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Title and Subtitle Can we assess what Australians are willing to pay for road safety?
A report to the Federal Office of Road Safety, Department of Transport and Communications

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Abstract

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by

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ABSTRACT

Road crashes are an avoidable cause of premature mortality and morbidity. Strategies to reduce the number of crashes are often subject to cost-benefit analyses in order to determine where scarce resources are best spent. However, the measure of benefit in these studies is often inadequate, being based on the avoidance of lost production of those killed or injured, savings in hospital costs, or savings in insurance payments.

Ideally benefits should be assessed in a manner comparable with costs, such that a cost-benefit analysis may be undertaken. This usually requires measurement of benefit in dollars.

One technique used to do this is termed willingness-to-pay (WTP), where a survey is used to ask people directly how much they would be prepared to pay to secure the benefits of a reduction in the risk of mortality and morbidity. This technique has been used to value environmental goods, life and road safety measures. Indeed, the UK Department of Transport now bases the value of programme effects on this method.

This study was a preliminary assessment of the feasibility of using WTP to value road safety measures in Australia. The measures included a car airbag, random breath testing, local area traffic management, roundabouts and intersection blackspot treatment. A questionnaire was administered to a convenience sample of 360 individuals (comprising drivers and nondrivers), of which 174 were completed and 145 useable.

Response varied from 16% for the self-complete questionnaires to 83% for those administered in a hospital setting. Road crashes were felt to be a priority by respondents, both on a societal level and personally. The valuations, although not generalisable, were found to be consistent with other recently published studies. Statistical analyses showed that WTP was strongly influenced by age and income, although other factors were important, such as education, whether the respondent understood risk and the amount of time they spent driving, although the significance of these varied across the five goods valued. Other factors, such as interviewer and starting-point bias, which have been hypothesised in the literature to influence the WTP value, were found not to be of influence in this study.

The results show that this sort of survey is feasible. However, problems of response rate, comprehension of risk, skewed distribution of values and wide variation remain. These problems may be a function of the size of the sample used in this study or its characteristics. A larger, more representative, study of this kind would yield data useful in planning road safety interventions in Australia.

1 INTRODUCTION

Road crashes[a] are the fourth highest cause of mortality (behind cardiovascular disease, cancers and respiratory problems), but the third highest cause of life years lost because of the relative age distribution of victims[1].

Identifying programmes which will reduce the number of crashes is not difficult. The problem is in choosing which programmes should be funded, and to what extent. There is variation in both the final impact of each programme on the number of crashes (and subsequent mortality and morbidity) and the level of resources each programme requires. Thus, if resources are to be targeted to those programmes which make the best use of these resources, then the costs and benefits of each need to be evaluated.

Strategies to reduce crashes have been subject to cost-benefit analysis. However, the major deficiency in most evaluations of road safety programmes to date is the use of inadequate measures of benefit. The benefit is often expressed in terms of savings in hospital expenditure, productivity gains, government transfers or a combination of each (Bureau of Transport and Communications, 1992; Steadman and Bryan, 1988; Monash University Accident Research Centre, 1992; Traffic Authority of NSW, 1986; Arthurson, 1985; Atkins, 1981). This leads to a cost-benefit ratio which is potentially misleading (Smith and Shiell, 1992). The real benefit of programmes to improve road safety is reduction in risk of mortality and morbidity. This benefit may be valued in various ways, such as by Quality Adjusted Life Years (QALYs), but this will mean that costs and benefits are expressed in different units (Shiell and Smith, 1993). To express benefits in the same units as costs, some estimate of individual willingness to pay to secure this reduction in risk is required.

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[a]In accordance with Millar and Guria[10], we have adopted the term road 'crash' rather than 'accident'. This is because the majority of road crashes do not just happen, but there is a person responsible The use of the word accident may excuse people, and may result in them not considering the risk carefully enough as 'accidents' presumably cannot be prevented with road safety measures. In the case of pure accidents, we are talking about uncertainty and not risk.

The use of willingness to pay techniques to value the benefits of publicly funded investments is enjoying something of a resurgence (Hutton, 1992; Morrison and Gyldmark, 1992). Willingness to pay is now the method used by the U.K. Department of Transport in valuing programme effects (Department of Transport, 1988). Use of the technique has been associated predominantly with the valuation of reductions in risk of death or disability. From the results of such exercises, it is argued, estimates of the value of a statistical life may be extrapolated. The most recent example of this comes from New Zealand, where Millar and Guria (1991) found a value of NZ$2 million for a statistical life.

An alternative to using willingness to pay to value reduction in risk *per se* is to ask people what they would be willing to pay for specific road safety measures designed to reduced risk. The advantage of using willingness to pay to value an intervention directly is that it allows individual preferences over the different interventions, or scale of intervention, to be incorporated into the estimates. Thus, for example, interventions which are equally effective may be valued differently by individuals because one reduces mortality and disability from causes more feared than the other.

However, despite this resurgence in interest, there remain a number of issues to be resolved before willingness to pay estimates may be considered valid and reliable measures of the value of road safety investments (Burrows and Brown, 1992).

The objective in this study was to examine the feasibility of using willingness to pay to value road safety interventions in Australia. It was beyond the scope of this study to consider the full range of relevant issues. Instead, the study focused on issues of method which were amenable to empirical investigation and testing, rather than those which require development and refinement of theory. The study considered five alternative means of increasing road safety as examples. These were accident blackspot treatment, roundabouts, random breath testing, local area traffic management and the compulsory fitting of airbags in cars. These

interventions were chosen to reflect a private good (airbag) and several public measures likely to elicit different values from individuals. These measures have each been previously evaluated by alternative techniques (Monash University Accident Research Centre, 1992; Traffic Authority of NSW, 1986).

The aim was not to estimate the value of life, or provide definitive social values of the various interventions. Rather, it was to test some of the practical issues to be addressed should such a study be considered. A convenience sample was selected, and so the values derived from this study cannot be generalised.

For background, an overview of the development of willingness to pay as a measure of benefit for public policy decision making is given in section 2. Issues which remain unresolved are discussed in section 3. Section 4 presents the issues chosen for further investigation in this study, and development of the questionnaire. The survey procedure and statistical analyses undertaken are outlined in section 5. Results are reported in section 6 The paper concludes with a discussion in section 7. The basic questionnaire is given in an appendix.

2 DEVELOPMENT OF WILLINGNESS TO PAY

The evaluation of road safety interventions requires measurement of the costs and benefits associated with an intervention. Cost-benefit analysis (CBA) requires that both costs and benefits be measured in commensurate units; usually dollars. Although cost is traditionally measured thus, it means a method must be used which ascribes a dollar value to reduction in death and injury. Two particular methods have been used in the literature: the human capital (HC) approach and the willingness to pay (WTP) approach.

The HC approach is an ex-post accounting procedure, focussing exclusively on an individual's potential productive capacity. This is valued by their potential future earnings, such that individuals are worth the discounted present value of their future earnings. The use of wage rates inevitably values programmes which affect people who are already advantaged in material terms more highly, and values programmes orientated towards men more highly than programmes aimed at women, simply because male earnings are some 25 per cent higher than female earnings (Australian Bureau of Statistics, 1991). Furthermore, market wages are used as the valuation proxy and as such are subject to errors. Because of imperfections in the labour market, the wage rate is unlikely to be equal to the marginal product of the individual. Apart from problems of valuing productive benefit, the HC approach takes no account of individual attitude toward risk, or to different means of reducing risk. Also important is that the HC approach takes no account of externalities, such as the desire to reduce the risk of death for people other than oneself.

WTP is founded on principles of modern welfare economics. In terms of road safety measures, this means that the decision on whether to implement the intervention or not should be made with reference to the attitude to risk and the preferences of those likely to be affected by the intervention, and that these values are best summarised in terms of the amount each individual is willing to pay, or accept in compensation, for the change in risk brought about by the intervention.

Many welfare economists, such as Schelling (1968), Dreze (1962), Jones-Lee (1969) and Mishan (1971), consider that the correct way to value public projects which influence mortality and morbidity is by asking individuals their WTP to reduce their own risk of death and injury under conditions of uncertainty. This is an approximation of what would occur under a competitive market, and therefore leads to the optimal provision of the public good. According to Mishan (1971) the WTP approach is the theoretically correct one as it is based on the Potential Pareto Improvement (Kaldor, 1939; Hicks, 1940). i.e. that an intervention is socially worthwhile if the gainers can compensate the losers, as would occur in the market. Although there are undoubtably some problems to be overcome with WTP in practice, Mishan (1971) believes that "there is more to be said for rough estimates of the precise concept [WTP] than precise estimates of economically irrelevant concepts [HC]".

Two methods are available for estimating individual WTP. These are variously termed implicit, hedonic or revealed preference, and survey or contingent valuation.

Implicit valuation involves the use of a 'proxy' value for the benefits which can be observed in the market place, such as house prices or wage levels. Analysis is then performed which tries to isolate the component of this proxy which is specific to the commodity under investigation. Examples of this method can be found in the environmental literature (Bradford, 1970; Maler, 1977; Cocheba and Langford, 1978; Randall et al, 1978; Dwyer and Bower, 1978; Meyer, 1979; Thayer, 1981; Bishop et al, 1983; Coursey and Smith, 1984; Gregory, 1986; Brookshire and Coursey, 1987; Bockstavel and McConnell, 1990) where much of the initial development of the approach was made. Examples of environmental goods valued in this way are the climate (Hoch and Drake, 1974), air pollution (Anderson and Crocker, 1971), social infrastructure (Cummings et al, 1978), and noise level (Nelson, 1979).

Studies can also be found in valuing life. This involves assessing the value individuals place on a statistical rather than an actual life. Thus, an intervention which reduces the risk of death by 2 in 10,000 per year will, on average, be expected to save 2 lives for every 10,000 people at risk. If the average amount an individual is willing to pay for the reduction in risk is $100, then, in aggregate, the community as a whole are prepared to pay $500,000 [$100*(2/10,000)] for each expected (or statistical) life saved.

The implicit approach to valuing a statistical life involves the identification of situations in which people trade off wealth and risk in an observable market. This has mostly been in the labour market, where riskier jobs can be expected to pay a wage premium as compensation for that risk. The majority of implicit valuation studies have been in this area, and are often termed 'compensating wage differential' studies (Viscusi, 1978a, 1978b, 1980; Smith, 1979; Needleman, 1980; Olson, 1981; Marin and Psacharopoulos, 1982). However, other kinds of studies have been performed, such as on time-inconvenience trade-offs involving use of pedestrian subways (Melinek, 1974) and car safety belts (Blomquist, 1979), house price-air pollution (Portney, 1981), price and maintenance costs of smoke detectors (Dardis, 1980) and frequency of car tyre replacement (Jones-Lee, 1977).

Survey valuation involves asking individuals directly the maximum amount they are prepared to pay to have the commodity in question, or the minimum amount they would accept in compensation to be deprived of it. The survey approach has also been used widely in valuing environmental benefits and valuing life. For examples of environmental valuation see Bohm (1972) and Brookshire et al (1976, 1980). In terms of valuing life, the survey valuation is based on asking a sample of individuals directly about their WTP - or required compensation - for various hypothetical changes in the risk of death. Individual marginal rates of substitution are then approximated by dividing the WTP value by the change in probability. Studies in this area have been wide ranging, including risk of death by heart attack (Acton, 1973), by fire (Melinek et al, 1973), by air travel (Jones-Lee, 1976) and by electrocution (Maclean, 1979).

Each method has its strengths and weaknesses. For implicit valuation, the major problem is controlling for the influence of confounding variables. Although implicit valuation has the advantage of being based upon real rather than hypothetical choices, the compensating wage approach, for example, has the disadvantage that wage rates depend upon many other factors besides risk. It is therefore necessary to control for these factors in order to isolate the pure wealth-risk trade-off. Clearly the reliability of any estimate derived in this way depends upon the quality of regression analysis and the nature of worker's *perceptions* of job risk. Another drawback is the production of highly aggregated results and the inherent incapability of generating estimates at the individual level.

For contingent valuation, the major weakness is its hypothetical nature, but this can also be its major advantage. In theory, it allows control of most confounding variables and so can be used to estimate directly the trade-off between risk and wealth. Furthermore, the survey method yields estimates of individual valuations, thereby allowing inferences to be made about the way in which the valuation varies with income, age, social class, *et cetera*. In practice, however, things are less straightforward. Jones-Lee (1989) identifies four possible problems: (i) There is the problem of ensuring that questions are intelligible, believable, unambiguous, and involve choices the respondent is familiar with (avoiding technical terms such as "statistically independent events", as well as excessively complex scenarios). Respondents are more likely to treat the survey seriously if the situation is believable; (ii) The way in which the question is worded may substantially influence responses. Great care needs to be taken in the design of the questionnaire; (iii) WTP responses may be made in a mendacious manner, such that subjects may seek deliberately to misrepresent their true preferences; (iv) Respondents may be unable to comprehend probability concepts, such that responses to the questionnaire are essentially meaningless. Therefore, it is important to embody consistency checks in questionnaires.

3 ISSUES IN THE USE OF WILLINGNESS TO PAY METHODS

There are a number of conceptual and measurement issues concerning the survey technique as used to assess individual WTP for the benefits of public policy. Although much has been learnt concerning these issues from previous research, many still remain unresolved. These unresolved issues provide the context for this study.

3.1 Conceptual issues

Conceptual issues are important both for the methods used to derive WTP values, and for the way in which these values are interpreted. Four main areas of interest can be identified.

First, there is an observed disparity between the values obtained from studies designed to elicit the WTP for an intervention and the values obtained from studies which examine the willingness to accept compensation (WTA) to go without it. (Gregory, 1986; Knetsch and Sinden, 1984, 1987; Meyer, 1979; Schulze et al, 1981). In theory, these two measures should be similar, providing income and wealth effects are small. The work of Willig (1976) has been especially influential in confirming the anticipated equivalence of WTP and WTA estimates of welfare, particularly in calculating bounds for the estimated magnitude of differences: in most cases being below 10%. Belief in the similarity between WTP and WTA measures has persisted in the face of a growing number of studies suggesting that the difference is indeed substantial, with compensation measures usually exceeding payment based procedures by a factor of three or more (Knetsch and Sinden 1984; Gregory 1986; Hanley 1989).

This dispute has important implications for the measurement of changes in consumer welfare. Any sizeable difference between WTP and WTA could lead to ambiguity in the assessment of losses and gains. The benefits of a proposal might exceed the costs if measured on one basis and fall short if measured on the other. This divergence can also give rise to the Scitovsky paradox, where a change from,

and a subsequent return to, the original position may both be warranted on the criterion that gainers are able to compensate losers: the latter presumably due to the effect of the change in wealth brought about by the initial redistribution of entitlements (Scitovsky, 1941).

Others have argued that the divergence is due to a perceived distinction between out-of-pocket costs and opportunity costs, with the former coded as losses and the latter viewed as forgone gains. That is, the phenomenon that 'once people have something it is very hard to take it away' (Gregory, 1986; Knetsch and Sinden, 1984, 1987; Meyer, 1979; Schulze et al, 1981). For instance, Knetsch and Sinden (1984) conducted a series of five experiments using real transactions of a lottery ticket with results suggesting that a wide disparity exits between the two bases for measuring economic values. The authors concluded that respondents were willing to spend actual or 'realised' income less readily than 'opportunity' income, possibly to protect against feeling regret.

An alternative explanation is put forward by Coursey et al (1987). They found that, although WTP was consistently below WTA, the values converged as the experiment was repeated. Iterative bidding caused convergence, but this was strongly asymmetrical: WTA collapsed downward under competitive market-like experience. As a result, the authors suggest that hypothetical WTP values are closer to true market values than WTA values. However, Knetsch and Sinden (1987) argue that correction of 'mistakes' has few parallels in the real market, and that iteration is likely to *shape* as well as *reveal* preferences.

Gafni and Ravid (1989) suggest that the disparity between WTP and WTA is due to WTP being a bounded question, and WTA a non bounded question. In valuing life, the amount an individual is willing to pay to avoid a given risk of death is bounded by the maximum amount they can afford to spend; ultimately their life time earnings. However, those asked how much compensation they would accept are not bounded in the same way and can ask for any sum as compensation. Thus, WTP must be finite, yet WTA may be infinite. This seems an intuitively

valid explanation.

These explanations provide no firm guidance on how to proceed in addressing this disparity nor how to interpret responses. As conventional economic theory predicts equivalence of WTP and WTA, the acknowledgment of divergence raises important questions, and may necessitate the development of a new conceptual framework to anticipate and explain the divergence.

The second conceptual issue is that individual WTP for an intervention will be constrained by ability to pay. i.e. *ceteris paribus,* people on higher incomes are likely to give higher valuations than those on lower incomes (Gafni and Feder, 1987; Appel et al, 1990; Thompson et al, 1982, 1984, 1986; Berwick and Weinstein, 1985; Garbacz and Thayer, 1983). It would seem that the problem may be viewed as one of a biased sample of society. Presumably, if one had a random sample of society then the influence of ability to pay on the WTP value would not be an issue.

Debate on this issue seems to be at two levels: (i) is ability to pay a problem; and (ii) if it is, how do we get around it? Gafni and Feder (1987) state that "overcoming [ability to pay] is impossible as equitable distribution of wealth does not exist in most (if any) places, and *does not seem to be the goal of Western societies*" (p16) (emphasis added). It is suggested that to the extent that society desires a more equal distribution of income, this should be performed at an earlier stage of taxation and benefit payment. These transfer payments reflect the extent to which society wishes to redistribute wealth. Thus, individuals are asked for their valuation with respect to their total income (including all transfer payments). This redistribution has therefore already occurred and so is reflected in the valuation.

Gafni and Feder (1987) correctly observe that income distributions are unequal, but seem to accept that it is appropriate to then extend this inequality to access to, for example road safety. Others, such as Thompson et al (1984) and Johannesson et al (1991) also accept that the current income distribution is unequal, but believe

that this inequality should not extend to access for public goods. Each individual should have an equal opportunity to consume these services, and so valuations should be adjusted to give each individual an equal weight in the analysis.

Thompson et al (1984) suggest that "this problem [tastes and judgements of the rich largely determine the programmes enacted] might be avoided if willingness to pay is expressed as a proportion of personal income, if the mean proportional willingness to pay is calculated, and if this proportion is multiplied by total income to determine total, adjusted, societal willingness to pay." (p200). This method of overcoming the problem of income constraint is designed to give an egalitarian (equal) distribution of influence on the WTP result. However, the aggregate WTP value will be a function of the aggregation procedure used (Loomis 1987). Adjusting the values explicitly to conform to a distribution function different to the prevailing one requires substantial justification.

The third conceptual problem concerns the value of externalities in estimating the benefit of a public intervention. Should the benefit, in terms of WTP, be constrained to the individual's value to themselves, or should they be allowed to express, and to incorporate, the benefit to them of reducing another person's risk of death in the WTP value? Externalities are known to exist, and their presence in health care has been acknowledged for some time (Culyer, 1971), although their importance in the estimation of WTP has not been so readily acknowledged (Donaldson, 1993). However, Arthur (1981) argues that societal WTP must incorporate the average individual WTP plus an amount representing the utility that these individuals gain from the increased safety of others. Jones-Lee (1991, 1992) believes it is legitimate to include an amount in the benefit estimate of people's WTP for others' safety, although only if such altruism is purely safety focussed. If altruism is generally focused then including an amount for the external benefits of road safety will result in their over provision relative to other goods contributing to individual utility. Jones-Lee et al (1985) state that "to the extent that people are willing to pay for others' safety as well as their own, it would seem appropriate to augment the value of statistical life by a sum that

reflects this additional willingness to pay" (page 50). However, there is no consensus on whether or not externalities are important, or how they should be incorporated in the analysis, if at all (Labelle and Hurley, 1991).

Finally, there is the question of whose values should be elicited. In the normal competitive market, economists assume the knowledgable consumer is the one whose preferences are to count. i.e. consumer sovereignty. Schelling (1968) has made the observation that "however much 'rationality' we impute to our consumer, we must never forget that the one thing he cannot control is his own imagination". This may mean that the individual has difficulty in controlling or understanding anxiety about death or about physical and psychological pain and may not be in a position to value rationally means to reduce the risk of them occurring. To this end, the importance and relevance of pursuing consumer sovereignty is questioned.

3.2 Measurement issues

Measurement issues are important because in order to use WTP as a tool in economic evaluation, and also in order to test various conceptual hypotheses, consistency is required in measurement of individual valuations. Measurement should be driven by a coherent methodology if the results are to be valid and reliable. It is therefore important that methodology in measurement is not left as an ad-hoc approach based on the disparate requirements of individual researchers. If measurement is not performed in a consistent and systematic way by researchers then biases may be introduced resulting in an incorrect assessment of the benefits of a project. Again, four major areas of concern can be identified.

The first is sample bias. This relates to the characteristics of the sample of individuals from whom values are obtained, and the response rate. For instance, Thompson et al (1984) focussed on "what characteristics of patients are associated with increased likelihood of responding to WTP questions?" (p201). Over three studies response rates were found to be 45%, 27% and 84% (Thompson et al, 1982; Thompson et al, 1984; Thompson, 1986). In each study, the response rate was

found to be correlated significantly with education and employment status. This indicates the potential for a sample biased by these response characteristics.

Second, there are issues stemming from the design of the questionnaire (design bias). These include:

(1) Market structure/bid vehicle. This refers to how the valuations are made, for instance in terms of individual out-of-pocket WTP, WTP more tax and whether the market is hypothetical or an observed "real" market (Garbacz and Thayer, 1983; Donaldson, 1990; Cummings et al, 1978) Cummings et al (1986) suggest that bid vehicle does not cause bias because it is part of the commodity being valued; that there is no one 'value' but a series of values all dependent on the bid vehicle used Other authors feel that it is significant (Donaldson, 1990; Garbacz and Thayer, 1983). Donaldson (1990) tried to make the 'market' within which the WTP bid occurred as realistic as possible by using the government as the payer, with the bid vehicle as tax consequences to be borne by the respondent. Garbacz and Thayer (1983) approached the issue by setting up a hypothetical market in which reductions in a Senior Companion Programme (a system of elderly volunteers visiting and shopping for the elderly living alone) would occur which were realistic given the, then current, political climate. The bid vehicle they used was social security payments. Both chose these means to ensure realism of the market, which would increase the seriousness with which respondents faced the questionnaire, and also ease of understanding.

(2) Bid format. This relates to the use of open or discrete questions. i.e. whether questions ask for WTP unaided, or whether respondents are prompted or given response categories. There is considerable evidence that starting point bias can influence the result (Johannesson et al, 1991; Rushby, 1991; Boyd et al, 1988). The advantage of discrete questions is that respondents feel more able to value something which they are unused to valuing and so leads to a higher response rate. Johannesson et al (1991) found a far higher response rate from discrete valuation questions (56% versus 26% for open questions) for self-complete

questionnaires, but also significantly different valuations between the two techniques.

(3) Administration. This refers to how the questionnaire is presented to the respondents, for instance by self-completion (by mail), by face-to-face interview or by telephone. Important here is the trade-off between cost and response rate. Some methods of administration (mail) may be cheaper than others (interview) but have lower response rates (Johannesson et al, 1991; Rushby, 1991).

The third set of measurement problems arises from strategic or hypothetical behaviour. Strategic behaviour refers to whether any incentive exists in the interview procedure which may lead respondents to over or under estimate the value of the intervention. For example, if respondents believe that their bid will influence whether the project is undertaken or not. It may therefore be desirable to indicate to respondents that answers can influence policy, and to say what the cost sharing/decision taking procedure will be.

Gafni and Feder (1987) note that "if [respondents] do learn that their answers to the [WTP] questions do not result in actual payment, they can start cheating." (p20). Garbacz and Thayer (1983) indicated "that strategic behaviour is generally not [considered] substantial" (p147) by studies in the environmental literature. Whereas, Donaldson (1990) states that "given the evidence of strong intensity of preference, there may be a tendency to underestimate the value of one's less preferred option." (p116).

Related to this is the concern that hypothetical questions will simply yield hypothetical answers (Gafni and Feder, 1987; Garbacz and Thayer, 1983; Donaldson, 1990; Brookshire et al, 1976; Bishop et al, 1983).

Fourth, data collection instruments must be reliable, valid, internally consistent and responsive to changes over time (Appel et al, 1990; Thompson et al, 1984,

1986; Garbacz and Thayer, 1983; Rushby, 1991; Brookshire and Coursey, 1987). Evidence is mixed concerning this. For example, Appel et al (1990) investigated the internal consistency of subjects' responses and were "encouraged by the number of respondents who gave consistent responses to the WTP questions." (p331). Others, such as Acton (1973) and Burrows and Brown (1992) refer to the lack of internal and external validity, and the paucity of studies investigating such issues.

While it is possible to make explicit the practical implications of different responses to the conceptual issues, the correctness of any one approach depends more on theoretical argument and development rather than empirical study. For this reason, attention in this study was focussed on some of the more practical problems associated with the measurement of WTP values.

4 QUESTIONNAIRE DEVELOPMENT

The questionnaire used in the study was based on the work of Miller and Guria (1991) in New Zealand and by Jones-Lee et al (1985) in the U.K. Some of the questions were taken directly from these authors' questionnaires, while others were based on the same style. The questionnaire was adapted in terms of the type and content of the questions posed, and as such was developed in its own right; including pilot testing.

4.1 Guiding principles

In designing their questionnaire, Millar and Guria (1991) identified six principles;

(1) The hypothetical market must be as real as possible. Respondents will give unrealistic answers to unrealistic situations. Respondents should be asked to value services of which they have experience and believe to work.

(2) Risks must be of such a size as to be understandable. If respondents have little or no understanding of the probabilities presented to them, then their subjective assessment of the risk may bear little relation to the objective risk. If this is so then the objective probabilities cannot legitimately be employed. The current lower limit of understanding is around 1 in 10,000.

(3) Risks must be realistic. Respondents will try to relate the objective risk presented to them to their subjective assessment of the risk. If the objective risk is perceived to be unrealistic they may provide invalid responses.

(4) Zero bids must be treated with caution. There may be a number of reasons for zero bids. The respondent may feel fatalistic, and that there is therefore no point spending money on safety. Alternatively, the respondents may genuinely be prepared to pay nothing. However, zero bids may also be protest bids.

(5) Very high bids should also be treated with caution. Again, these bids may be legitimate, but they may also be protests. This is particularly important if the individual has some interest in the intervention to be valued. In this case they may suggest a high valuation to secure implementation of the intervention.

(6) Bid format and method are important. Method refers to the use of out-of-pocket payment, taxes etc. The method should be as "neutral" as possible, in that it should not bias the results. For instance respondents may not wish to pay more tax for something, or they may think that out-of-pocket payment is not realistic for a public good. e.g. a roundabout. Bid format refers to the use of market or price type mechanisms, or different types of bidding (English, Dutch, Sealed bid).

Four additional principles should be added to those identified by Millar and Guria (1991).

(7) The individual's estimate of the value of the intervention to his or herself should be separated from their estimation of its value to other family members or the general public (Millar and Guria, 1991).

(8) Questions should be open to avoid starting point bias (Jones-Lee et al, 1985; Mishan, 1971).

(9) Visual aids should be used to enhance the respondents ability to understand the question posed (Millar and Guria, 1991; Appel et al, 1990; Thompson et al, 1984).

(10) The respondents should be assured anonymity, and the purpose of the research should be outlined, to ensure full cooperation from the respondent (Thompson et al, 1986).

The design of the questionnaire used in this study was based on these principles. However, some of the principles contradict each other. For example, principles (2)

and (3) are obviously contradictory where the actual risk is very small. The principles also run counter to some of the other factors relevant to the feasibility of using willingness to pay techniques. For example, despite the need to avoid starting point bias (8), mailed questionnaires generally have a higher response rate if the questions are discrete (Johannesson et al, 1991; Rushby, 1991).

4.2 Hypotheses

The scope of the study, its timing and resourcing also limited what could be tested. Therefore decisions had to be made about what issues should be examined and how they should be addressed in the questionnaire.

The questionnaire was designed to test:

(1) For differences in response rate between self-complete and interview techniques, and amongst different respondents

(2) Whether respondents understand risk and probability, in order to establish some validity of the WTP valuations, and to test if there is a significant difference in valuation with attitude toward risk.

(3) Whether respondents could give unaided or unprompted responses. This may help to establish if there is any starting point bias. If there is no statistical difference between prompted and unprompted responses then starting point bias is not a problem.

(4) For interviewer bias.

(5) Whether respondents were able to provide consistent valuations of reduction in risk of death.

(6) For influences on the WTP value from the questions asked on socio-demographic characteristics and attitudes toward risk. This may show that there

are distinct values given for distinct groups.

(7) Whether the marginal rate of substitution between wealth and risk is linear.

(8) For the relative value of death versus injury.

In particular, the choice of bid vehicle and format, the understanding of risk and probability and the valuation of one's own versus other's safety were important considerations.

Bid vehicle. The choice here was essentially between out-of-pocket payment for the intervention under scrutiny, or an increase in personal taxation. Which is most suitable depends upon the context in which the questions are asked. Out-of-pocket payments are more realistic as a method of valuing private goods, while changes in taxation are more appropriate for valuing public goods (Donaldson, 1990). Each approach should be used in the most realistic context. Thus, for the questions presented here we asked about out-of-pocket payment for the airbag, which is a private excludable good, and increased fuel tax for the other interventions. Fuel tax was used as it was felt that respondents would have experience of the current NSW '3x3' Levy (three cents per litre for three years to fund various road projects), and would find a fuel tax to finance the interventions to be realistic. The exception was for nondrivers who were presented with an annual increase in income tax.

Bid format. The choice here was to offer open or discrete questions. Open questions are not influenced by an interviewer-prompt in any way, and so the risk of starting point bias is removed. However, this may lead to the respondent being unable to answer if they may have no idea of how much to value the risk reduction. Discrete questions overcome this problem by presenting a starting point for the valuation process; rather like a price in the market place. However, this may lead to starting point bias, as valuations may cluster around this 'price'. Upon reflection, it was decided that Jones-Lee et al (1985) used the most flexible

and simple format, by asking single questions in which response prompt boxes were only used when the respondent was unable to give an unprompted response. The results of whether the respondent used a prompt or not were used in two ways. First, to compare the valuations given by those who needed prompts and those who did not to see if there was a systematic starting point bias. Second, to assess the feasibility of the approach by calculating the proportion of respondents who could give unaided and unbiased responses. If providing responses was shown to bias the result, but few people could respond without a prompt, then this would have serious implications for the feasibility of such research.

Risk and probability. Risks must be of a size which is understandable, yet be realistic enough for respondents to feel it is worth answering and valuing. The real probability of reducing death by the measures evaluated here would be too small for the respondent to comprehend or consider worth answering. It was decided that it would be better to use risks that were of a magnitude that was reasonable to consider. The baseline risk reduction used was from 10 in 10,000 to 8 in 10,000 (a reduction of 2 in 10,000, or 20%). For the valuation of the airbag, a question was also asked concerning a 5 in 10,000 (50%) reduction in risk of death.

Valuations of self and others. It is desirable to separate the individual's estimate of the value of improved safety to themselves from their estimate of the value to them of improvements in the safety of others. The separate values can then be used to assess the total benefit from the intervention to society by taking into account the external effects. Thus, we asked for willingness to pay for driver and passenger airbags[2]; thus separating the willingness to pay for solely-own and solely-others improvement in safety.

4.3 Content of questionnaire

The basic questionnaire used can be found in appendix 1. This was administered to drivers. Modification to this questionnaire enabled it to be applied to non-

[2] Note that in the case of nondrivers the airbag questions were reversed to ensure that valuations remained comparable for solely-own versus solely-others improvements in safety.

driver, students and administration by mail. A brief description of the function of each section of this questionnaire is presented below.

1. Introduction

This section introduced the interviewer and the study to the respondent, outlined what was expected of the respondent, and stressed that the results were to be used in confidence.

2. Demographics

This section recorded personal and demographic characteristics of the respondents, used in testing the effects of personal characteristics on the valuations in order to detect any systematic bias. In particular, we were interested in the influence of income, socio-economic status, the level of driving experience, whether or not respondents usually drive alone, and how respondents rate their skill as a driver.

3. Explaining Risk

This section was designed to ensure that the respondent was aware of what was meant by risk in the study, and to introduce the types of questions and visual aids which would be used during the rest of the questionnaire. We were interested in investigating the respondents ability to process simple probability information. The results of this section were analysed to assess whether the respondent's answers were 'correct' (i.e. rational).

4. Value of safety

This was the core section of the questionnaire. From the information provided in this section the value of the different modes of improving road safety were derived. These modes were: driver side airbag; passenger side airbag; random breath testing; roundabout; local area traffic management scheme; intersection blackspot treatment.

5. Value of injury

Road safety programmes reduce injury as well as death, and so a valuation of this is needed to assess the overall benefit (i.e. overall willingness to pay) for reduction in death and injury from road safety improvements. However, instead of using money valuations, here we asked for trade-offs between death and serious injury. The alternative (to repeat the valuation questions from section 4) would make the exercise long and monotonous and so run the risk of lower response rates or discredited answers. The answers from these questions were used to assess the marginal rate of substitution of death for serious injury.

6. Value of time

Here we were interested in assessing the respondent's marginal rate of substitution of money for time. We were not concerned with the specific safety schemes outlined.

7. Assessing individual attitude toward risk

This section attempted to assess how risk averse or risk loving the respondent was. The answers were used in regression analyses to assess whether valuations varied systematically with the level of respondent attitude toward risk taking activities, such as gambling.

8. General questions

These questions were largely developed by the authors to assess how difficult the respondent found the interview. They included questions concerning difficulty in assessing risk and valuation, whether the interview was distressing, whether the respondent was thinking of other factors when answering the questions, and whether the respondent was fatalistic. i.e. do they think that they can do something to prevent premature death?

Overall, the questionnaire was divided into four areas: factual questions concerning demographics, vehicle ownership, annual mileage etc (section 2); perception and consistency questions which test the respondent's understanding of

the concept of probability, and their ability to be 'rational' in responses to the valuation questions (section 3); valuation questions, which provide estimates of the marginal rate of substitution of money or time for risk (sections 4 - 7); attitude towards risk - these concern respondent's risk taking behaviour in terms of gambling, speeding, etc (section 8).

The questionnaire was piloted on a convenience sample of 15 respondents to assess ambiguities in the wording of the questions, time taken to complete the questionnaire, and any difficulties respondents had in answering questions. There were two major changes made as a result of piloting. First, the reported baseline average risk was changed to be constant across all parts of the questionnaire at 10 in 10,000 (rather than the previous 2, 10 and 5 in 10,000). Respondents found the changes in risk of death, due to different denominators being used in the different parts of the questionnaire, confusing. Second, valuation questions for the public goods were changed to weekly fuel bills rather than annual fuel bills. Respondents were thinking weekly (or each time the car was filled with petrol) and then trying to multiply out to get annual valuations.

5 SURVEY METHOD AND STATISTICAL ANALYSES

5.1 Survey method

5.1.1 Subjects

Quota sampling was the primary technique used. That is, successive individuals were approached until an allocated number of completed responses was achieved As the study was a feasibility test of various practical issues, the site of interview was varied to test for differences in response rate. Interviews where therefore conducted in three sites. First house to house calls, second hospital clinics and third Sydney University. Self-complete questionnaires were administered in three phases. Phase one was a random mail-out of 50 questionnaires to residents from the Sydney Telephone Directory. Phase two involved posting 50 questionnaires to hospital staff via the internal mail system. Follow up letters were sent three weeks later. A letter was sent again another three weeks later, this time enclosing a $1 Scratch Lottery ticket. Phase three occurred three weeks later when 50 more questionnaires were given out to Master of Public Health (MPH) students following a lecture given by one of the authors (RS) at Sydney University. All respondents who completed a questionnaire were given a $1.00 Scratch Lottery ticket.

It was aimed to get a sample of 200 completed responses overall, split into four subsamples of 50 each:

1. General public - drivers - interview;
2. General public - nondrivers - interview;
3. General public - drivers or nondrivers - self-complete;
4. Students - drivers or nondrivers - interview.

5.1.2 Elicitation of values

After agreeing to the interview, the respondents were informed of the purpose of the study, and asked a number of demographic questions and questions concerning risk. The respondents were then presented with a given probability of

being killed in a road crash in NSW, and with scenarios relating to the implementation of five separate road safety measures to reduce this risk. The respondents were asked to give their maximum WTP to finance each scheme; given its contribution to the reduction in risk of death. Following this, the value of injury and time questions, and the final section of general questions, concerning the extent to which the respondent was a gambler, and how difficult they found the exercise were administered. The self-complete questionnaire followed the same format, with all visual aids, instructions about which visual aid to refer to, and a return addressed envelope enclosed.

5.2 Statistical analyses

A number of statistical analyses were carried out on the collected data. Much of this related to univariate analyses, for instance with respect to demographic data and the WTP values. Tests of significance were conducted for various sections, for instance on the presence of interviewer bias. The sample distribution was highly skewed, and so parametric tests could not be used. The Mann-Whitney (or Wilcoxon) test was therefore used to assess the significance of any hypotheses (Siegal and Castellan, 1988).

Multivariate analyses were also undertaken to assess the independent influence on WTP of various factors. *A priori*, a number of variables, such as income, age, social class and education, were expected to be correlated with a respondent's WTP (Jones-Lee et al, 1985; Jones-Lee, 1989). The multivariate models used by Jones-Lee et al (1985) and Millar and Guria (1991) were also tested on our data.

Prior to the regression analysis, the correlation between pairs of variables was assessed (appendix 2). This allowed several variables to be dropped from the model, with the 'best' used as a proxy for that particular aspect. For instance 'married' was used as a proxy for dependents as it was highly correlated with 'children'.

6. RESULTS

In this section, we present the results of the study. Response rates are given first, followed by the sample characteristics. This is followed by the WTP values found, and then the issues tested for are presented in a corresponding order to section 4.2.

6.1 Response rate

Overall the response rate was 48.3%; 174 complete questionnaires out of 360 administered or posted. This is heavily influenced by the response rate for interview versus self-complete (60 refusals versus 126 non returned mail-outs).

Table 1: Response rate

INTERVIEW STATUS	HOME	UNIVERSITY	HOSPITAL	SELF COMPLETE	TOTAL
Administered	52	64	94	150	360
Refused	30	14	16	126	186
Complete	22	50	78	24	174
Response rate	42%	78%	83%	16%	48.3%

The response rates for the place of interview varied (table 1). The self-complete was the worst in terms of response, with only 16% returned. The interviews fared far better, but there is an obvious split between those administered at home and at hospital or university (twice the response rate at university and hospital than at home).

Not all of the 174 returned questionnaires were useable. Eleven respondents answered the question concerning risk preference incorrectly and were deleted from subsequent analysis. A further 18 observations were deleted as they had not answered the core valuation questions. Nine questionnaires were not completed

fully, but have been retained for analysis as they provided responses to the core questions. Thus, the useable sample for subsequent analysis was 145.

We aimed to have four subgroups of 50 respondents; driver and non-driver interviews, student interviews and self-complete. Table 2 shows the useable response rate for each of the subgroups, as a proportion of those interviewed/returned.

Table 2: Useable response rate

	DRIVER	NONDRIVER	STUDENT	SELF-COM.	TOTAL
Returned	50	50	50	24	174
Useable	37	39	47	22	145
Rate	74%	78%	94%	92%	83%

Here we can see how the useable response rate varied across the four subgroups. Students provided the highest number of useable responses. Only half of the self-complete questionnaires were returned, but of these the proportion of useable responses was high.

This left, out of an overall sample of 145, a driver sample of 37, non-driver sample of 39, student sample of 47 and a self-complete sample of 22. The characteristics of these samples are given in section 6.2.

6.2 Sample characteristics

Table 3: Characteristics of study population

CHARACTERISTIC	WHOLE n=145	DRIVER n=37	NON DRIVER n=39	STUDENT n=47	SELF-COMP. n=22
Mean age (S.D[3])	32 (13)	33 (11)	38 (14)	22 (4)	39 (14)
Age range	18-87	18-53	19-75	18-35	25-87
Sex (male)	48%	43%	49%	52%	N/A
Married (yes)	47%	60%	77%	6%	59%
Children (yes)	40%	49%	64%	2%	62%
Nationality					
Australian	73%	81%	69%	68%	77%
British	7%	8%	13%	2%	5%
European	6%	8%	5%	13%	0%
Asian	11%	3%	8%	17%	9%
Other	3%	0%	5%	0%	9%
Income ($pa)					
<20,000	42%	18%	17%	87%	24%
20,001-30,000	11%	12%	14%	9%	10%
30,001-40,000	13%	15%	22%	2%	19%
40,001-50,000	9%	9%	19%	2%	5%
50,001-60,000	8%	15%	11%	0%	10%
>60,001	17%	30%	17%	0%	33%
Education					
<School Cert.	18%	26%	28%	0%	27%
High School Cert	7%	9%	13%	2%	45%
Trade	6%	9%	13%	0%	0%
Degree	43%	26%	23%	88%	9%
Postgrad	27%	31%	23%	10%	19%

[3] In all subsequent tables, the standard deviation (S.D) is given as a measure of the variance.

The subsamples are matched well for age and sex, with the obvious exception of the students who were, understandably, younger. Marital status and whether the respondent had any children varied across the groups. In all groups there was a high proportion of Australians. With respect to income, there were similar proportions earning below $30,001 in the driver, nondriver and self-complete groups (30%, 31% and 34% respectively), and above $40,000 (54%, 47% and 48%). However, the sample as a whole had 53% earning below $30,001 and only 34% earning more than $40,000 because of the strong skew in income distribution of the students. This was reversed for education, with the driver, nondriver and self-complete groups having 44%, 54% and 72% educated below degree level, but only 2% of students educated below this level, and 98% equal or above.

6.3 WTP values

6.3.1 Importance of road safety

We wished to assess how important the respondent felt road safety was before eliciting from them valuations of specific projects.

Table 4: Cause of death prefer to have reduced (%)

CAUSE OF DEATH	TOTAL	DRIVER	NONDRIVER	STUDENT	SELF-COMP.
Heart disease	7	3	13	4	9
Cancer	24	19	36	21	18
Road crashes	28	35	25	26	27
Drowning	22	19	8	38	14
All equally	19	24	18	11	32

Table 4 presents a comparative valuation of the top causes of death for anonymous lives. Overall, road crashes came out as the most important cause of death, but this varied over the groups, with this being the case for the drivers only. The others all had different priorities: for nondrivers this was cancer, for students it was drowning and for people sent a mailed questionnaire all causes of

death were ranked equally. However, road crashes did receive a consistent valuation, and was ranked at least second from all groups, so does seem to be an area of concern.

Table 5: Cause of death ranked as personally most risky (%)

MODE	WHOLE	DRIVER	NONDRIVER	STUDENT	SELF-COMP.
Car	67	60	65	77	64
Coach	5	0	0	17	0
Train	0	0	0	0	0
Aeroplane	3	3	5	0	4
Cancer	17	32	15	4	23
Heart disease	8	5	15	2	9

Table 5 shows how important individuals rate the car as a cause of risk of death for themselves, compared to other transport modes and the two main disease killers. Overall the car is rated as the riskiest activity, and this is the case across all the groups. The students attached a higher risk rating to cars, which is most likely because of their age.

Road crashes come out as a general and specific concern, with the reduction of deaths from road crashes given high priority. Consistent with this is that car travel is the mode most people see as being a risk to them.

6.3.2 Dollar WTP valuations

There were eight WTP questions asked of the respondent: for a 20% and 50% reduction in risk of death (from the baseline of 10:10,000) from an airbag on the driver's side of the car only (Self 20% and Self 50% in table 6); for a 20% and 50% reduction in risk of death from an airbag on the passenger's side of the car only (Pass 20% and Pass 50%); for a 20% reduction in risk of death from random breath

testing (RBT), intersection blackspot treatment (B'spot), roundabout (R'bout) and local area traffic management (LATM). All analyses are based on a sample of 145 unless otherwise stated.

The distribution of values was highly skewed toward the origin, which is reflected in the divergence of the mean and the median. To correct for this a "trimmed mean" based on the middle 80% of the observations (i.e. excluding the top and bottom 10% of values) was calculated. This resulted in 41 observations being lost. The geometric mean and median is also reported.

Table 6 gives the values for all questions.

Table 6: WTP values by question

QUESTION	MEAN		TRIMMED MEAN		MEDIAN	GEOMETRIC MEAN
	$	(s.d)	$	(s.d)	$	$
Self (20%)	285	(277)	218	(165)	200	189
Self (50%)	406	(429)	326	(274)	250	268
Pass (20%)	287	(317)	203	(180)	200	208
Pass (50%)	391	(434)	295	(288)	200	275
RBT	110	(166)	60	(66)	50	69
B'spot	126	(198)	69	(71)	50	72
R'bout	108	(234)	49	(57)	50	62
LATM	78	(141)	35	(45)	20	51

6.3.3 WTP values by subgroup

The distributions across each subgroup were also skewed, especially for R'bout and LATM. The median valuations for each subgroup are given in table 7. The mean, trimmed mean and geometric mean are given in appendix 3.

Table 7: Median WTP values ($) by subgroup

QST	DRIVER	NONDRIVER	STUDENT	SELF COMPLETE	WHOLE
Self (20%)	150	300	100	175	200
Self (50%)	200	500	250	275	250
Pass (20%)	100	250	100	175	200
Pass (50%)	150	500	150	275	200
RBT	50	50	50	30	50
B'spot	50	50	50	50	50
R'bout	50	50	30	21	50
LATM	40	40	30	0	20

There is quite considerable variation among the groups for certain questions. All groups show a marked difference in the valuation of private and public goods. In terms of the private good (airbag), the students and drivers gave very similar valuations, with the self complete slightly higher, but the nondrivers were much higher than the others. For the public goods, there was little variation in values among the drivers, nondrivers and students, but there was among the self complete group. This is most marked for R'bout and LATM For RBT and B'spot all groups give approximately the same valuations.

6.4 Null Hypotheses

6.4.1 There is no difference in response rate between self-complete and interview techniques, and between different samples of respondents.

The response rate differed among different sites of interview and modes of administration. The useable rates also differ across the samples of respondents, although the variation was not so dramatic.

6.4.2 Respondents understand risk and probability as presented.

Eleven respondents answered the first question assessing their understanding of the basis of probabilities incorrectly. The question was as follows:

> *Imagine that you have to face two different risks of being killed. In one your risk of death is 10 in 10,000. In the other your risk of death is 40 in 10,000. If you had to choose between them, which one of the risks would you rather face:*
>
> *(i) a risk of 10 in 10,000 of being killed?*
> *(ii) a risk of 40 in 10,000 of being killed?*

The correct answer is (i). It is irrational to wish, all else equal, to face a higher risk of death than a lower one. This was our most basic question and respondents were rejected for analysis based on their answer to this question.

The second question on understanding of risk was as follows:

> *Now assume that you cannot avoid either of these risks but you can choose to have one of them reduced. Which would you prefer:*
>
> *(i) the risk of 10 in 10,000 reduced to 5 in 10,000?*
> *(ii) the risk of 40 in 10,000 reduced to 30 in 10,000?*

Risk option (i) reduces overall risk from 50 in 10,000 to 45 in 10,000, whereas (ii) reduces the risk to 40 in 10,000. Answer (ii) is therefore correct because the net risk is lowest. However only 70 out of 145 gave this answer. It could be argued that individuals were not concentrating upon the risks in combination, but still viewed them as separate, as in the first question. This second question is a little harder to understand, and so we have kept all respondents in the analysis, but have compared the valuations of those who answered correctly with those who answered incorrectly.

Table 8 shows the WTP results split between the two subsets. One can see that those answering (ii) to the question gave a higher valuation than those who

answered (i), but this difference is only statistically significant for three goods (self 20%, B'spot, R'bout and LATM).

Table 8: WTP values split by answer to risk questions

QUESTION	INCORRECT			CORRECT			APPROX t-STAT[4]
	MEAN $	(s.d)	MEDIAN	MEAN $	(s.d)	MEDIAN	
Self (20%)	244	(249)	150	325	(292)	200	0.047
Self (50%)	374	(417)	200	464	(429)	400	0.085
Pass (20%)	243	(280)	100	319	(355)	200	0.107
Pass (50%)	359	(440)	200	424	(433)	300	0.166
RBT	78	(110)	50	144	(206)	64	0.57
B'spot	94	(158)	50	160	(230)	90	0.028
R'bout	61	(105)	25	158	(312)	50	0.011
LATM	53	(96)	20	104	(174)	50	0.102

6.4.3 There is starting-point bias resulting from giving respondents a prompt.

Those who used a prompt tended to use one for the first valuation question (Self 20%) only. We therefore analysed those who used one for the first question versus those who did not, as it is likely that those who use one initially have it in their mind for the remainder of the exercise. Twenty five respondents required a prompt for the first question, against 98 who were able to answer unaided (22 were self-complete). The percentage using a prompt was therefore only 20%. This is consistent with Jones-Lee et al's (1985) finding of 20-30% requiring a prompt. The results are given below.

[4]The Mann-Whitney (Wilcoxon) test gives an approximate t-statistic. Significance level is $P = 0.05$.

Table 9: WTP values split by use of prompt

QUESTION	PROMPT			NO PROMPT			APPROX t-STAT
	MEAN $	(s.d)	MEDIAN $	MEAN $	(s.d)	MEDIAN $	
Self (20%)	266	(334)	100	293	(270)	200	0.204
Self (50%)	352	(442)	200	428	(407)	300	0.167
Pass (20%)	208	(304)	100	306	(341)	200	0.089
Pass (50%)	264	(334)	100	416	(447)	300	0.104
RBT	131	(142)	100	105	(173)	50	0.179
B'spot	150	(183)	100	117	(191)	50	0.221
R'bout	121	(157)	50	112	(261)	50	0.155
LATM	114	(145)	50	73	(143)	20	0.081

Those requiring a prompt gave higher values for public goods and lower values for the private good than those who answered unaided. Although these differences are large, they are not statistically significant. These results suggest that although statistically there may be no starting point bias, the substantial differences in the values will affect the final WTP valuation.

6.4.4 There is interviewer bias.

Here the sample was split between the two interviewers (leaving aside the self-complete sample) to test if the valuations were significantly different. Interviewer A accounted for 68 useable interviews, and interviewer B for 55.

Table 10: WTP values split by interviewer

QUESTION	INTERVIEWER A		INTERVIEWER B		APPROX t-STAT
	MEAN $ (s.d)	MEDIAN $	MEAN $ (s.d)	MEDIAN $	
Self (20%)	281 (281)	200	295 (288)	200	0.605
Self (50%)	372 (402)	250	460 (245)	350	0.138
Pass (20%)	264 (359)	100	311 (306)	200	0.064
Pass (50%)	336 (429)	150	442 (426)	300	0.3
RBT	161 (211)	100	51 (51)	50	0.002
B'spot	175 (237)	100	64 (78)	50	0.009
R'bout	167 (310)	50	52 (96)	25	0.009
LATM	122 (181)	50	35 (52)	10	0.001

The mean values show a marked disparity, although this is not significant for the private good. However, the difference is confounded by the income distributions across the groups by interviewer. Interviewer A had substantially more respondents earning over $30,000 than interviewer B, as illustrated in table 11 (note that n=116 due to missing information concerning income for 29 respondents). Once this is controlled for in the regression analysis (section 6.4.6) there is no significant influence on the WTP values by interviewer.

Table 11: Income distribution by interviewer

	<$30,000 n (%)	>$30,000 n (%)	TOTAL n (%)
Interviewer A	28 (24)	39 (34)	67 (58)
Interviewer B	38 (33)	11 (9)	49 (42)
Total	66 (57)	50 (43)	116 (100)

6.4.5 Respondents are unable to provide consistent valuations of reduction in risk of death.

Consistency of valuation was tested in a number of ways. First, the valuation questions were checked to see if any respondents had valued a 20% reduction in risk more highly than a 50% reduction, either for themselves or a passenger. There were no respondents who had done this.

Second, we applied the criterion used by Millar and Guria (1991) to relative valuations of self versus others. They omitted responses if the value of others safety alone was over four times that of the respondent's own safety, on the basis that the utility gained from another's improvement is unlikely to be of such magnitude. Again, our sample had no such responses, the highest being a valuation of a passenger's safety three times that of the respondent's own.

Third, we asked if the respondents had experienced difficulty answering the risk and valuation questions on a scale from very difficult to very easy. For the risk questions, 50% rated the exercise as easy or very easy, with a further 27% as neither difficult nor easy, and 22% difficult. For the valuation questions, 41% rated the exercise as difficult or very difficult, 28% as neither difficult nor easy, and 31% as easy or very easy. Respondents therefore found the valuation questions harder than the risk questions, and on average found the valuation questions hard to answer.

6.4.6 WTP is not influenced systematically by various socio-demographic factors.

Multiple regression was used to test a model correlating the WTP value for each question with socio-demographic factors, using the SAS package (SAS Institute Inc., 1989). Stepwise regression was used on the full set of independent variables listed in table 12, split between the private good (the airbag) and the four public goods. In all analyses, n=140. Criterion for entry in to all models was significance at P=0.2.

Table 12: Variables in the regression analysis

VARIABLE	DESCRIPTION	DUMMY (DV) OR CONTINUOUS (C)
Age	Age of respondent	C
Married	Married=1	DV
Alc	Drink before driving=1	DV
Sunhat	Wear a sunhat when spending a period in the sun=1	DV
Oth'r	Other considerations in valuations than death/injury=1	DV
Perisk	Personal risk of death greater than average=1	DV
Sex	Male=1	DV
Inc	Income over $40,000=1	DV
Car	Car size greater than average=1	DV
Edu	Education greater than HSC/trade=1	DV
Valdif	Difficulty answering valuation questions=1	DV
Fatal	Fatalistic=1	DV
Rank	Ranked car as most risky=1	DV
Risk	Correct answer to risk reduction question=1	DV
Crash	Involved in crash in last 3 years =1	DV
Abilty	Own ability as driver greater than average =1	DV
Dhrs	Amount of time spent driving each week	DV
Inttime	How long the interview took to complete	C
Dcount	Amount of time per week spent driving outside Sydney metropolitan area	DV
Pass	Amount of time carry passengers	C
Gamble	How often gamble per month	C

The results of the separate regressions on the private and public goods are given in tables 13 and 14.

Table 13: Regression model for the private good[5]

VARIABLE	SELF (20%)	SELF (50%)	PASS (20%)	PASS (50%)
Intcept	+114.21 (98.15)	+345.57* (153.47)	+216.36** (114.99)	+401.78* (155.64)
Age	+7.03* (2.09)	+8.73* (3.27)	+6.39* (2.45)	+8.13* (3.32)
Risk	-104.04* (45.04)	-108.59 (70.44)	-85.83 (52.78)	-76.41 (71.43)
Valdif	-54.77 (46.33)	-44.91 (72.45)	-99.62** (54.28)	-107.49 (73.47)
Inttime	-1.74 (2.39)	-5.33 (3.74)	-4.27 (2.80)	-7.59* (3.79)
Car	-93.94** (55.66)	-223.71* (87.03)	-140.19* (65.21)	-228.97* (88.25)
Oth'r	-3.73 (46.04)	-87.96 (71.10)	-85.82 (53.95)	-157.67* (73.01)
Married	+54.58 (52.12)	+75.08 (81.50)	+93.01 (61.06)	+133.44 (82.64)
Ranking	+87.18** (51.14)	+62.09 (79.97)	+99.78** (59.92)	+60.89 (81.10)
Adj R^2	0.10	0.09	0.11	0.12

* Significant at $P = 0.05$. ** Significant at $P = 0.10$.

[5]Figures in parentheses are standard errors.

Table 14: Regression model for the public goods

VARIABLE	RBT	B'SPOT	R'BOUT	LATM
Intcept	-40.87 (59.09)	+12.83 (73.19)	+57.09 (85.86)	-53.08 (51.66)
Inc	+60.55** (34.27)	+81.66** (42.45)	+83.54** (49.80)	+44.45 (29.96)
Edu	+90.62* (33.27)	+58.05 (41.20)	+22.40 (48.34)	+82.33* (29.09)
Age	+2.23** (1.30)	+1.96 (1.61)	+2.42 (1.89)	+1.71 (1.14)
Risk	-48.58** (27.72)	-53.85 (34.33)	-104.38* (40.28)	-31.53 (24.24)
Dhrs	+2.52** (1.36)	+2.71 (1.69)	+2.34 (1.98)	+1.70 (1.19)
Sunhat	-20.71 (29.15)	-34.82 (36.11)	-76.97** (42.36)	-3.25 (25.49)
Married	+37.82 (35.15)	+26.60 (43 54)	+35.45 (51.07)	+21.82 (30.73)
Adj R^2	0.16	0.10	0.11	0.12

* Significant at $P = 0.05$. ** Significant at $P = 0.10$.

The two "goods", private and public, are influenced by some of the same factors, but also by differing ones. The value of the public good is influenced predominantly by what might be called demographic factors (age, education, income, married, driving hours). In contrast, the value of the private good was much more influenced by personal and methodological factors (comprehension of probabilities, difficulty in the valuation exercise, length of interview, whether factors other than death and injury are considered and how important they consider road safety). Age and comprehension of probabilities are factors influencing all valuations. In terms of statistically significant variables, these differ between the private and public goods also. Age and size of car are the most consistent influencing factors for the private good, with income the most consistent influence over the public goods. Interestingly, neither income nor

education are factors influencing WTP for an airbag, though they are for the public goods. The ease with which respondents found answering the valuation questions and the priority they associated with road safety were influences on the WTP for the private good but not the public goods, and attitude toward risk (as proxied by sunhat wearing) was a positive influence on the public goods, but not the private good.

From these separate analyses, a general model was fitted across all five schemes (table 15). This shows that there are eight independent factors correlated with the WTP value. As mentioned in section 5.2 some of these were hypothesised to be influences from a review of the literature. These are age, income and education. However, the signs on the coefficients differ across questions. *A priori* it was predicted that WTP would increase with age, income, education, driving hours and the consideration of factors other than death and injury (eg medical expenses). The interview time and type of car driven were also expected to be correlated but we had no expectation of sign. However, not all of the models conform to these expectations. Private good valuations for Self 20%, Self 50% and Pass 20% do not correspond, as the variable "Oth'r" (representing consideration of factors other than death and injury when giving valuations) is of the opposite sign. Pass 50% has opposite signs on both "Oth'r" and "Dhrs" (number of hours spent driving per week). The public goods do conform to expectations, although some variables, such as "Inttime" (time taken to interview) have a different sign to the private good. In terms of statistically significant variables, age is strongest, influencing most questions at $P=0.05$. Income and education are only significant for the public goods and car size for the private goods. The number of hours spent driving also has influence over only public goods. It is also interesting to note that whether the respondent could comprehend risk correctly is an influencing factor over some questions.

Table 15: Regression model one

VAR	SELF		PASS		RBT	B'SPOT	R'BOUT	LATM
	20%	50%	20%	50%				
Int cept	+177.11** (101.96)	+357.84* (159.1)	+303.51* (121.2)	+437.95* (163.15)	-79.60 (59.99)	-19 45 (74.93)	-3.57 (88.65)	-85.93** (51.63)
Age	+6.32* (2.16)	+9.24* (3.37)	+5.51* (2.57)	+8.39* (3.46)	+2.65* (1.27)	+2.23 (1.59)	+2.81 (1.88)	+1.95** (1.09)
Inc	+81.27 (53.69)	+37 62 (83.78)	+81.56 (63 82)	+55.68 (85.91)	+73.80* (31.59)	+92.21* (39 26)	+97 90* (46.68)	+47.00** (27.19)
Edu	+38.95 (56.93)	+31.99 (88.83)	+13.84 (67.67)	+1.75 (91.09)	+82.42* (33.49)	+50.88 (41.67)	+10.42 (49.5)	+76.37* (28.83)
Risk	-81.96** (47.69)	-96 45 (74.12)	-69.24 (56.7)	-65.35 (76 31)	-52.05** (28.06)	-50.38 (35.05)	-98.93* (41.47)	-40.29** (24.15)
Car	-94.81** (56 70)	-222.53* (88.48)	-136.04* (67.41)	-219.66* (90.74)	+15.33 (33.36)	+0.87 (41.67)	+24.47 (49 3)	+24.00 (28.72)
Oth'r	-27.83 (46.97)	-97.78 (73.29)	-107.76** (55.83)	-169.63* (75.16)	+44.70 (27 63)	+11.91 (34.52)	+21.05 (40.84)	+54.23* (23.79)
Dhrs	+0.22 (2.42)	+1.23 (3.73)	+0.16 (2.88)	-0.22 (3.88)	+3.05* (1.43)	+2.97** (1 78)	+2.67 (2.11)	+2.17** (1 23)
Int time	-3.82 (2.6)	-6.23 (4.05)	-5.99** (3.09)	-8.18** (4.16)	+0.07 (1.53)	+0.13 (1.91)	-0.37 (2.26)	-0.29 (1.32)
Adj R^2	0.09	0 08	0.07	0.09	0.16	0 08	0.08	0.14

* Significant at $P = 0.05$. ** Significant at $P = 0.10$.

Our model explains between 7% and 16% of the variance, which is similar to results elsewhere. For instance, Jones-Lee et al (1985) found that his models accounted for between 1.6% and 5.3% of the variance, whilst Millar and Guria (1991) found their models accounting for 2% to 20%. Johannesson et al (1991) report a (McFadden) R^2 of between 0.17 and 0.24, and Thompson et al (1984) an R^2 of 0.25. Other studies have performed better. For instance, Thompson et al (1982) report an adjusted R^2 of 0.45, Marin and Psacharopoulos (1982) an R^2 of between 0.38 and 0.59, and Brookshire et al (1980) report R^2s of between 0.40 and 0.90. This latter study was in the area of environmental benefits.

Our overall model has more in common with that used by Jones-Lee et al (1985) than by Millar and Guria (1991). Jones-Lee et al (1985) found that income, age, education, amount of time spent driving and whether the respondent had experienced a crash were influencing factors. Apart from crash experience the same is true of the model presented in table 15. Millar and Guria (1991) found that the WTP value was influenced by age, whether the respondent lived in an urban or country area, income, family size, and whether the respondent was a gambler. Our model did not include gambling (although sunhat, a proxy for gambling, was significant for the public goods), crash experience or driving experience, but otherwise matched well in terms of age, sex and education, thus providing further evidence of the importance of these variable in choosing the sample of respondents.

6.4.7 The Marginal Rate of Substitution of wealth for risk is linear.

The marginal rate of substitution of wealth for improved safety was assessed by repeating the question on the value of the airbag, but this time substituting a reduction in risk of death of 5 in 10,000 for the 2 in 10,000 rate used previously. The results are shown in table 16.

Table 16: WTP for reduction in risk

	2 in 10,000		5 in 10,000	
	MEAN	MEDIAN	MEAN	MEDIAN
Self	$285	$200	$400	$250
Passenger	$285	$200	$390	$200

Using the mean rates for illustration, the average individual was prepared to pay $285 for a reduction in risk from 10 in 10,000 to 8 in 10,000 and $400 for a reduction in risk from 10 in 10,000 to 5 in 10,000. Thus, the marginal rate of substitution of wealth for improved safety diminishes as the reduction in risk increases. Individuals are prepared to pay $200 for the first 2:10,000 reduction in

risk but only an extra $150 for a further 3:10,000 reduction.

This has a general implication for the estimation of the value of a statistical life using WTP. Using the 2 in 10,000 rate, the value of a statistical life is $1,425,000 ($285*5,000). However, if the valuation questions were to have used a 5 in 10,000 reduction instead, then the value of a statistical life would be equal to $800,000 ($400*2,000). Thus, it is essential to justify the choice of baseline estimate of risk before any credibility may be placed on the final estimate of the value of a statistical life.

It also has implications for the estimation of the benefits of road safety measures if, as in this study, the actual reductions in risk achieved by the intervention (i.e. those which would be used in the WTP questionnaire) are smaller than the minimum rate which respondents could reasonably be expected to value. In both this case and in the estimation of the value of a statistical life, the results should be subject to a sensitivity analysis involving alternative reductions in risk.

It is possible that many respondents valued the airbag independently of the risk reduction presented. In fact, 64 out of the 145 responses (44%) placed the same value on the 2 in 10,000 as they did on the 5 in 10,000 reduction in risk of death for **both** self and passenger. This figure increases to 87 (60%) if those giving the same figure for a 2 in 10,000 reduction as a 5 in 10,000 for **either** self or passenger are included. This reflects our feeling that respondents were paying for the airbag *per se* and not taking account of the change in risk between the two versions of the question.

This leads to an interesting methodological dilemma. Should the question be re-phrased to allow the individual to revise downward their original valuation of the airbag at a reduction of 2 in 10,000, given that they probably answered the maximum they would pay for an airbag *per se* at this level of risk reduction, or should we have outlined that various levels of risk reduction would be used to begin with? Are the respondents discounting the risk presented and using the risk

they think is real on both occasions?

6.4.8 What is the relationship between the value of death and injury.

The section asking the individual to trade off a number of deaths for a number of injuries is used here to infer the number of injuries equivalent to one death, and so the benefit of each intervention in terms of reducing injury. We adopted the same definition of serious injury as that used by Millar and Guria (1991), namely, a situation where the victim is admitted to hospital for an average of a week, receives medical treatment such as stitching of wounds or setting of bones, and needs a further month to recover fully.

The basic question asked in this section is given below.

> *Let's say that the local council has two road safety projects planned. One would prevent 10 deaths, the other would prevent 100 serious injuries. Only one can be funded. Both cost the same. Which of the two is most important to you.*
>
> *The project saving 10 road deaths or the project saving 100 serious injuries, or would they be about the same?*

After expressing their preference, the respondent was asked two further questions to get the actual figures of death or injury required to change the original choice. The results are presented in table 17 below, which shows the number of deaths considered equal to 100 injuries. Note that n=133, as 12 interviewees did not answer this question.

Table 17: Number of deaths equivalent to 100 injuries

MEAN	MEDIAN	GEOMETRIC MEAN	TRIMMED MEAN
7.3 (13.05)	2	3	4.9 (5.7)

This means that on average 7.3 (2 or 3 or 4.9 depending on what measure is used) deaths are considered equal to 100 serious injuries as we defined them.

Alternatively, one death is considered equivalent to 14, 50, 33, or 20 serious injuries (depending on the measure used). Using the median, this translates into a MRS of wealth for risk of serious injury of one-fiftieth the corresponding rate of substitution for risk of death. The corresponding value found by Millar and Guria (1991) was one-thirtieth. Jones-Lee et al (1985) found a value of over one-hundredth, but used a different definition of serious injury.

6.5. The validity of WTP values elicited.

In order to use the WTP values derived from this study in CBA the value of mortality and morbidity avoided must be calculated. For this, it is necessary to calculate the value of one statistical death avoided (the value of morbidity is derived from section 6.4.8 using the MRS of death for injury to yield a value of injury 1/50th that of death).

As mentioned in section 3.1, the valuation of externalities in estimating the benefit of a public intervention is a difficult issue to resolve, although Jones-Lee et al (1985) state that "if the value of statistical life is also to take account of people's concern for the safety of other's (presumably maintaining the safety of family and friends) then it would seem appropriate to add to the [value for oneself] a sum that reflects willingness to pay for others safety" (p69). Jones-Lee et al (1985) assess the value of externality in their evaluation of road safety improvements by asking for the WTP for a car safety feature which would reduce risk of death for an average passenger. This was added to the value given by the individual for themselves to estimate the total benefit of the reduction in risk of death by improved road safety[6]. Millar and Guria (1991) take a similar approach by estimating individuals' WTP for their own safety, plus that for other members of the family. Jones-Lee et al (1985) also make the distinction between the valuation

[6]Jones-Lee et al (1985) also asked if the respondent had taken account of the direct economic effects in assessing their WTP (for example, cost of repairs, lost working hours). Jones-Lee et al (1985) argue that it is necessary to add in such costs to the benefit of the intervention, but only if the individuals had not taken these in to account in their WTP responses.

of a statistical life other than one's own and the value of an 'anonymous life' (i.e. a member of the general public).

We followed the example set by Jones-Lee et al (1985) and Millar and Guria (1991) by asking for the respondents WTP for reduction in risk to themselves alone, to their passengers alone and for society in general. Our intention was to assess the relationship between the individuals' WTP for themselves, versus a known other versus an anonymous life. For the general public four questions were used as we also wanted to see if the valuations depended upon the mode of risk reduction.

Given our small and unrepresentative sample, it is nevertheless interesting to compare the values found in this study with those found by Jones-Lee et al (1985) and Millar and Guria (1991), as well as with a value of statistical life estimated by the human capital method (Monash University Accident Research Centre, 1992). The values of statistical life found in this study are presented in table 18. The values for both the private and public good are given, as well as the separate values for the driver and passenger, and the value of each of the four public measures. Both the median and mean values are provided.

Table 18: The value of a statistical life

GOOD VALUED	VALUE OF STATISTICAL LIFE ($) MEDIAN	MEAN
Self	1,000,000	1,425,000
Passenger	1,000,000	1,435,000
Total for the airbag	**2,000,000**	**2,860,000**
Random breath testing	250,000	550,000
Blackspot treatment	250,000	630,000
Roundabout installation	250,000	540,000
Local area traffic management	100,000	390,000
Average for the public good	**250,000**	**525,000**

The value of life for the private good, the airbag, from our survey is therefore AU$2m (using the median, AU$2.9m using the mean). In comparison, Jones-Lee et al (1985) found a mean value of statistical life to be approximately AU$3m plus AU$1m for the value of a passenger. However, the use of the median value would reduce this to approximately AU$1.6m, with a zero valuation of the passenger. Millar and Guria (1991) found a value of life to be approximately AU$1.6m (AU$1.2m using the median), including a value for the individual alone of AU$1m. In comparison, the human capital value estimated by the Monash University Accident Research Centre (1992) was AU$332,300.

Our valuation of statistical life is around one-half of the value found by Jones-Lee et al (1985), though the value of a passengers life was found to be the same in both studies. Our valuation compares reasonably well with the value found by Millar and Guria (1991). All these values are considerable higher than that found by the human capital method, and would therefore lead to a corresponding increase in the estimated benefits of a project.

However, the value found for the public goods do not correspond well with either our value of the private good, or the values of life found by these other studies. Indeed, it gives a lower value than that using the human capital method.

The question asked of respondents for the public measures was what they would be willing to pay for a reduction in risk of death to themselves and the general public. Given this, *a priori*, one would expect the rational respondent to give a higher (or at least equal) valuation than for themselves alone. Possible explanations for this depend upon whether the respondents answered the questions as posed.

If respondents were answering the question as posed, the most likely explanation for the low values is that there is some characteristic of the public goods which causes respondents to under-reveal their true WTP. This may reflect resistance to paying more tax. Jones-Lee et al (1985) remark that there is "a very marked

tendency for people to under-reveal willingness to pay for publicly provided safety" (page 68), and that their questions concerning a safety device fitted to a car "clearly involve safety effects that are privately rather than publicly provided and were designed to avoid the non-revelation effects that might be expected to influence responses to questions involving public goods" (page 58).

Alternatively, if the respondents were not answering the question as posed, then it is possible that the respondents were either valuing these methods as for the public other than themselves, or they used a different level of risk. For instance, if they felt that the reduction in their own risk from the public measures was lower than the 2 in 10,000 presented to them in the question they would give a lower value to the benefits of the measures. In this case, our values are invalid. If it is the former, then there is an argument that this value, of AU$250,000 (or AU$525,000 if the mean is used), should be added to those for the airbag and this summary value (AU$2.3m, or AU$3.4m) then be used across all measures. It is interesting to note that Millar and Guria (1991) found a WTP for members of the public outside the family of approximately AU$285,000, which is approximate to our public valuations.

From the qualitative information provided by interviewers, it seems likely that respondents were either valuing safety for those other than themselves, or under-revealing their true WTP because the goods are tax financed. In many cases, a zero bid was offered with the comment that the individual should not be expected to pay more tax, but that the tax should be redistributed. However, we cannot be sure which is the case, and so cannot draw any firm conclusions.

Whatever the reason for the lower value attributed to the public measures, the answers may still be used to assess whether there is any difference in valuation across the different public goods. The most obvious feature of table 18 is that the value of LATM is valued at less than one half that of the other public measures (three quarters if the mean is used). Apart from this measure, there is little variation in the valuation of the other three public measures. However, the

divergence between these and the valuation for LATM illustrates that one must be careful in only using the valuations given for one mode of risk reduction.

6.6 Qualitative review

Qualitative impressions of how each interview had progressed was recorded on the "Interviewer Complete" section of the questionnaire. These were discussed at a 'debriefing' session after the survey. The following reports some of these impressions. The section is split between the home, hospital and university interviews.

Home interviews

The home interviews were the least successful in terms of response. Although the statistics are provided in table 1, this can slightly mask the experience. For instance, one interviewer in a single day tried 30 houses in succession with not a single interview conducted. This impacts both on the cost of employing that interviewer, but also on morale of the interview staff. The reasons for such low response are numerous. In some instances residents accused the interviewer of "trying in some way to 'case the joint' or rob them [the resident]". Even when someone was found who was initially willing to participate, a number subsequently refused when they found out it was such a long questionnaire.

An attempt was made to improve response by posting a letter to 100 houses, outlining who the interviewer was, the purpose of the study, what the interview would involve and when the interviewer would be calling. It was hoped that this prior exposure to the study would ensure that the resident would be aware of why the interview was important, that it was not just another marketing ploy and also that the resident would be expecting the interviewer and so allay any fears of being robbed.

The letter improved response dramatically. However, still only about four or five interviews per day were being completed. Not only was time taken in travel and time looking for respondents, but often those who did complete the questionnaire

took over an hour as they insisted on talking about the issues, offering a cup of coffee etc. It was decided after day four that the cost effectiveness of this was unacceptable, and would lead to about 30 interview days required for the 100 respondents.

Hospital interviews

Interviews took place in the obstetric and optical outpatient clinics at Westmead Hospital over a two week period, when 78 interviews were completed, at a rate of eight per afternoon.

Most people were happy to fill in the questionnaire whilst they waited to see the clinician. Also, the interviewers were based in Westmead and as such had hospital ID which may have influenced the willingness of people to respond. The response rate may therefore be higher for this group than a general survey would be.

However, the interviews were likely to be cut short as respondents were called in to clinic. Interviewing whoever was accompanying the patient did not solve the problem completely. Associated with this was that the interviews were generally rushed, as both patient and interviewer were aware that the patient could be called to clinic at any time.

University

Fifty interviews were completed within five days at Sydney University outside the Fisher library and in the dining areas of the Wentworth building. These places were chosen as there are often large groups of students taking a break from study or lectures. Most were happy to complete a questionnaire, and this group was probably the most influenced by the free Scratchie. Individuals who appeared not to be occupied with any "meaningful" activity (e.g. reading a newspaper) were approached.

Overall impressions

The interview was seen by some (although not many) as a positive way they could express feelings about numerous matter relating to road safety and taxation. Thus, zero valuation were often accompanied by the respondent voicing the opinion that tax was already too high, and that instead of paying more to fund road safety, the current tax receipts should be redistributed. Another problem felt by the interviewer was that the risk reduction given was being ignored as individual prejudice about certain interventions came through. This occurred particularly with roundabouts, where a typical response was "bloody useless mate". Visual aids were seen as useful and helpful and most respondents referred to them throughout the interview.

However, the questionnaire was long which caused problems with its administration. In the hospital, we had a captive audience which ensured the questionnaires were completed, but in a general population this may not happen.

For the self-complete questionnaires, the low response rate may be because the questionnaires were too long and complex. Upon reflection, the Scratchie should have been sent with the questionnaire rather than on receipt of the completed questionnaire (Chapman and Wong, 1991).

7. DISCUSSION

Safety is an economic good, the provision of which uses scarce resources. Thus, improvements in safety can only be achieved at the expense of reductions in consumption elsewhere in the economy. As it is the "consumer" who ultimately has to forgo these other benefits of consumption it is the "consumer" whose values should count. Using WTP to value the benefits gives the consumer this sovereignty. The optimal provision of road safety in a perfect market would be at a level where the perceived marginal benefit to the consumer is equated with the marginal cost of its provision. However, as the market is not perfectly competitive, there is a lack of accurate information and competitive pressure in production. Furthermore, much of road safety is a public good, in that it is non-excludable. Thus, governments often intervene in the provision of road safety measures to improve social welfare. In this way they are acting as a proxy for the perfectly informed consumer, and are therefore in need of information relating to how individual consumers' would act in a perfect market. WTP provides an estimate of how consumers would act, as the valuations are based on individual preferences.

There have been numerous studies using the survey method to elicit individual WTP over the last twenty years However, there remain a number of issues to be resolved before the method becomes a valid and reliable standard. This study investigated practical issues concerning the use of such a survey.

The response rate was modest at only 48.3%. However, there was considerable variation with site of interview and among the four sample-subgroups. The interviews conducted at the university (corresponding to the student subgroup) and hospital resulted in higher response rates than those completed at the respondent's home, or completed by mail. The mail-out provided a low return rate, but a high percentage of useable responses from those returned. Our sample is, therefore, likely to be biased by those most likely to respond (the highly educated and the young). Particular care should be taken in further research to ensure the sample characteristics will avoid this biasing.

There are various options for increasing the useable response rate. The self-complete questionnaires had a low overall response rate, but a high useable rate. It is possible that a large mail-out could prove successful, especially with a greater incentive, and perhaps backing by an organisation such as NRMA, or by 'adding' the WTP questions to a related survey instrument as was the case in the studies by Millar and Guria (1991) and Jones-Lee et al (1985). The use of a phone questionnaire was not tried but is worth investigating.

The importance of road safety to the respondents was derived from the answers given to two questions outlined in section 6.3.1. However, although these appear to show that road safety is a major concern to people, it is possible that the respondents are responding to the 'demand characteristics' of the survey (Orne, 1962). That is, the respondent professes to be interested in road safety precisely because they realise that the interviewer is conducting a survey on road safety. Thus, we may well have found that heart disease or cancer were major concerns, and road safety was of little relevance, had we conducted a survey in these areas.

There are no statistically significant differences in WTP according to whether the respondent used a prompt. However, the differences in valuations between prompted and unprompted answers are substantial. The variance of each subsample was also very large and any test of significance is unlikely to be rendered less meaningful by this finding. It would also appear that a potential area for concern is the respondents understanding of risk. One-half of the respondents answered the questions concerning risk incorrectly, and although the valuations of those who answered incorrectly did not differ significantly from those who answered correctly in pairwise comparison, the regression analyses showed that the difference was significant in some cases once the influence of confounding variables was controlled. This casts doubt upon the legitimacy of the values. The regression analysis also found that the WTP value was influenced most strongly by age and income, and to a lesser extent by the size of car normally driven.

An important issue concerning the WTP value is the presence of a highly skewed distribution. In such a case what is the correct measure of social benefit to use? Should it be the median, mean or some other statistical measure, for example the geometric mean? According to welfare theory, the mean WTP value is the correct measure of societal benefit because it reflects total community welfare (Mishan, 1971; Sugden and Williams, 1978). However, there are practical reasons for not wishing to use the mean. As Jones-Lee et al (1985) outlines, the existence of skewed data "might be a case in which efficiency ought, to a degree, to be sacrificed in the interests of democracy, with the value .... being set at a median value" (p70). This argument for using the median does have appeal, especially when summary measures other than the arithmetic mean are close to each other, and all are different to the arithmetic mean.

The respondents appeared to be able to give consistent valuations, although a question still remains over validity. In particular, there was massive variation in values, in some cases having a standard deviation greater than the mean. Such variation was not found by Jones-Lee et al (1985) nor Millar and Guria (1991), who used samples approaching 1,000, randomly selected and adjusted to be representative of society. It may well be, therefore, that the variation in this study is due to our small and non random sample.

The fact that some respondents also gave the same valuation for a 20% and 50% decrease in risk is also a cause for concern over the legitimacy of these values, and suggests that the respondent valued the airbag independently of the risk reduction presented. Both interviewers reported on a sense that the respondents were valuing the airbag *per se*, quite irrespective of the risk reduction.

So, can we assess what Australians are WTP for road safety? The results of this exercise suggest that a survey of individual WTP for road safety is feasible. However, problems of response rate, comprehension of risk, skewed distribution of values and wide variation remain. These problems may be a function of the size of the sample used in this study or its characteristics. Any future survey would

need to be substantially larger and use a more representative sample, and so would be more expensive. One final point of mention is that neither this, nor any other study, has established conclusively the validity of the valuations. However, there does seem to be a comparability over the magnitude of estimates for the value of a statistical life (Millar and Guria, 1991).

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APPENDIX 1: QUESTIONNAIRE

INTRODUCTION

Ensure that the respondent can drive.

My name is ..... and I am employed by the Department of Community Medicine at Westmead hospital/Sydney University, and am conducting a survey on behalf of the Federal Office of Road Safety. Would you be willing to answer a few questions concerning road safety measures?

Thank you.

PLACE OF INTERVIEW.....

DATE OF INTERVIEW.....

TIME INTERVIEW COMMENCED.....

I am interested in finding out what people such as yourself think about the risks faced in travelling, and how much **you** value improvements in road safety. The results of this study will be used to help plan and improve road safety.

The responses you give will be treated in **confidence** and will be used **anonymously**. Only group results will be used.

I am **interested in your opinion** so remember that means there are no right or wrong answers, **just your own views.**

But first of all I would like to find out some information about yourself if that's ok.

DEMOGRAPHICS

NAME.....

ADDRESS .....

.....

TELEPHONE No.....

SEX

[CIRCLE ONE ANSWER]

MALE	1
FEMALE	2

1. What is your age?

   [WRITE NUMBER OF YEARS] .....

2. What is your marital status?

   [CIRCLE ONE ANSWER]

NEVER MARRIED	1
MARRIED/DE FACTO	2
SEPARATED/DIVORCED	3
WIDOWED	4

3. Have you any children?

   [CIRCLE ONE ANSWER]

NO	1
YES	2

   [If yes] what are their ages?

   [RECORD ALL AGES] .....

.....

.....

.....

4. What is your nationality?

[CIRCLE ONE ANSWER]		
	AUSTRALIAN	1
	BRITISH	2
	EUROPEAN	3
	ASIAN	4
	OTHER	5

5. At what level did you cease education?

[CIRCLE ONE ANSWER]		
	YEAR 10 OR UNDER	1
	HSC	2
	VOCATIONAL/TRADE	3
	DEGREE	4
	POSTGRADUATE	5

6. What is your occupation?

[WRITE ANSWER, AND WHETHER FULL OR PART TIME]

.....

7. What is your household's annual income? (personal income for students)

[CIRCLE ONE ANSWER]		
	LESS THAN OR = $20,000	1
	$20,001 to $30,000	2
	$30,001 to $40,000	3
	$40,001 to $50,000	4
	$50,001 to $60,000	5
	ABOVE $60,000	6

8. How long have you held a driving licence?

[RECORD YEARS] .....

9. On average, how many hours per week do you drive?

[WRITE NUMBER OF HOURS] .....

10. What distance do you cover?

[WRITE DISTANCE IN KM] .....

11. What is the make and model of the car you regularly drive?

[WRITE MAKE AND MODEL] .....

12. How old is your car?

[WRITE DOWN NUMBER OF YEARS] .....

13. What is the engine capacity of your car?

[WRITE DOWN NUMBER OF LITRES] .....

14. Who owns the car?

[CIRCLE RELEVANT ANSWERS]

YOURSELF	1
YOUR PARTNER	2
OTHER MEMBER OF FAMILY	3
FRIEND	4
OTHER (SPECIFY)	5

.....

15. In an average week approximately what percentage of the time you spend driving do you carry passengers?

[WRITE PERCENTAGE] .....

[IF GREATER THAN 50%, GOTO 16]

[IF LESS THAN 50%, GOTO 17]

16. On average, do you spend most time driving:

[READ OUT RESPONSES]

WITH YOUR PARTNER	1
WITH OTHER MEMBER OF FAMILY	2
WITH FRIENDS	3
WITH OTHER (SPECIFY)	4

[CIRCLE ONE OF THE ABOVE] .....

17. What percentage of your time do you drive, on average, outside the Sydney metropolitan area?

[WRITE PERCENTAGE] .....

18. Compared to the average driver, how do you rate your ability?

[CIRCLE ONE ANSWER]

MUCH WORSE THAN AVERAGE	1
WORSE THAN AVERAGE	2
AVERAGE	3
BETTER THAN AVERAGE	4
MUCH BETTER THAN AVERAGE	5

19. Here is a list of causes of death, and the number of people who died from each cause in NSW during 1991.

[SHOW LIST]

Suppose next year it were possible to reduce the number of deaths from any one of these causes by 10. Which of these causes would it be most important to reduce?

[CIRCLE ONE ANSWER]

HEART ATTACK	1
CANCER	2
ROAD CRASHES	3
DROWNING	4
ALL EQUALLY	5

20. This is a list of four different transport modes, and two diseases.

[SHOW LIST]

Could you rank these from what you consider to be the **most risky** to the least risky for a person of your age.

[RECORD RANKING]

1.....

2.....

3.....

4.....

5.....

6.....

21. About how many times more dangerous is **[the mode judged most dangerous]** than **[the mode judged safest]**. For example, twice as dangerous, three times, etc.

[WRITE DOWN ANSWER] .....

22. Over the past 10 years, do you think that the risk of dying on NSW roads has:

[CIRCLE ONE ANSWER]

DECREASED	1
INCREASED	2
REMAINED THE SAME	3

EXPLAINING RISK

In this survey I am going to talk a lot about risk - so let me explain what I mean by risk in this sense.

When I say that something is **risky** I mean that there is a chance that someone will be killed in a road crash. The larger the risk, the greater the chance of being killed in a road crash.

When talking about risk I will be refering to the number of people killed in a road crash. For example:

Suppose that last year there were 1000 people killed in road crashes in NSW. This is the same as saying that **out of every 10,000 people in NSW around 10 were killed** in road crashes during 1991. This means that the average risk of being killed in a road crash is 10 in 10,000. The figures **10 in 10,000** tell us how large the risk of death on the road is.

Here is another way of thinking about it.

This piece of graph paper **[SHOW GRAPH]** has 10,000 squares on it. If each square is a person, at the end of one year 10 of these people would've died in a road crash. These are shown by the red squares. The other squares stand for people in the group who were not killed in a crash.

The next few questions deal with risk, and this type of graph will be used throughout.

23. Imagine that you have to face two different risks of being killed. In one your risk of death is 10 in 10,000 (red). In the other your risk of death is 40 in 10,000 (green). If you had to choose between them, which one of the risks would you rather face:

[CIRCLE ONE ANSWER]

a risk of 10 in 10,000 of being killed (red) 1

a risk of 40 in 10,000 of being killed (green)? 2

24. Now assume that you cannot avoid either of these risks but you can choose to have one of them reduced. Which would you prefer:

[CIRCLE ONE ANSWER]

the risk of 10 in 10,000 reduced to 5 in 10,000 1

the risk of 40 in 10,000 reduced to 30 in 10,000 2

25. As we've just discussed, the average risk of being killed in a road crash is 10 in 10,000. Do you think your chance of getting killed on the roads is

[CIRCLE ONE ANSWER]

BELOW AVERAGE	1
ABOUT AVERAGE	2
ABOVE AVERAGE	3

26. Where on this scale do you think you would fall

[SHOW SCALE AND POINT OUT THAT 10=AVERAGE]

[RECORD NUMBER] .....

VALUE OF SAFETY QUESTIONS

These next few questions relate to how much you would be prepared to pay to improve road safety by various means. Although most relate to you, your family and the wider community risk, in each case I am asking for your **personal willingness to pay** for each intervention, o.k. This should incorporate your willingness to pay to reduce risk to yourself, and any amount that you would be willing to pay to reduce the risk to others.

27a. The risk to you personally of being killed in a road crash is about 10 in 10,000. This is represented by the red squares in the graph. **[SHOW GRAPH]** However, it is possible to reduce this by fitting a drivers side AIRBAG to the car. If fitted, this will reduce the risk of death **to you alone** once involved in a crash by 20%, to 8 in 10,000. This is shown by the green squares in the graph. Taking into account what you can personally afford, what is the most you would be prepared to pay to have the airbag fitted to the car?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$10, $20, $30, $40, $50, $100, $200, $300, $400, $500, $1000

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED

PROMPT NOT USED

27b. How much would you be prepared to pay if the risk was reduced by 50%, to 5 in 10,000 represented in green here **[SHOW GRAPH]**?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$10, $20, $30, $40, $50, $100, $200, $300, $400, $500, $1000

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED
PROMPT NOT USED

27c. I now want to ask you a similar question concerning a **passenger** side airbag. The risk of dying for passengers in car crashes is broadly the same as for a driver, and is again indicated by the red squares in the graph. **[SHOW GRAPH]** Again, it is possible to reduce this by fitting an AIRBAG to the **passenger side** of the car only. If fitted, this will reduce the risk of dying **to the passenger alone** by 20%, again shown by the green squares in the graph. Taking into account what you can personally afford, what is the most you would be prepared to pay to have the airbag fitted to the car?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$10, $20, $30, $40, $50, $100, $200, $300, $400, $500, $1000

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED

PROMPT NOT USED

27d. How much would you be prepared to pay if the risk was reduced by 50%, represented in green here **[SHOW GRAPH]**?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$10, $20, $30, $40, $50, $100, $200, $300, $400, $500, $1000

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED

PROMPT NOT USED

28. As mentioned earlier, the risk to you personally as a car user of being killed in a road crash is around 10 in 10,000. This is represented by the red squares in the graph. **[SHOW GRAPH]** However, it is possible to reduce this by various publicly funded projects. To pay for these requires an additional levy on the price of fuel. If undertaken, all of these programmes will result in the reduction of risk from 10 in 10,000 to 8 in 10,000. That is, all programmes are equally effective, leading to a reduction in risk of 20%, shown by the green squares in the graph.

The first programme involves increasing the level of random breath testing in your local area. Bearing in mind that the lives saved are as likely to be other members of the community as yourself, how much extra are you prepared to pay weekly on your fuel bill to fund this?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$1, $2, $3, $4, $5, $10, $20, $30, $40, $50, $100

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED

PROMPT NOT USED

29. A second means of reducing risk of death involves treatment of specific blackspot areas in your region, such as by installing more traffic lights and greater street lighting. Again, how much extra are you prepared to pay on your weekly fuel bill for this reduction in risk?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$1, $2, $3, $4, $5, $10, $20, $30, $40, $50, $100

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED
PROMPT NOT USED

30. A third means of risk reduction involves installing more roundabouts as a traffic calming device. By installing roundabouts at intersections in your local area known to be dangerous the number of crashes at these intersections will be reduced. Again, how much are you prepared to pay on your weekly fuel bill to secure this reduction in risk from roundabouts?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$1, $2, $3, $4, $5, $10, $20, $30, $40, $50, $100

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED

PROMPT NOT USED

31. The final means of reducing risk in your area by public works involves controlling the flow of traffic in your area by Local Area Traffic Management Schemes. This will involve use of speed bumps, one way systems and reduced parking. Again, how much extra are you prepared to pay on your weekly fuel bill to reduce the number of crashes in this manner?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out *some amounts of money*. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$1, $2, $3, $4, $5, $10, $20, $30, $40, $50, $100

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED

PROMPT NOT USED

VALUE OF INJURY

Of course, road crashes cause injury as well as the deaths which we have been talking about so far. Now I am going to ask you some questions about how much you would be prepared to pay to avoid serious injury. But, first let me explain what I mean by serious injury.

[SHOW CARD]

It is one where the victim

* is admitted to hospital for an average of a week, and

* receives medical treatment such as stitching of wounds or setting of bones, and

* needs a further month to fully recover.

[SHOW GRAPH]

This is like the graph that I used to show you the average risk of road deaths each year. There are 10,000 squares. If each square were a person, at the end of a year 10 of these people would have been killed. These are shown by the red squares. Also, another 100 people would have been seriously injured. They are shown by the green squares. The remaining squares show the people who didn't have a crash.

32. Let's say that the local council has two road safety projects planned. One would prevent 10 deaths, the other would prevent 100 serious injuries. Only one can be funded. Both cost the same. Which of the two is most important to you.

[CIRCLE ONE ANSWER]

The project saving 10 road deaths or	**(GOTO 33)**
The project saving 100 serious injuries	**(GOTO 34)**
or would they be about the same	**(GOTO 35)**

33. O.K so it is more important to carry out a project that would stop 10 road deaths than it is to carry out a project that would stop 100 people being injured. What is the smallest number of prevented deaths you would accept before this choice would change?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of prevented deaths. Please stop me when I get to the correct amount. *Read out figures steadily and quickly*

9, 8, 7, 6, 5, 4, 3, 2, 1

When respondent stops, ask

You stopped me at ..... Is this right.

WRITE IN AMOUNT.....

PROMPT USED (GOTO 35)

PROMPT NOT USED (GOTO 35)

34. O.K so it is more important to carry out a project that would stop 100 people being injured than it is to carry out a project that would prevent 10 road deaths. How many prevented deaths would there need to be before you change your opinion?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of prevented deaths. Please stop me when I get to the correct amount. *Read out figures steadily and quickly*

10, 11, 12, 13, 14, 15, 20, 30, 40, 50, 100

When respondent stops, ask

You stopped me at ..... Do you mean exactly ..... or slightly more or less. How many exactly?

WRITE IN AMOUNT.....

PROMPT USED (GOTO 35)
PROMPT NOT USED (GOTO 35)

VALUE OF TIME - ALL RESPONDENTS

35. Imagine that you shop for groceries once a week, and that there are two supermarkets you could shop at. One has lower prices, but it takes longer to travel there and back. The other is closer, but the food costs more. When shopping for groceries you could save an average of $10 if you went to the lower price supermarket, or 30 minutes if you went to the closest supermarket. If travel was free, which would you choose?

[CIRCLE ONE ANSWER]

The closest supermarket and save 30 minutes travelling time	1	**(GOTO 36)**
The lower price supermarket and save $10 on groceries	2	**(GOTO 37)**
or are the choices about the same.	3	**(GOTO 38)**

36. O.K. so saving 30 minutes of your time is more valuable than saving $10 a week. Thinking about what you (your household) can afford, what would the saving have to be before you would change your choice?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$11, $13, $15, $20, $25, $30, $40, $50, $100, $200, $500

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED (GOTO 38)
PROMPT NOT USED (GOTO 38)

37. O.K so saving $10 a week on groceries is more valuable than saving 30 minutes on the trip. How small would the saving have to be before you would change your choice?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$9, $8, $7, $6, $5, $4, $3, $2, $1, $0

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED (GOTO 38)

PROMPT NOT USED (GOTO 38)

VALUE OF TIME - **WORKERS ONLY**

38. How do you most often travel to work?

[CIRCLE ONE ANSWER]

CAR (DRIVER)	1
CAR (PASSENGER)	2
PUBLIC TRANSPORT	3
OTHER (SPECIFY)	4

39. How long does it take you to travel to work and back each day?

[RECORD NUMBER OF MINUTES] .....

40. Imagine that your employer wants you to transfer to a new branch. The new job will be the same in every respect, except that it will take an extra 30 minutes to travel there and back. Your employer offers to pay you an extra $10 per day, plus extra travel costs, if you agree to travel for the extra 30 minutes. Which would you choose?

[CIRCLE ONE ANSWER]

Continue working where you are	**GOTO 41**
Travel the extra half hour and get paid the extra $10	**GOTO 42**
Or are they about the same?	**GOTO 43**

41. O.K. so saving 30 minutes of your time is more valuable to you than an extra $10. What would you accept to travel for an extra half an hour each day?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$11, $13, $15, $20, $25, $30, $40, $50, $100, $200, $500

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED (GOTO 43)

PROMPT NOT USED (GOTO 43)

42. O.K. so an extra $10 pay is more valuable than 30 minutes of your time. What is the smallest amount of money you would accept in return for travelling the extra half hour each day?

Interviewer
If respondent gives answer, enter below and circle "prompt not used", otherwise use prompt and circle "prompt used".

PROMPT

I'll read out some amounts of money. Please stop me when I get to the correct amount.*Read out figures steadily and quickly*

$9, $8, $7, $6, $5, $4, $3, $2, $1, $0

When respondent stops, ask

You stopped me at ..... Would you pay exactly ..... or slightly more or less. How much exactly?

WRITE IN SUM $.....

PROMPT USED (GOTO 43)
PROMPT NOT USED (GOTO 43)

ASSESSING INDIVIDUAL ATTITUDE TOWARD RISK

43. How often each month do you buy some form of lottery or raffle ticket, or gamble in some other way?

[WRITE ANSWER] .....

44. When you are going to spend time in the sun, such as at the beach or on a picnic, how often do you wear a hat?

[CIRCLE ONE ANSWER]

NEVER	1
RARELY	2
OFTEN	3
VERY OFTEN	4
ALL OF THE TIME	5

45. And how often do you put on sunscreen?

[CIRCLE ONE ANSWER]

NEVER	1
RARELY	2
OFTEN	3
VERY OFTEN	4
ALL OF THE TIME	5

46. Do you drink **any amount** of alcohol when knowing that you will soon (within the next 5 hours) be driving?

[CIRCLE ONE ANSWER]

NEVER	1
RARELY	2
OFTEN	3
VERY OFTEN	4
ALL OF THE TIME	5

47. Have you ever lost points on your licence?

[CIRCLE ONE ANSWER] NO 1

YES 2

If yes, why?

[RECORD ANSWERS] .....

48. Have you been involved in a road crash in the last two years?

[CIRCLE ONE ANSWER] NO 1

YES 2

If yes, did it involve

[CIRCLE ONE ANSWER] PROPERTY DAMAGE ONLY 1

MINOR INJURY 2

SERIOUS INJURY 3

FATALITY 4

GENERAL

Thank you for answering those questions.

I'd like to finish the interview with a few questions about how you found the interview.

49. How difficult was it to answer the questions on risk/probability?

[CIRCLE ONE ANSWER]

VERY DIFFICULT	1
DIFFICULT	2
NEITHER DIFFICULT NOR EASY	3
EASY	4
VERY EASY	5

50. How difficult was it to answer the valuation questions?

[CIRCLE ONE ANSWER]

VERY DIFFICULT	1
DIFFICULT	2
NEITHER DIFFICULT NOR EASY	3
EASY	4
VERY EASY	5

51. Did you find the interview at all distressing?

[CIRCLE ONE ANSWER]

NO	1
YES	2

52. During the earlier questions you were asked to think only about death and injury. However, traffic crashes can have other effects. Did you consider any other factors when giving your answer to the earlier questions?

[CIRCLE ONE ANSWER]

YES	1
NO	2

[If yes] what were they?

[CIRCLE ONE ANSWER]		
	LOST WORKING TIME	1
	INCONVENIENCE	2
	COST OF REPAIRS	3
	MEDICAL COSTS	4
	OTHER (PLEASE SPECIFY)	
	.....	

53. I'm now going to read out a statement concerning death and dying and ask your level of agreement with it. Please consider the statement carefully before answering.

"If your time is up, your time is up and there's nothing you can do about it"

O.K. I'll repeat that again **[REPEAT]**.

How strongly do you agree with this statement?

[CIRCLE ONE ANSWER]		
	STRONGLY DISAGREE	1
	DISAGREE	2
	NEITHER DISAGREE NOR AGREE	3
	AGREE	4
	STRONGLY AGREE	5

Thank you very much indeed.

TIME INTERVIEW COMPLETED .....

LENGTH OF INTERVIEW .....

INTERVIEWER COMPLETE ONLY

54. Status of interview

[CIRCLE ONE ANSWER]

REFUSED	1
NON RESPONSE TO SOME QUESTIONS	2
COMPLETED	3

If not complete, please explain

.....

55. Was anyone other than respondent present?

[CIRCLE ONE ANSWER]

NO	1
YES	2

If yes, who

.....

56. Please rate how difficult you felt the respondent found the exercise.

RISK

[CIRCLE ONE ANSWER]

VERY DIFFICULT	1
DIFFICULT	2
NEITHER DIFFICULT NOR EASY	3
EASY	4
VERY EASY	5

VALUATIONS

[CIRCLE ONE ANSWER]

VERY DIFFICULT	1
DIFFICULT	2
NEITHER DIFFICULT NOR EASY	3
EASY	4
VERY EASY	5

57. How distressed did the respondent appear during the interview?

[CIRCLE ONE ANSWER]

NOT AT ALL	1
A LITTLE	2
SOME	3
VERY	4

58. Any other comments or impressions of this interview.

[WRITE BRIEF COMMENTS]

.....

APPENDIX 2: CORRELATION TABLES FOR BEST 'PROXY' VARIABLES[7]

	QTYPE	**INTTIME**	INTVIEW
QTYPE[8]	1.00000	0.05184	-0.47977
	0.0	0.5415	0.0001
	145	141	145
INTTIME	0.05184	1.00000	-0.56105
	0.5415	0.0	0.0001
	141	141	141
INTVIEW	-0.47977	-0.56105	1.00000
	0.0001	0.0001	0.0
	145	141	145

	MARIED	CHILD
MARIED	1.00000	0.65869
	0.0	0.0001
	145	144
CHILD	0.65869	1.00000
	0.0001	0.0
	144	144

	EDUCAT	OCCUP
EDUCAT	1.00000	-0.09148
	0.0	0.2877
	143	137
OCCUP	-0.09148	1.00000
	0.2877	0.0
	137	139

	RISKDIFF	**VALDIFF**
RISKDIFF	1.00000	0.52104
	0.0	0.0001
VALDIFF	0.52104	1.00000
	0.0001	0.0

[7] The variable chosen for inclusion in the regression models is in bold in the tables.

[8] Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0 / Number of Observations.

	DLICYRS	AGE	DHRS	DDIST	CTYPCODE	CARAGE	ENGCAP
DLICYRS	1.00000	0.95004	-0.07900	0.15694	0.08210	-0.08122	0.14609
	0.0	0.0001	0.4566	0.1591	0.4365	0.4441	0.1931
	97	96	91	82	92	91	81
AGE	0.95004	1.00000	-0.07947	0.15630	0.06998	-0.07199	0.11867
	0.0001	0.0	0.4540	0.1608	0.5098	0.5002	0.2944
	96	144	91	82	91	90	80
DHRS	-0.07900	-0.07947	1.00000	0.69575	-0.00506	-0.03920	0.09142
	0.4566	0.4540	0.0	0.0001	0.9620	0.7138	0.4199
	91	91	91	82	91	90	80
DDIST	0.15694	0.15630	0.69575	1.00000	0.06616	-0.03063	0.15831
	0.1591	0.1608	0.0001	0.0	0.5548	0.7860	0.1841
	82	82	82	82	82	81	72
CTYPCODE	0.08210	0.06998	-0.00506	0.06616	1.00000	-0.26261	0.77296
	0.4365	0.5098	0.9620	0.5548	0.0	0.0119	0.0001
	92	91	91	82	92	91	81
CARAGE	-0.08122	-0.07199	-0.03920	-0.03063	-0.26261	1.00000	-0.17595
	0.4441	0.5002	0.7138	0.7860	0.0119	0.0	0.1185
	91	90	90	81	91	91	80
ENGCAP	0.14609	0.11867	0.09142	0.15831	0.77296	-0.17595	1.00000
	0.1931	0.2944	0.4199	0.1841	0.0001	0.1185	0.0
	81	80	80	72	81	80	81

	GAMBLE	SUNHAT	SUNSCRN	ALCOHOL
GAMBLE	1.00000	-0.04388	-0.26401	0.13312
	0.0	0.6107	0.0019	0.1984
	141	137	136	95
SUNHAT	-0.04388	1.00000	0.57469	-0.06342
	0.6107	0.0	0.0001	0.5481
	137	137	136	92
SUNSCRN	-0.26401	0.57469	1.00000	0.02437
	0.0019	0.0001	0.0	0.8167
	136	136	137	93
ALCOHOL	0.13312	-0.06342	0.02437	1.00000
	0.1984	0.5481	0.8167	0.0
	95	92	93	96

APPENDIX 3: WTP VALUES BY SUBGROUP

TABLE 3.A: DRIVER

QUESTION	MEAN $	(s.d)	TRIMMED MEAN $	(s.d)	MEDIAN $	GEOMETRIC MEAN $
Self (20%)	235	(230)	195	(174)	150	145
Self (50%)	350	(395)	220	(173)	200	207
Pass (20%)	182	(202)	116	(127)	100	148
Pass (50%)	260	(308)	132	(135)	150	183
RBT	141	(221)	98	(148)	50	82
B'spot	173	(266)	104	(148)	50	94
R'bout	179	(389)	97	(144)	50	82
LATM	99	(164)	85	(145)	40	64

TABLE 3.B: NONDRIVER

QUESTION	MEAN $	(s.d)	TRIMMED MEAN $	(s.d)	MEDIAN $	GEOMETRIC MEAN $
Self (20%)	413	(330)	360	(258)	300	281
Self (50%)	580	(497)	480	(310)	500	392
Pass (20%)	441	(425)	371	(290)	250	291
Pass (50%)	590	(541)	484	(333)	500	391
RBT	115	(176)	83	(71)	50	77
B'spot	120	(189)	80	(77)	50	80
R'bout	109	(194)	69	(76)	50	80
LATM	91	(171)	58	(69)	40	74

TABLE 3.C: STUDENT

QUESTION	MEAN $	(s.d)	TRIMMED MEAN $	(s.d)	MEDIAN $	GEOMETRIC MEAN $
Self (20%)	210	(221)	185	(135)	100	155
Self (50%)	324	(320)	259	(190)	250	222
Pass (20%)	223	(283)	181	(164)	100	193
Pass (50%)	306	(362)	228	(213)	150	258
RBT	90	(115)	68	(64)	50	59
B'spot	97	(116)	77	(65)	50	57
R'bout	76	(111)	56	(54)	30	47
LATM	70	(111)	49	(49)	30	36

TABLE 3.D: SELF-COMPLETE

QUESTION	MEAN $	(s.d)	TRIMMED MEAN $	(s.d)	MEDIAN $	GEOMETRIC MEAN $
Self (20%)	290	(260)	245	(180)	175	210
Self (50%)	444	(461)	371	(293)	275	309
Pass (20%)	277	(239)	252	(174)	175	206
Pass (50%)	432	(450)	376	(296)	275	294
RBT	92	(131)	37	(67)	30	61
B'spot	120	(220)	46	(65)	50	64
R'bout	53	(74)	31	(35)	21	44
LATM	37	(88)	11	(18)	0	42