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ASSESSING NEW TRANSPORT POLICY INSTRUMENTS

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Abstract

This research examines the contribution of an explanatory model of behaviour to understanding response to a new transport policy instrument. The travel demand management technique; individualised marketing campaigns (IMCs; a form of personalised journey planning) are considered. IMCs are voluntary and are used to reduce car use where there is excess demand, or current levels of demand make it difficult to meet environmental and social policy objectives. However, reducing car use, which has many benefits and can be habitual, without penalties, which can be politically unacceptable, is slow and sometimes results in small amounts of behaviour change. One reason may be that IMCs are poorly understood, and not used in an optimal way. The research reported aimed to explain response to IMCs using an expectancy-value model. The aims of the research were two fold. Firstly, to establish whether such a model explains response to IMCs sufficiently to predict response and inform decision making. Secondly, to ascertain whether the explanation provided can contribute to improving the performance of such projects through improved design, and by identifying the most receptive target audience for IMCs. The expectancy-value model used was the Theory of Planned Behaviour (TPB). Expectancy-value modelling is based on an assumption of utility maximisation and rational decision making, but unlike some analysis frameworks, the TPB also considers three core social constructs underlying personal decision making. Experimental IMCs were implemented in two English cities to gauge transferability. The design of the IMCs was based on previous case studies to enable comparison of behaviour change. Data on the core social constructs, intentions to respond to the IMCs by reducing car use, and actual responses were collected. The data was analysed to compare samples, and explain intended and actual responses to the IMCs. The results of the IMCs are presented, comparing them to other such projects, followed by the TPB model analysis, and the questions raised above are considered. The results suggest that it is possible to explain some intentions to reduce car use as a result of the IMCs, but that explanation of actual response is lower. However, for the intentions that were explained, significant explanatory constructs were identified. Further to this, individuals who may respond positively to IMCs has been identified. These individuals provide in important target audience of innovators who could establishing a precedent for reducing car use and achieving critical mass. Consequences for the design and targeting of IMCs are discussed.

Keywords: Travel Demand Management, Travel Awareness, Individualised Marketing Campaigns, Theory of Planned Behaviour.

Topic Area: E5 Speculative Futures

1   Introduction

This research examines the contribution of an explanatory model of behaviour to understanding response to a new transport policy instrument. The travel demand

management technique; individualised marketing (a form of personalised journey planning) is considered. Individualised marketing campaigns (IMCs) can be used to reduce car use in situations where there is excess demand, or current levels of demand are making it difficult, if not impossible, to meet environmental and social policy objectives seeking to reduce the negative impacts of private motorised transport. These include reducing congestion (and associated financial costs, especially to the economy), atmospheric and noise pollution (which affect physical health as well as the environment), accidents and severance amongst others. Application of an IMC can be specifically designed to meet the needs of the local area in which it is being implemented. For example, it can be designed to increase public transport patronage to raise revenue, or increase cycling to bring health benefits. However, changing travel behaviour, especially reducing car use, which has many benefits and can be habitual, without penalties, which can be politically unacceptable, is slow and sometimes results in comparatively small amounts of behaviour change. One reason may be that new instruments are poorly understood and not used in an optimal way. Better understanding of response to personalised journey planning will help to improve effectiveness.

The research reported in this paper sought to explain response to IMCs using an expectancy-value based model. Response to individualised marketing to reduce car use is relatively poorly understood because it is a comparatively new transport policy instrument, and expectancy-value based modelling is being used more often in analysis of travel decisions, especially mode choice in response to travel awareness work (discussed in more detail below). However, evidence of the suitability of expectancy-value based modelling in this context is not clear cut. Hence, the aims of this research were two fold. Firstly, to establish whether an expectancy-value based model explains reactions to IMCs sufficiently to predict response and inform decision making. Secondly, to ascertain whether the explanation provided can contribute to improving the performance of such projects by identify the most suitable (receptive) target audience for personalised journey planning type projects.

1.1   Individualised marketing campaigns

The research examined the role of attitudes, norms and control in reducing car use through IMCs – a form of personalised journey planning. IMCs fall into the travel awareness category of transport policy instruments, which cover a wide spectrum of schemes to promote reductions in car use. Such policy instruments tend to be attitudinal and behavioural measures, many of which are relatively new transport initiatives. They range from conventional passive advertising (e.g., bill board and television adverts) to the more interactive IMCs.

Passive travel awareness campaigns generally seek to communicate the need to reduce car use and provide information to help people use alternative modes of transport. Information provision might include generic bus timetables delivered to all households along a bus route, or a map of cycle routes in a city for example. Such information provision is not targeted at any specific socio-economic or psychographic group - it is blanket marketing. IMCs on the other hand work with individuals to provide information that is relevant to the person and the journeys they make. Thus, IMCs are at the opposite end of the targeting spectrum.

IMCs have been introduced in Europe, Australia and America to varying degrees of success. Two leading IMC projects have been developed – Indimark®/Travel Smart® developed by SocialData, and Travel Blending®/Living Neighbourhoods® developed by Steer Davies Gleave. Both projects have been implemented internationally. Success rates vary considerably, with reductions in car use ranging from of 1% to 20% plus. In the UK

reductions range from approximately 3% to nearly 7%. Direct comparisons between projects is difficult as sampling and monitoring methods vary. However, cost-benefit analysis of the Travel Smart® project in Perth, Western Australia has demonstrated that the project represents value for money. Nevertheless, there is concern amongst UK local authorities who are increasingly required to implement travel awareness schemes, that individualised marketing looks promising, but does not deliver in terms of reducing the number of cars on the road (the visible change that the authorities would like to see), and is consequently too expensive for the results obtained. At the end of 2002 the UK Government announced nearly £300,000 worth of funding for IMC demonstration projects to improve understanding of effectiveness and identify best practice. This will make a positive contribution to the rather small body of evidence relating to IMCs, particularly in the UK where there were only two projects (that the author is aware of) prior to 2001. The completion of this research is therefore particularly timely in that it will contribute knowledge that identifies how reductions in car use through IMCs are achieved in theoretical terms. This theory can then be used to improve the design and implementation of future projects.

The research sought to examine how an IMC (based on the design of existing campaigns) works using a psychological model of behaviour grounded in expectancy-value theory. Expectancy-value theory is more a way of looking at motivation and behaviour than a conventional theory. It states that people (and other organisms) behave in accordance with the expected outcomes of various courses of action and the values associated with each of those outcomes. Expectancy-value theory is based on an assumption of utility maximisation and rational decision making given the available information. Unlike some analysis frameworks, the model used in this research proposes and explicitly considers three core social constructs underlying personal decision making. These are, attitudes, norms and control. The theory used is the Theory of Planned Behaviour (TPB), developed by Ajzen in the 1980's (Ajzen, 1988). The Theory is illustrated in Figure 1.1 and explained below. The theory calculates expectancy-values with regards to attitudes, norms and control pertaining to the behaviour in question (car use in this research), and uses these values as independent variable inputs to regression modelling that seeks to explain the behaviour being considered.
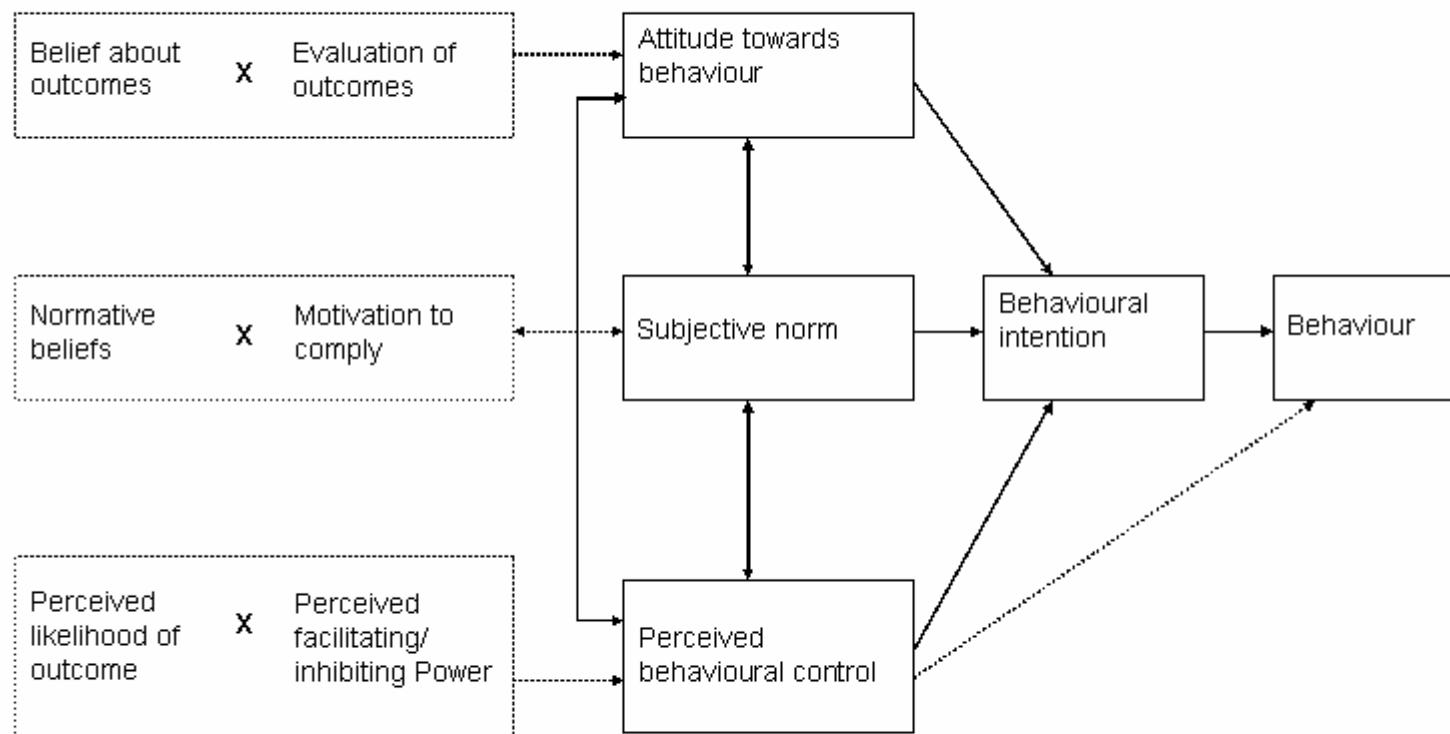
Figure 1.1 Theory of planned behaviour
Adapted from Ajzen (1988) and Conner and Sparks (2001)

1.2   The theory of planned behaviour

The TPB is an extension of the Theory of Reasoned Action (TRA; Ajzen and Fishbien, 1977). The TRA is concerned purely with decisions that are within an individual's volitional (conscious) control. According to the TRA, the proximal determinant of behaviour is our intentions to engage in behaviour, and further, intention is determined by an individual's attitudes and subjective norms (see below). The TPB adds perceived behavioural control (PBC) as a determinant of both intentions and behaviour to make the model applicable to decisions about behaviour that the individual does not have complete volitional control over. PBC comprises internal control factors incorporating self-efficacy, and external factors incorporating influences beyond the individual's control. These include dependence on others and chance. PBC is "assumed to reflect past experience as well as anticipated impediments and obstacles" (Ajzen, 1988).

Each of the determinants of intentions (attitudes, subjective norms and PBC) are themselves determined by a set of antecedent beliefs. "Attitudes are a function of beliefs about the perceived consequences of the behaviour [under consideration] based upon two perceptions: the likelihood of that outcome occurring as a result of performing the behaviour and the evaluation of that outcome" (Conner and Norman, 2001). This is expressed by an expectancy-value equation; equation A

$$A_B \propto \sum_n b_i e_i \qquad \text{Equation A}$$

where A_B is the attitude towards behaviour B, b_i is the belief (subjective probability) that performing behaviour B will lead to outcome i, e_i is the evaluation of outcome i, and the sum is over the n salient behavioural beliefs (Ajzen, 1988).

Subjective norms are "a function of normative beliefs, which represent perceptions of specific significant others' preferences about whether one should or should not engage in a behaviour" (Conner and Norman, 2001). The model quantifies this as "the subjective likelihood that specific salient groups or individuals (referents) think that …[one] should perform the behaviour [in question], multiplied by …[one's] motivation to comply with the referent's expectation" (Conner and Norman, 2001). This is expressed by equation B – also an expectancy-value equation.

$$SN_B \propto \sum_n b_j m_j \qquad \text{Equation B}$$

where SN_B is the subjective norm relating to behaviour B, b_j is the normative belief concerning referent j, m_j is the person's motivation to comply with referent j and the sum is over the n salient normative beliefs (Ajzen, 1988).

Perceived behavioural control is influenced by "beliefs concerning whether one has access to the necessary resources and opportunities to perform the behaviour successfully, weighted by the perceived power of each factor to facilitate or inhibit the execution of the behaviour" (Conner and Norman, 2001). This is expressed by equation C.

$$PBC_B \propto \sum_n b_k d_k$$

$$\text{Equation C}$$

where PBC_B is the PBC relating to behaviour B, b_k is the belief that behaviour B can

be carried out over time period *k, d_k* is how difficult carrying out behaviour *B* in time period *k* will be, and the sum is over the *n* salient control beliefs (Forward, 1998).

The influence of these antecedent beliefs regarding attitudes, subjective norms and PBC, and their influence on intentions and consequently, behaviour are thought to demonstrate a clear causal chain.

When operationalising the TPB, some researchers have included additional independent variables (e.g., habit). It can be argued that such additional variables are already incorporated into the original formulation of the model. This research has concentrated on the original formulation of the TPB to establish whether this works with regard to reducing car use. Without knowing how the theory performs in its basic operationalisation, it would be impossible to establish what, if anything, is gained when constructs such as habit are considered as distinct inputs to the model. Whilst questions relating to additional constructs could be asked and data analysed selectively to permit analysis of the original model, inclusion of the additional questions in the questionnaire used to collect TPB data would influence peoples' responses to the questions relating to the core concepts.

Interest in the TPB is growing in the transport field and it is being or has been used to examine a range of behaviours, including mode choice (Forward, 1998; Anable, 2002; Ahern and O'Mahony, 2003; Stapleton, 2004) and driving violations (Parker et al, 1992a and 1992b; Stradling 1997). However, the majority of studies are outside the transport context and many of the behaviours investigated have more direct physiological impacts, e.g., dieting. Typically, the TPB is able to explain approximately 50% of intention and 25% of actual behaviour. Discussion of whether this is an acceptable and useful level of performance is limited. However, there appears to be consensus that whilst performance could be improved, the TPB is useful in that it identifies salient predictors of behaviour. This research considers whether the TPB has sufficient explanatory power to provide information that would help to improve the design and implementation of IMCs. This is a pertinent question given that reducing car use has more indirect physiological impacts than many of the behaviours previously studied using the TPB.

It was hypothesised that it is not attitudes that need to be changed to reduce car use, but subjective norms and perceived behavioural control. This hypothesis was based on evidence that the general public already accept car use has negative impacts that need to be reduced through less car use, but do not actually reduce their car use (Jopson, 2003). Past research (Hodgson et al, 1997 and 1998; Tertoolen et al, 1998 and numerous attitude surveys) has revealed favourable attitudes towards the idea of using alternative modes of transport amongst the general public, but minimal behaviour change when confronted with passive information about using alternatives to the car. Further to this, the INPHORMM (Information and Publicity Helping the Objective of Reducing Motorised Mobility) project (Transport Studies Group, University of Westminster, 1998) reports "practical advice and ongoing support are essential if organisations and individuals are to maintain changes in travel behaviour." IMCs can provide this advice and support, whereas it is beyond the capacity of more passive campaigns. Additionally the INPHORMM results state "there is evidence of successful cultural change in targeted sectors, which have been clearly delineated, including schools, businesses, discrete local communities and households." This supports the development of IMCs to achieve actual behaviour change, although more passive marketing continues to have a role in communicating the need to reduce car use and maintaining the favourable attitudes referred to here.

2   Methodology

Experimental IMCs were implemented in two English cities to provide comparison and gauge transferability of the results between urban areas. The design of the IMCs was based on that of previous UK case studies to enable comparison of behaviour change and provide a marker against which success could be estimated. The IMCs incorporated use of a travel diary before and after intervention to monitor behaviour change. At the same time TPB data was collected using a questionnaire. The data was analysed using t tests to compare samples, exploratory factor analysis and multiple regression to explain intended and actual responses to the IMCs. Following an outline of the research methodology, the results of the IMCs are presented, followed by the TPB model analysis.

2.1   The experimental IMCs and control groups

Experimental IMCs were implemented in conjunction with TPB analysis. The experimental IMCs were modelled on Travel Blending® as it was implemented in Leeds, UK (Steer Davies Gleave, 1998) with the kind permission of Steer Davies Gleave who gave consent for a small scale replication of Travel Blending® to be implemented in Leeds and Greater Manchester for the purposes of this research. However, the experimental IMCs were not known as or associated with Travel Blending® to avoid any potential bias. The experimental work altered some aspects of the Travel Blending® procedure in light of comments from Leeds Travel Blenders. Most notably, the length of the travel diaries used to obtain individuals' travel data was reduced from a week to three days. Two case studies were used to enable comparison that would reveal the existence of city effects.

Participants were recruited through employers in Leeds and Manchester using e-mail, posters and leaflets explaining what the IMC was. Those who volunteered to take part were sent a three day travel diary and TPB questionnaire to complete. The questionnaire also checked for any mobility problems, and other practical barriers to reducing car use. The diaries were then analysed along side this practical information, to identify the journeys that people made and those that could be undertaken using public transport, by bicycle or on foot. Feedback was sent to participants giving details of the alternatives available for the journeys they made. Trip chaining was also suggested where appropriate, as were alternatives such as teleshopping and undertaking multiple activities in one place, or use of local amenities. An information leaflet explaining the need to reduce car use and the benefits of using alternatives was also included, as were a second travel diary and TPB questionnaire to collect monitoring data. Participants were asked to complete the second diary and questionnaire four weeks after receiving their feedback pack to give them an opportunity to change their travel patterns, but not so long that they would forget.

A control survey was used to obtain a dataset from people who had not received any intervention against which the experimental results could be compared. The desire was to establish whether behaviour change achieved was the result of the intervention or some other factor. Thus, the same number of respondents (120) was sought for a control survey in both Leeds and Manchester as were sought for the main experimental IMCs. The control cohorts were sought from companies similar to those involved with the experimental project to allow a comparable sample to be obtained. The control cohorts were asked to complete a questionnaire at more or less the same time as the experimental after survey to allow comparability. The control questionnaire asked the same TPB and personal questions, with an additional question to ascertain whether respondents had changed their travel behaviour in the past three

months (i.e. the period from the start to the end of the experimental project), and if so, how and why. The control respondents were not asked to complete a travel diary, as, after discussion with employers, this was felt to be a particularly onerous task, if neither the company, nor the respondents were to receive any intervention with the potential for beneficial behaviour change.

2.2   Operationalisation of the theory of planned behaviour

To identify the antecedent attitude, subjective norm and PBC beliefs that should be included in the TPB questionnaire, in-depth interviews were undertaken with the Leeds Travel Blending® participants. These discussed the attitudes, subjective norms and PBC factors participants associated with car use and the decision to drive or not. Other attributes that the researcher considered important based on previous work were also included in the TPB questionnaire. Attitude questions included the following topics; atmospheric pollution, protection from the weather, reliability, exercise, comfort, congestion, privacy, safety, convenience, expense and accessibility. Subjective norm questions included partner, boss, parents, friends, colleagues and children as significant others. PBC questions covered bus and train use, cycling and walking. All questions were asked about in relation to the target behaviour, i.e. car use.

Operationalisation of the TPB uses a number of paired bipolar semantic differential questions to measure the attitudes, subjective norms and PBC antecedent beliefs. Intentions are also measured with bipolar semantic differential questions, but they need not be paired. Figure 2.2 illustrates the format of TPB questions using examples from the experimental questionnaire. The first question in a pair measures belief in relation to the individual and the action under consideration; it is referred to as the item belief. The second part measures the outcome evaluation of the action; it is referred to as the evaluation item. For attitudes, the first question measures the attitude belief in relation to the individual and the second evaluates the outcome. For subjective norms the belief item is concerned with normative beliefs and the evaluative measure is motivation to comply. For PBC the belief item is perceived likelihood of occurrence and the evaluative measure is perceived facilitating/inhibiting power. A plus three, minus three semantic differential scale was used as this was considered most appropriate for use with bipolar descriptors. However, the responses were converted to a one to seven scale for analysis. The data was analysed using multiple regression. The attitude, subjective norm and PBC data was processed using equations A, B and C above to provide the independent variable data required for the regression analysis. Data from the two intention questions was summed. Attitude, norm and control data is regressed onto intention to establish whether the antecedent beliefs considered explain intentions. Assuming they do, intentions are considered an independent variable and regressed onto behaviour with PBC, which can have a direct effect on behaviour (see Figure 1.1).

Attitudes ([1]Belief about outcomes, [2]Evaluation of outcomes)
A Using a car pollutes the atmosphere[1]

| Likely | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Unlikely |

B Polluting the atmosphere is[2]

| Good | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Bad |

Subjective Norms ([1]Normative beliefs, [2]Motivation to comply)
A My partner thinks I

| Should | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Should not |

Use a car less over the next month[1]

B With regard to your using a car, how much do you want to do what your partner thinks you should do[2]

| Very much | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Not at all |

Perceived Behavioural Control ([1]Perceieved likelihood of occurrence, [2]Perceived facilitating/inhibiting power)
A I could catch a bus instead of using a car for some journeys over the next month[1]

| Agree | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Disagree |

B For me to catch a bus for some journeys over the next month is[2]

| Easy | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Difficult |

Intentions
A I intend to use a car less over the next month

| Do | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Do not |

B How likely is it that you will use a car less over the next month

| Likely | 3 | 2 | 1 | 0 | -1 | -2 | -3 | Unlikely |

Figure 2.2. Theory of Planned Behaviour Questions

3 Results
3.1 Sample composition

A number of non-drivers responded to the surveys despite requests for drivers only. These respondents have been removed from the data set used for analysis. Further to this, a small number of drivers who made an extremely high or low number of car journeys - usually due to atypical events - which appeared as outliers have been removed. Outliers were defined as cases with a total number of car journeys exceeding one standard deviation from the mean. One standard deviation was chosen, as more than one removed so few cases, it made no difference, whilst less removed data not obviously different to that retained. These respondents were removed to avoid individuals with exceptionally high or low levels of car use due to atypical events biasing the analysis. Consequently it should be borne in mind that the results apply to car drivers making an average number of journeys. The fact that meaningful analysis has only been possible with the portion of the sample which can be described as average is not surprising as one would not expect those driving above or below

average mileage to have the same reasoning as the average driver. The final sample sizes are presented in Table 3.1.

Table 3.1. Respondents returning a travel diary and questionnaire before and after intervention

	Total travel diary and questionnaire	Non-drivers removed	Respondents removed due to outlying travel data	Usable data
Leeds experimental cohort	19	3	2	14
Leeds control* cohort	30	3	n/a	27
Manchester experimental cohort	20	2	1	17
Manchester control* cohort	39	3	n/a	36

* questionnaire only.

These final sample sizes are considerably less than initially sought. More people returned the before surveys than the after surveys, but the response rate per cohort was still less than was hoped for at the outset. Given that 120 volunteers were recruited to the experimental cohorts on the basis of response to a real life IMC, which experienced a drop out rate of approximately 47%, it is not clear why so few people responded. However, there are a number of possible reasons. The Leeds based case study on which the experimental IMCs were modelled, was implemented at the City Council Highways, Planning and Development offices, West Yorkshire Passenger Transport Authority and Executive offices, Steer Davies Gleave's Leeds office and the Boys Grammar School in Leeds (Steer Davies Gleave, 1998). Consequently, many of those taking part may have had work related motivations for taking part and not dropping out. A further reason for the low response to the experimental work may have been dislike of the survey materials (both the questionnaire and travel diary) and survey fatigue. The questionnaire may have appeared repetitive, although this issue was tackled in a covering letter explaining that the questionnaire was based on a scientific model and therefore appeared as it did for a reason. An incentive – a £50 prize draw - was offered. With hindsight this may have encouraged people with no real motivation to change their travel behaviour to volunteer, and therefore resulted in a high drop out rate. As the separate experimental cohorts in table one were too small to be analysed with multiple regression, t tests were run to establish the degree of difference between the cohorts, with a view to merging the groups to create a bigger pool of data for analysis with multiple regression.

t Tests were run to test for difference between the Leeds and Manchester experimental respondents on the basis of residential location (in or outside the city (outside was defined as outside the outer ring road)), age, gender, occupation, qualifications, number of children in household, car ownership, number of car trips reported and total number of journeys reported. The t statistics suggested that there is little significant difference at the 0.01 and 0.05 levels. Where there was difference, examination of the raw data indicated that the differences would not invalidate a

merged data set. Thus, the two groups were combined for the purposes of analysis, to give an experimental n of 31. As an n of 31 is still rather small, further t tests were undertaken to establish whether there was any difference between the experimental and control groups, with a view to combining the two groups for the purposes of analysis. Again there were no differences that gave cause for concern. Thus, the experimental and control groups for both Leeds and Manchester have been combined. This gives an n of 94. However, this can only be used for analysing intentions, since no behavioural data is available for the control groups. For this reason analysis of behaviour is limited to a sample of 31. These small sample sizes should be borne in mind when considering the results and conclusions. The Central Limit Theorem states that statistically speaking, a sample of ≥ 30 can be considered large and further it can be assumed that it has an approximately normal distribution (Kazmir and Pohl, 1987). However, it should be noted that the results reported here are only generalisable to the socio-economic and psychographic groups represented by the sample analysed. Greater generalisability would have been preferable, but the results are nonetheless interesting and form a good grounding for further research.

3.2   Reductions in car use

Twenty of the 31 people who returned their second travel diary had reduced their car use. A 21.4% reduction in car driver journeys was achieved in Leeds and a 19.8% decrease in Manchester. This is greater than the 3% to 7% achieved in previous UK IMCs. In absolute terms this is only a reduction of 50 car driver journeys, which is insignificant in comparison to the total number of such journeys undertaken in the UK each year. However, if this number is scaled up to cover a full twelve month period and the entire driving population it becomes notable. The control data did not reveal a clear pattern of reductions in car use amongst those who had not received any intervention, and therefore confirmed that change amongst the experimental group was the result of the intervention.

In socio-demographic terms, those who completed the before surveys tended to live outside of the city (beyond the outer ring road), be men aged between 26 and 55, work in office based occupations (especially administration) and hold A' levels or equivalent qualifications. Unsurprisingly, the usual mode of transport is the car as driver. It is not clear why most initial respondents live outside the city, since one might expect those within the city where there is denser provision of alternatives to respond more readily. It could be that the radial, corridor based public transport networks in Leeds and Manchester, mean that those living outside of the city have more scope to reduce their car use by using these public transport corridors than those living inside the city needing to make within-city journeys that do not follow a particular corridor. Amongst those who went on to return the after survey and complete the IMC process, t tests did not identify notable significant differences between Leeds and Manchester, suggesting that results will be transferable to similar urban populations elsewhere. Amongst those who did reduce their car use, more were women and over all there was a higher level of educational attainment.

Segmentation by attitudes is also possible. It is apparent that within the group who returned the before surveys and reduced their car use that there are people who are less concerned about protection from the weather and privacy than one might expect. Additionally, beliefs that car use is safe and reliable are held less strongly than is often assumed.

In terms of subjective norms, there was a lot of ambivalence with regard to motivation to comply with the wishes of others, but a view that others did not want

the respondent to reduce their car use. However, these norms were significant in regression analysis as discussed below, suggesting that they do have a pivotal role. Children were particularly identifiable as a group perceived not to want respondents (presumably their chauffeurs, aka parents) to reduce their car use. It is notable that those who reduced their car use had a greater tendency to be neutral in terms of perceived wishes of others.

In terms of PBC there was widespread belief amongst respondents that they could catch the bus or train, or walk more, but that it would not be easy. With regard to cycling, respondents mainly perceived that they could not cycle more and that if they did it would be difficult. This suggests a significant need to raise PBC, especially self-efficacy amongst the socio-demographic group most likely to reduce their car use. It also lends support to the idea that consideration of self-efficacy as a construct in its own right within the TPB model may enhance its performance (Conner, 2003) with regard to reducing car use. The fact that cycling was seen as particularly unlikely and difficult suggests that work to increase cycling would be least productive. It appears that walking, and public transport are both potential targets around which to base communications. It is also worth noting that those who reduced their car use did not perceive the difficulty of using alternatives as much. Although they did not feel they could use alternatives to any greater extent, they may not take so much persuading if IMCs seek to overcome practical barriers.

The intentions expressed by those who reduced their car use support this view. Amongst the wider group there was an intention not to reduce car use, and an expectation that this intention would be fulfilled, whereas, those who did reduce their car use held neutral intentions and expectations on average. Thus, negative intentions did not form a barrier to change.

3.3   Internal consistency of the data

Having established the sample to be used in the multiple regression analysis, it was important to check the internal consistency of the data. That is to say, check that the questions asked all measured what they set out to measure. Each independent variable in the TPB is measured using multiple items (pairs of questions), all relating to car use. Taking the attitudes variable as an example, it is necessary to confirm that all the items (individual questions) are indeed measuring attitudes with regard to car use, not some other attitudes. High internal consistency (indicated by high correlations between item scores) indicates that all the items are measuring the same variable (i.e. attitudes towards car use), whereas low consistency indicates that the items are measuring multiple variables.

Where the demands of the experiment undertaken do not allow the use of a test-retest process to confirm reliability, the Cronbach's alpha test is widely used in TPB applications and psychology research in general. The Cronbach's alpha test splits the data in half in every way possible, and compares the resulting halves for consistency. Cronbach's alpha values can range between 0 and 1. High values are considered to be around 0.75 to 1, although Aron and Aron (1998) note that values of less than 0.6 can be acceptable. Whilst Aron and Aron (1998) suggest that values below 0.6 can be acceptable, it is felt that more robust analysis will be achieved with higher values (around 0.75 or above) of Cronbach's alpha. On this basis, the values obtained for belief items and outcome evaluations making up attitudes tend towards the low side (.56 and .53 respectively). The subjective norm component values are acceptable (.95 for the normative beliefs and .89 for the motivation to comply), as is the intention

value (.92). The PBC values are slightly less than 0.75 (.72 for perceived likelihood of occurrence and .73 for perceived facilitating/inhibiting power), but not worryingly so.

It is possible to increase the reliability of a test through item analysis (Coolican, 1999). It is possible to calculate a Cronbach's alpha value for each individual item and then deduce what the overall score would be if individual items were removed. Items that correlate least with other items can then be removed and the variable set re-tested in a process of elimination until an acceptable Cronbach's alpha is achieved. The relatively low Cronbach's alpha values for the attitude items suggest that improvements in statistical reliability would be beneficial (improved reliability usually results in more robust analysis later on). The re-test process results in notable improvements in the Cronbach's alpha values for the attitude items. The highest alpha value obtainable for the belief item data was 0.76. This was obtained with seven of the eleven belief items (weather, reliability, comfort, privacy, safety, convenience and accessibility (pollution, exercise, congestion and expense were removed by the re-test process; it is notable that the items removed are those that the individual could consider disbenefits)). When outcome evaluations for the seven retained belief items were tested the alpha value was 0.71. This is slightly lower than desirable but not worryingly so. Other processes of elimination were tested, but they did not improve on this combination. This suggests that a data set based on the first re-test should be taken forward, since this has the highest alpha values and removes least items from the attitude measure.

A criticism of this process is that high reliability may be achieved at the cost of a reduction in validity if too many items are removed. Coolican (1999) cites the example of intelligence tests, "which, though quite reliable, measure only a narrow range of intellectual ability, missing out, for instance, the whole range of creative thought which the public language definition would include." To establish whether high reliability has been gained at the cost of excessive loss of validity, validity can be examined using factor analysis to analyse construct validity. Factor analysis extracts components, each of which consists of multiple items that have high internal correlation, on the basis that the components account for much of the variance in the dataset (although the extracted factors themselves are orthogonal). If particular items do not contribute significantly to any of the components, they can be discarded. If, when all items are subject to factor analysis, the resulting factors contain the items that remain after the Cronbach's alpha re-test process, but not those excluded by it, then the combination derived through Cronbach's alpha analysis is valid. The attitude data was studied using exploratory factor analysis, as this is most appropriate in the development of theory.

The factor analysis did not produce a clear set of components that confirmed the Cronbach's Alpha re-test selection of attitude items as explaining the majority of variance in the data set. Hence one could argue that eliminating any items makes the attitude measure invalid, so all attitude items measured in the questionnaire should be retained. Since Aron and Aron (1998) note that Cronbach's alpha values under 0.6 can be accepted, where no alternative presents itself, the initial Cronbach's alpha values (.56 and .53) could be interpreted as acceptable. However, the factor analysis did reveal a factor based largely, but not wholly, on the attitude components giving high reliability in the Cronbach's alpha analysis. These corresponded with internal benefits of car use and gave the Cronbach's alpha re-test results some validity. Consequently, an independent variable based on this internal benefits factor and the Cronbach's alpha re-test process was tested in the regression analysis. Thus, an attitude variable containing all items and one comprising weather, reliability, comfort,

privacy, safety, convenience and accessibility was tested. However, one must bear in mind at the interpretation stage that the attitudes in the latter are primarily those concerned with the benefits of car use to the individual, since the Cronbach's alpha selection eliminated items concerned with pollution and congestion, as well as expense and exercise (these could all be considered disbenefits).

3.4   Multiple regression analysis

The TPB analysis used multiple regression to predict intentions and behaviour, i.e., change in car use. The data meets all the requirements of multiple regression. Enter method regression (entering all independent variables simultaneously) was used since methods that dissect the sample in any stepwise procedure are not worthwhile with so few independent variables (Joanes, 2003). The first regression model used an attitude variable based on all of the outcome beliefs and evaluations. Thus, the attitude variable included the following constructs; pollution, weather, reliability, exercise, comfort, congestion, privacy, safety, convenience, expense and accessibility. The subjective norms variable included; partner, boss, parents, friends, colleagues and children. The PBC variable included; catching the bus, catching the train, walking and cycling. Subjective norm and PBC variables in later models always include the constructs listed here. The constructs included in the attitude variable, vary where specified.

When attitude (including all items), subjective norm and PBC were regressed onto intentions (n=94) using enter method regression the value of R was 0.52, indicating that there is a linear relationship between the dependent and independent variables. The Durbin-Watson statistic was 1.5, indicating that there is not a notable autocorrelation problem. The skewness statistic equals 0.85, indicating that the distribution of the dependent variable is normal. With regard to homoscedasticity, Tabachnick and Fiddell (2001) note that, it "is related to the assumption of normality because when the assumption of multivariate normality is met, the relationships between variables are homoscedastistic." Since the dependent variable considered here (intention) is normally distributed, we can assume that it is homoscedastistic. In addition to these conditions, it is also wise to check for multicollinearity – a relationship between the independent variables. Such a relationship makes it difficult to establish, which independent variable is having the greatest effect on the dependent variable. Multicolinearity can be identified through the condition index associated with eigenvalues. In this case, the condition index was less than 30, indicating that there is no serious multicollinearity problem.

The adjusted R^2 obtained from this model was 0.25, explaining only 25% of intentions. Nevertheless, the statistics do corroborate the initial hypothesis that subjective norms (Beta .22, t 2.31, sig 0.02) and PBC (Beta .46, t 4.84, sig <0.01) are more important in decisions to reduce car use than attitudes (Beta -.13, t –1.35, sig 0.18), as only the attitudes are insignificant. Further, PBC is the most significant with the highest Beta values, indicating that it is the most important predictor of intention to reduce car use. The relationship is also a positive one. Additionally, the value of F is significant at less than 0.01 indicating that the results probably are not due to random chance (F 10.1, $p < 0.01$).

Low adjusted R^2 values like this tell us that something important is missing from the model (Joanes, 2003). However, it is reasonable to attach value to the t statistics and their significance levels (Joanes, 2003). Thus, we can conclude from this model that the basic formulation of the TPB alone is not sufficient to explain all intentions with regard to reducing car use. However, it does support the hypothesis that

subjective norms and PBC need to be changed to reduce car use, not attitudes. It should be borne in mind that this may not prove to be the case amongst those who strongly believe there is no need for constraints on car use. However, these people are unlikely to voluntarily participate in an IMC and thus, they are not the focus of this study.

Given the low level of explanation of intentions, prediction of actual change in car use is unlikely. This is confirmed by regression with change in car driver trips as the dependent variable. When intentions and PBC were regressed onto behaviour (n=31) using enter method regression the value of R was 0.19, indicating that there is little linear relationship between the dependent and independent variables. When this happens, data can be transformed until a linear relationship is obtained. However, since the TPB states that when explanation of intention is low, behaviour will not be explained (Ajzen, 1988), transforming data to obtain an explanation would not result in believable conclusions. Hence, no transformations were undertaken. The skewness statistic equals 2.4, indicating that the distribution of the dependent variable (change in car driver trips) deviates slightly from normal. The kurtosis statistic is positive (0.7) indicating that the data tends towards clustering around a central point slightly more than normal. Again, transformation is possible, but would not lead to believable conclusions. These results alone tell us that intentions to reduce car use are not leading to actual reductions, i.e. intentions are not explaining behaviour, and that those who do reduce their car use are not representative of a normal population.

The adjusted R^2 value obtained from the regression (-0.05) confirms that intentions do not explain behaviour in this case. Indeed, a negative value such as this indicates erratic behaviour (Joanes, 2003), as one might expect when there is no linear relationship. The regression statistics are not considered since the conditions for regression are not met, no importance can be attached to the statistics. However, the implications of erratic behaviour are worth some consideration. Given that reducing car use is likely to involve breaking a long established habit, and further that few habits are broken instantly without force, erratic behaviour may not be surprising. It may represent drivers reducing car use for one journey, but not for another because it is not practical, despite an over all intention to reduce car use. Considered in light of Prochaska and DiClemente's (1983) Transtheoretical Model, which states that people cycle backwards and forwards through five stages of change (pre-contemplation, contemplation, preparation, action and maintenance) when changing behaviour, the so called erratic behaviour revealed here seems reasonable. Indeed, if the hypothesis that drivers who intend to reduce car use do not do so for some journeys because it is impractical is correct, it supports the idea that work to reduce car use needs to concentrate on PBC to help overcome practical barriers to reducing car use. It could be that practical barriers explain, in part at least, the oft discussed gap between intentions and actual behaviour that occurs when attempting to reduce car use. Further understanding of the nature of such a practical barrier would be useful in car use reduction work, since it could be that practical steps such as increasing bus frequency may do as much to increase PBC and thus, bring about reductions in car use, as information about the existing service.

Given the low levels of explanation of intentions discussed above, a key question is, 'what is missing from the basic TPB model tested here?' Some researchers, including Forward (1998) have included socio-demographic variables in their TPB regression models. This was tested here to establish whether the ability to explain intentions and behaviour was improved. The socio-demographic variables included were age group, gender, residential location (inside or outside the city), occupation,

qualifications, usual mode of transport and number of children the respondent has. Enter method regression was used to ensure comparability (n.b., when a stepwise model was tested, the results were no better). A model to explain intentions was tested with all socio-demographic variables included, but as one would expect with the increase in number of independent variables, there was an increase in the adjusted R^2 value; but without improving other aspects of the model (n=94). When individual socio-demographic variables were added into the model, they were always insignificant. Moderate increases in adjusted R^2 were obtained when residential location, occupation, usual mode of transport and number of children the respondent has were included individually, giving values of .27, .32, .32 and .36 respectively. However, insignificant t statistics tell us that these models should be rejected, and that the addition of socio-demographic variables does not improve the performance of the model. Since a model including socio-demographics has been rejected at the stage of predicting intentions, explanation of behaviour was not attempted. Forward (1998) drew the same conclusion when testing the effect of inclusion of socio-demographic variables, and noted that this is in line with expectations since the TPB should incorporate the effects of socio-demographics in its core variables. That is to say, the beliefs and evaluations reported in response to a TPB questionnaire will be grounded in and reflect socio-demographics. Therefore adding socio-demographics into the model independently should not be expected to improve performance. Whilst there are differences in the behavioural contexts of the experimental work reported here and in Forward's work (Forward was concerned with mode choice, particularly walking and cycling for short trips), Forward's (1998) results and those obtained here suggest that in this respect at least, the TPB is performing as it should in the context of mode choice.

As discussed above, the Cronbach's alpha analysis suggested an alternative formulation of the attitude variable based on items concerned with benefits of car use. Whilst it is not valid as a complete measure of attitudes towards car use, it may result in greater explanatory power due to its greater reliability, and possibly relevance to behaviour change given the explanation of variance within the attitude items and the internal benefits component identified by the factor analysis. A multiple regression model to explain intentions using an attitude variable based on the items retained by the Cronbach's alpha re-test analysis (weather, reliability, comfort, privacy, safety, convenience and accessibility) was tested. Again, enter method regression was used (n=94). The value of R was 0.62, indicating that there is a linear relationship between the dependent and independent variables. The Durbin-Watson statistic is 1.5, indicating that there is not a notable autocorrelation problem. The skewness statistic equals 0.85, indicating that the distribution of the dependent variable is normal. Since the dependent variable considered here is normally distributed, we can also assume that it is homoscedastistic (Tabachnick and Fiddell, 2001). All eigenvalue condition index values are less than 30, indicating that there is no serious multicollinearity problem.

The adjusted R^2 value obtained was 0.34, indicating that thirty four percent of the variance is explained. Whilst this is greater than that for the model discussed above, it remains low, although the F value does indicate that the results are not due to random chance (F 8.6, $p < 0.01$). The statistics continue to support the hypothesis that it is not attitudes (Beta –0.11, t – 0.83, sig 0.41) that need changing for the population represented by the sample analysed here. However, it is only PBC (Beta 0.55, t 4.20, sig <0.01) that is significant in this instance (subjective norm: Beta 0.29, t 2.22, sig 0.32). One would still not expect behaviour to be predicted by regression including an

intention variable with such low levels of explanation. However, there is an improvement on the previous model, with an adjusted R^2 value of 0.17 (n=31). Thus, the model that utilises a more reliable, but selective attitude variable (that could be criticised as invalid, i.e., incomplete) does explain a small proportion of behaviour. The gap between explanation of intention and behaviour that this model reveals is typical of behavioural studies. Ajzen et al (in press) "confirm the existence of a strong bias for people to overestimate the likelihood that they will engage in a socially desirable behaviour." Ajzen et al (in press) go on to suggest procedures, to be used when eliciting responses from survey subjects, to reducing the gap between explanation of intention and behaviour. It would be interesting to establish whether such procedures would be effective with regard to reducing car use. Further to this, it is interesting to note that a change to the formulation of the attitude variable has improved the model performance, despite remaining insignificant. This suggests that attitudes cannot be completely ignored (they could for example, influence disposition to take part in an IMC in the first place, and in turn disposition to form intentions to reduce car use) and that some attitudes may be more important than others. This is an issue that requires further investigation.

Whilst the amount of variance it has been possible to explain using the models discussed here is low, it has been observed that any amount of explanation of response to a new transport policy instrument such as individualised marketing is a significant development in the transport field (Allsop, 2004). Transport economics has a long history of predicting demand; modeling mode choice decision making and travel behaviour analysis continues to grow, however, actual explanation of what motivates travel behaviour decisions beyond socio-economic and external practical considerations (e.g. availability of alternatives, luggage to carry etc) is less well developed. Economic models frequently account for intangible factors through error values. Whilst this may indicate where these are having a significant effect, it may not explain what that effect might be. It is hoped that the work reported here and its continued development will contribute to the explanation of these error terms. The fact that this research using theory grounded in expectancy-value analysis has been successful adds further value to the development since it means that the psychological analysis of intangible error terms is based on the same set of utility maximisation and rationality assumptions as the economic analysis.

4   Summary
The results suggest that it is possible to explain 25 to 34 per cent of intentions to reduce car use as a result of the IMCs, but that explanation of actual response is lower. This tells us that the core TPB constructs (as formulated here) underlying personal decision making regarding car use and intentions to reduce it are not providing a full explanation of all decision making in this context, i.e., something fundamental is missing from the model, and other constructs need to be identified. The model was tested to establish whether socio-demographic factors had any significant influence, but they did not.

However, for the 25 to 34 per cent of intentions that were explained, significant explanatory constructs were identified. It is often assumed that attitudes alone can dictate behaviour, however, in this case, only PBC and subjective norms (the influence of others) were significant, especially PBC. These results also indicate that the basic TPB formulation does work in this context, i.e., it does at least explain intentions, all be it for a small number of cases. Thus, investigation of other constructs to add to the model to increase explanation would be worthwhile.

Further to this, consideration of the constructs explaining intentions, socio-demographic characteristics and actual behaviour change data has identified the type of individual who responds positively to IMCs. It appears that women and those with higher educational attainment (post 18) are most likely to respond positively. Within this group, beliefs that car use offers protection from the weather, privacy, safety and reliability are held less strongly than they are on average, and belief that significant others are concerned with the individual's mode choice is neutral. Additionally, those who reduce their car use do not believe that using alternatives to the car is difficult, and their intentions do not express a desire to maintain existing travel behaviour. Whilst the number who actually reduced their car use is small, such individuals provide in important target audience of innovators who are willing to take risks and experiment with new behaviours. These people are important to establishing a precedent for behaviour change and working towards achieving critical mass. It is worth observing that behaviour change is very rarely instant. It has taken 20 years or more to reduce drink driving and smoking in the UK. Thus, one should not expect to change travel behaviour over night.

5   Conclusions

Taking the explanation of intentions and behaviour together, the regression outputs suggest that the TPB has made a positive contribution to the understanding of intentions to reduce car use, but is less useful in terms of explaining actual behaviour. Whilst the small sample size limits generality of conclusions, meaning that the results can only be generalised to others matching the profile of the sample analysed here, the results do confirm the hypothesis that it is not attitudes that need changing, but subjective norms and PBC. Further, they suggest it is PBC that is most important (as do Forward's (1998) results). However, this can only be said to be true with regard to intentions, since the model does not explain sufficient behaviour to generate significant regression statistics.

The low explanation of intentions and behaviour obtained by this research indicates that something is missing from the core TPB operationalisation used here that is pertinent to the explanation of intentions to reduce car use and actual behaviour change. What this is, is not clear. However, the inclusion of socio-demographic variables in the model as independent variables does not improve explanation. Thus, two conclusions can be taken forward from this work. Firstly, communications designed to increase intention to reduce car use, as a step towards actual reductions amongst the socio-economic and psychographic groups represented by the sample analysed for this research, should focus on PBC, and to a lesser extent subjective norms. This supports the use of IMCs and other projects that make drivers aware of the alternatives available to them, where, when and how to use them.

Secondly, further research is needed to work with a larger sample to establish whether other socio-economic and psychographic groups are influenced by different antecedents to car use, and improve over all generality of conclusions, and to establish what is missing from the core TPB model that also contributes to the process of reducing car use. Habit is one possibility, since Forward (1998) included this and found it to be significant. However, Forward (1998) also concluded that it did not increase explanation substantially, and the model told the same story in terms of the role of attitudes, subjective norms and PBC when habit was not included. Given the multiplicity of other norms associated with car use and the associated car culture there are many possibilities concerned with moral and personal norms. For example, Maxwell (2001) has suggested that car use is associated with care ethics, so for

example driving children and other family members around is a demonstration of care and family obligations. Similarly, Maxwell (2001) suggested that car use is associated with modern work ethics, where arriving by other means of transport is often frowned upon. Expressions of this that have come to be seen as expected work benefits include company cars and executive parking spaces. Indeed, other TPB researchers (Conner, 2003) have suggested that personal norms, moral norms, self-identity, self-efficacy, past behaviour and implementation intentions as well as habit may improve the performance of the TPB. Further, whilst this work has concluded that IMCs should not focus on attitudes, it also suggests that the role of attitudes requires more investigation in this context. It remains to be seen whether the constructs suggested here can improve the TPBs performance in this context, but this work has demonstrated that the core model works sufficiently to warrant further research.

Acknowledgements

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