it theoretically possible to divert en-route in response to near real-time changes in charges. However, given the usage patterns of existing routing and traffic information software, it seems unlikely that people would consult such tools for their regular journeys. Although it is likely that the introduction of charges would stimulate the development of commercial services (including innovations such as exception-reporting systems) government has a role in facilitating this development while staying alert to the equity implications of the best advice being available only to those equipped with the latest technological aids.
5. Information about charges is, of course, of particular value prior to departure (because the mode, departure time, destination and approximate route are generally fixed before departure) but, given that people often retain some

flexibility as to route and perhaps destination, there is a continuing need for access to information after departure.

6. In-car charge meters and/or post-journey logs which summarise the charges incurred on a particular journey could help people to monitor charges and so learn to predict them and to have trust in the correctness of charges being levied. However, even with such aids, it is inevitable that people's experience will be incomplete and distorted by misperceptions and selective recall.
7. The form in which information is presented (e.g. structure, content and amount) is likely to be crucial in determining the decisions strategies that people use, and hence the choices that they make. Map-based information about charges might be useful for some people but would be of little use to others. Colour coding would probably be more universally useful but it would be inequitable to rely exclusively on any one form of display or communication.
8. It is, as ever, impossible to escape the dilemma faced in any attempt to introduce a new charge which seeks to influence behaviour while achieving public acceptance (see, for example, *309*); if the price signal is too weak it will not achieve its objective but if it is too strong it may stir up such opposition that the whole scheme has to be abandoned.

5.4 Implications for the Implementation Strategy

1. The provision of information about the purpose of the scheme and about the logic of the charging structure must be given particular prominence in the period leading up to the launch and in the immediate period thereafter.
2. As in Singapore, the system should be trialled with no actual charging to help people become familiar with the charge structure.
3. In the early stages of implementation it is likely that people will think quite carefully, perhaps even logically, about the likely cost of using different routes at different times but, unless the price differentials are significant, they will in time begin to take less care about optimising their behaviour. The implication is that, to maintain a given response, the strength of the pricing signal may have to be increased over time.
4. To the extent that complexity brings unpredictability, it may be best to limit the impact of complexity (by restricting the differences between the different rates) until people are familiar with the basic concept of charging. By keeping the initial system fairly simple the risk of its provoking an adverse public reaction may be reduced. Also, the operators can use data collected during the initial period to refine their estimates of the relevant elasticities and so move to a more finely tuned set of charges.

5.5 Expectations of Response

1. If road pricing induces strong task engagement people will make an effort to predict accurately, if not, they will resort to simple rules and heuristics (e.g. "try to avoid town centres and peak traffic") or may make no effort to adjust their behaviour in the light of the charges. We believe that people would have strong task engagement in the early stages of implementation but that, unless the

financial sums involved are significant this engagement would diminish as familiarity increases.

2. In general we would expect that higher prices will bring higher engagement but the level of engagement will undoubtedly vary from person to person and from situation to situation. We expect higher engagement from people:
   - who are paying the charges themselves (or who have to provide a detailed account for their expenditures to the person or organisation that will be paying the bill);
   - for whom the charges represent a significant fraction of their available income;
   - who have a tendency to be analytical (or, to use the jargon, people with high need for cognition who have a predisposition to apply *type 2* evaluations);
   - who have a very cost-conscious approach to life; or
   - who have easy access to an easily understood source of information or advice about charges.

   We would expect higher levels of engagement when drivers:
   - are planning a significant journey (of significant length or likely to be repeated) – particularly if the planning is not being done under pressure;
   - have ready access to easily understood information about the different charges;
   - are paying directly and immediately (rather than via an account); or
   - are making a journey for which a third party will require evidence of an effort to minimise charges.
3. Even though they might wish to choose routes and journey timings so as to minimise charges, some people will not be equipped to do so – either because they lack the analytical skills or because they do not have access to the requisite information. Such people will make estimates based on rough guesses, personal experience and the advice of friends and colleagues. They are bound to make mistakes! However, the efficiency with which they respond to the intended price signals could be increased if they are supplied with good feedback and advice from trip-planning services.
4. Some people will respond to perceived complexity of charges by reducing their use of the roads about whose charges they are uncertain. Although this response might be welcomed in as much as it tends to reduce use of congested roads (assuming that these are the ones with, for example, the greatest peak/off-peak differential), it would not be a wholly satisfactory situation. Not only would the response be imprecisely aligned to the intended price signal (e.g. if, off peak, people use roads which have a fixed, higher, charge in preference to ones whose off peak charge is much lower), but the loss of individual welfare would lead the entire scheme to be viewed in a worse light than necessary.
5. Although acceptance of a degree of price differentiation might be increased if it were portrayed as a system of “discounts” available to people who choose to use lower priced roads and cheaper times of day, this might lead to an increase in the total number of journeys made.
6. It would be wrong to assume that responses to complex price signals will always be in the ‘logical’ direction; for example, if higher prices are associated with higher levels of service (as on the I-15) they may attract drivers with high values of time.

7. Even if a majority of travellers are employing inaccurate heuristics, or ignoring the pricing signal altogether, considerable efficiency gains may be achieved provided that a sufficient number of drivers are reacting to the signals in the manner intended (see, for example, 029). Efficiency gains would arise not only from changes in journey timing, route and mode on particular journeys but also from the re-arrangement of travel plans, rescheduling of activities, and even from decisions on choice of home or job location which would affect travel patterns in the longer term.

8. Research on people's ability to understand complex prices, and on their behavioural responses when faced with such prices, stresses that their response, *and their ability to understand* the price signals depends on their emotional reaction to the price regime – particularly their perception of its fairness and rationale. If they do not trust the motives of the body responsible for introducing it they are likely to be more anxious and less able to make a calm and rational assessment of their best course of action. It is thus impossible entirely to separate the question of people's acceptance of the concept of road pricing from their ability to respond to the price signals which it seeks to send. However, recognising that the question of the public acceptability of road pricing has been the subject of separate studies, the report from which is available at: http://www.dft.gov.uk/stellent/groups/dft_roads/documents/page/dft_roads_029786.doc , we have not attempted to fully explore its implications. We do, however, conclude that every effort must be made:
    - to explain the reason for introducing congestion charging and the necessity for a degree of complexity in the tariff structure (bearing in mind that the inclusion of a complex tariff structure could be cast by a hostile media as the product of a marriage between bureaucratic incompetence and technocratic arrogance or as a taxman's trick to confuse the poor motorist);
    - to ensure that charges always reflect the published rationale and that any overcharging is corrected immediately and without quibble (both of which will help maximise trust in the system); and
    - to encourage an initial positive reaction to the scheme by, for example, introducing it initially as a voluntary scheme to which people can sign up in exchange for being excused their annual VED payment, and offering free equipment and reduced tariff rates to the first few thousand subscribers. (Note however that the option to stay with a fixed charge could not be offered indefinitely because, unless VED were raised significantly, it would give high mileage motorists subsidised access to the most congested roads).

6 Knowledge Gaps

6.1 The Most Important Questions

We have identified six questions where additional research would yield information of particular relevance to the specification and implementation of charge structures. Topics 1 and 2 seek evidence from existing behaviours while topics 3-6 deal more directly with responses to road charges.

1. ***How accurately can people predict journey distances, durations and costs?*** Research into people's ability to predict distance, although relatively simple, is needed because an ability to predict distance is a prerequisite to the prediction of distance based charges. Mindful of the equity issues involved, the research would seek to establish the factors affecting abilities to predict distances as well as the distribution of abilities within the population. Research into people's ability to predict journey durations and costs would help establish whether accurate prediction of costs is a serious issue for drivers and how it ranks in importance compared to the prediction of journey durations. The research would seek to identify the basis of people's predictions, the mental models they use (e.g. the assumed structure of parking charges), the extent to which they care about any inaccuracy, the nature of any systematic biases and the extent to which abilities differ between people and between situations.

2. ***How accurately can people predict the complex or imprecisely defined charges which they meet in everyday life and what implications does this have for their behaviour?*** Research into people's ability to predict costs such as taxi fares, phone charges, and electricity bills would provide a useful baseline for assumptions about people's abilities to predict complex road charges. It would build on existing evidence from disparate sources, some of which may not have been entirely disinterested, and, by using a consistent approach, would help establish the transferability of results between contexts. The study would establish the extent to which predictive abilities vary across the population and between contexts. Explanatory factors might include: socio economic factors such as educational background, income, age and gender; contextual factors such as the amount of experience of such charges and their significance (relative to disposable income); and presentational factors such as the provision of feedback and explanation of the logic underlying the charge structure. The research would allow for a wide range of behavioural responses (e.g. ignoring the cost altogether, using a heuristic to estimate approximate charge, calculating charges as accurately as possible and then acting 'rationally', adding a notional premium to such charges, or avoiding such charges wherever possible). The study would seek to establish the circumstances in which people do/don't seek to predict or estimate charges in advance (in the context of travel, phone calls, utility bills, taxi journeys etc) and how they react to any error in their estimate; is it simply a matter of the price (or price variance) and complexity or are there some types of expenditure for which people are content not to know the price in advance? It might also explore the extent to which elasticities derived in the

context of fixed charges are applicable in the context of complex or variable charges.

3. ***How easily could people understand the kinds of logic likely to be used to define the structure of road charges?*** The results of this research would help to determine which logical bases could be used to define the structure of road charges because, since we expect people to rely on heuristics and since it is desirable that people should respond to price signals in a 'logical' way, it is important that they are able to develop efficient and accurate heuristics. The research would test people's understanding of different logical bases for charges (e.g. avoiding busy roads, avoiding causing environmental nuisance, avoiding undue impact on others, avoiding putting other people at risk, avoiding contributing to congestion or environmental nuisance or danger). The research would explore, for each logical basis, how consistently and accurately it is interpreted by a range of driver types.

4. ***How accurately could (and would) individuals predict hypothesised road charges?*** The results of this research would provide the basis for predicting driver response to road charges of the type(s) being considered by RPFS. It is more ambitious than the topics described above in that it seeks, in one step, to establish how accurately people might predict road charges. Although it is more precisely focussed, it carries greater risks because it requires people to consider hypothetical situations and because some of the context might be difficult to create (this is why we do not regard this project as a complete substitute for those described above). The research would test people's **abilities** to predict charges and their **motivation to do so**. It would test *charge structures of various degrees of differentiation* (e.g. different numbers of time bands, inclusion of seasonal differentiation, different numbers of road types, different minimum lengths of road having a given charge), *different levels of complexity in the underlying logic* (e.g. charges based simply on expected degrees of average congestion, taking account of other environmental factors in addition to expected levels of congestion, or based on a proxy such as road type and urban/non-urban designation), and *different degrees of advice, explanation and feedback* (e.g. colour-coded road signs and maps, clear description of the underlying logic, instant feedback from the in-vehicle device to indicate the current charge rate, and hardcopy feedback via itemised bills). The research would also seek to establish the extent to which abilities and motivations are influenced by experience and socio-economic factors.

5. ***What loss of efficiency and welfare losses would be attributable to individuals' inability to estimate charges correctly or to any tendency of individuals to avoid imprecisely priced options?*** This research, although not completely within the scope of the current project, is clearly central to any decision on the appropriate structure of road charges and should be seen as the culmination of this line of research. Although important, we do not think that this topic can be tackled until more is known about likely response to complex or imprecisely defined charges - a fact which serves to emphasise the urgency of topics 1-4 above. We see this research as a model-based analysis of behaviour in a network. We think that it requires a model of traveller behaviour which has been calibrated using results from research such as topic 4 above.

6. ***What are the most effective ways to convey the kind of quantitative information that would be involved in a national implementation of distance-based road user charges?*** This research, although perhaps less urgent than topics 1-5, would be a necessary step on the way to implementation of distance-based road user charges and early completion of this project would enable its conclusions to be built into topics 4 and 5. The project would involve a review of the state of the art.

6.2 Other issues on which more evidence would be useful

Considerable efforts were expended, under the current contract, to identify evidence of people's response to complex or imprecisely defined charges and we are not aware of any additional, readily accessible evidence on this issue. Nonetheless, we do not rule out the possibility that further evidence might come to light in the fullness of time. For example, we have no doubt that the telecommunications industry will have conducted market research before moving towards relatively simple prepayment tariffs for phone and internet access and that they detected an aversion to high pay-as-you-go charges. Much of the resulting evidence will have been commercially sensitive but might, in time, be revealed to a disinterested party. Although much less likely, it is also possible that, prior to privatisation, the rail, power-supply, post and telecommunications industries may have conducted market research into their customers' reactions to different cost structures. If it has survived, the results of such research may be buried quite deeply in the archives but might still be retrieved if the right contact can be made. We suggest that these avenues of research might be pursued informally by DfT and other interested parties (including academics), but that, unless and until a new cache of information is unearthed and warrants careful investigation, this activity does not merit specific funding.

Acknowledgements

We would like to take this opportunity to thank the Project Steering Group (Aoife O'Grady, Helen Bullock, Nigel Campbell, David Knight and Gillian Smith) for their advice, availability and encouragement, the interviewees (Lynn Barton, Hilary Cavanagh, Rod Cole, David Gutteridge, Graham Hogg, Barry Humphreys, Chin Kian Keong, Jean Mesqui, Simon Pearson, Tony Richardson, John Strutt, Ed Sullivan and Januz Supernak) for their insight and readiness to help, and those fellow academics (Tommy Garling, Bjorn Harsman, David Hensher, Max Herry, Robin Lindsey, Lars-Goran Mattsson, Jens Schade, Alf Vanags, Erik Verhoef and Bernhard Wieland) who responded so generously to our request for leads and comments on an earlier draft of this report. Despite all this help we must remain responsible for any errors in interpretation or reporting.

Annex 1: The Original Project Brief

ROAD USER CHARGING: PRICING STRUCTURES

Aim

1. The Department for Transport (DfT) wishes to commission research to explore the issues around an effective pricing structure for road user charges. Tenders are invited for an important first stage that will identify what evidence and information already exists, and to make recommendations for future research to plug key evidence gaps.

2. Some of the key issues to be explored will include:

   - the complexity/simplicity of the structure of tariffs for the scheme;
   - to what level of detail pricing information is required;
   - whether conclusions about structure will change over time;
   - the interaction between the key issues, structure and behavioural response.

Background

3. Results from this research will be used to inform discussions and the work of the Road Pricing Feasibility Study (RPFS). The RPFS was announced last July and was established to advise the Secretary of State on practical options for the design and implementation of a new system for charging for road use in the UK[1].

4. The RPFS is considering a range of different charging schemes, with charges varying by time and place. For the purpose of this research, tenderers should focus on charges that are set per kilometre rather than through cordons. This research will need to consider how issues and conclusions on structure vary between the different types of schemes being considered.

Objectives

5. The objectives of this research are to:

   i) Identify the key questions/issues which need to be explored;
   ii) Review existing studies of road pricing schemes (targeting all types of vehicles) to assess what information and evidence already exists on the key issues;
   iii) Identify what we can learn about pricing structures from other transport modes and other industries (e.g. mobile phones), and in particular what issues and conclusions might be transferable;
   iv) Improve our general understanding of the relationship between information and people's ability to respond;

[1] Further details can be found in DfT, Managing our Roads, 2003, www.dft.gov.uk/stellent/groups/dft_transstrat/documents/page/dft_transstrat_022865.hcsp

v) Recommend what further new research or pieces of research would be most valuable to fill the evidence gaps and enable conclusions to be drawn about an effective structure.

6. Any road pricing structure will take account of the economic, social and environmental consequences, and technological requirements. The most economically-efficient prices involve price being set at marginal social cost. If information could be processed costlessly (which it can't), that would point to a particular detailed structure of prices. If it were costly and difficult to use information a different scheme would work best. This research project will seek to identify the trade-off between information and economic benefits, and the implications for the pricing structure.

7. One approach is to recognise that people cannot process extremely detailed information, and that a road pricing structure should recognise this.

8. On the other hand, people do make decisions based on fairly complex pricing tariffs, e.g. mobile phone tariffs, electricity and gas, air fares, different levels of public transport fares between peak and off-peak, and the availability of Saver and Super Saver fares. These decisions are not based on a full understanding of the complete pricing schedule, but some broad-brush understanding, which differs between people. What are the implications for road pricing structure of the evidence from these sectors?

Scope

9. We anticipate that this work will use, and build on, existing work on pricing structures in other modes of transport and other industries, as well as road charging. It should also take into account international evidence and information.

10. Previous research into road pricing has touched on some of the issues around structure, but we anticipate that compared to earlier work this project will look at the question of structure in more depth; and make the links between social, economic and technological issues. The focus of the project is about the complexity of information that people can process and use.

Issues to be addressed

11. One of the key objectives of the research is to identify the relevant questions and issues, so the list in this section is simply a starting point.

Complexity and Simplicity

i) *A complex structure involving a lot of different charges would allow a lot of differentiation between times of day, types of roads, areas and levels of congestion. (In all cases, we are assuming that a car has a schedule of per-km charges, varying by place and time, which are publicly available in advance of the journey.) In theory, the differentiation enables the charges to be finely targeted, enhancing choice and increasing effectiveness. In practice, there are issues of comprehensibility. A balance will need to be struck.*

Level of detail on the charges

ii) *This is closely linked to the first issue. What is the level of detail on prices that road users need? Do they need to know the exact p/km details or is a basic understanding of how the price varies by area or time sufficient?*

Information in advance

iii) *How far in advance do prices have to be set so that the users can incorporate the information in their decision making process?*

Structure of Penalties

iv) *In addition to a structure of prices, should a structure of penalties be designed so that, individuals also face a price to their evading/non-compliance tendencies? How much information in advance do the users require about the penalty structure and the linkages between the structure of penalties and the structure of road user charges?*

Structure of the scheme over time

v) *Do the issues or conclusions change over time as users become used to charging for road use?*

Behavioural response

vi) *How are the key issues identified likely to interact with behavioural response?*

Method

12. *Tenderers are required to develop a programme of work to deliver in full the Department's requirements for this research project. We envisage that this project is largely a desk study, which thinks systematically about the issues concerned, carries out a literature review to produce the available evidence and recommends further research (including future surveys, if necessary) as appropriate.*

13. *We also envisage that interviews with some key price-setting companies may be worthwhile.* We invite tenderers to consider the merit of these interviews, and suggest which organisations may be worth approaching.

14. Tenderers are asked to consider and include in their proposal appropriate methods to identify the relevant issues and meet the objectives set out in paragraph 5. This is likely to include (but not be limited to):

    - a review of the relevant studies on road pricing. (We are <u>not</u> in this project looking for a review of elasticities);
    - a review of work/research on pricing structures in other transport modes and relevant industries. How do people understand, and respond to, prices? What level of complexity is "manageable"? Can complicated systems be understood as simple messages? How complicated? How simple?

15. At a minimum tenders should clearly set out the approach to the literature review:

    Your search strategy:

    There is potentially a large amount of work to be trawled through in a limited amount of time. You should therefore highlight how will you ensure that your review adequately captures all the relevant and meaningful evidence, including:

- What search engines you will use
- What keywords and search terms you will use to identify relevant research
- What years you will cover in the search
- How you will capture relevant non-UK material

    Your inclusion/exclusion criteria:

- What criteria will be used for assessing which studies are relevant to the review?
- What information will be used to sift studies (e.g., on the basis of the title, abstract, summary, conclusions, or full report?)

Your criteria for critically appraising the quality and robustness of the evidence:

- How will you assess the strength of the evidence reviewed?
- How will you ensure that you will assess large quantities of information in a consistent manner?

Organising the review:

The process of undertaking this review will need to be recorded and presented in as clear and transparent a way as possible, to aid researchers and reviewers in this field after this review has completed. This will include, for example: detailing areas which have been searched but not yielded any useful material; recording assumptions and judgements made; presenting data which is easy to understand and navigate. Issues you will need to consider include:

- What record-keeping systems will you have in place to ensure that each stage of the process is accurately documented and presented?
- How will you present the review as a whole, so that any general discussions are easily followed, but specific detail and studies can be easily traced?
- How will you physically present such a potentially large quantity of studies and syntheses that will make the review as clear, navigable and accessible as possible to potentially interested people?

16. This is not intended as an exhaustive list of methodological issues. As well as addressing those raised above, you should also discuss any further issues you consider significant in undertaking the review, and how you propose to address them.

17. Tenderers may wish to refer to Cabinet Office guidance on undertaking systematic reviews, available in the 'Magenta Book'[2].

18. Tenderers should also provide full details about any interviews that will be undertaken - e.g., what is the optimum number that would be required? How long would an interview typically take? Would they be undertaken face to face, or via the telephone? At what stage in the programme of work these interviews should take place?

Outputs

19. The main outputs from the research will be:

    i) An initial paper identifying and discussing key questions/issues. This will be discussed at a first meeting of the research project's Steering Group (see below).

    ii) Regular update reports (i.e., at least fortnightly) that summarise progress with the research, and provide feedback to the Department on emerging findings. Please note that

[2] The Magenta Book: Chapter 2: 'What do we already know', http://policyhub.cmps.gov.uk/servlet/DocViewer/doc=1504/

the Department wishes to keep in close contact with this research as it progresses, and be kept informed of emerging findings.

iii) A draft final report with updated discussion on key questions and evidence and a detailed recommendation for future research. The report should highlight clearly the evidence from existing road pricing studies, trials or schemes; and set out evidence or lessons that might be transferable from other transport sectors or industries. The draft final report will be discussed at a meeting of the Steering Group.

20. All documents should be provided electronically in Word 97 format.

21. The final report should include a free-standing executive summary of no more than 7 pages. The final report will need to be revised in the light of discussion at the final Steering Group and other DfT comments. The format and content (the latter insofar as it relates to the presentation of the results of the research and/or interpretation of relevant policy) of the final report shall be subject to the agreement of DfT's project officer. Once finalised 50 copies of the final report should be provided, including one unbound copy. The report should also be provided electronically on in Word 97 format.

Links to other work

22. The contractor will need to keep up-to-date with the work of the RPFS, taking this into account as necessary.

23. Two research projects on attitudes towards road pricing have been let recently[3]. The contractor will be expected to keep up to date with progress on those projects and have discussions with the appointed contractors so that ideas and information can be exchanged.

Publication and Dissemination

24. The report and summary will be published and made available on DfT's website. Tenderers will also be required to present their findings to a meeting of the RPFS arranged by DfT.

Timescale

25. The study should be completed by the end of June 2004 at the latest. The contractor should provide a programme of work that is consistent with this completion date. Tenderers are invited to comment on the feasibility of meeting this timetable.

Project Plan

26. The tender proposal should include a detailed project plan and time schedule for the work that identifies the main tasks and key milestones that will be used to monitor progress, indicating clearly where DfT (usually the Project Officer) is expected to contribute. The plan should also be accompanied by a breakdown of the resources in person days allocated to each task (a resource profile).

[3] One project is an evidence-base review of attitudes to road pricing, which is due to report in early June; and the other is qualitative research to explore attitudes to road pricing, due to report in mid-June.

27. To ensure that this research is of most benefit to the work of the RPFS Steering Group, the programme of work proposed by tenderers should give full consideration to the Department's wish for a 'drip-feed' approach to emerging findings.

Quality Plan

28. Tenderers should provide details of their quality plan for the study. The plan should explain the practices and procedures that will be developed and implemented to assure quality in all aspects of the research. Within the quality plan tenderers should identify the appropriate stages for reviewing the programme of work with DfT.

Management arrangements

29. The contractor is required to appoint a project manager who will manage the contract and will be regarded by DfT as being fully responsible for performance of the programme of work.

30. The contract with the appointed contractor will be managed by DfT's project officer, Aoife O'Grady, who will expect to be kept in touch with progress and emerging issues on a regular basis. This may include periodic working meetings between the appointed contractor and DfT's project officer.

31. Tenderers should provide details of the proposed project team, (including their CVs) which is linked to the project plan and which, where possible, indicates the grade of staff and number of days allocated to specific work areas.

32. A Steering Group will be appointed to provide advice on the scope and direction of the study. It is envisaged that there will be no more than three Steering Group meetings during the study.

33. The contractor will be required to undertake the following administrative tasks in support of the Steering Group: canvassing steering group members on availability for meetings; sending out agendas and supporting papers at least five working days before the meetings; and writing minutes of the meeting and distributing them (once they have been agreed with DfT) to Steering Group members. Tenderers should programme these meetings into the project plan at appropriate stages of the research.

Tender evaluation criteria

34. Tenders will be evaluated against the following criteria:

- understanding of the issues to be addressed in the study;
- a sound methodology which responds well to the study brief;
- arrangements for managing the study and ability to complete the work within the timetable;
- the qualifications and experience of the project team, and track record in similar work;
- strong analytical and communication skills, including the ability to gather and present information efficiently and coherently;
- overall cost and value for money.

Annex 2: Template used in the Interviews

Preamble:

> *I am phoning from the Institute for Transport Studies at the University of Leeds. We are working on a project for the Department for Transport as part of their programme of research to inform decisions on whether and how to introduce new ways of charging for road use. We are contacting you because we think you can help our understanding of the public's ability to predict prices in the context of variable or highly differentiated price structures.*

Questions:

1. *Do people expect prices to be predictable? (Are customers put off when prices are not immediately predictable? Are your prices immediately predictable?)*
2. *Which aspects of unpredictability/ complexity/ imprecision are most off-putting to customers?*
3. *What level or type of complexity/imprecision can people cope with and how much uncertainty is tolerable?(do customers predict prices asccurately? Do they care?)*
4. *What determines people's ability to predict prices based on complex or imprecise tariffs? (what information do people require to make choices and when do they need it? What methods do you use to communicate the basis of your prices?)*
5. *How important is it to have a clear rationale and what sorts of rationale are understandable? (any evidence of ones that are not understandable?)*
6. *With experience, do people become more adept at predicting prices based on complex or imprecise tariffs? (Over time, do people begin to find complex or imprecise tariffs more acceptable?)*
7. *To what extent is it possible to identify different types of customer who have different attitudes to complex or imprecise tariffs or different abilities to deal with them?*
8. *Are people more willing or able to deal with complex or imprecise tariffs if they perceive the overall system to be fair?*
9. *Would you anticipate any significant differences in the ways people would react to complex or imprecise tariffs as levied by the private as opposed to the public sector?*
10. *Are there other aspects of complexity, not mentioned already, that are important for pricing? (Are there (other) examples of complex or imprecise tariffs working well or badly?)*

Annex 3: Interviews and Enquiries Completed

Interviews with people with direct experience of setting tariffs or monitoring their impact:

- **A.** John Strutt, Head of Pricing Policy and Design**, BT Retail**
- **B.** Januz Supernak, **San Diego State University** (responsible for monitoring of responses to the San Diego I15, HOT Lane)
- **C.** Lynn Barton, Head of Value Pricing, **Caltrans** (responsible for California HOT lanes)
- **D.** Ed Sullivan, **California Polytechnic State University** (responsible for evaluation of SR91 HOT lane)
- **E.** Dr Chin Kian Keong, Senior Manager Transportation, **Singapore Land Transport Authority**
- **F.** Graham Hogg, Pricing and yield manager, **First Group**
- **G.** Hilary Cavanagh, Revenue Manager, **Virgin Trains**
- **H.** Simon Pearson, Revenue Manager, **GNER**
- **I.** Barry Humphreys, Director – External relations, **Virgin Atlantic**
- **J.** David Gutteridge, Head of Pricing (Corporate Strategy), **Vodaphone**
- **K.** Rod Cole, Fares and Pricing Manager, **Arriva Rail**
- **L.** Tony Richardson, Fares Analysis Manager, **TFL**
- **M.** Jean Mesqui, Director, **ASFA**

Interviews with people with a direct interest in tariff-setting or consumers' response to tariffs:

- **N.** Simon Chapman, Chief Economist, **Freight Transport Association**
- **O.** Tom Worsley**, DfT, Economics**
- **P.** John Dawson, **Automobile Association**
- **Q.** Mike Hewitson, Policy and Research Manager, **Rail Passengers Council**
- **R.** Phil Evans, Principal Policy Advisor, **Consumers Association.**

Informal Enquiries:

- **S.** Prof. Werner Rothengatter**, Karlsruhe University**
- **T.** Prof. Peter Jones, **Westminster University**
- **U.** Derek Beevor**, Roadtech Computer Systems**

Annex 4: The literature review process and database structure

Overview:

The literature review focused on three aims:

- To review existing studies of road pricing schemes and assess what information and evidence already exists;
- To identify what could be learnt about pricing structures from other transport modes and other industries, and in particular what issues and conclusions might be transferable to road pricing; and,
- To produce an accessible synthesis of the relevant evidence.

The search for sources was as thorough and systematic as possible and covered a wide range of material and sectors. Particular efforts were made to locate sources likely to contain robust and reliable evidence from real case studies.

The review identified 76 relevant papers, reports and other articles from the UK, Europe, North America, Asia and Australasia. These have been catalogued in an Access format Database

Assembling the Material:

The literature search attempted to cover all (English language) sources worldwide. Given the large amount of work to be examined in a limited period of time, it was important to be selective while attempting to unearth as much as possible of the relevant evidence. The list of potentially relevant material was drawn up using a mix of online journal resources, web search engines, specific websites, personal contacts and interest group mailing lists.

The University of Leeds library service subscribe to a number of specialised search engines and databases including *TRIS Online, Transport, Web of Science, ATHENS, Ingenta, Science Direct* and *Econlit.* These contain information on journal and periodical articles, disaggregated by subject type, e.g. economics, marketing, transport etc. Carefully chosen words and phrases were used to interrogate the online resources (‘*Variable tolls’, ‘Complex pricing structures’, ‘Complex tariffs’, ‘Variable pricing’, Information processing’, ‘Decision making’, ‘Response to uncertainty’,* and *‘Heuristics’).* These key words were used in conjunction with qualifiers (such as ‘*road*’, ‘*train*’, ‘*air*’, ‘*telecoms*’, ‘*mobile phones*’, ‘*gas*’, ‘*banking*’, ‘*consumers*’ and ‘*passengers*’) to make the searches more sector-specific. Even so, many of the articles identified by this process were not relevant to the study and so were not entered into the final database.

When searching databases and online journals the key words/phrases were used to search the titles of the studies. If that proved relevant the abstract was examined and a judgement then made whether or not to examine the full study. Factors considered when making the judgement included the relevancy of the article to the question in hand, the presence of reliable and robust empirical evidence and the transferability of the findings to the road sector. The searches proved very successful for highlighting

articles related to psychology and people's decision making processes (specifically experimental research) resulting in 27 entries into the final data base. It was less successful in identifying relevant material within other fields and sectors (especially transport) resulting in only 10 entries into the final data base. As expected, considerable overlap was found, in the road transport sector, with the results of the searches on Attitudes to Road Pricing conducted on behalf of DfT by the University of the West of England (2004).

A general web search was conducted using three public-access search engines (*Google, Yahoo* and *Alta Vista).* This identified several hundred possible articles, reports etc but the majority were discounted at an early stage. The initial trawl and subsequent follow up resulted in 14 entries in the database.

A number of key websites had been identified at the outset of our work. They included: Transport operators and regulators (e.g. BA, Virgin, GNER, National Express. Rail regulator and CAA); Telecoms companies and regulators (e.g. BT, Vodafone, Orange and OFCOM); Utility companies and regulators (e.g. OFGEM); Financial companies and operators (e.g.. Lloyds Bank and the Financial Services Authority; Market research companies (e.g. MORI); Government Departments (e.g. DTI, DfT); and Consumer Organisations (e.g. The National Consumer Council). This original list was extended via a general web search and the final list provided around 7 entries to the database.

Further leads were obtained through personal contacts, both within the Institute for Transport Studies and externally. An internal seminar produced several leads as did personal emails to fellow academics. Some of the most valuable leads came from current and past project partners who had particular experience in this field (e.g. our partners in the IMPRINT project). Personal contacts provided leads that resulted in 18 entries into the final database – including several of the most useful. We were disappointed at the poor response to an email (requesting information) sent to the Universities Transport Studies Group email distribution list. Previous research studies had found this a very fruitful source of leads but our request generated only four responses, none of which led to entries in the final database. Whilst disappointing, this low response may reflect the shortage of good quality evidence on the issues being examined by this research.

Compiling the Database Contents:

A large number of reports, articles, journal papers etc. were gathered from the initial literature search. A series of iterative sifts was used to identify those articles which could shed light on the issues being addressed. The decision on what and what not to include in the database was based upon the relevancy of the article to the question in hand, the extent and significance of empirical evidence and the transferability of the findings to the road sector.

The fields used in the current study are:

- the basic reference and contact details;
- relevancy of the project (low, medium or high);
- keywords;
- the context of the road pricing scheme (if relevant);

- the status of the road pricing scheme (if relevant);
- the road pricing scheme type (if relevant);
- type of evidence;
- survey details;
- synopsis of relevant content;
- objectives/methods;
- findings/conclusions of relevance to the current investigation; and
- strengths and weaknesses (where appropriate).

Future users of our database should note that the entries should not be assumed to summarise the full content of the papers and articles in question; they relate only to that part of each paper or article that was relevant to our investigation.

Attitudes to road pricing RESEARCH COMPENDIUM

Compendium ID	**Date of Entry** **Full article?**		**Restricted?** **Electronic copy?**
Project Title			
Document Title			
Reference Details			
Web Address			
Sponsor(s)			
Contact Details			
Country/Region/City			
Relevance		**Indicative Quality Score**	
Keyword(s)			
Attitudes:	Public?	Businesses?	Political?
Context:	Urban?	Inter-urban?	
Pricing Scheme:	Hypothetical?	Proposed?	Actual?
Scheme Type:	Cordon?	Area?	Route?
Issues:	Technology?	Hypothecation?	Privacy?
Evidence:	Quantitative?	Qualitative?	Review article?
Survey Details (if applicable):			
Date(s) of Survey(s):		Population(s) of Interest:	
Sample Size(s):		Response Rate(s):	
Synopsis			
Objectives/ methods			
Findings/ conclusions			
Strengths/ weaknesses			

Annex 5: Literature included in the database

The 76 papers and reports included in the database are listed below. Items which proved particularly valuable are shown in bold font.

Ref. *Title*

001 **Bolton, L.E., Warlop, L., Alba, J.W, Journal of Consumer Research, Mar 2003, 29, 474-491, "Consumer perceptions of price (un)fairness".**

002 Lurie, N.H, Journal of Consumer Research, Mar 2004, 30, 473-486, "Decision making in information-rich environments: The role of information structure".

003 **Ofir, C, Journal of Consumer Research, Mar 2004, 30, 612-621, "Re-examining latitude of price acceptability and price thresholds: Predicting basic consumer reaction to price".**

004 Russo, J.E., Meloy, M.G., Medvec, V.H, Journal of marketing research, Nov 1998, 35, 438-452, "Predecisional distortion of product information".

005 **Garbarino, E.C. & Edell, J.A., Journal of Consumer Research, Sep 1997, 24, 147-158, "Cognitive Effort, Affect and Choice".**

006 Janiszewski, C., & Lichtenstein, D.R, Journal of Consumer Research Mar 1999, 25, 353-368, "A range Theory account of price perception".

007 **Kang, Y.S., Herr, P.M., Page, C.M. Journal of consumer Research, Dec 2003, 30, 420-429, "Time and distance: Asymmetries in consumer trip knowledge and judgements".**

008 Gotlieb, J.B., Dubinsky, A.J. Journal of Applied Psychology, 1991, vol 76, No. 4, 541-549, "Influence of price on aspects of consumers' cognitive process".

009 **Chemev, A., Journal of Consumer Research, Sep 2003, 30, 170-183, "When more is less and less is more: The role of ideal point availability and assortment in consumer choice**".

010 Suri, R., Monroe, K.B, Journal of Consumer Research, Jun 2003, 30, 92-104, "The effects of time constraints on consumers' judgments of prices and products".

011 **Menon, G., Raghubir, P, Journal of Consumer Research, Sep 2003, 30, 1, 230-243, "Ease-of-retrieval as an automatic input in judgments: A mere-accessibility framework".**

012 Diehl, K., Kornish, L.J., Lynch, J.G., Journal of Consumer Research, Jun 2003, 30, 1, 56-71, "Smart agents: When lower search costs for quality information increase price sensitivity".

013 Grewal, D., Krishnan, R., Baker, J. & Borin, N. Journal of Retailing, 74 (3), 331-352, "The effects of store name, brand name and price discounts on consumers' evaluations and purchase intentions".

014 Drolet, A., Journal of Consumer Research, Dec 2002, 29, 3, 293-305, "Inherent rule variability in consumer choice: Changing rules for change's sake".

015 Devetag, M.G., Industrial and Corporate change, Jun 1999, 8, 2, 289-351, "From utilities to mental models: A critical survey on decision rules and cognition in consumer choice".

016 **Bettman, J.R., Luce, M.F., Payne, J.W., Journal of Consumer Research, Dec 1998, 25, 3, 187-217, "Constructive consumer choice processes".**

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