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The value of mortality risk reductions in Delhi, India

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Abstract We interviewed commuters in Delhi, India, to estimate their willingness to pay (WTP) to reduce their risk of dying in road traffic accidents in three scenarios that mirror the circumstances under which traffic fatalities occur in Delhi. The WTP responses are internally valid: WTP increases with the size of the risk reduction, income, and exposure to road traffic risks, as measured by length of commute and whether the respondent drives a motorcycle. As a result, the value of a statistical life (VSL) varies across groups of beneficiaries. For the most highly-exposed individuals the VSL is about 150,000 Purchasing Power Parity (PPP) dollars.

Keywords Mortality risk valuation · Traffic safety

JEL Classification R41 · I18

Each year over 1 million people die in road crashes. Over 75% of these deaths occur in developing countries, where vulnerable road users (pedestrians, motorcyclists and cyclists) constitute the majority of fatalities. According to recent estimates, the situation is likely to get worse: Kopits and Cropper (2003) predict that road traffic fatalities will increase by more than 80% in developing countries between 2000 and 2020. This estimate, however, assumes that historic trends in road safety will continue. Actions could be taken to reduce fatalities, but such actions are often difficult to justify unless the benefits of road safety improvements can be quantified.

For governments in developing countries to make informed decisions about investments in traffic safety, it is imperative that the benefits of road traffic improvements be monetized

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and compared with the costs. This, however, requires estimates of the value of reductions in risk of death. Ideally, a reduction in the risk of dying in a traffic accident should be valued by what a person would pay for it. This value should reflect not only the loss in income to the person's family, but the loss of enjoyment from living the remainder of his life. Since estimates of willingness to pay to reduce risk of death do not exist for most developing countries, foregone earnings—the human capital approach—is used instead to value lives lost. The concern is that this may understate the value of improvements in road safety.

This paper reports the results of a contingent valuation survey in Delhi, India that was designed to provide estimates of the value of mortality risk reductions in a traffic safety context. These estimates can be used both to calculate the benefits of specific traffic safety improvements and to compute the social cost of traffic crashes.

To estimate the value of road safety improvements in Delhi requires understanding the nature of developing country traffic risks. As with cities in most developing countries, in Delhi pedestrians constitute over half of all traffic fatalities. Bicyclists and the drivers and passengers of two-wheelers constitute 30% of fatalities, whereas the drivers/occupants of cars account for only 5% of fatalities.[1] This suggests that the methods of valuing traffic fatalities used in high income countries—methods based on seatbelt use (Blomquist, 1979) or the purchase of safer cars (Atkinson and Halvorsen, 1990; Andersson, 2005)—are not applicable here. A more reasonable approach is to confront people with the types of choices that they must make in daily life—for example, whether to purchase a safer motorcycle helmet—and to infer the value of safety from such choices.

In our survey we asked 1,200 commuters what they would pay to reduce their own risk of dying (a) as a pedestrian, (b) as a driver of a two-wheeler, and (c) as a commuter, regardless of travel mode. We pool the responses to these questions to estimate the value of a statistical life in a traffic safety context. We find that mean willingness to pay to reduce one's risk of dying increases with income and education, and also with baseline exposure to risk, measured by commute time, by whether the respondent travels as part of his job and by whether he drives a two-wheeler. Mean willingness to pay (WTP) is three times larger for a respondent who drives a two-wheeler and travels on the job than for one who does not. We also find that responses are sensitive to the size of the risk change valued. For all respondents the elasticity of WTP with respect to the size of the risk change is approximately 0.55. For respondents with a high school degree this increases to 0.80, while for respondents with a bachelor's degree the elasticity of WTP with respect to the risk change is not significantly different from one.

Our preferred estimate of the value of a statistical life (VSL)—approximately 1.3 million Rupees or $150,000 Purchasing Power Parity (PPP) USD—is based on the mean WTP of a commuter with a high school degree who drives a two-wheeler and travels while on the job. This represents the benefits to a person with high exposure to traffic risks of a reduction in risk of death. This number exceeds the value of a statistical life currently used in evaluating the benefits of road safety projects by the World Bank (generally, foregone earnings) or in Indian studies (Mohan (2001) uses Rs. 535,000). It is, however, smaller than the VSL that would be used if official values were transferred from high income countries to India assuming an income elasticity of one.

The paper is organized as follows. Section 1 places our study in the context of the transport literature on mortality risk valuation. Section 2 provides background information on traffic

[1] Throughout the paper we use the term "two-wheeler" to refer to motorized two-wheelers, i.e., motorcycles and motor scooters.

risks in Delhi, describes our target population, sampling plan, the structure of the questionnaire and the details of its administration. Section 3 describes our sample respondents—their socio-economic characteristics, commuting patterns and experience with traffic crashes. It also summarizes the raw responses to our WTP questions. In Section 4 we analyze the WTP responses and provide estimates of the value of a statistical life (VSL). Section 5 concludes.

1 Estimates of the VSL in a road safety context

Reductions in risk of death in the context of road safety have been valued using both revealed and stated preference approaches. Studies in high income countries have used expenditures on safer automobiles, child safety seats and bicycle helmets to infer the value placed on reductions in risk of death. Hedonic studies of automobile prices (Atkinson and Halvorsen, 1990; Dreyfus and Viscusi, 1995; Andersson, 2005) decompose automobile price into the price of various vehicle characteristics, including the probability of a fatal accident. The marginal cost of a risk reduction should equal the value of the reduction to the purchaser at the margin. Studies involving bicycle helmets and car seats (Jenkins et al., 2001; Blomquist et al., 1996) are based on the assumption that, for the marginal buyer, the value of the risk reduction achieved equals the cost of buying it. This allows the researcher to infer the value of safety from purchases of such safety equipment.

Studies have also attempted to infer the value of safety from seatbelt usage (Blomquist, 1979, 1991) and vehicle speeds (Ghosh et al., 1975; Ashenfelter and Greenstone, 2002). To accomplish the former, the time cost of using a seatbelt (assumed equal at the margin to the benefits of using the belt) must be monetized. Likewise, the time saving associated with faster speeds must be monetized to infer the rate at which people are trading money for higher risk of death at faster speeds.

Revealed preference studies are difficult to implement in a developing country context. The data required to implement a hedonic pricing study of the automobile market would be difficult to obtain in India. Even if such data existed, they would apply to a small segment of the population. (Only 13% of households in Delhi own cars.) More importantly, revealed preference studies have a serious drawback even in a developed country setting. These studies measure the risk reductions associated with safety equipment or safer vehicles by the *objective* risk reductions achieved. The studies implicitly assume that consumers' risk perceptions match objective risks—that consumers think they are buying the risk reduction that is measured by objective methods. Studies have, however, cast doubt on laypersons' abilities to accurately estimate small probabilities (Viscusi and O'Connor, 1984). If this is the case, the values from revealed preference studies correspond to risk changes of an unknown magnitude.

This has led to the use of stated preference studies. In a pioneering study to value mortality risks in a transport context, Jones-Lee et al. (1985) asked respondents what they would pay to travel on a safer bus, i.e., what they would pay to reduce their risk of death on a bus trip from (e.g.) 8 in 100,000 to 4 in 100,000 and from 8 in 100,000 to 1 in 100,000. Other studies have asked respondents about their WTP for living in a city with lower risk of mortality from road accidents (Guria et al., 2005; Viscusi, 1995), or what they would pay to install an optional safety device in their car (Dubourg et al., 1997; Corso et al., 2001; Persson et al., 2001).[2]

[2] See also Schwab Christie and Soguel (1995).

The vast majority of WTP studies in the context of road safety have been conducted in high income countries; few have been conducted in developing countries. Exceptions include stated preference studies in Chile, Thailand and Malaysia (Ortuzar et al., 2000; Vassanadumrongdee and Matsuoka, 2005; Melhuish et al., 2005). In spite of the very different pattern of road traffic deaths in developing countries, these studies have relied on the same scenarios as studies in high income countries.[3] We have attempted to construct scenarios that reflect the profile of road accidents in developing countries, where pedestrians and motorcyclists bear the brunt of road fatalities.

2 The survey

2.1 Traffic fatalities in Delhi, India

Over the past three decades, Delhi, India has experienced a nine-fold increase in motor vehicles. This has led not only to vehicular pollution, but also to road accidents. According to the statistics released by the Delhi Police (2002), about 2000 persons are killed each year in traffic crashes in Delhi. This implies a death rate of approximately 14 persons per 100,000, about the same as the United States. In terms of fatalities per vehicle, however, the death rate in Delhi—60 fatalities per 100,000 vehicles—is more than three times the equivalent figure for the U.S.

In Delhi, as in many developing countries, the majority of traffic fatalities occur among vulnerable road users. In 2001, 50% of fatalities occurred among pedestrians, 12% among bicyclists or cycle rickshaw drivers, and 21% among drivers of motorized two-wheelers. The vehicles at fault were most often trucks and buses: In 2001 they accounted for 70% of accidents in which the vehicle at fault was recorded, while cars were responsible for only 15% of fatal accidents.

The incidence of traffic fatalities by gender is especially relevant for our study. In Delhi, 10 men die in a traffic crash for every woman who dies. To be more precise, the road traffic death rate for adult males is 36 per 100,000, whereas it is only 3.6 per 100,000 for adult women.[4] This likely reflects differences in exposure, i.e., in kilometers traveled, as well as in risk-taking behavior. It also implies that estimates of willingness to pay for improvements in road safety should focus on the willingness to pay of men, as they are likely to be the main direct beneficiaries of reductions in the risk of fatal accidents.

2.2 The commodity valued

The objective of the survey was to estimate respondents' WTP for reductions in their own risk of dying, in contexts appropriate to Delhi. Three scenarios were used, each implying a private risk reduction. In the first, the respondent was asked to imagine that he had to cross a busy street on his way to work each day. He could cross the street, with an attendant risk of

[3] Vassanadumrongdee and Matsuoka (2005) elicit willingness to pay for an airbag, while Melhuish et al. (2005) use a scenario similar to Jones-Lee et al. (1985). Ortuzar et al. (2000) ask respondents what they would pay to travel on a safer road but do not associate this with a reduction in the respondent's personal risk reduction.

[4] The death rate for children is approximately 2 per 100,000.

dying, or could use a pedestrian subway. The respondent was asked what he would pay for an annual subway pass that would reduce his risk of dying to zero.

In the second scenario the respondent was asked to imagine that he had to move to one of two cities. He was told that the cities were identical in all respects, except in their risk of dying in a traffic crash and in commuting costs.[5] He was then told:

> In City A the cost of commuting to and from work is Rs. 2400 a year. Your chance of dying while commuting is 35/100,000 each year.
>
> In City B your chance of dying while commuting is 5/100,000 a year.
>
> How much extra money would you be willing to pay every year in transportation costs to live in the safer city?

In the third scenario the respondent was asked to imagine that he drove a two-wheeler to work each day and that it was time to buy a new helmet. (By law, all drivers and passengers on two-wheelers in Delhi are required to wear helmets, except Sikhs.) He could buy a helmet for Rs. 300 with a stated risk of dying in a traffic crash, or could reduce his risk of dying by a specified amount by buying a safer helmet. The respondent was asked how much more he would pay for the safer helmet.

In sum, the respondent trades road safety for money in the contexts in which most traffic fatalities occur in Delhi. Our scenarios differ from those in stated preference studies in the U.K., Sweden and New Zealand, in which respondents were asked how much they would pay for a safer coach ride (Jones-Lee et al., 1985) or for a hypothetical safety device worn by drivers or passengers that would reduce the risk of dying in a road traffic accident by a specified level or percentage (Johannesson et al., 1996; Persson et al., 2001). In our survey respondents value a private risk reduction, in contrast to Johannesson et al. (1996) who estimate WTP for public road safety interventions that would reduce the death toll nationwide by a given amount.

To test for sensitivity to the size of the risk change, we varied the risk reduction delivered by each scenario (see Table 1). The risk levels presented to respondents ranged from 6 to 35 in 100,000, spanning the actual risk levels of men and women in Delhi. Respondents received either the lower risk reduction for all scenarios, shown in Table 1, or the higher one. The cost of commuting in City A was also varied across respondents. The nature of the three scenarios dictates the relative magnitude of the baseline risks and risk reductions that appear in Table 1: baseline risks and risk reductions are highest in the City scenario, in which risks are attributable to all travel modes. The annual risk reductions delivered by the pedestrian scenario are lower than in the city scenario, and the helmet scenario, which lowers risk of death due to head injuries only, delivers the lowest annual risk reduction of the three scenarios.[6]

[5] The city A v. city B choice question is modeled after Viscusi et al. (1991), who used a similar approach to elicit the additional cost of living at which respondents would be indifferent between a city with a specified risk of dying in a road traffic accident and another city with a lower death rate in a crash. City A v. City B questions were also used to elicit the rate at which people trade road safety for the risk of contracting chronic bronchitis.

[6] A corollary of this is that both the scenario dummies and baseline risk are highly correlated with the size of the risk change (delta risk) presented to the respondent.

Table 1 Study design

Scenario	Version	R_1	R_2	Risk reduction	Baseline value provided[a]
Pedestrian	1	15/100,000	0/100,000	15/100,000	none
	2	15/100,000	0/100,000	15/100,000	
	3	7/100,000	0/100,000	7/100,000	
	4	7/100,000	0/100,000	7/100,000	
City A/B	1	35/100,000	5/100,000	30/100,000	Rs. 2,400/yr
	2	35/100,000	5/100,000	30/100,000	Rs. 4,800/yr
	3	20/100,000	5/100,000	15/100,000	Rs. 2,400/yr
	4	20/100,000	5/100,000	15/100,000	Rs. 4,800/yr
Helmet	1	10/100,000	2/100,000	8/100,000	Rs. 300
	2	10/100,000	2/100,001	8/100,000	Rs. 300
	3	6/100,000	2/100,002	4,100,000	Rs. 300
	4	6/100,000	2/100,003	4,100,000	Rs. 300

[a]City A/B scenario: annual commute cost; helmet scenario: price of the helmet.

2.3 The questionnaire

Because the main beneficiaries of road safety programs are those persons who are most exposed to traffic, our survey targeted commuters.[7] Specifically we required respondents to be between the ages of 18 and 65, to be employed and to commute regularly to their place of work. The questionnaire, which was administered through in-person interviews, began by asking respondents about a typical journey to work, including the time and money cost of each leg of the trip. Respondents were also asked about travel they undertook while on the job.

The next section of the questionnaire introduced probability concepts and administered a short probability quiz. This was followed by a discussion of fatal traffic risks faced by Delhiites. Risks were communicated using a grid of 100,000 squares, each 1 mm by 1 mm. Squares were colored in red to indicate risk of death in a traffic accident.[8] The use of a grid of squares has been found to be a successful risk communication tool in other stated preference surveys involving mortality risks (Alberini et al., 2004; Krupnick et al., 2002; Corso et al., 2001) and has also been used previously in a developing country context (Melhuish et al., 2005). Earlier road traffic safety studies have also used grids of 100,000 squares (Jones-Lee et al., 1985; Persson et al., 2001).

Risk communication exercises were followed by the three WTP scenarios. In all three scenarios a payment card (shown in the Appendix) was used to elicit WTP. In pretests of the questionnaire, we found that standard dichotomous choice questions did not work well: The percentage of “yes” respondents was insensitive to the bid assigned to the respondents, and over half of respondents who said “yes” to a given bid value in a dichotomous choice framework later stated that their maximum WTP was less than the bid value. We therefore

[7] In cities in developing countries, work trips constitute a higher percent of kilometers traveled than in the U.S. Baker et al. (2005) report that in Mumbai work trips constitute 67.5% of all trips made by adults, weighted by distance traveled.

[8] In earlier versions of the questionnaire, we attempted to communicate risks of death by placing black grains of rice in a jar containing 100,000 white grains of rice. This device was useful in communicating the order of magnitude of fatal traffic risks, but difficult to use to represent specific risks changes in different scenarios.

switched to a payment card, which we found to work reasonably well in a subsequent pretest.[9] Respondents were also allowed to state a bid not shown on the card.

The survey ended with questions asking respondents about their experience with traffic crashes, as well as the experience of persons in their family. This was followed by questions asking respondents whether they thought that particular policies would be effective in reducing traffic fatalities in Delhi.

2.4 Sample selection and questionnaire administration

Our respondents were selected by sampling households at random from the urban population of Delhi and inquiring whether the household contained a person meeting our selection criteria. Four hundred enumeration blocks (EBs) were selected, in proportion to population, from the 132 urban wards in Delhi. Households in each EB were counted, and a systematic sampling rule used to select the households to be interviewed. We administered a screening questionnaire to determine whether the household contained a person between the ages of 18 and 65 who was employed and commuted regularly to his or her place of work. We also required respondents to have at least an 8th grade education, in order to understand the risk information provided in the survey, and to have resided in Delhi for at least three months. The questionnaire was administered to 1,200 respondents during October–December of 2005, following two pretests involving 601 households.

3 Sample characteristics and responses

3.1 Individual characteristics of the respondents

Descriptive statistics of the sample respondents are displayed in Table 2. The top panel of Table 2 reports information about demographic and socioeconomic characteristics of the sample. Briefly, we note that the average age of the respondent is 35 and that 95% of the respondents are male. The high proportion of males reflects the fact that only 15% of women in Delhi work outside the home (National Sample Survey, 2005). About 48% of respondents have a high school diploma or vocational degree, and 28% a bachelor's degree or better. Mean household income is Rs. 135,000 a year, or approximately $15,350 in purchasing power parity terms. Mean earnings (personal income) are approximately $10,250 in PPP terms.

As shown in the table, we place our respondents in three income groups, depending on personal income. Individuals earning less than Rs. 8,000 a month constitute our low-income group, which accounts for 44% of the sample. Individuals with monthly personal income between Rs. 8,000 and 20,000 are considered to have middle income (48% of the sample). Those with monthly personal income greater than Rs. 20,000 (8% of the sample) make up the high income group. Finally, about 67% of the sample is the primary wage earner for their household.

[9] Because respondents are shown an array of possible payment amounts, rather than a single figure, the payment card approach is generally held to be free from anchoring effects or starting point biases associated with other elicitation approaches (Boyle, 2003) as long as the range of bids on the card is not arbitrarily cut off (Rowe et al., 1996; Roach et al., 2002). To avoid this problem, our payment card included Rs. 0 and explicitly allowed respondents to announce a willingness to pay amount greater than Rs. 3000. We also experimented with two variants of the payment card in our pretest, and found that changes in the bids on the payment card did not have a statistically significant effect on mean WTP.

Table 2 Demographic characteristics

Variable	N Obs	Mean	Std. Dev.
Socioeconomic profile			
Age (years)	1,200	35.09	11.03
Male	1,200	0.95	0.22
Currently married	1,200	0.77	0.42
Household size	1,200	5.01	2.54
Completed High School and above	1,200	0.48	0.50
Completed Bachelor's Degree and above	1,200	0.28	0.45
Personal Income (Annual, Rupees)	1,200	90,190	84,624
Household Income (Annual, Rupees)	1,200	134,970	125,960
Low Personal Income (< Rs. 8,000 p.m.)	1,200	0.44	0.50
Middle Personal Income (Rs. 8,000–Rs. 20,000 p.m.)	1,200	0.48	0.50
High Personal Income (> Rs. 20,000 p.m.)	1,200	0.08	0.28
Primary wage earner	1,200	0.67	0.47
Commuting and Vehicle Ownership			
Commute time (minutes)	1,200	36.02	28.39
Travel while on the job	1,200	0.31	0.46
Monthly commuting cost (Rupees)	1,200	490.55	771.49
Drive two-wheeler	1,200	0.51	0.50
Drive two-wheeler to work	1,200	0.25	0.43
Drive car to work	1,200	0.07	0.26
Take a bus to work	1,200	0.26	0.44
Walk to work	1,200	0.26	0.44
HH owns a motor vehicle	1,200	0.50	0.50
HH owns a two-wheeler	1,200	0.43	0.50
HH owns a car/jeep/van	1,200	0.15	0.35
Accident History			
Ever had an accident	1,200	0.23	0.42
Ever been injured in an accident	1,200	0.17	0.38
Know a friend or family member who has had an accident	1,200	0.14	0.34
Believe higher than average risk as:			
Pedestrian	1,200	0.23	0.42
Driver	1,200	0.17	0.37
Passenger	1,200	0.25	0.43
Wear seatbelts when in front seat of car	1,200	0.60	0.49
Wear and strap helmet when riding a two-wheeler	1,200	0.48	0.50

The center section of Table 2 reports information about commuting and vehicle ownership. The average commute takes 36 min and costs Rs. 490 a month. These figures, however, mask the high variance in commuting times and costs across modes: Approximately one-quarter of respondents walk to work, one-quarter take the bus and one-quarter drive a two-wheeler. Only 7% drive a car to work. About 30% of respondents travel while on the job.

Vehicle ownership in our sample is higher than reported in the 2001 Indian census, as would be expected given our education and employment criteria: About 43% of the respondents live in households that own a two-wheeler, and 15% in households that own a car.[10] Over half of our respondents drive a two-wheeler, which bodes well for the salience of our two-wheeler helmet scenario.

[10] The 2001 Census reports that 28% of households in Delhi own a two-wheeler and 13% own a car.

Experience with traffic accidents may influence the rate at which people are prepared to trade income for risk reductions, so we examine our respondents' accident history, safety behavior and opinions about safety in the bottom section of Table 2. Twenty-three percent of our respondents report having been in an accident, with 17% actually suffering an injury. In addition, almost 14% have a family member or a friend who has had a road traffic accident.

Regarding their own assessment of road traffic risks, 17, 23 and 25 percent of the respondents rate their own risks as higher than the average driver, pedestrian and passenger, respectively. These figures seem reasonable, as do the percentage of respondents who claim to use seatbelt when driving or riding in the front seat of a car (60%) and to wear and properly strap a helmet when riding a two-wheeler (48%).

3.2 The WTP responses

We report descriptive statistics for the responses to the payment questions in Table 3. This table displays the mean WTP, and the implied VSL, as well as the percentage of zero WTP responses, by the size of the risk reduction. The top section of Table 3 uses the full sample (1,200 respondents times 3 scenarios, for a total of 3,600 observations), the center section only the responses to the payment questions provided by persons with at least a high-school diploma (580 persons and 1,740 WTP observations), and the bottom section only the WTP figures of persons with college degree or better (335 persons and 1,005 WTP responses).

The WTP data exhibit clear patterns. First, they are generally increasing in the size of the risk reduction, with the exception of the WTP for the 8/100,000 risk reduction. Second, WTP

Table 3 Mean willingness to Pay and VSL

Deltarisk	N Obs	Scenario	Mean Willingness to pay (Rupees)	Value of a statistical life (PPP$. based on mean WTP)[a]	% Zeroes
All observations					
4/ 100,000	600	Helmet	30.76	87,393	25.67
7/ 100,000	600	Pedestrian	36.48	59,218	51.00
8/ 100,000	600	Helmet	30.13	42,791	27.33
15/ 100,000	1,200	Pedestrian & City A/B	116.77	88,462	43.25
30/ 100,000	600	City A/B	186.34	70,581	38.17
Only persons with high school diploma & above					
4/ 100,000	256	Helmet	31.00	88,068	22.66
7/ 100,000	256	Pedestrian	29.61	48,068	51.95
8/ 100,000	324	Helmet	35.00	49,716	25.62
15/ 100,000	580	Pedestrian & City A/B	117.15	88,750	43.45
30/ 100,000	324	City A/B	241.40	91,439	34.57
Only persons with an undergraduate degree & above					
4/ 100,000	121	Helmet	31.20	88,636	24.79
7/ 100,000	121	Pedestrian	23.72	38,506	48.76
8/ 100,000	214	Helmet	37.38	53,097	27.57
15/ 100,000	335	Pedestrian & City A/B	89.97	68,159	43.58
30/ 100,000	214	City A/B	293.15	111,042	32.71

[a]VSL is calculated by dividing Mean WTP by the risk reduction.

PPP$ used in this analysis for converting from Rupees is 8.8 (Source: WDI).

Table 4a Probit model for those whose willingness to pay is zero in all three scenarios

Variable	Coeff	Standard error	*P*-value
Intercept	0.692	0.491	0.159
Age	−0.054	0.025	0.030
Age squared	0.001	0.0003	0.045
Low income dummy	−0.046	0.185	0.803
Middle income dummy	0.085	0.174	0.625
Primary wage earner ∗ household size	0.036	0.016	0.020
High school diploma	−0.233	0.099	0.018
Has had an accident (or knows someone who did)	−0.041	0.095	0.666
Whether travels as part of the job	0.037	0.099	0.713
Commute time (minutes)	−0.005	0.002	0.001
High risk version of questionnaire	−0.020	0.088	0.819
Whether drives a two-wheeler	−0.812	0.092	<.0001
− 2 Log-Likelihood		1087.901	
Percent Correctly Predicted		71.80	

Table 4b Probability of paying nothing in all three scenarios
The effect of age and mode[a]

	18 years old	35 years old	50 years old
Drives a two-wheeler	0.15	0.08	0.09
Does not drive a two-wheeler	0.41	0.29	0.30

[a]*Assume:* HS diploma, middle income, primary earner with household of 5, does not travel on the job, commute time equal to average.

The effect of education[b]

Has a High School Diploma or Higher	0.08
Does Not have a High School Diploma	0.13

[b]*Assume:* 35 years old, middle income, primary earner with household of 5, does not travel on the job, drives a two-wheeler, commute time equal to average.

does not increase in a strictly proportional fashion with the size of the risk reduction, at least for the lowest risk reductions considered in this study. Taken together, these two points imply that the VSL is not necessarily constant with respect to the size of the risk reduction. Third, at least a quarter of the respondents who were shown a specified risk reduction declined to pay anything at all for this risk reduction. The percentage of zero WTP responses is especially high for the pedestrian scenario (50% across all respondents), but also substantial for the city scenario (38% of all respondents) and for the helmet scenario (27% of all respondents). Approximately 20% of respondents announced a WTP of zero for all three scenarios.[11]

To determine how we should treat persons who were unwilling to pay anything to reduce their risk of dying we estimated a probit equation to identify the characteristics of the 242 respondents who reported zero WTP for all three risk reductions. The results of this probit

[11] A possible explanation for these results is provided by Viscusi (1989) whose prospective reference theory describes how people may update the risk information we provide them in a Bayesian fashion. We return to this point below.

equation are displayed in Table 4a. Briefly, there is evidence of a U-shaped quadratic relationship between the likelihood of being unwilling to pay anything at all for the risk reductions and age. The probability of three zero WTP responses is lowest for respondents aged 42, and is higher for respondents that are younger and older than 42.[12] Respondents tended to be more reluctant to pay for risk reductions as the number of their dependents increased, as shown by the positive and significant coefficient on (being the primary breadwinner in the family) × (household size). This suggests that the effect of additional dependents on per capita household income outweighed their impact on the respondent's bequest motive.[13]

Higher education and high exposure to road traffic risks (proxied by commute time, and driving a two-wheeler) make people *more* likely to pay for risk reductions, whereas previous experience with accidents is not important. As Table 4b indicates, driving a two-wheeler has a dramatic impact on whether a respondent is unwilling to pay for reductions in risk of death: An 18-year-old who does not drive a two-wheeler has a predicted probability of 0.41 of having zero WTP; this probability falls to 0.15 if he drives a two-wheeler. The corresponding figures for a 35-year-old are 0.29 and 0.08. Education, by contrast, has a quantitatively smaller effect: for a 35-year-old driver of a two-wheeler, not having a high school diploma raises the probability of zero WTP by only 5 percentage points. We also checked whether the propensity to pay for the risk reduction differed for those persons who were shown the versions of the questionnaire with the higher baseline risks and risk reductions, but we did not detect any statistically significant pattern.

Taken together, these results suggest that the responses of people who will pay nothing to reduce their risk of dying in a traffic accident must be treated as serious responses rather than protest bids or indications of scenario rejection. We therefore include these individuals in our analysis of WTP responses.

4 Analysis of willingness to pay responses

4.1 A model of willingness to pay

Willingness to pay, WTP, is defined as the amount of money that must be taken away from an individual when his risk of death is lowered to keep his utility unchanged. Let $V(y, p)$ denote the individual's indirect utility, which depends on income and the risk of dying in an auto accident, p. Formally,

$$V(y - \text{WTP}, p_1) = V(y, p_0), \tag{1}$$

where y is income, p_0 is the baseline risk and p_1 is risk after the reduction. Willingness to pay should thus depend on the baseline and final risk, income, and individual characteristics. Since $p_1 = p_0 - \Delta p$, where Δp is the risk reduction, it follows that, conditional on individual

[12] This quadratic relationship is the mirror image of the quadratic relationship that earlier studies—including Jones-Lee et al. (1985) with contingent valuation and Viscusi and Aldy (forthcoming) with compensating wage studies—have observed between age and WTP for a reduction in mortality risks. Kniesner et al. (2006) condition their compensating wage equation on consumption expenditure.

[13] In the absence of life insurance, having more dependents should increase WTP to reduce mortality risk in order to provide for one's dependents in the future.

characteristics,

$$\text{WTP} = \text{WTP}(p_0, \Delta p, y). \tag{2}$$

We assume that for respondent i:

$$\text{WTP}_i = \exp(\mathbf{x}_i \beta_1) \times (p_{0i})^{\beta_2} \times (\Delta p_i)^{\beta_3} \times \exp(\varepsilon_i) \tag{3}$$

where $\mathbf{x}$ is a $1 \times k$ vector of individual characteristics thought to influence WTP (including income) and ε is an econometric error term.

4.2 Baseline risks and risk reductions

By design, both baseline risk and the risk reduction are varied within and across respondents. We assume that when answering the WTP questions our respondents accept the risk reductions stated to them in the survey questionnaire, but assess baseline risks subjectively by combining their prior beliefs on exposure to road traffic risks—which we denote as π_i—with the baseline risk stated to them in the questionnaire. In other words, we replace p_0 in Eq. (3) with p_0^*, the subjectively assessed baseline risk, which is obtained through Bayesian updating:

$$p_{0i}^* = \frac{\alpha \pi_i + \theta p_{0i}}{\alpha + \theta}, \tag{4}$$

where α and θ are the weights assigned to the prior and to the questionnaire information, respectively.[14]

We do not observe π_i and p_{0i}^*, so for estimation purposes we proxy the latter with p_{0i}, the baseline risk assigned to the respondent in the survey,[15] and with $\mathbf{C}_i$, a vector of variables capturing exposure to road traffic risks, such as commute time and commute mode.[16] In sum, the WTP equation is

$$\text{WTP}_i = \exp(\mathbf{x}_i \beta_1) \times (p_{0i})^{\delta_1} \times \exp(\mathbf{C}_i \delta_2) \times (\Delta p_i)^{\beta_3} \times \exp(\varepsilon_i), \tag{5}$$

which, on taking logs, becomes

$$\log \text{WTP}_i = \mathbf{x}_i \beta_1 + \delta_1 \log p_{0i} + \delta_2 \mathbf{C}_i + \beta_3 \log \Delta p_i + \varepsilon_i. \tag{6}$$

[14] The weight assigned to the prior depends on the precision of the prior itself. See Viscusi and O'Connor (1984).

[15] Our approach can be compared with that in Gayer et al. (2000), who do not observe the mortality risks residents associate with proximity to contaminated sites on the Superfund National Priorities List, and assume them to be equal to the average risks from Superfund sites. This prior belief is assumed to be updated with information disseminated by the U.S. Environmental Protection Agency at the end of site assessment. Gayer, Hamilton and Viscusi use the hedonic price approach.

[16] This may be interpreted as implying that prior risks are obtained as the product of risk per mile driven (which presumably depends on the mode of transportation used) times distance driven (which we proxy with commute time, and, as explained below, with whether the respondent travels as part of his job).

Since individuals are queried about their willingness to pay for a total of three risk reductions, we further amend Eq. (6) to reflect the panel structure of our data:

$$\log \mathrm{WTP}_{ij} = \mathbf{x}_i\beta_1 + \delta_1 \log p_{0ij} + \delta_2\mathbf{C}_i + \beta_3 \log \Delta p_{ij} + \varepsilon_{ij}, \tag{7}$$

where $i = 1, 2, \ldots, n$ and $j = 1, 2, 3$.

4.3 Estimated model and testable hypotheses

Practical considerations and the need to create credible scenarios dictated that in our survey questionnaire larger baseline risks should be accompanied by larger risk reductions. This means that in our study the baseline risks are very highly correlated with risk reductions, which forces us to omit the former from regression Eq. (7),[17] and to estimate

$$\log \mathrm{WTP}_{ij} = \mathbf{x}_i\beta_1 + \delta_2\mathbf{C}_i + \beta_3 \log \Delta p_{ij} + \varepsilon_{ij} \tag{8}$$

We expect β_3 to be positive. The magnitude of this coefficient determines the sensitivity of willingness to pay to scope, i.e., to the size of the risk reduction. If $\beta_3 = 1$, willingness to pay is strictly proportional to the size of the risk reduction (Hammitt and Graham, 1999). Theory suggests that proportionality should hold for very small changes in risk, but there is no particular reason to expect that it should hold when the risk change is perceived to be large. Indeed, WTP fails to increase significantly with the size of the risk reductions in many CV surveys (Hammitt and Graham, 1999).

We also expect WTP to be higher among persons with higher exposure to road traffic risks, i.e., persons with a longer commute to work, persons with significant road travel as part of their jobs, and persons who drive a two-wheeler, since WTP should be increasing in p_0 for expected utility maximizers (Jones-Lee, 1976). The willingness to pay for a risk reduction should also increase with income, and may depend on the respondent's age and previous experience with road accidents.

Finally, WTP may be influenced by the respondent's education, to the extent that it affects prior assessment of risks and acceptance of the risk reductions stated to the respondents in the questionnaire. For this reason, we enter education and education interacted with risk reduction in the right-hand side of the WTP regression equation.

4.4 Estimation strategy

To estimate Eq. (8) we must determine how to treat respondents who say they will pay nothing for a risk reduction. We must also determine whether to treat the non-zero responses selected from the payment card as the individual's true WTP or to assume that the individual's true WTP lies in the interval between the chosen response and the next higher number on the payment card. Our preferred approach is to treat respondents who announce a WTP of zero as having a WTP in the interval between 0 and Rs. 5 (the lowest interval on the payment card).

Regarding non-zero responses, we estimate both models in which these are treated as the individual's true WTP and models in which WTP is assumed to lie in the interval between the chosen number and the next higher number on the payment card. We estimate our models

[17] In other words, in our empirical analysis we impose the restriction that δ_1 is equal to zero.

by the method of maximum likelihood. In the first case, the log likelihood function of the data is:

$$\sum_{i=1}^{n}\sum_{j=1}^{3}\left[Z_{ij}\cdot\log F(5;\lambda)+(1-Z_{ij})\cdot\log f(\mathrm{WTP}_{ij};\lambda)\right], \tag{9}$$

where Z is a dummy indicator that takes on a value of one for a zero WTP response, $F(\cdot)$ and $f(\cdot)$ are the cdf and pdf of WTP, respectively, λ is a vector of parameters indexing the distribution of WTP, and WTP is the observed continuous WTP amount.

In the second case, the log likelihood function is

$$\sum_{i=1}^{n}\sum_{j=1}^{3}\log\left[F\left(\mathrm{WTP}_{ij}^{H};\lambda\right)-F\left(\mathrm{WTP}_{ij}^{L};\lambda\right)\right] \tag{10}$$

where WTP^H and WTP^L are the upper and lower bounds, respectively, of the interval around the respondent's true WTP. (When the announced WTP amount is zero, then WTP^L is 0 and WTP^H is 5.)

4.5 Internal validity of the WTP responses

We fit Eqs. (9) and (10) assuming that ε follows the type I extreme value distribution, which makes WTP a Weibull variate.[18] Estimation results for the Weibull model are reported in Table 5 for the full sample (panels 1 and 2), and then for the subsamples with high-school diploma or better (panel 3), and with college degree or better (panel 4). All four models assume that the WTP responses are independent both within and across respondents. Panels 1, 3, and 4 assume interval data, whereas in panel 2 the non-zero WTP responses are treated as continuous.

In all four specifications, the coefficient on log risk reduction is positive and significant, confirming that WTP satisfies the "scope" requirement (i.e., WTP increases with the size of the risk reduction). When the full sample is used, the coefficient on log risk reduction is 0.54–0.55. In other words, it is less than one, implying that WTP increases less than proportionately with the size of the risk reduction.[19] However, when attention is restricted to people with a high school diploma or better (panel 3), or a college degree or better (panel 4), the estimated β_3 approaches 1. It is still significantly different from one for high school graduates, but is not statistically different from 1 for respondents with a bachelor's degree.

WTP is also reasonably responsive to income: As expected, people in the low-income group report systematically lower WTP figures than people in the middle-income group, who in turn tend to report lower amounts than the high-income group. The statistical significance of these differences varies across the subsamples, and is most pronounced in the most highly

[18] The cdf of the Weibull distribution is $[1-\exp(-\mathrm{WTP}_i/\sigma_i)$, where σ_i is the exponential function of the right-hand side of Eq. (8), except for the error term. Mean WTP is computed as $\sigma_i\cdot\Gamma(1/\theta+1)$, where θ is the shape parameter of the Weibull. The λ in Eqs. (9) and (10) is thus comprised of all βs, δs, and θ.

[19] Further analysis shows that 92% of the respondents reported WTP amounts for the largest risk reduction (city A v. city B questions) that were no less than those for the smallest risk reduction (the pedestrian crossing scenario), and that 74% held higher WTP values for the largest risk reduction than for the second largest risk reduction (the helmet question). This suggests that WTP exhibited good internal validity.

Table 5 Weibull models with all scenarios

Variable	Panel 1: All persons (interval based)			Panel 2: All persons (interval based for zero WTP responses; continuous for non-zero responses)			Panel 3: Only persons with high school diploma and above (interval based)			Panel 4: Only persons with undergraduate degree and above (interval based)		
	Coefficient	Standard error	*P*-value	Coefficient	Standard error	*P*-value	Coefficient	Standard error	*P*-value	Coefficient	Standard error	*P*-value
Intercept	0.53	0.51	0.30	0.58	0.49	0.24	-0.35	0.68	0.61	-0.71	0.90	0.05
Log of risk reduction	0.55	0.09	<.0001	0.54	0.08	<.0001	0.80	0.08	<.0001	0.89	0.11	<.0001
Age	0.03	0.02	0.18	0.03	0.02	0.20	0.05	0.03	0.16	0.13	0.05	0.01
Age squared	-0.0002	0.0003	0.46	0.00	0.00	0.53	-0.0004	0.0004	0.33	-0.0016	0.0006	0.01
Low income dummy	-0.37	0.16	0.02	-0.37	0.16	0.02	-0.31	0.19	0.11	-0.79	0.27	0.00
Middle income dummy	-0.19	0.15	0.22	-0.18	0.15	0.23	-0.05	0.16	0.76	-0.27	0.18	0.14
Primary wage earner ∗ household size	-0.04	0.01	0.01	-0.03	0.01	0.02	-0.04	0.02	0.09	-0.03	0.03	0.39
High school diploma	-0.51	0.30	0.09	-0.52	0.29	0.07						
Has had an accident (or knows someone who did)	0.09	0.09	0.33	0.10	0.08	0.25	0.14	0.12	0.24	-0.04	0.15	0.81
Whether travels as part of the job	0.32	0.09	0.00	0.32	0.08	0.00	0.20	0.13	0.12	0.04	0.17	0.81
Commute time (minutes)	0.01	0.0015	<.0001	0.01	0.00	<.0001	0.01	0.0022	<.0001	0.01	0.0028	<.0001
Risk reduction ∗ high school	0.24	0.12	0.04	0.24	0.11	0.04						
Whether drives a two-wheeler	0.85	0.08	<.0001	0.80	0.08	<.0001	0.80	0.12	<.0001	1.16	0.15	<.0001
Scale		2.28			2.27			2.35			2.29	
Weibull Shape		0.44			0.44			0.42			0.44	
Log Likelihood		− 8296.37			− 5940.56			− 4163.04			− 2404.86	
Number of Observations		3600			3600			1740			1005	

Table 6 Mean WTP and VSL from all three scenarios based on an interval based Weibull model

The effect of travel patterns and mode[a]

	Mean WTP (rupees)	VSL (PPP$)
Does not travel on the job, does not drive two-wheeler	54 (5)	46,000 (3,000)
Travels on the job, does not drive two-wheeler	74 (4)	64,000 (3,400)
Travels on the job and drives two-wheeler	173 (9)	149,000 (7,600)

[a]*Assume:* 35 years old, middle income, primary earner with household of 5, HS diploma, commute time equal to average. Standard errors in parentheses.

The effect of income levels[b]

	Mean WTP (rupees)	VSL (PPP$)
Low income	143 (7)	123,000 (6,000)
Middle income	173 (9)	149,000 (7,600)
High income	208 (11)	179,000 (10,000)

[b]*Assume:* 35 years old, primary earner with household of 5, HS diploma, commute time equal to average, drives a two-wheeler, travels on the job. Standard errors in parentheses.

educated subsample. WTP is quadratic in age, and appears to be highest at age 40, but this effect is statistically significant at the conventional levels only among the most highly educated.

Previous experience or familiarity with accidents does not affect WTP, but traveling as part of the job, longer commutes and driving a two-wheeler do, and have the expected positive association with WTP. (We examine the magnitude of these effects in the next section and in Table 6) We conclude that the data support our model of Bayesian updating of the respondent's prior assessments of baseline risks.[20]

4.6 Is the VSL "Individuated"?

We use the coefficients of the interval-data Weibull model of Table 5, panel 1, to predict the mean WTP for different types of road users in Delhi, and hence their VSL. The resulting figures, displayed in Table 6, allow us to determine whether the VSL is "individuated," i.e., whether the VSL differs for specific groups of beneficiaries.

The top panel of Table 6 suggests that perceived exposure to road traffic risks affects the VSL dramatically. Holding age, education, and income constant, and assuming a risk reduction of about 13 in 100,000—the average risk reduction across all scenarios and all variants of the questionnaire—the VSL is three times larger for "high exposure" people than for "low exposure" individuals. For the former, which we define as individuals who travel as part of their job and drive a two-wheeler, the VSL is 149,000 PPP$, while for the latter it is 46,000 PPP$. The bottom panel of Table 6 shows that the VSL does increase with

[20] We also fit models that assume that WTP is a lognormal variate, so that the error term in Eq. (8) is normally distributed. We found that the Weibull distribution fits the data much better than the lognormal. Moreover, the shape parameter of the Weibull distribution is less than one, and indeed rather low, implying that the shape of the density of the WTP observations is not compatible with that of a lognormal variate.

income. If we focus on a high-exposure respondent with a high-school diploma, the VSL is roughly 123,000 PPP$ if this individual has a low income, 149,000 PPP$ if this individual is middle-income, and over 179,000 PPP$ if this individual falls in the high-income group.[21]

Our preferred estimate of the VSL is about 150,000 PPP$ and is based on a high-exposure individual. This figure is roughly equal to 1.75 times the discounted flow of personal income over the rest of the working life of the average respondent in our sample, using a discount rate of 12%.[22]

5 Conclusions

We have employed a stated preference approach—contingent valuation—to elicit the WTP for reductions in the risk of dying in road traffic accidents from a sample of commuters in Delhi, India. We presented people with three scenarios mirroring the circumstances under which the majority of the road traffic fatalities occur—among pedestrians, among users of two-wheelers, and while commuting. By design, both baseline risks and risk reductions were varied within and across respondents.

The WTP responses exhibit good internal validity. Willingness to pay is sensitive to scope, in the sense that it increases with the size of the risk reduction, as predicted by economic theory. It also increases with income, decreases with the number of dependents for the primary breadwinner in the household, and increases with increased exposure to road traffic risks. We take the latter association as evidence supporting our conjecture that respondents combine the information about baseline risks provided to them in the questionnaire with their subjective prior assessments of road-traffic mortality risks.

As a result, the VSL is "individuated" and is dramatically higher among the individuals who are likely to be the primary beneficiaries of any road safety programs—people who travel for work and drive a two-wheeler—for whom the VSL is about 150,000 PPP$. We note that this value is much higher than the present discounted value of per capita GDP (PPP), which is often used to value reductions in fatalities in evaluating traffic safety programs. At Rs. 1.3 million, it is also higher than the figure used to value traffic fatalities by Mohan (2001), Rs. 535,000, in a recent study of the social cost of traffic crashes in India. At the same time, it is lower than what would be implied using a simple benefits-transfer of the U.S. Department of Transportation's VSL ($3 million) to India.[23] It is also lower than the VSL implicit in labor market tradeoffs in India which Shanmugam (2001) estimates to be Rs. 56 million, or about $3 million, after correcting for self-selection bias. This suggests that stated preference studies such as the one reported here may have value in a policy context.

[21] We note that the VSLs reported in Table 6 are almost identical if they are computed using a model that drops answers to the pedestrian scenario—the least successful of our scenarios—which elicited a zero WTP response from 50% of respondents. The respective VSLs are: 121,000 (low income), 149,000 (middle income), 168,000 (high income).

[22] The Planning Commission of India currently uses a social discount rate of 12%.

[23] Assuming an income elasticity of one (i.e., multiplying by the ratio of Indian to U.S. per capita income in Purchasing Power Parity terms) would yield a VSL of $235,000 for India.

Appendix: Valuation questions from the survey

Part D: Behavioral Questions

In this section I am going to ask you a few questions about travel and travel safety. I will describe situations where you are a pedestrian or a two-wheeler driver and will ask you to tell me what you would do if you were in that situation. There is no right or wrong answer to any of the questions in this section. Please answer whatever you honestly feel you would do if you were actually in such a situation in real life.

Question D1

D1. Suppose that to get to work in the morning you have to cross a very busy street in front of your workplace/ office. You need to cross that street 240 days in a year. You have two options available to you for crossing the busy street in the morning:

Serial No.	Questions	Coding categories	Instructions
D1	**<u>INTERVIEWER</u>: PLEASE HAND OUT CARD NO. 3 TO THE RESPONDENT NOW.** You can cross the street right away, dodging speeding traffic, with a **<u>chance of '15/100,000' each year</u>** of dying in an accident on that street. If you choose this option you will not be spending any money for crossing the road **<u>(cost Rs. 0)</u>**. **<u>INTERVIEWER:</u> PLEASE SHOW THE GRID WITH 15 RED SQUARES TO EXPLAIN THE CHANCE OF DYING.** **OR** You can cross the street using the pedestrian subway with a **<u>chance '0/100,000' each year</u>** of dying in an accident on this street. However, to use this new pedestrian subway you must buy a pass that is valid for a year. Please note that this pass	(in Rupees per year from the card) or (Rupee per year - independently stated by the respondent)	

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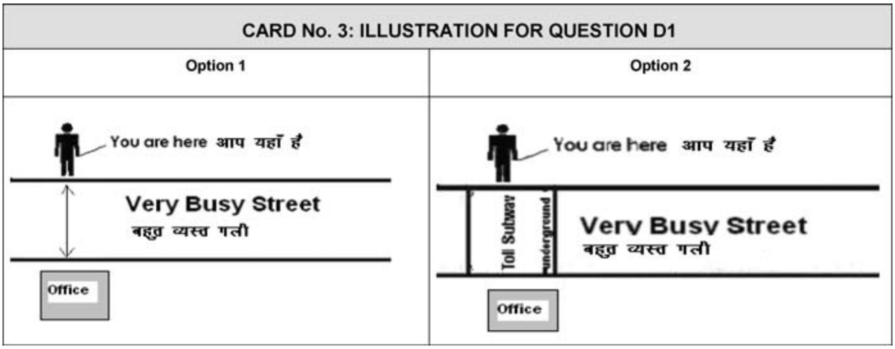
	can be used only for this subway and cannot be transferred or sold to another person. **<u>INTERVIEWER</u>: PLEASE SHOW THE GRID WITH THE 0 RED SQUARES** **<u>INTERVIEWER:</u> PLEASE SHOW CARD NO. 4 NOW.** What is the maximum amount of money you would be willing to spend every year to use the pedestrian subway in order to reduce your chance of dying in a road accident from <u>15/100,000</u> to <u>0/100,000</u>? *(Please remember if you spend more money each year for your safety, you will have less money available for food, clothing, etc.)* **<u>INTERVIEWER</u>: PLEASE SHOW CARD NO. 5 NOW.** To help you answer this question, here is a card with several possible values. Which of them is closest to the maximum amount you would spend to get a pass for the pedestrian subway? **<u>INTERVIEWER</u>: PLEASE READ THE SENTENCE BELOW AFTER A PAUSE.** *(Please feel free to suggest any other value too that is not mentioned in this card.)* *** ***		

51-65



Card No. 4: QUESTION D1		
	OPTION 1	**OPTION 2**
Chance of Dying	Cross street right away. $\frac{15}{100,000}$ per year	Use a toll subway at the place where you want to cross the street. $\frac{0}{100,000}$ per year

Card No. 5: PAYMENT CARD FOR QUESTION D1

What is the maximum amount of money you would spend—over a year—to use a pedestrian subway on your way to work each day?

(in Rupees)

0	5	10	15	20	40
50	75	100	125	150	200
250	300	350	400	500	600
800	1000	1500	2000	3000	more than 3000

or

Any other amount (not mentioned above)

Question D2

D2) Suppose that there are two cities. The two cities are identical in all respects except the chance of dying from road accidents and transportation costs. Assume that you live the same distance away from your workplace/ office in either of these two cities.

Serial No.	Questions	Coding categories	Instr.
D2	In City A the cost of commuting to and from work is **2400 Rs. a year. Your chance of dying while commuting to and from work is 35/100,000 each year.** **INTERVIEWER: PLEASE SHOW THE GRID WITH 35 RED SQUARES TO EXPLAIN THE CHANCE OF DYING.** In City B your chance of dying while commuting to and from work is **5/100,000** a year. **INTERVIEWER: PLEASE SHOW THE GRID WITH THE 5 RED SQUARES** **INTERVIEWER: PLEASE SHOW CARD NO. 6 NOW.** How much extra money would you be willing to spend every year in transportation costs to live in the safer city in order to reduce your chance of dying in a road accident from 35/100,000 to 5/100,000? Please remember if you spend more money each year for your safety, you will have less money available for food, clothing, etc. **INTERVIEWER: PLEASE SHOW CARD NO. 7 NOW.** To help you answer this question, here is a card with several possible values. Which is the closest to the maximum amount of extra money you would spend as transportation costs to live in the safer city? **INTERVIEWER: PLEASE READ THE SENTENCE BELOW AFTER A PAUSE.** *(Please feel free to suggest any other value too that is not mentioned in this card.)*	[ ][ ][ ][ ][ ] (in Rupees chosen from the card) or [ ][ ][ ][ ][ ] (Rupee - independently stated by the respondent)	
	***		

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Card No. 6: QUESTION D2		
	City A	**City B**
Chance of Dying	$\frac{35}{100,000}$ per year	$\frac{5}{100,000}$ per year
Transportation Costs for Commuting to and from Home to Workplace	**Rs. 2400 per year**	

Question D3

D3	Do you drive a two-wheeler? **SINGLE CODING ONLY**	Yes 1 No 2	→ GOTO SEC D4 → GOTO SEC D5

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Question D4

D4 Suppose it is time to replace the two-wheeler helmet that you wear. Imagine that you are shown two helmets that look exactly identical but differ in price and quality. Please note that both helmets last for **three** years. Assume that **you** will be the only person wearing this helmet.

INTERVIEWER: IN CASE, IF THE RESPONDENT OBJECTS BY SAYING THAT HE DOES NOT HAVE A HELMET (EVEN IF REQUIRED BY LAW), THEN SAY "WELL, PLEASE IMAGINE THAT YOU HAVE ONE, AND THAT IT NEEDS TO BE REPLACED, OR THAT YOU ARE BUYING ONE FOR THE FIRST TIME."

Serial No.	Questions	Coding categories	Instructions
D4	You can buy Helmet 1 that lasts for three years and costs Rs. 300. If you wear this helmet, your chances of dying due to a head injury in a two-wheeler accident are **30/100,000 during the three years that the helmet will last.** **INTERVIEWER: PLEASE SHOW THE GRID WITH 30 RED SQUARES TO EXPLAIN THE ANNUAL CHANCE OF DYING.** **Or** You can buy Helmet 2 that also	(in Rupees chosen from the card) or (Rupee - independently stated by the respondent)	

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	lasts for three years. Wearing this helmet will reduce your chance of dying due to a head injury in a two-wheeler accident to **6/100,000** during the three years that the helmet will last. **INTERVIEWER: PLEASE SHOW THE GRID WITH 6 RED SQUARES TO EXPLAIN THE ANNUAL CHANCE OF DYING.** **INTERVIEWER: PLEASE SHOW CARD NO. 8 NOW.** How much **extra money** are you willing to spend for Helmet 2 in order to reduce your chances of dying from head injury in a two-wheeler accident from 30/100,000 to 6/100,000 during the three years that you would wear the helmet? *(Please remember if you spend more money each year for your safety, you will have less money available for food, clothing, etc.)* **INTERVIEWER: PLEASE SHOW CARD NO. 9 NOW.** To help you answer this question, here is a card with several possible values. Which is the closest to the maximum **extra amount of money** you would spend for helmet 2? **INTERVIEWER: PLEASE READ THE SENTENCE BELOW AFTER A PAUSE.** Please feel free to suggest any other value too that is not mentioned in this card. **		

(→ GO TO PART E)

Question D5

D5) Suppose that you drive a two-wheeler to go to work every day. Under the law all drivers of two-wheelers must wear a helmet. Imagine that you are shown two helmets that look exactly identical but differ in price and quality. Please note that both helmets last for **three** years. Assume that you will be the only person wearing this helmet.

INTERVIEWERS: IN CASE, IF THE RESPONDENT OBJECTS BY SAYING THAT HE DOES NOT HAVE A HELMET (EVEN IF REQUIRED BY LAW), THEN SAY "WELL, PLEASE IMAGINE THAT YOU HAVE ONE, AND THAT IT NEEDS TO BE REPLACED, OR THAT YOU ARE BUYING ONE FOR THE FIRST TIME."

Serial No.	Questions	Coding categories	Instructions	
D5	You can buy Helmet 1 that lasts for three years and costs Rs. 300. If you wear this helmet, your chances of dying due to a head injury in a two-wheeler accident are **30/100,000 during the three years that the helmet will last.** **INTERVIEWER: PLEASE SHOW THE GRID WITH 30 RED SQUARES TO EXPLAIN THE ANNUAL CHANCE OF DYING.** **Or** You can buy Helmet 2 that also lasts for three years. Wearing this helmet will reduce your chance of dying due to a head injury in a two-wheeler accident to **6/100,000** during the three years that the	[ ][ ][ ][ ][ ] (in Rupees chosen from the card) or [ ][ ][ ][ ][ ] (Rupee - independently stated by the respondent)		*107-111*

	helmet will last. INTERVIEWER: PLEASE SHOW THE GRID WITH 6 RED SQUARES TO EXPLAIN THE ANNUAL CHANCE OF DYING. INTERVIEWER: PLEASE SHOW CARD NO. 8 NOW. How much **extra money** are you willing to spend for Helmet 2 in order to reduce your chances of dying from head injury in a two-wheeler accident from 30/100,000 to 6/100,000 during the three years that you would wear the helmet? *(Please remember if you spend more money each year for your safety, you will have less money available for food, clothing, etc.)* INTERVIEWER: PLEASE SHOW CARD NO. 9 NOW. To help you answer this question, here is a card with several possible values. Which is the closest to the maximum **extra amount of money** you would spend for helmet 2? INTERVIEWER: PLEASE READ THE SENTENCE BELOW AFTER A PAUSE. *(Please feel free to suggest any other value too that is not mentioned in this card.)* *** ***		

Card No. 8: QUESTION D4 or D5
Both helmets last for exactly 3 years.

	HELMET 1	HELMET 2
Chance of Dying (for 3 years)	$\frac{30}{100,000}$ for 3 years	$\frac{6}{100,000}$ for 3 years
Cost of Helmet	**Rs. 300**	

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