Session 4b

BETTER ROADS

THURSDAY 29 AUGUST 11.00-12.30PM

UNDERSTANDING COMMUNITY TRADE-OFFS BETWEEN THE COSTS AND BENEFITS OF URBAN ROAD PROJECTS

Rhonda Daniels

LAND TRANSPORT PRICING STUDY

Brian Michie

HIGHWAY SAFETY ISSUES IN RURAL AND URBAN ENVIRONMENTS: VERIFICATION OF COMMUNITY PERCEPTIONS

Lal Wadhwa

Session Chair: Robin Dunlop

ATRF 96

UNDERSTANDING COMMUNITY TRADE-OFFS BETWEEN THE COSTS AND BENEFITS OF URBAN ROAD PROJECTS

Rhonda Daniels
Institute of Transport Studies

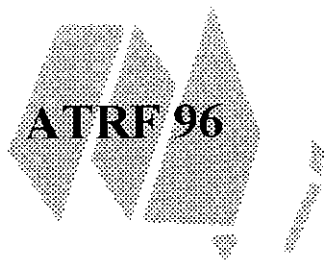
ABSTRACT

The paper presents a research approach for understanding community preferences regarding trade-offs between the costs and benefits of major urban road projects Stated preference methods are used to investigate how people trade-off the various social and environmental costs and benefits of urban freeways, at both an individual and aggregate level Little is known about community preferences in this context The research proposes the use of stated preference methodology in a new transport application

An illustrative case study, the proposed M5 East motorway in southern Sydney, is presented and preliminary descriptive results from the empirical work are reported The survey of residents contained a suite of stated preference experiments, in which respondents were given descriptions of transport alternatives (the current network or the M5 East) and asked to make a choice based on the trade-offs between the costs and benefits of the proposed project Further analysis to utilise the richness of the stated preference data is outlined

Contact Author

Rhonda Daniels
Institute of Transport Studies
Graduate School of Business
The University of Sydney NSW 2006
Australia
Phone: 61 2 351 0068
Fax : 61 2 351 0088
Email: rhondad@its.usyd.edu.au



Introduction

The paper presents a research approach for understanding community preferences regarding trade-offs between the costs and benefits of major urban road projects. In the research described here, stated preference methods are used to investigate how people trade-off the various social and environmental costs and benefits of urban freeways, at both an individual and aggregate, community level, through monetary valuation of environmental impacts. Little is known about community preferences in this context, thus a key aspect of the research is to determine what monetary value people place on aspects of the environment affected by urban freeways. The research proposes the use of the stated preference methodology in a new transport context.

Firstly, the paper presents the research issue of trade-offs in transport infrastructure projects and discusses the stated preference method as a means of determining monetary values. An illustrative case study, the proposed M5 East motorway in southern Sydney, and data strategy is then introduced. Preliminary descriptive results on support for building the M5 East and using it are then described, with an outline of further analysis to utilise the richness of the stated preference data, concluding with the contribution of the research approach.

The research issue: trade-offs

In many types of urban infrastructure, including transport projects, there are conflicts between the "traditional" benefits and the environmental impacts. Major new roads in urban areas are particularly controversial. For instance, a major urban road may save time for users but may also adversely affect the environment, particularly for nearby residents. Often environmental impacts can be reduced, but at a higher cost for the project.

However, despite these inherent conflicts, there is a lack of knowledge about the nature of trade-offs the community is prepared to make regarding transport infrastructure. What trade-offs do people make between the costs and benefits of major projects? How much is worth spending to reduce environmental impacts? Which impacts are most important and worth reducing? The relative weightings people give to the different costs and benefits of projects are not known. There is little understanding of community preferences in this context.

The aim of this research is to investigate the factors which may explain the nature of preferences and trade-offs, including the costs and benefits of the project, as well as personal impact or benefit, attitude to the environment, attitude to funding of transport infrastructure, knowledge of and familiarity with the project, transport use and familiarity with tolls, and socio-demographic characteristics.

Because environmental impacts are more difficult to value in dollars, they tend to be excluded from cost-benefit analysis, the dominant method of project evaluation in which the benefits expressed in dollars are compared to the costs expressed in dollars. Although the environmental impacts are examined in the Environmental Impact

Statements which are required for most large projects, the environment impacts are isolated from the other project costs and benefits. They are not summed up with other costs and thus the trade-offs between the benefits and the environmental costs of a project are not clear. The trade-offs are implicit rather than explicit. However, through monetary valuation, environmental amenity would have an explicit value, rather than the current implicit value. The benefits of monetary valuation are discussed in more detail in Daniels (1994).

Stated preference methods

Methods of determining monetary values for non-market goods such as environmental amenity can be broadly grouped into 2 classes: revealed preference methods, which derive values from behaviour observed in existing markets; and stated preference methods (SP), which estimate values from people's behaviour in "hypothetical" markets. The ENVALUE database (NSW EPA 1995) is a unique compilation of monetary values for environmental impacts from many different studies. However the values are not project-specific and thus the information is difficult to use in evaluation at the project level. This paper concentrates on the use of stated preference methods to determine community preferences towards trade-offs through monetary valuation.

In the stated preference method, descriptions or profiles of products or goods are presented to respondents who are asked to trade-off the levels of the various characteristics in the description with a price. Respondents express their preference by ranking, rating or choosing profiles. The advantages of the method include its flexibility and application to a wide range of contexts.

Stated preference methods have been widely used in transport to forecast demand for new modes, for determining value of travel time savings, and for understanding the role of other characteristics of travel such as guaranteed seating and frequency of service. Hensher (1994) and Nash et al. (1991) discuss transport applications of stated preference analysis. But as Nash (1990: 9) notes, "stated preference, although widely used in the UK [and Australia] for demand forecasting and valuing travel time savings, has been little used in the area of environmental valuation". The few applications of SP examining community preferences and the environmental impacts of transport include Hunt et al. (1995) and Saelensminde (1995), although Hopkinson et al. (1992) asked respondents for their willingness to pay to secure the benefits of preferred road schemes in their local village area.

Illustrative study: M5 East

To test the application of stated preference methods in this context and to investigate community preferences, an illustrative "case study" approach was adopted for several reasons including the need for realism, to make it easier for respondents, and to ensure internal consistency between attributes. The M5 East motorway project in Sydney was chosen as the base for the empirical work. The M5 East is a proposal by the Roads and Traffic Authority (of NSW) to build a new motorway between Padstow and General

Holmes Drive (south of Sydney airport) as an extension of the existing M5 motorway (with costs met by a toll). It is proposed that part of the road will be at ground level, with a 4 km tunnel under the Wolli Creek valley bushland.

The M5 East was selected for several reasons. Firstly, an Environmental Impact Statement had been recently released, thus up-to-date data was available on the costs and benefits of the proposal. Secondly, a decision had not been made on the project by the determining authority at the time of the scheduled fieldwork. Thirdly, there was a relatively clear way to reduce environmental impacts by increasing construction costs (surface road vs tunnel), thus providing an opportunity for people to make trade-offs between the environmental costs and benefits. The project also typified many of the concerns about major road projects in urban areas, as it passed through an area of urban bushland rare in this part of Sydney.

Data strategy: SP experiments

A series of stated preference experiments were designed to elicit community preferences. As well as the SP experiments, the survey included questions to collect other contextual information to enrich the analysis of preferences and develop greater understanding including data on respondents' attitudes and behaviour regarding the environment and transport, knowledge of the M5 East, the socio-demographic characteristics of respondents and the household, and characteristics of transport use.

The heart of the empirical work was a suite of four stated preference experiments. The relationship between the experiments is shown in Table 1. In each experiment, respondents were given descriptions of pairs of transport alternatives (either the current network vs the M5 East at ground level, or the current network vs the M5 East in a tunnel), and asked to make a choice (either the current or M5 East option) based on their personal trade-offs between the costs and benefits of the proposed project (either at ground level or in a tunnel) compared to the current situation. The description of the "current" alternative was fixed and never varied, while the description of the M5 East ground and tunnel options varied (see attributes later).

Table 1 Relationship between stated preference experiments

	Attributes	
Choice question	"Traditional" costs and benefits	"Traditional" + Environmental impacts
Build M5 East or do nothing?	Experiment 1	Experiment 2
Use M5 East or use current route? (if built)	Experiment 3	Experiment 4

In Experiments 1 and 2, respondents were asked the choice question: "Based on the costs and benefits in this description (of the current network and the M5 East option), do you think the government should build the M5 East or not?". The description in Experiment 1 contained the traditional benefits of road projects expressed at an aggregate, "community-benefit" level. In Experiment 2, environmental impacts were added to the description.

There were many possible attributes to include in the project description, however an illustrative subset was selected. The attributes used to represent the "traditional" benefits were travel time savings (across the network), operating cost savings, and accident reductions (number of serious or fatal accidents per year). The "environmental" attributes were households moderately to highly affected by traffic noise close to the proposed road and in the region, area of bushland and open space lost, elevation of the ground level road, and reduction in local traffic. Funding or provision-related attributes included ownership (public or private), method of funding (only users, the community in general, or a combination), construction cost, and a household levy to cover the extra cost of the tunnel option.

Most of the attributes varied at 3 levels, expressed on an ordinal scale, rather than categorical. The levels of the construction cost and some of the environmental attributes were different for the ground level and tunnel options. For instance, construction costs were higher for the tunnel option than the ground-level option and some environmental impacts were not present in the tunnel option.

In the second 2 experiments (Experiments 3 and 4), respondents were asked the choice question: "Based on the costs and benefits in this description (of your current route and the M5 East), would you use the M5 East or your current route?" (for a trip like your most recent trip in a specified area). The description in Experiment 3 contained the traditional project benefits at an individual level (travel time of trip in minutes, vehicle operating costs per trip and toll). In the descriptions for Experiment 4, environmental and funding attributes (as above) were added.

With many attributes and 3 levels of most attributes a fractional factorial design was adopted for manageability. To ensure a sufficient sample for reliable statistical analysis, in each experiment, the respondent was given 3 different showcards and asked the choice question 3 times, producing 12 choices in total.

Data collection

The survey was administered to respondents through face-to-face interviews due to the nature of the stated preference experiments and to reduce non-response bias. Four areas in the vicinity of the M5 East were defined for sampling purposes including an area close to the proposed route likely to suffer impacts but with no benefits; an area unlikely to suffer impacts, but with some benefits of reduced traffic; and 2 areas at the north- and south-western end of the road, with no impacts, but likely to be gain benefits from using the new road.

150 respondents were surveyed at their homes on weekends in February-March 1996 by trained interviewers from a professional market research company. The 39% response rate was considered reasonable for a survey with an average length of 45 minutes.

Descriptive analysis of contextual responses

Preliminary descriptive analysis of the many attitudinal and contextual questions in the survey provides insights to assist in the discrete choice modelling. Only a few results are presented here.

Benefits and impacts of major roads

Respondents ranked a given list of 8 benefits of building major new roads in order of importance. The results are reported in Table 2. Reducing accidents for vehicles and pedestrians, together with producing a better road surface, were considered to be the most important benefits (from the list given) of building new major roads. Saving businesses time and taking traffic off local streets were ranked least important. Interestingly, in the cost-benefit analysis for the M5 East (Applied Economics 1994: 24), the value of reducing accidents contributes less than 2% to the value of the total benefits of the road ($17 million out of total user benefits of $1,011 million).

Respondents also ranked a given list of 7 impacts of building major urban roads in order of importance. Air pollution, noise pollution and loss of open space were considered to be the most important impacts, with each one ranked either 1 or 2 by 40% of respondents. Impact on historic or Aboriginal areas was clearly considered to be the least important of the impacts given, with half of respondents ranking it lowest.

Table 2 Benefits and impacts of major new roads

		% of respondents ranking benefit as	
Benefits	Average rank (1-8)	most or second most important	least important
Reduce vehicle accidents	3.1	54%	6%
Better road surface to drive on	4.0	35%	13%
Reduce pedestrian accidents	3.9	31%	5%
Less stressful for drivers	4.6	22%	7%
Save people time	4.9	18%	9%
Take traffic off other streets	5.3	17%	22%
Less stopping/starting at traffic lights	4.5	13%	8%
Save businesses time	5.8	8%	29%
		% of respondents ranking impact as	
Impacts	Average rank (1-7)	most or second most important	least important
Air pollution	3.1	44%	6%
Loss of bushland (plants/animals)	3.3	42%	7%
Noise	3.3	40%	6%
Changing the character of an area	3.8	27%	7%
Loss of open space	4.1	25%	10%
Demolition of houses	4.6	17%	19%
Impacts on historic/Aboriginal areas	5.9	4%	49%

Funding

To indicate the importance to the community of government expenditure on transport and the environment relative to other sectors, respondents ranked a list of 6 items of government spending. Health and education were considered the most important items for government spending, with transport ranked least important of the 6 sectors. Environment and community services were ranked similarly in the middle order of importance.

Private sector involvement in traditional government activities, particularly in toll roads, has generated much debate. Table 3 shows the degree of support for private sector involvement in different types of transport infrastructure, and for other infrastructure, as a comparison. In expressing their support, respondents differentiated between types of toll roads (urban or rural) and types of rail projects.

Table 3 Support for private sector involvement in infrastructure

Type of infrastructure	% supporting private sector
Transport	
tollroads in cities	61%
tollroads in country areas	47%
railway lines like the Sydney airport link	66%
light rail or monorails	59%
high speed railways between cities	73%
Non-transport	
hospitals	56%
prisons	45%
power stations	49%
Support private sector involvement in all sectors	14%
No private sector involvement in any sector	9%

Attitudes to trade-offs

As major urban roads involve trade-offs between environmental costs for economic benefits, respondents were asked for their attitude towards broad trade-offs between environment and economic growth. Three-quarters of respondents (74%) agreed that environment and economic growth are equally important; but were divided as to whether the government should do more to protect the environment with higher taxes (41%) or keep taxes low and do less for the environment (32%).

In terms of trade-offs between the environment and transport, over 50% disagreed that the government spent enough money reducing the environmental impacts of cars and roads; but 50% would pay more to use the roads if the money went towards helping the environment; and 62% of respondents preferred maintenance of existing roads to building new roads (24%).

Descriptive analysis of M5 East stated preference experiments

Knowledge about the M5 East

Before respondents were asked to make choices about building and using the M5 East, they were asked about their knowledge of the project. 88% of respondents had heard about the M5 East proposal, and half the respondents had seen a map or diagram of the proposed route. A quarter of respondents considered themselves "informed" about the proposal and 10% "very well-informed". As expected, extent of knowledge about the proposal was greater in Area 1, the location of the proposed road, compared to other locations. Two-thirds of Area 1 respondents were "informed" or "very well-informed" about the proposal, and over 80% had seen a map or diagram of the route. In contrast, two-thirds of Area 3 respondents had not seen a map of the proposed route.

The major source of information about the M5 East proposal was reading the local newspaper, cited by over 60% of respondents, with the next most cited sources being a 4 page colour brochure about the M5 East produced and distributed by the RTA (25%), and word of mouth through friends, neighbours or work colleagues (20%).

Support for building the M5 East

The choices made in the SP experiments are summarised in Table 4. Although this preliminary analysis makes no allowance for which showcards and levels of attributes respondents actually saw, it provides an overview of the choice results. In the first choice experiment (Experiment 1), respondents were read information about the M5 East proposal and were then given a showcard showing the traditional costs and benefits of major road projects. The 150 respondents each evaluated 3 cards, making a total of 450 choices. 72% of the 450 choices made were for building the M5 East (rather than "do nothing"). In Experiment 2, the showcards given to respondents contained additional attributes with information about the environmental impacts of the M5 East proposal. Thus the second set of showcards included the same information as the first set of showcards, but with the addition of the environmental impacts. Again, each respondent saw 3 cards, producing 450 choices. When environmental impacts were explicitly introduced into the choice process, support for the M5 East fell slightly to 64% (of the 450 choices).

In Experiment 1, 60% of respondents always chose the build M5 East option (3 times in 3 choices), while 1 in 5 respondents always chose the "do nothing" option. In Experiment 2 with the additional information, the proportion of respondents who always chose the M5 East option dropped to 50%. When the 3 choices from each set of experiments are combined into 6 choices about building the M5 East or not, it is seen that about 60% of respondents made all 6 of their choices the same (45% always chose the M5 East and 15% always chose do nothing), while about 40% varied their choices.

Table 4 Support for building the M5 East: consistency of choice

Option chosen	Build M5 East or do nothing?		
	Experiment 1 Trad. attributes	Experiment 2 Trad + env attributes	Exp. 1 & 2 (6 choices)
Total choices	450	450	
% of choices for "build the M5 East"	72%	64%	
% of choices for "do nothing" option	28%	36%	
Total respondents	150	150	150
Chose M5 East option 3 out of 3	60%	50%	45%
Chose do nothing option 3 out of 3	19%	21%	14%
Respondents whose choice varied	21%	29%	41%

Support for using the M5 East

The final 2 sets of experiments asked respondents to make choices about using the M5 East (if it was built). Only "potential users" completed Experiments 3 & 4. Potential users were defined as those respondents who had made a car trip as the driver within a specified area in the last 2-3 months. The specified area included the major roads from which the M5 East would draw drivers. 76% of respondents (114) had made such a trip.

The first set of experiments for "potential users" (Experiment 3) was very simple—a traditional route choice experiment based on travel time savings, operating cost savings and the toll. In this experiment, all the M5 East options had a toll. Referring to a trip like their most recent trip of at least 20 minutes in a specified area, respondents were asked whether they would choose the M5 East or their current route. When the choice referred to respondents' own behaviour, respondents were much less likely to choose the M5 East (Table 5). As before, each respondent evaluated 3 profiles, producing 340 choices. In the simple route choice experiment, 31% of the 340 choices were for using the M5 East, while 69% of choices were for the current route. These percentages are the reverse of the first 2 sets of experiments about building the M5 East.

Table 5 Support for using the M5 East: consistency of choice

Option chosen	Use M5 East or current route?			
	Experiment 3 Trad. attributes	Experiment 4 Trad + env attributes	Exp. 3 & 4 (6 choices)	Exps 1-4 (12 choices)
Total choices	340	340		
% of choices for M5 East	31%	34%		
% of choices for current route	69%	66%		
Total respondents	114	114	114	114
Chose M5 East option 3 out of 3	14%	12%	6%	4%
Chose current route 3 out of 3	53%	47%	42%	9%
Respondents whose choice varied	33%	40%	52%	87%

In the second of the experiments for "potential users" (Experiment 4), the showcards contained the same information as the Experiment 3 showcards, but with additional information about the environmental impacts of the M5 East. Again referring to a trip like their most recent trip of at least 20 minutes in the specified area, respondents were asked whether they would choose the M5 East or their current route. A similar proportion of choices, 34%, were for using the M5 East and 66% for the current route.

14% of respondents always chose the M5 East in Experiment 3 and 12% in Experiment 4, while 53% always chose the current route from the Experiment 3 showcards and 47% from the Experiment 4 showcards. Combining the choices from both Experiment 3 and 4, half of the respondents (48%) made the same choice 6 times (42% always for the current and 6% always for the M5 East), while half the respondents (52%) varied their choice at least once. Combining all choices (Experiments 1, 2, 3 and 4), 87% of respondents varied their choice at least once.

Factors influencing choice decisions

Design attributes and contextual variables were investigated as factors influencing the choice decisions. They provide indicators of variables to test in the choice modelling phase of the analysis.

Most and least important design attributes in choice

After the first choice decision in both Experiment 2 and Experiment 4 (with traditional and environmental attributes), respondents were asked which factors on the showcards were most and least important in their decision (Table 6). Respondents could mention as many factors as they liked. Although the results are not linked to the actual attribute level seen by respondents, further analysis of the most/least important responses with the level of attribute seen by the respondent did not reveal associations with particular levels more often than would be expected.

For the choice about *building* the M5 East (Experiment 2), 42% of respondents cited accident reductions as *most* important in their choice and 34% mentioned time savings (Table 6). These results were consistent with respondents' ranking of the benefits of roads. Visibility (elevation) of the road and funding arrangements were not important. 31% of respondents cited the owner of the road as *least* important in their decision, and further analysis showed this was not particularly associated with either private or public ownership.

When making a decision about *using* the M5 East (Experiment 4), in the absence of the accidents attribute (which was considered difficult to express on an individual trip basis), 44% of respondents cited time savings as *most* important and 28% mentioned the toll. Again, 27% thought ownership of the road was *least* important. Funding arrangements, construction cost and toll were also mentioned as least important.

Table 6 Most and least important design attributes in choice decisions

Attributes on showcards	Experiment 2 Build M5 East?		Experiment 4 Use M5 East?	
	Most impt	Least impt	Most impt	Least impt
Traditional attributes				
Accident reductions	42%	1%	NA	NA
Time savings	34%	10%	44%	8%
Operating cost savings	21%	13%	21%	6%
Environmental attributes				
Bush lost	26%	8%	21%	5%
Traffic noise near the road	21%	6%	8%	7%
Traffic noise in the region	20%	7%	13%	3%
Open space lost	19%	10%	14%	7%
Reduction in traffic on local streets	18%	2%	14%	2%
Type of road (ground or tunnel)	17%	12%	13%	8%
Visibility of the road	9%	14%	4%	13%
Funding attributes				
Toll (one-way)	NA	NA	28%	10%
Funding arrangements	11%	17%	5%	19%
Owner of the road (private or govt)	7%	31%	4%	27%
Construction cost	4%	14%	5%	14%
Increase in rates	3%	7%	5%	9%
Total respondents	150	150	114	114
Av. responses per respondent	2.5	1.5	1.9	1.3

Note: % are proportion of respondents (not total responses); NA: attribute not applicable in this Experiment

Factors affecting support for building the M5 East

The likelihood of respondents always choosing the *build* M5 East option in Experiments 1 and 2 varied according to subsets of the sample (Table 7).

Personal impacts/benefits. Respondents in Area 1, close to the proposed route and likely to bear the adverse impacts, showed less support for the M5 East: only 30% of respondents always chose the M5 East option, compared to over 60% of respondents in other areas (as many as 78% in Area 3). There was a similar level of support for the M5 East when environmental factors were added in: support was also low in Area 1 (36% always chose the M5 East option), but with over 60% support in Areas 3 and 4.

Of respondents whose most recent trip in the area would have been more convenient if the M5 East had been built, 88% always chose the M5 East option in Experiment 1 and 67% always chose the M5 East option in Experiment 2 (compared to 60% and 50% of the total sample). People who had made a trip recently in the area of the proposed M5 East were slightly more likely to always choose the M5 East option (in both Experiments 1 & 2), but frequency of travel in the area did not affect respondents' support for always choosing the M5 East.

Respondents who drive to work were more likely to always choose the M5 East option, whereas non-workers (and train users) were less likely to always choose the M5 East option (similar for both Experiments 1 and 2). Respondents who pay a toll on the M5 or M4 once a month or more frequently were more likely to always choose the M5 East, a result stronger for Experiment 1 choices, but also true for Experiment 2 choices.

Table 7 Selected factors influencing support for building the M5 East

Experiment 1	Always M5 East	Always Do nothing	Varies
Most recent trip more convenient on M5 East (43%)	88%	4%	8%
Frequent toll-payer on existing M5 (38%)	79%	5%	16%
Drive car to work (47%)	73%	10%	17%
Age: 35-44 yrs (19%)	69%	21%	10%
Drive car as part of job (28%)	68%	13%	20%
Building roads more important than maintenance (25%)	67%	8%	25%
Employed (61%)	66%	12%	22%
Total sample (100%=150)	**60%**	**19%**	**21%**
Govt should do more for the env (42%)	50%	23%	27%
Non-workers (36%)	49%	30%	21%
Donated time/money to protect environment (17%)	40%	32%	28%
Personal income: $0-$5,000 pa (12%)	39%	33%	28%
Live in Area 1 (24%)	31%	36%	33%
Experiment 2	**Always M5 East**	**Always Do nothing**	**Varies**
Most recent trip more convenient on M5 East (43%)	67%	12%	20%
Building roads more important than maintenance (25%)	67%	8%	25%
Frequent toll-payer on existing M5 (38%	61%	16%	23%
Drive car to work (47%)	61%	16%	23%
Age: 55-64 yrs (15%)	59%	14%	27%
Total sample (100%=150)	**50%**	**21%**	**29%**
Govt should do more for the env (42%)	39%	21%	40%
Live in Area 1 (24%)	36%	36%	28%
Donated time/money to protect environment (17%)	28%	32%	40%

Attitudes. Respondents who thought the government should do more for the environment were more likely to always choose the do nothing option or vary their choice in Experiment 1 choices, a result even stronger for Experiment 2 choices. Respondents who had donated time or money to protect the environment were less likely to always chose the M5 East (only 40% compared to 60% of the sample) and more likely to always chose the "do nothing" option (32% compared to 19% of the sample). In Experiment 2, 50% of the sample always chose the M5 East compared to only 28% of those who had donated to protect the environment. If respondents believed building new roads was more important than maintenance, they were more likely to always choose the M5 East and less likely to always choose do nothing options, in both Experiments 1 and 2. Whether respondents had heard about the M5 East or how much they knew, or whether they had seen a map or diagram of the proposed route did not

affect "always chose M5 East" or always "do nothing", for either Experiment 1 or 2 choices.

Socio-demographics. Employed respondents were more likely to always choose the M5 East option, whereas retired and home duties respondents were more likely to always choose the do nothing option (for Experiment 1 choices). However for the Experiment 2 choices, only self-employed respondents were more likely to always choose the M5 East option (but note small sample). There was little difference in support for the M5 East by sex. The age group most likely to always choose the M5 East was the 35-44 years group. For the Experiment 2 cards, the 55-64 years age group was most likely to always choose the M5 East. Respondents with low personal income ($0-$5,000) were less likely to always choose the M5 East and more likely to always choose the "do nothing" option in Experiment 1. There was no clear pattern amongst the other income categories, although three-quarters of $20,000-$30,000 income respondents always chose M5 East option. The same conclusions cannot be drawn from choices made from the Experiment 2 cards. Generally, the proportion of respondents who varied their choice increased with increasing level of education (for both Experiments 1 & 2). Housing tenure and years of residence did not influence choice decisions.

Factors affecting support for using the M5 East

Table 8 shows how the likelihood of *using* the M5 East is affected by subsets of the sample.

Personal impacts/benefits. Area 1 respondents were both more likely to always choose the M5 East and more likely to choose their current route in Experiment 3, and more likely to always choose their current route in Experiment 4. Area 2 respondents were more likely to always choose the M5 East in Experiment 4.

As in Experiments 1 and 2, frequency of travel in the area did not influence choice in Experiments 3 and 4. However, respondents who thought their most recent trip would have been more convenient on the M5 East were twice as likely to always choose the M5 East route (27% compared to 14% in the sample for the Experiment 3 choices, and 29% compared to 12% in the sample for the Experiment 4 choices). Respondents who paid a toll for using current tollroads in Sydney including the existing M5 motorway at least once a month or more frequently were more likely to always choose the M5 East in both Experiments 3 and 4.

Attitudes. Respondents who had donated time or money to protect the environment were less likely to always choose the M5 East (only 1 person out of 23 who had donated money always chose M5 East compared to 14% of the sample) in the Experiment 3 cards.

Respondents who had seen a map or diagram of the proposed route were more likely to always choose the M5 East for their trip (24% compared to 14% in the sample for Experiment 3). This refers to respondents who had seen a map of diagram *before* the survey, as all respondents in the survey were shown the proposed route before the choice questions about using the proposed road.

28% of respondents who thought building new roads was more important than maintenance always chose the M5 East for their trip compared to 14% of the sample (Experiment 3 choices). There was not quite the same pattern for the Experiment 4 choices, but respondents who thought maintenance was more important were less likely to always choose the M5 East (7% compared to 12% in the sample).

Socio-demographics. Respondents aged 65 years and over were more likely to always choose M5 East in Experiment 3. No other clear associations were evident amongst the other socio-demographic factors, in fact some patterns were confusing, or different between Experiments 3 and 4. For instance, both low income ($0-$5,000 pa) and high income ($40,001-$50,000) respondents were more likely to always choose the M5 East in Experiment 3, but in Experiment 4 it was the middle income earners ($12,001-$30,000).

Table 8 Selected factors influencing support for using the M5 East

Experiment 3	Always M5 East	Always Current route	Varies
Age: 65 years and over (19%)	32%	50%	18%
Building roads more important than maintenance (26%)	28%	52%	21%
Most recent trip more convenient on M5 East (43%)	27%	31%	43%
Have seen map/diagram of proposed route (52%)	24%	53%	24%
Live in Area 1 (25%)	21%	62%	17%
Total sample (100%=114)	**14%**	**53%**	**33%**
Live in Area 2 (23%)	12%	46%	42%
Donated time/money to protect environment (20%)	4%	57%	39%
Experiment 4	**Always M5 East**	**Always Current route**	**Varies**
Most recent trip more convenient on M5 East (43%)	29%	16%	55%
Live in Area 2 (23%)	23%	35%	42%
Total sample (100%=114)	**12%**	**47%**	**40%**
Live in Area 1 (25%)	7%	62%	31%
Maintenance more important than building roads (61%)	7%	52%	41%

Further analysis

The richness and complexity of information about respondents' behaviour and preferences arising from the use of a stated preference research design can only be fully utilised through sophisticated analysis including the development of discrete choice models and valuation functions.

Choice models

Further analysis being undertaken includes the development of choice models, in which the utility derived from each alternative (current road network/route; M5 East at ground level; M5 East in tunnel) is a function of the design variables and contextual variables. Models containing only the design variables (that is, traditional, environmental and

funding attributes) are to be developed first, then contextual variables highlighted in the descriptive analysis will be added to the models.

After developing a set of utility expressions for each Experiment, the significance levels of variables will be compared to meet the research aims of determining community preferences and to investigate the relative importance of attributes and see how the importance of attributes in the choice process varies between the community perspective and the individual perspective. While some variables may appear in more than one model, it is not possible to directly compare the coefficients across models. Only the significance level of variables can be compared.

Valuation functions

The analysis will include the development of valuation functions. By including quadratic transformations (of continuous variables) in the utility expressions, marginal rates of substitution or monetary values can be derived. Valuation functions will help to explain variations in people's values according to the levels of the attributes in the experiments and the extensive range of contextual information collected.

The more advanced analysis will also cover issues such as differences in values at the "community" level compared to the "individual" level, the significance of environmental impacts relative to "traditional" attributes in people's decisions, the importance of funding options (whose money is being used to reduce the environmental impacts) and whether values vary according to the presence or absence of environmental impacts.

Conclusion

The paper has described a research approach which uses SP to investigate trade-offs. Although the empirical work is based specifically on the M5 East motorway proposal, the research is a contribution to the development of the stated preference methodology in this context and towards greater understanding of trade-offs in transport infrastructure projects. SP methodology is useful for other applications in transport involving trade-offs between cost and other factors, such as the design of road and rail noise attenuation measures. In all applications, a critical aspect is how to express the cost attribute and ensure respondents take cost into account in making trade-offs between the different attributes. By investigating community preferences and what explains differences, the research described here will assist planning authorities to be more responsive to community preferences and assist in the planning and development of transport projects.

Acknowledgment and note

The NRMA's contribution to funding of fieldwork is gratefully acknowledged. Parts of this paper were presented to the 17th Conference of Australian Institutes of Transport Research (CAITR), University of NSW, 6-8 December 1995.

Copies of the survey material and more detailed results are available from the author on request.

References

Applied Economics (1994) *M5 East Motorway Economic Evaluation*, Prepared for the Roads and Traffic Authority (Specialist Working Paper for the Environmental Impact Statement).

Daniels, R. (1994) Monetary valuation of the environmental impacts of transport, *Papers of the Australasian Transport Research Forum* 19, 365-382.

NSW Environment Protection Authority (NSW EPA) (1995) *ENVALUE: NSW EPA Environmental Valuation Database Handbook*, NSW EPA, Sydney.

Hensher, D.A. (1994) Stated preference analysis of travel choices: the state of practice, *Transportation* 21 (2), 107-1033.

Hopkinson, P.G., Nash, C.A. and Sheehy, N. (1992) How much do people value the environment? A method to identify how people conceptualise and value the costs and benefits of new road scheme, *Transportation* 19 (2), 97-115.

Hunt, J.D., Abraham, J.E. and Patterson, D.M. (1995) Computer generated conjoint analysis surveys for investigating consumer preferences, *Proceedings of the 4th International Conference on Computers in Urban Planning and Urban Management*, Melbourne, 11-14 July, Volume 2 p 13-25.

Nash, C.A. (ed) (1990) *Appraising the Environmental Effects of Road Schemes: A Response to the SACTRA Committee*, Institute for Transport Studies Working Paper 293, ITS, The University of Leeds.

Nash, C.A., Preston, J.M. and Hopkinson, P.G. (1991) Applications of stated preference analysis, in J.H. Rickard and J. Larkinson (eds) *Longer Term Issues in Transport*, Avebury, Aldershot.

Saelensminde, K. (1995) Conjoint analysis as a method of assessing environmental benefits, Institute of Transport Economics, Oslo (draft September 1995).