“Your money or your life !” The influence of injury and fine expectations on helmet adoption among motorcyclists in Delhi

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WORK IN PROGRESS

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Abstract

In this paper, I study the individual decision of wearing a helmet using original data collected among motorcyclists in New Delhi in 2011. The data measures the motorcyclists' subjective expectations of medical expenditures and fines. In my empirical analysis, I first study whether previous personal experiences influence individuals' beliefs. I show that knowing some one who experienced a road crash or having been sanctioned by the traffic police modify motorcyclists' subjective expectations. Nonetheless, differences across individuals may be partly due to actual differences in health hazards and police enforcement intensity. In a second step, I investigate to what extent injury and fine expectations impact helmet adoption, this depending on the characteristics of the trip. I find that subjective expectations of injuries are correlated with helmet use for long distance journeys while expected fines are rather linked with helmet adoption for short distance trips either on main roads or within residential neighborhoods. I use geographical fixed effects to control for area related specificities which could bias my estimates, such as differences in health infrastructures or neighbors' attitudes. Finally, in view of designing policies, I assess the impact of different safety measures which raise either expected medical expenditures or expected fines. The increase of police threat, through enforcement, information and fine levels are likely to increase helmet adoption among motorcyclists. Information campaigns stressing the utility of helmet to avoid severe injuries even for motorbike trips nearby one's hone should have a similar effect.

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1 Introduction

Every five minutes in India someone dies from a road traffic accident (NCRB, 2011). This phenomenon is expected to escalate to one death every three minutes by 2020. Many of these fatalities are nevertheless preventable. While Hsiao et al. (2013) found that 62% of Indian road casualties suffered from a cerebral trauma;[1] Liu et al. (2008) highlighted that standardized quality helmets efficiently reduce risk of mortality and injuries by 40% and 70% respectively. Besides road infrastructures or the quality of motorized vehicles, behaviors adopted by road users are actually a crucial lever to reduce the frequency and severity of road traffic accidents. Indeed, individual characteristics and attitudes toward risk may play a role in road habits, risk exposure and conduct while traveling. Grimm and Treibich (2014) studied the influence of individual risk aversion on helmet use and choice of speed among motorcyclists. Their results suggest that risk averse drivers are more likely to wear a helmet. Nevertheless, safety behaviors adopted on the road correspond to "economic decisions involving uncertainty" that are, according to Delavande et al. (2011a), "shaped not only by preferences but also by subjective expectations of future outcomes". Given the important share of motorcyclists in the traffic mix and among road fatalities in developing countries, a better understanding of the individual decision process of this particular group would definitively help design appropriate and efficient policies. In order to fill this gap, this paper considers individuals' heterogeneity regarding expected consequences of not using a helmet. More precisely, it provides empirical evidence on the relation between helmet adoption and subjective expectations of injuries and fines among motorbike users in New Delhi, as well as insights into the way these beliefs are shaped.

In recent years, a growing literature of applied development economics has started to investigate the impact of subjective expectations on probabilities and outcomes in the individual decision making process in areas like investment, education, health and entrepreneurship (see for instance Attanasio, 2009; Delavande and Kohler, 2009; Dominitz and Manski, 1997b; McKenzie et al., 2007). As all other uncertain decisions, road safety conducts are likely to be the result of a combination of factors among which perceptions and beliefs play a key role. These include the subjective probability to be caught by the police for infringing road rules, or, in case of an accident, be injured and suffer financial, physical and psychological losses.

Awareness programs on road dangers have extensively used shocking ads in order to raise citizens' expectations of negative outcomes in case they should choose not to use a seat belt or a helmet. Nevertheless, given the low probability of accident occurrence on a given trip, individuals still face difficulties in internalizing this risk and adapting their behaviors. Many countries have therefore chosen to bind attitudes by law. In low and middle income countries, where two wheelers represent up to 70% of all motorized vehicles, an increasing number of governments have implemented compulsory helmet legislations. This, to urge motorcyclists to protect them-

[1] Their study is based on a nationally representative survey of 1.1 million homes.

selves. In India, for instance, a legislation was enacted in 1988 (Motor Vehicle Act). However, it is the responsability of each and every Indian state to implement and enforce the law. The effect of such a punitive measure on road safety attitudes may thus vary substantially across the country depending on the actual and perceived strength of its enforcement.[2] This can be captured by the subjective probability of being caught by the police if infringing the law and the subsequent expected fines.

In this study, elicited subjective expectations of injury and fine if one does not use a helmet were obtained through a unique dataset collected among motorcyclists in New Delhi in 2011. The methodology, which will be presented in detail below, comes from studies on investment in education (Attanasio, 2009), migration decisions (McKenzie et al., 2007) or health prevention exams (Delavande, 2008). This questionnaire allows me to estimate the impact of injury and fine expectations on road safety behaviors, in particular helmet adoption. Moreover, information gathered on previous experiences of road crash and traffic police arrest enables me to investigate how individuals form their beliefs on the consequences of not using a helmet. Finally, based on my findings, the impact of various road safety measures on helmet use are simulated. This will provide evidence as for the possible ways to improve road safety in large metropolitan cities in developing countries.

The remainder of the paper is organized as follows. Section 2 summarizes the road safety literature, with a focus on the work done at the microeconomic level. In particular, I stress why information on subjective probabilities and outcomes could help the understanding of observed conducts of road users. Then, the methodological literature on the measurement of subjective expectations of probabilities and outcomes is introduced. Section 3 presents the data and the survey methods used to draw expectations out. Some descriptive statistics are also reported. In section 4, I discuss the channels through which personal experiences may impact the formation and updating of beliefs as well as the role of the latter in the decision process regarding helmet adoption by motorcyclists. Section 5 reports the empirical strategy and findings. In this analysis, I first explore the influence of previous experiences of road crash or police arrest on subjective expectations. In a second step, I look at the extent to which subjective expectations of medical expenditures and fines influence helmet use depending on the trip's characteristics. The impacts of different policy measures raising either expected medical costs or expected fines are reported in section 6. Section 7 concludes.

[2] In the last Global Status Report on Road Safety WHO (2013), the Indian rate of enforcement of helmet law appears to be very low (2 on a scale going from 0 to 10). Nonetheless, this figure does not reflect the potential variation across Indian states.

2 Literature review

2.1 Studies on motorcycle safety

Studies implemented in developed countries have examined the effectiveness of compulsory helmet legislations. For instance, using U.S. longitudinal data, Dee (2009) found that a universal helmet law reduces motorcyclist fatalities by 27 percent. As for French et al. (2009), they compared the capacity of different safety policies to reduce both fatal and non fatal road injuries and showed that legislations making helmet use mandatory outperform alcohol policies as well as speed limit measures or education programs targeted to riders. It is worth highlighting that motorbike users from the U.S.A or Europe differ – in terms of demographics, uses and engine sizes – from those of developing countries such as India. In low income countries for instance, most drivers ride scooters or mopeds, and this on rather short distances. Given the specificities of motorcyclists and the traffic environment in which they evolve, contextualized evaluations are required. Nonetheless, to my knowledge, and despite the implementation of compulsory helmet legislations in many developing countries, studies estimating the efficiency of such regulation have not yet been undertaken in these regions.

In addition, very few studies have investigated the determinants of road safety habits. One exception is Ritter and Vance (2011) who looked at the socio economic characteristics influencing voluntary helmet use among German cyclists. The scarcity of behavioral analysis can be explained by the absence of data on road habit issues. Indeed, micro level data on road safety behavior are all but inexistent, partly because this issue has been less prioritized by the authorities. This considerably limits research on the topic. We started filling the gap in 2011 by collecting information on road habits among motorcyclists in New Delhi. Information on socio demographic characteristics, preferences toward risk and beliefs were also gathered. In a previous paper (Grimm and Treibich, 2014), we focused on the influence of risk aversion on helmet use and choice of speed and on the existence of risk compensation behaviors. We found that among drivers, individuals who are more risk averse are significantly more likely to use a helmet. As to passengers, their use of a helmet depends on the environment they face (driver's characteristics or traveling speed for instance).

While Grimm and Treibich (2014) assumed that probabilities of accident and subsequent injuries are identical for all motorcyclists, this paper takes into account the possible heterogeneity in expectations individuals may have regarding the consequences of not using a helmet. Indeed, besides their risk aversion, the discomfort of wearing a helmet, the protection it offers in case of a crash (in terms of probability and severity of the injury) or the capacity of avoiding police sanctions are various dimensions that may enter the individual decision process regarding helmet adoption and which plausibly differ from one person to the other. Introducing subjective expectation data in the analysis allows to disentangle explanations based on preferences and those based on beliefs. More adequate behavioral interventions might then be suggested.

Both the fear of negative health outcomes and the threat of financial sanctions may influence motorcyclists' behavior toward helmet use. Elicited subjective probability of injury and subsequent medical expenditures on the one hand, and subjective probability of police halt and financial penalties on the other hand have been gathered using similar methodologies to the ones already extensively used in the literature (see Delavande et al., 2011a; Manski, 2004, for reviews). In other words, the "frequency" and the "severity" dimensions have been elicited through our survey. This paper discusses the possible mechanisms at play in the formation of beliefs and their theoretical impact on helmet use. Based on a unique dataset, I then empirically test these relations.

To summarize, behavioral studies on road safety conducts investigating the influence of educational and repressive policies, in particular in developing countries, have not yet been undertaken. Individuals' beliefs regarding the gains and costs of not using a helmet are certainly an important dimension to explore in the safety decision process. Moreover, the formation or updating of road related subjective expectations as well as the influence of the latter on helmet adoption are questions which remain overlooked. To fill these gaps, I first explore the role of personal experiences on the observed heterogeneity in beliefs across individuals. Second, I study to what extent subjective expectations of medical expenditures and fines impact helmet adoption in different trip circumstances and third I estimate the impact on helmet use of various safety measures modifying expectations. I report in the following subsection the various methods used in the literature to elicit this specific type of information.

2.2 Measurement of subjective expectations

Despite the development of elicitation methodologies, in particular in psychology, economic empirical studies of individual choices have often only focused on preferences, while individuals' beliefs were assumed homogenous. However, Tversky and Kahneman (1974)'s results suggested that individuals tend to use heuristic rules to process data. These findings brought concerns regarding the assumption of rational and homogenous expectations across agents. Furthermore, as pointed by Manski (2004), expectations may vary from one person to the other and different combinations of subjective expectations and preferences may lead to the same observed behavior. By collecting data on individuals' expectations regarding the occurrence of specific events and their subsequent outcomes, researchers aim at relaxing the homogeneity assumptions made on expectations.

Attanasio (2009) highlighted that a careful design of questionnaires should enable to elicit information on subjective probabilities and distribution of future variables. He added that such procedure is important for economic welfare and relevant to determine economic choice. Because of lower cost and higher willingness of individuals to spend time on answering surveys in developing countries, such data collection has particularly increased in these regions. Detractors have called into question the quality of these datasets putting forward the limited formal education of some respondents and their unfamiliarity with the formal concept of probability. Delavande et al. (2011a) refuted these arguments based on a survey of recent contributions to the literature on the measurement of subjective expectations in developing countries. They showed that elicitation of probability is feasible in low income countries despite the average low level of education of respondents. These authors also provided advice regarding the methods to be used in the questionnaire to limit numeracy difficulties. For instance, visual aids (balls, beans, sticks) could be used in low income countries where probability concepts might be too abstract for respondents. When such tools were used only few people gave degenerated forecasts, supporting the idea that individuals understand the questions asked (cf. Luseno et al., 2003; Lybbert et al., 2007). Initial formulation of questions eliciting continuous variables, such as future earnings or retirement benefits, enabled to obtain only one value of the outcome of interest, leaving unclear whether the respondent gave the minimum, the maximum, the median or the average of what he expects. Different methods have been used since then to draw out the distribution of the outcome of interest. Dominitz and Manski (1997a), for instance, asked the following questions to respondents: *"what do you think is the percent chance that your total household income, before taxes, will be less than Y over the next 12 months?"*. Four income thresholds in increasing order were presented to the individual. The thresholds about which a given respondent was queried were determined by the respondents' answer to a pair of preliminary questions asking for the lowest and highest possible income that the household might experience in the next year. Such methodology generates flexible thresholds, a way of avoiding the anchoring problem which appears when using pre-determined intervals among population differing regarding their wealth. Finally, Delavande et al. (2011b) conducted an experiment in India to test the sensivity of elicited expectations to variation in three dimensions of the elicitation methodology: (i) the number of beans,[3] (ii) the design of the support (pre-determined vs. self-anchored) and (iii) the ordering of questions. While more accuracy was obtained by using more beans and a larger number of intervals with a pre-determined support, the results remained very robust to variations in the elicitation design.

I now proceed with the presentation of the dataset.

3 Data

3.1 Road safety survey

With the help of a local survey firm,[4] we implemented an household survey in Delhi in 2011 targeting motorcyclists. Besides socio demographic characteristics, data on risk aversion, perception of road rule enforcement and of road risks were gathered along with helmet use, previous

[3]Beans are used as visual aids by respondents.

[4]Sigma Research and Consulting: http://www.sigma-india.in

involvement in road traffic crashes or traffic police arrests. Finally, we attempted to elicit the subjective expectations of medical expenditures and fines, based on the methodologies developed in the literature and describe in more detail below in section 5.3.2.

The following sampling design was adopted: (i) New Delhi was divided into five zones, (ii) in each zone, ten polling booths were randomly drawn, (iii) the location of each of these polling booths represented the starting point from which every fifth household was selected for the interview. Around each polling booth, 30 households were interviewed, leading to a total of 1,502 households. In 545 of them at least one member had traveled by motorbike in the previous four weeks. Up to three drivers or passengers per household could answered the survey. In the end, 902 motorbike users agreed to reply to our questions.

Our respondents are 36 years old on average, two thirds of them are men and 70% pray daily. 97% of the drivers are men while they only represent 25% of the passengers. Regarding road safety efforts, while men use full face helmets, women more often opt for a half helmet. Motorcyclists were asked about their helmet use in three different circumstances. On average, motorbike users are more likely to declare wearing a helmet for long trips[5] (81%) than for short trips on main roads (61%) or trips in residential neighborhoods[6] (54%). Nonetheless, significant differences in helmet use are observed between men and women, drivers and passengers and motorcyclists who frequently or occasionally use this mode of transportation. Drivers without passengers travel at a higher speed on average. More than 60% of the passengers declare being three or more people when they use the motorbike. 46% of the respondents declare to frequently circulate on a motorbike, 64% use it mainly to commute to work. Finally, 7% of the interviewed motorcyclists have already been involved in a road crash, they are about the same percentage to have been sanctioned by the traffic police.

3.2 Eliciting subjective expectations of medical expenditures and fines

3.2.1 Subjective probability of injury and subsequent medical expenditures

Starting with the potential injuries, two situations were presented to the interviewees. First, they were asked to consider the way they usually travel on their motorbike ("in general"). Second, they were put in the situation where they would not use the helmet ("if no helmet").[7] In each case, respondents were asked to establish the likelihood they would be involved in an

[5]Long trips are defined as journeys lasting more than 15 minutes.

[6]Residential neighborhoods correspond to residential areas with small food and clothes markets.

[7]One could argue that we should have elicited probabilities of being injured with and without helmet in order to derive the individuals' perceived health utility of wearing a helmet. Nonetheless, we thought that asking these two questions would have exacerbated the social desirability bias. Controlling by the type of injuries individuals have in mind and the answer to the "in general" question should allow me to capture the perceived utility of helmet. As a matter of fact, helmet use questions came before the elicitation of subjective probabilities and outcomes. Furthermore, in the case of respondents who report usually not wearing a helmet, the subjective probabilities of being involved in an accident if the respondent travels (i) as s/he usually does and (ii) not wearing a helmet should be similar.

accident and injured using an 11 point response scale going from 0 "this event will never happen" to 10 "this event will surely happen". Answers were divided by ten in order to obtain values between 0 and 1 which can be related to probabilities. In order to control for the understanding of the scale, five general questions were asked before eliciting subjective probabilities regarding road risks (further detail regarding these "check questions" are included in the Appendices).[8]

I acknowledge that no explicit time horizon was included in the formulation of the question. Therefore, some of the respondents may refer to the next trip while others may think about their entire lifetime. Literature on protective behaviors (Kunreuther and Slovic, 1978) highlighted that time horizon matters when asking about probability of accident. However, if individuals who refer to a really short time horizon are not systematically different from those who consider their whole life, the absence of time horizon is not such a concern. Later on, I discuss possible reasons implying a correlation between individuals' characteristics and elicited subjective expectations and attempt to control for this potential bias in the empirical analysis.

Table 1 provides the distribution of subjective probabilities of injury in the two situations of interest. Notably, the "no helmet" variable is on average higher and has fatter tails than the "in general" probability. The graph on the left of Figure 1a draws the distribution of subjective probability of being hurt if not wearing a helmet. This distribution is broken down by different socio demographic characteristics and preferences toward risk in Figure 2a. This subjective probability seems to vary substantially among respondents, even for individuals of similar gender, education, religion or presenting the same level of risk aversion.

[8] We use similar questions as Delavande and Kohler (2009). When performing robustness checks, I exclude from the sample individuals who did not answer correctly to the check questions (see results in Appendix F, Table 18).

Table 1: Distribution of subjective probabilities of injuries and police arrest

	percentile 25th	50th	75th	mean	std. dev.	*observations*
Probability of injury						
in general	0.2	0.4	0.5	0.37	0.25	*841*
if no helmet	0.4	0.5	0.9	0.58	0.31	*836*
Probability of arrest						
in general	0.2	0.4	0.5	0.39	0.29	*840*
if no helmet	0.4	0.7	1	0.65	0.34	*878*
for no reason	0.1	0.3	0.5	0.36	0.30	*845*

FORMULATION OF QUESTIONS

Probability of injury

in general - *"Think about the way you generally travel on the motorcycle. Given this, how likely do you think that you have an accident in which you get injured?"*

if no helmet - *"In case you are not wearing a helmet, how likely do you think that you have an accident in which you get injured?"*

Probability of police arrest

in general - *"Think about the way you generally travel on the motorcycle, what is the likelihood that you will be stopped by the police in the next month?"*

if no helmet - *"If you do not use the helmet at all during the next month, what is the probability the police stops you at least once over the period?"*

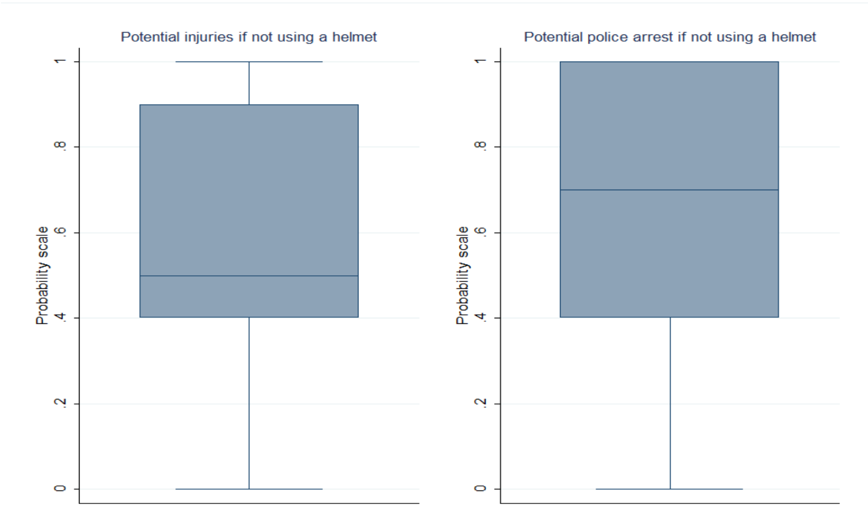
for no reason - *"According to you, what is the likelihood you will be stopped by the police for no reason in the next month?"*

Answer scale

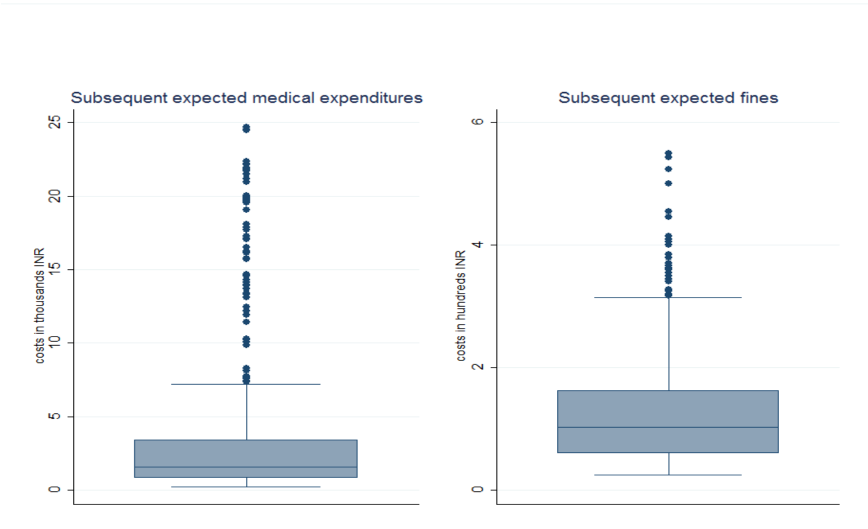
Respondents answered using a 11 point scale going from 0 "this event will never happen" up to 10 "this event will surely happen". I then divided their answer by 10 to obtain probabilities, between 0 and 1.

Figure 1: Heterogeneity in beliefs

a. Subjective probabilities if non use of helmet



b. Subsequent expected outcomes



Box plot legend:

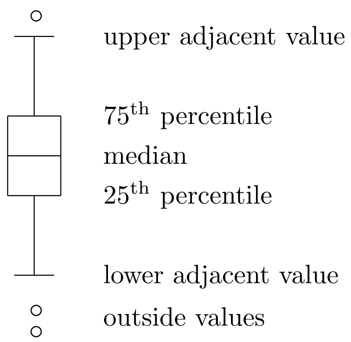
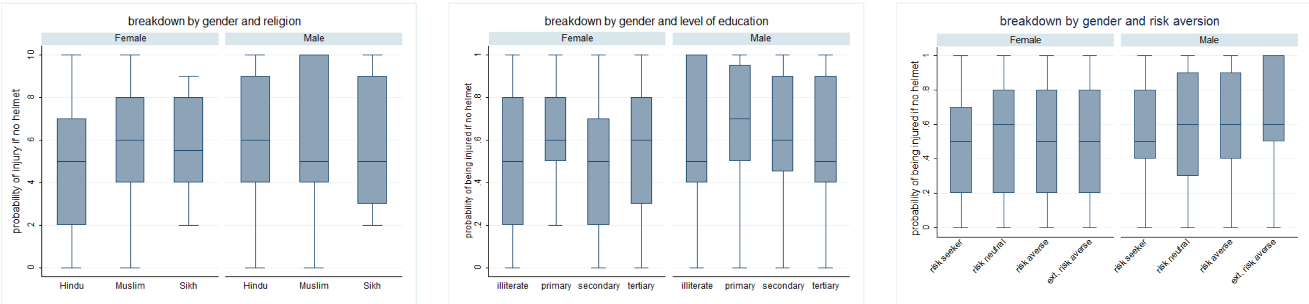
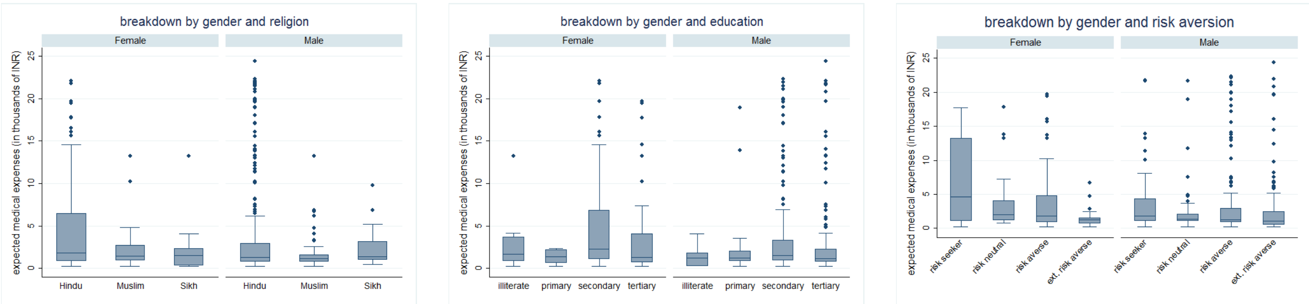


Figure 2: Heterogeneity in beliefs breakdown by socio-demographics

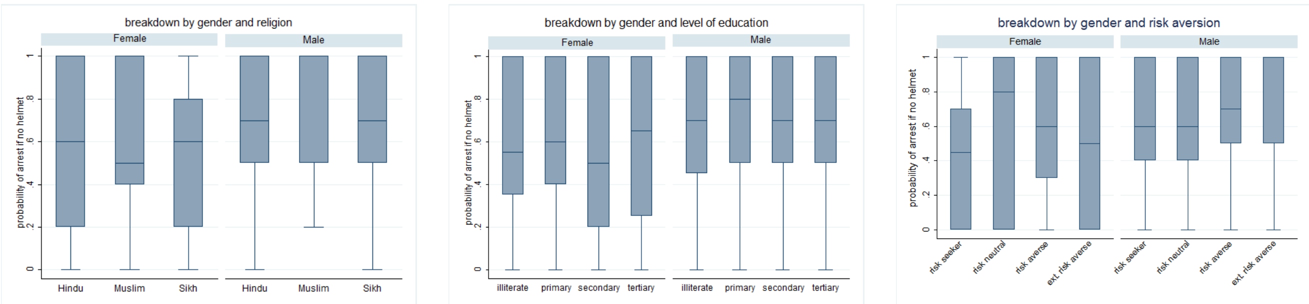
a. Regarding potential injuries if not using a helmet



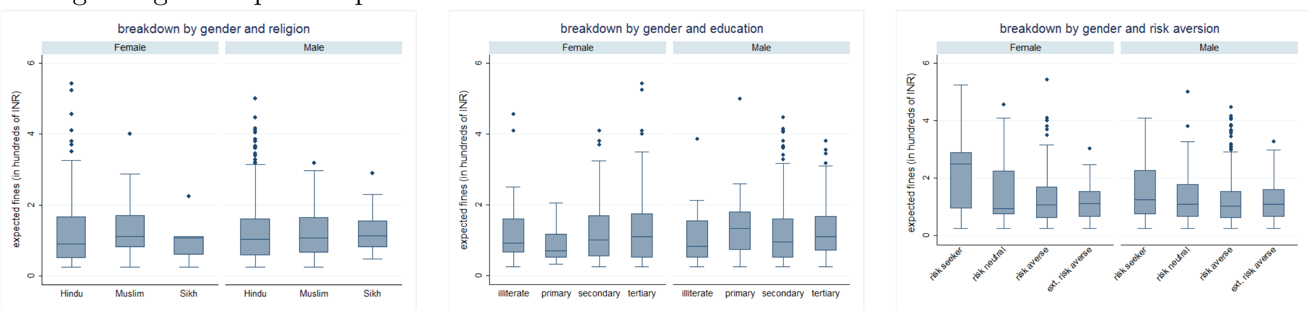
b. Regarding subsequent expected medical expenditures



c. Regarding potential police arrests if not using a helmet



d. Regarding subsequent expected fines



Notes: Answers to the self-assessed risk aversion in general question have been used to build the above graphs.

Following the question regarding the likelihood of being injured, respondents were asked which type of injury would most likely happen in each of the two cases ("in general" and "if no helmet"). Trauma to inferior and superior members[9] are the most commonly cited

[9]This covers broken arm, broken leg or possibly the loss of one of these members.

injuries. However, based on data from one of the biggest hospitals in Delhi, Kumar et al. (2008) highlighted that more than 60% of road related fatalities sustained head injuries. Cerebral trauma is mentioned by only 7% of my sample when considering the "in general" case.[10] This share goes up to 48% of respondents in case the individual is not using a helmet. Nevertheless, this figure is likely to cumulate actual beliefs and the fact that respondents answer what they think they should say.

If the individual answered that the probability of being hurt while not using a helmet was strictly higher than zero, the interviewer proceeded with questions regarding the subsequent medical expenditures. More precisely, respondents were asked the percent chance the medical expenditures would be less than a series of fixed amounts going from 500 INR up to 200,000 INR.[11] The enumerator kept proposing higher amounts till the respondent answered 100%. The main drawback of using one unique and fixed scale to elicit the distribution of a continuous variable, in particular among a heterogenous population, is the possibility that the range offered doesn't correspond to the intervals the individual has in mind. By asking each respondent about the range of values which is relevant for him, we would instead create a self-anchored support. In our case, expected medical expenditures may vary quite substantially according to the motorcyclist's wealth but also to his access to medical care, in particular whether he has health insurance or not. Taking into account this potential anchoring issue, in the initial version of the questionnaire the respondent was first asked about the minimum and the maximum amounts of medical expenditures. The interviewer then computed three thresholds and asked what was the percent chance the individual would have to pay less than each of these thresholds (the three computed thresholds and the maximum) following the elicitation methodology used by Dominitz and Manski (1997a). Nevertheless, the pilot phase revealed the interviewer's difficulties in computing the intervals, which also increased the duration of the interview and exacerbated interviewee's fatigue. This led us to opt for pre-determined scales to derive the distribution of medical expenditures each motorcyclist expect to pay. Yet, no significant differences in subjective medical costs are actually found between income groups. I acknowledge that not all relevant costs are drawn out here, in particular job revenues due to a temporary or a permanent incapacity to work were not asked to the respondents. Similarly, a possible fatal accident, which would correspond to the worst case scenario in terms of health but which doesn't imply any medical costs, is not explicitly elicited.

Based on the elicited cumulative distribution function, I built the expected cost for each respondent using the following methodology. Let's denote p_{ik} the percent chance that the cost will be less than the amount C_k for individual i. The motorcyclist's expected cost $E_i(C)$ is then

[10] No significant differences are detected when comparing motorcyclists who declare using or not the helmet and this no matter the trip circumstance considered.

[11] The exact formulation used was the following: *"Thinking about the medical expenditure you would have to pay if you were injured in a road crash right now without wearing a helmet, what do you think is the percent chance that this amount will be less than X INR?"*

equal to :

$$E_i(C) = \sum_{k=1}^{n}(p_{ik} - p_{ik-1}) \cdot \left(\frac{C_k + C_{k-1}}{2}\right)$$

with $\frac{C_k + C_{k-1}}{2}$ the central value of each interval and $p_{ik} - p_{ik-1}$ the percent chance associated to each interval. Initial values C_0 and p_{i0} are equal to zero.[12]

Let's take the example of a respondent who answered that there was a 20% chance the health expenses would be less than 500 INR, 50% chance that they would be less than 1,000 INR and 100% chance that they wouldn't exceed 1,500 INR. Following the above formula, this person's expected medical expenditures amounted to 900 INR ($0.2 \times 250 + 0.3 \times 750 + 0.5 \times 1{,}250$).

The average expected medical cost is 5,189 INR.[13] We observe a lot of heterogeneity across motorcyclists, the standard deviation being equal to 9,012 INR (cf. Table 2). Based on provided answers, the 25$^{\text{th}}$ and the 75$^{\text{th}}$ percentiles were derived through linear extrapolation. When a respondent gave for the first proposed amount a higher percentage than 25% or 75%, the lowest amount of medical expenditures (500 INR) was imputed to the related percentile.[14] Interquartile range (75$^{\text{th}}$ percentile - 25$^{\text{th}}$ percentile) captures the variation in the potential financial costs individuals have in mind. The extent of potential medical expenditures appears to vary a lot across respondents. Some individuals may consider both minor and extremely severe injuries when answering the outcome question while others may have a clear opinion of what type of injuries they would face. We note that expectation and variance parameters of medical expenditures are significantly correlated with the type of injuries a person thinks he would suffer from if he wasn't wearing a helmet at the time of the crash. More precisely, they are positively related to head trauma and negatively correlated with injuries to superior or inferior members.

[12]When using different computations of the first central value (either by applying an exponential function or a power function instead of a linear one or fixing a strictly positive minimum amount of medical costs), the expected cost is almost not modified – between 0.27% and 1.36% of change.

[13]I unfortunately can't compare this figure with actual medical expenses faced by road victims due to unavailability of hospital data.

[14]The minimum of 500 INR has been imputed to the 25$^{\text{th}}$ percentile for 236 individuals and to the 75$^{\text{th}}$ percentile for 97 of them.

Table 2: Summary statistics of expected medical expenditures and fines

	observations	mean	std. dev.	median	minimum	maximum
Expected costs (in INR)						
medical expenditures	*772*	5,189	9,012	1,688	250	64,003
fines	*760*	129	103	105	25	783
Interquartile range (in INR)						
medical expenditures	*772*	6,718	15,039	1,500	0	94,000
fines	*760*	112	109	88	0	500

FORMULATION OF QUESTIONS

Medical expenditures

"Thinking about the medical expenditure you would have to pay if you were injured in the road crash right now without wearing a helmet, what do you think is the percent chance that this amount will be less than X INR ?"
A serie of fixed amounts going from 500 INR up to 200,000 INR were proposed, the enumerator kept on proposing higher amounts till the respondent answered 100%.

Fines

"Thinking about the fine you would have to pay if you were stopped by the police right now without wearing a helmet, what do you think is the percent chance that this amount will be less than X INR ?"
A serie of fixed amounts going from 50 INR up to 1,000 INR were offered.

Variables built

1. Based on provided answers, the expected cost $E_i(C)$ was computed: $E_i(C) = \sum_{k=1}^{n}(p_{ik} - p_{ik-1}) \cdot \left(\frac{C_k + C_{k-1}}{2}\right)$, with p_{ik} the percent chance that the cost will be less than the amount Y_k for individual i, $\frac{C_k + C_{k-1}}{2}$ the central value of each interval and $p_{ik} - p_{ik-1}$ the percent chance associated to each interval. Initial values C_0 and p_{i0} being equal to zero.

2. The interquartile range, which corresponds to the difference between the 75^{th} and 25^{th} percentiles, has also been computed. Based on provided answers, the 25^{th} and the 75^{th} percentiles were derived through linear extrapolation. When a respondent gave for the first proposed amount a higher percentage than 25 or 75, the lowest amount of medical expenditures (500 INR) was imputed to the percentile.

3.2.2 Probability of police arrest and subsequent fines

The mandatory helmet law aims at providing incentives toward helmet use through financial penalties. Nonetheless, such sanctions are likely to modify motorcyclists' behavior only if they are credible and sizeable enough. To capture the actual beliefs of motorcyclists regarding helmet legislation, respondents were asked about their perception of road rules enforcement. More precisely, their subjective probabilities of being stopped by the police in the next month in three different situations were assessed. In addition to the "in general" and "if no helmet" cases, individuals were asked the likelihood they would be stopped by the police for no reason (situation hereinafter labelled "for no reason"). It seemed important to set this third case given that unfair and random police sanctions may have an unproductive and potentially adverse effect on safety decisions. From Table 1, it appears that the mean of the perceived probability of being stopped by the police in the "no helmet" situation is much higher than "in general" or "for no reason" (0.65 vs. 0.36-0.39). The variance is also a bit higher.

As previously, when the respondent said that there was a strictly positive probability of being stopped by the police when not wearing a helmet, his expectations regarding the fine he would have to pay were elicited by the interviewer. More precisely, interviewees were asked the percent chance the financial penalties would be less than a series of fixed amounts going from 50 INR up to 1,000 INR; the official fine for infringing the helmet law being 100 INR. Following the same methodology as the one used to derive the expected medical expenditures, expected fines have been computed for each individual. The individual's lack of information regarding the level of financial penalties has also been derived by computing the interquartile range.[15] On average, motorcyclists slightly overestimate the financial sanctions, the observed mean of expected fines across respondents in the sample being 129 INR (cf. Table 2).[16] Nonetheless, the variation in answers is quite important and half of the respondents have expectations which do not exceed the official fine. The dispersion parameter also indicates that the level of the official fine is somewhat unclear for many individuals given that on average interviewees gave an interquartile range which is higher than the official fine (112 INR).

After this presentation of the collected data, and before turning to the empirical analysis, I discuss in the next section the potential mechanisms at play in the formation of the subjective expectations of injury and fine as well as the expected role of such beliefs in the decision to

[15] In this case, the minimum of 50 INR has been imputed to the 25th percentile for 330 individuals and to the 75th percentile for 78 of them.

[16] One may argue that the proposed pre-determined scale may have biased answers upward given that it starts at 50 INR. Nevertheless, respondents were not told the maximum offered amount (1,000 INR) and 75% of interviewees said the maximum possible fine was below 300 INR (90% below 500 INR). I acknowledge however that it could have been preferable to have a scale starting at 25 INR and increasing by a smaller amount. This would have allowed me to obtain more accurate information. Moreover, I cannot rule out the possibility that respondents also include in the financial consequences of being caught by the police for helmet non use additional fines related to other road regulations they would have simultaneously violated.

wear a helmet or not.

4 Mechanisms at play

Hereinafter, I approach the problem from the theoretical side. This discussion serves to guide the following empirical analysis. First, I consider the formation and updating of individuals' beliefs regarding the medical expenditures and fines they expect to pay if they don't use a helmet. In particular, I look whether personal experiences of road crash or traffic police arrest influence motorcyclists' subjective expectations. In a second step, I discuss the theoretical role of subjective expectations on the decision of helmet use along with additional variables which may directly impact the adoption of a head protection device.

4.1 Influence of previous experiences on subjective expectations

From every motorbike trip, individuals obtain new information with respect to the health and financial risks they face from not using a helmet. This new information can, as defined by Haselhuhn et al. (2012), come from a traffic accident they witness (information via observation) or from being involved in a road crash themselves (information via personal experience). Motorcyclists are also likely to modify their beliefs after hearing the story of someone who suffered from road injuries (information via description).

Being involved in an accident and injured or being caught by the police while not wearing a helmet certainly increase the subjective probabilities that such events occur. Nonetheless, the effect of personal experiences on expected medical costs and expected fines are more ambiguous. More precisely, whether personal experience increases or decreases expected outcomes depends on (i) the individual's prior belief and (ii) the severity of the loss the person faces. In other words, if a person, who expected to face tremendous medical expenditures in case of a road crash, is involved in a minor accident, he will certainly correct his expectations downward. If instead, the motorcyclist thought that he would not be injured at all, he will rather modify his beliefs upward. Furthermore, a person is likely to decrease or increase the expected fine to be paid in case of police halt if he was respectively able to corrupt or not the police officer. Finally, a same road experience may have different lasting effects depending on the frequency at which the victim uses the motorbike after the event.

One may think of many other variables which may play a role in the formation of individuals' expectations. Older people have had more time to experience road accident or police arrest. As for women, given their low participation in the labor market, they are much less exposed to motorbike risks. Despite the influence of socio demographic characteristics, I mainly focus, in my empirical analysis, on previous experiences. Due to the cross section data at hand, I acknowledge that I am neither able to properly study the updating process nor to estimate accurately the impact of a road crash or a police arrest on one's subjective expectations.[17] Nevertheless, I can look whether individuals who experienced a traffic accident or who have been sanctioned by the traffic police report significantly different beliefs regarding injuries and fines.

4.2 Potential influence of subjective expectations on helmet adoption

Unconditional expected costs

When investigating the impact of expectations on helmet adoption, it seems relevant to consider the product of the subjective probabilities and subsequent expected outcomes rather than the two dimensions separately. Indeed, on the one hand, two motorcyclists who think they will certainly be caught by the police if they don't wear a helmet but who have different expectations in terms of fines to be paid may not adopt the same conduct. On the other hand, a motorcyclist who thinks that he has a low probability of being injured but that he will suffer from severe injuries, should this occur, and a person who believes he has a high probability of accident but the subsequent medical expenditures will be rather small may opt for the same attitude toward helmet use. Therefore, it seems key to look at the combination of the two dimensions. This product of variables is called unconditional expected costs in the empirical analysis.

Different influence of expectations depending on trip circumstances

Helmet use is a renewed decision, i.e. individuals decide to use a helmet or not before each of their motorbike trips. The characteristics of each journey (its length, the type of roads taken, etc.) are therefore likely to influence the use of head protection. Habits and routines may also to some extent be adopted by motorcyclists who will always use the helmet in some circumstances and never in others. Very short trips in small streets are commonly assumed to be less dangerous in terms of injuries. While statistics from developed countries showed that a large share of accidents occur very close to the victims' home,[18] road users often only consider the risk of injuries in long distance trips on big roads where a lot of vehicles circulate at a high speed. A reason for that may be the willingness not to take into account all the risks, so as to limit the stress generated by the fear of injuries. Indian motorcyclists may follow a similar reasoning. Furthermore, the probability of crash remains low for short distance trips when compared to the number of times a person takes the same path. Given this difficulty in internalizing all the health risks constantly faced, it would not be surprising that subjective expectations of injuries either do not impact at all safety behaviors or only influence helmet use in long trips on main roads. On the contrary, traffic police operates throughout the city, both

[17] Panel data could permit to estimate the influence of such events by comparing before and after level of expectations.

[18] This is the case of France where 75 % of road casualties are locals, pedestrians or occupants of vehicles registered in the district. A peak of mortality is also observed around 6 pm, when people return from work (www.securite-routiere.gouv.fr). Unfortunately, to my knowledge, no such data is available for the city of Delhi or at the Indian national level.

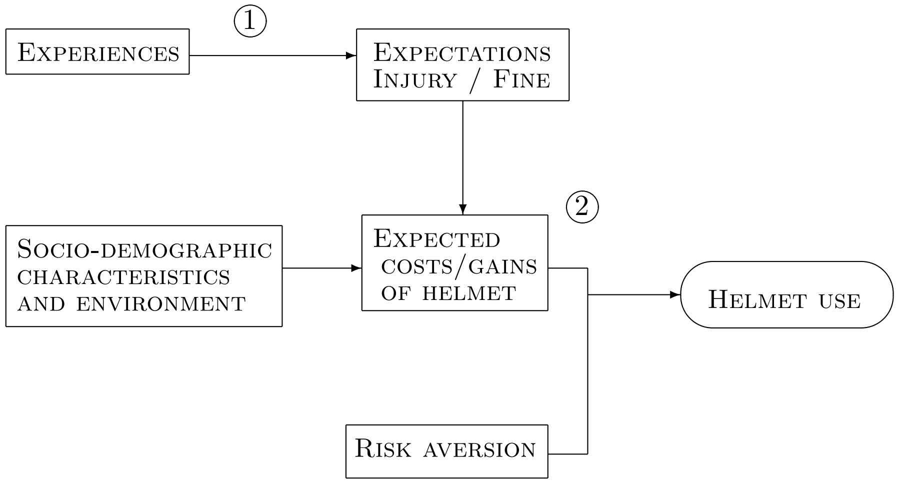
on main inner city roads and within neighborhoods. Therefore, the threat of financial penalties is more likely to impact helmet use on short distance trips.

Additional variables impacting the expected costs and gains of helmet use

Other important determinants of helmet use include preferences toward risk. Indeed, a more risk averse individual will prefer to adopt a safe conduct to avoid the potential loss. Results from a previous paper (Grimm and Treibich, 2014) show that, indeed, more risk averse drivers wear a helmet more often. However, this relation is not found for passengers. Age is likely as well to affect the individual's time preference rate through the horizon over which the person discounts the consequences of a negative event. As for the level of education, it may capture the person's ability to collect and deal with information regarding road risks. Income earners, in particular heads of households, married people and individuals with children, may also opt for a safer conduct because of their family responsibilities and the additional financial consequences implied by a temporary or permanent incapacity to work. Moreover, access to health care may also matter, through the mitigation of negative health consequences. Finally, people who believe that their life is in the hand of a superior force and that their date of death is already written may decide not to use a helmet despite high subjective expectations of injuries.

Figure 3 summarizes the main channels through which individuals may form their expectations of injury and fine and then choose whether to wear a helmet or not, in different traveling circumstances. The discussion above aimed at highlighting the role of previous experiences in the formation and updating of individuals' beliefs regarding injury and fine in case one doesn't use a helmet as well as the potential role of these expectations on helmet adoption. This guides my empirical analysis. In particular by helping me to decide which explanatory variables should be introduced in the different regressions of my empirical study.

Figure 3: Formation of subjective expectations and their influence on helmet adoption



Research questions:

(1) To what extent subjective expectations influence helmet use decision?

(2) Do individuals' experiences modify their subjective expectations?

5 Empirical analysis

I now empirically test the mechanisms previously brought to light. I first explore the influence of previous experiences on subjective probabilities, expected financial consequences and the variance regarding these costs. In a second step, I look at the extent to which subjective expectations influence helmet adoption and whether the beliefs regarding injury and fine impact the use of a head protection device in different ways depending on the circumstances of the motorbike trip.

5.1 Do individuals' experiences modify their subjective expectations?

I investigate here whether previous experiences of road crash and police arrest influence the individuals' subjective expectations regarding the risk they face when not wearing a helmet.

5.1.1 Empirical specification

Road hazards and police enforcement intensity are likely to vary across neighborhoods and influence subjective expectations. In other words, if in a given area, police officers are more present, individuals living in that neighborhood are likely to report higher subjective probabilities of being stopped by the police. Similarly, in an accident prone area, individuals are more likely to report higher subjective probabilities of accident. These characteristics are thus likely to bias my estimates if not taken into account. New Delhi is divided into 47 police zones, called "circles". A specific police budget and man power is allocated to each of these areas. As 32 different circles are present in our survey, I take advantage of the geographical division of the city to capture potential local effects.

I therefore estimate the following specification:

$$\text{Expectation}_{itk} = \beta \cdot \text{Experience}_{it} + \sum_{j} \gamma_j \cdot X_{ij} + \mu_c + \varepsilon_{itck}$$

I consider seperately the subjective probabilities, the expected costs and the variance regarding these costs which is captured by the interquartile range (Expectation_{itk}, with $k = 1$, 2 or 3). My variables of interest are previous experiences and differ depending on the type of subjective expectations t considered (injury or fine). In all regressions, I control for the frequency and the purpose of motorbike use in order to control, at least partly, for the probability that the motorcyclist experienced either a road crash or a police arrest. In addition, religious practices are also included in the analysis as they may actually alter individuals' beliefs. Given that for several of my variables of interest no variation is found within a circle (cf. Table 11, Appendix A), I also report the results found with ordinary least square results and when relevant the results of the random effect specifications.

5.1.2 Influence of road traffic experiences on injury expectations

Both personal and relatives' experiences of road crash are introduced as dummy variables in the analysis. As mentioned previously, the purpose and the frequency of motorbike use control for possible differences in road risks and therefore for the probability of being involved in an accident.[19] Furthermore, the trauma caused by one experience of crash is likely to have a smaller impact on people who frequently uses this mode of transportation and who balances this negative event with many safe journeys. I thus introduce an interaction term between frequency of motorbike use and personal involvement in a road accident. Hausman tests indicate that the estimation with police zone fixed effects should be preferred to ordinary least square or random effect specifications.

Table 3 reports the results found for the different specifications described above. Interestingly, involvement in an accident decreases the variance related to medical costs. Following an accident, individuals actually seem to have a clearer idea of the health risks they face. While praying daily decreases one's subjective probability of being injured in a road crash when not using a helmet, expected medical expenditures and variation in these costs are higher among religious individuals who personally experienced a road accident than among those who didn't. As for individuals who use the motorbike to commute to work, they report significantly higher probabilities of being hurt. Frequent use of a motorbike seems to decrease the impact of personal road crash on the subjective probability of being injured, indicating that the number of trips impact the repercussions of road crash experiences. Furthermore, it appears that knowing someone who has been involved in an accident increases by 0.09 the subjective probability of being injured in a road crash if not using a helmet, while personal experience has no significant impact (cf. column(1), Table 3). Different reasons may explain this finding. First, personal involvement in a traffic accident may correspond to very different events. Second, a sample selection may be at play as individuals who suffered from severe road injuries may no longer use a motorbike or may not even have survived the crash.[20] Third, remembering that a friend or a family member got caught in a traffic accident is more likely if this crash was quite severe. Differences in road quality and incidence of road crash between neighborhoods may partly explain the level of expectations as the influence of knowing a person who got caught in an accident vanishes once circle fixed effects are introduced. In 15 circles out of 32, none of the respondents knew a person who got involved in a road traffic accident. This may either support the quality of roads argument or imply that fixed effects estimations cannot capture the effect of knowing someone who got caught in a crash because individuals are rather homogenous in this regard within areas.

[19] In my sample, individuals who frequently use a motorbike are more likely to have personally experienced a road crash.

[20] While information on the severity of the accident was gathered, very few individuals (2% of the sample) were involved in a severe crash.

Table 3: Determinants of injury expectations

	subjective probability of injury if no helmet		subsequent outcomes: expected costs		subsequent outcomes: interquartile range	
	(1)	(2)	(3)	(4)	(5)	(6)
Specification	OLS	FE	OLS	FE	OLS	FE
Experienced a road crash (=1)	0.078	0.042	-6.092***	-5.377**	-9.576***	-8.266**
	(0.080)	(0.052)	(1.366)	(2.146)	(2.553)	(3.607)
Has a relative involved in a road crash (=1)	0.093**	0.030	1.554	2.275	2.070	3.226
	(0.041)	(0.040)	(1.814)	(1.500)	(2.910)	(2.149)
Uses the moto to commute to work (=1)	0.044*	0.068***	-0.124	0.071	0.411	0.758
	(0.025)	(0.019)	(0.770)	(0.583)	(1.278)	(0.851)
Uses the moto frequently (=1)	0.071***	0.053**	-2.450***	-0.676	-3.804***	-1.254
	(0.025)	(0.023)	(0.723)	(1.064)	(1.192)	(1.769)
Experienced a road crash × Uses the moto frequently	-0.151**	-0.125	4.425**	2.263	7.670*	4.119
	(0.073)	(0.080)	(2.176)	(2.129)	(4.330)	(4.422)
Prays daily (=1)	-0.142***	-0.069***	-1.300*	-1.059	-1.714	-1.420
	(0.024)	(0.023)	(0.771)	(0.759)	(1.285)	(1.208)
Experienced a road crash × Prays daily	0.094	0.065	5.128***	5.668**	9.639***	10.401**
	(0.087)	(0.072)	(1.811)	(2.210)	(3.484)	(4.183)
R^2/ R^2 within	0.077	0.048	0.028	0.017	0.026	0.018
Observations	*828*	*828*	*765*	*765*	*765*	*765*
Hausman test (p-value)						
OLS vs. FE	0.000		0.000		0.000	
FE vs. RE	0.003		0.088		0.061	

Notes: Robust standard errors are reported in parentheses. *** 1%, ** 5% and * 10% significance.

Remark: The difference in the number of observations comes from the fact that individuals who gave a zero probability of injury did not answer to the medical expenditure questions. Moreover some respondents who gave a non zero probability did not reply to the outcome questions.

5.1.3 Influence of interactions with the traffic police on fine expectations

I now turn to the influence of personal experiences on fine expectations. Besides previous police arrests for infringing road rules, individuals' subjective probability of being stopped by the police for no reason and the possibility of bribing police officers are my variables of interest. The former may capture the discretionary power of the police and the latter the bargaining power of the motorcyclist.[21] Both can be considered as proxies for previous interactions with traffic forces and might impact individuals' subjective expectations. As previously, road exposure and religious practices are introduced in all regressions.

From Table 4, it appears that the random effect specifications should be preferred to the fixed effect ones. Having been already sanctioned by the traffic police increases both the expected fines to be paid and the uncertainty with respect to the financial penalty. This latter effect may be explained by repeated sanctions of different amounts. Arbitraireness in the traffic police sanctions increases the subjective probability of being sanctioned if not using a helmet, while individuals who think they can bribe police officers report significantly lower probabilities of arrest.

As for the effect of road habits and religious practices. Motorcyclists who use the motorbike to go to work report significantly higher probabilities of being caught by the police if not wearing a helmet. The observed differences between ordinary least square and fixed effect specifications indicate that differences in expectations may therefore also come from actual differences in police enforcement intensity in each circle. Nonetheless, I acknowledge that this result may be simply caused by the reduced variation within a circle. In 11 circles, none of the respondents reports having been stopped by the traffic police.

[21] Expectations and opinion on the work made by the traffic police may actually be both related with a third variable which reflects the individual's acceptance of authorities and their power.

Table 4: Determinants of fine expectations

	subjective probability of police arrest if no helmet			subsequent outcomes					
				expected costs			interquartile range		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Specification	OLS	FE	RE	OLS	FE	RE	OLS	FE	RE
Has been sanctionned by the police (=1)	0.086*	0.032	0.045	0.598**	0.538*	0.548*	0.516**	0.469*	0.487*
	(0.046)	(0.035)	(0.034)	(0.244)	(0.297)	(0.298)	(0.214)	(0.273)	(0.271)
Discretionnary power of police	0.271***	0.189***	0.201***	0.281**	0.168	0.198	0.492***	0.206	0.258
	(0.041)	(0.061)	(0.059)	(0.123)	(0.198)	(0.190)	(0.144)	(0.243)	(0.230)
Police officers can be bribed (=1)	-0.045*	-0.041	-0.044*	-0.085	-0.126	-0.123	-0.093	-0.153	-0.149
	(0.023)	(0.025)	(0.025)	(0.081)	(0.100)	(0.097)	(0.084)	(0.100)	(0.100)
Uses the moto to commute to work (=1)	0.011	0.034*	0.033*	0.002	0.045	0.044	0.009	0.038	0.036
	(0.027)	(0.018)	(0.019)	(0.086)	(0.084)	(0.084)	(0.091)	(0.083)	(0.081)
Uses the moto frequently (=1)	0.029	0.038	0.035	-0.098	-0.051	-0.059	0.010	0.023	0.017
	(0.026)	(0.027)	(0.027)	(0.083)	(0.090)	(0.093)	(0.087)	(0.077)	(0.078)
Prays daily (=1)	-0.050**	-0.040	-0.042	-0.137	-0.006	-0.020	-0.224**	-0.120	-0.132
	(0.025)	(0.029)	(0.029)	(0.089)	(0.074)	(0.074)	(0.101)	(0.097)	(0.099)
R^2/ R^2 within / R^2 overall	0.076	0.050	0.025	0.030	0.028	0.026	0.041	0.028	0.034
Observations	*821*	*821*	*821*	*702*	*702*	*702*	*702*	*702*	*702*
Hausman test (p-value)									
OLS vs. FE	0.000			0.000			0.000		
FE vs. RE		0.105			0.687			0.751	

Notes: Robust standard errors are reported in parentheses. *** 1%, ** 5% and * 10% significance.
Remark: The difference in the number of observations comes from the fact that individuals who gave a zero probability of injury did not answer to the medical expenditure questions. Moreover some respondents who gave a non zero probability did not reply to the outcome questions.

5.2 To what extent do subjective expectations influence helmet adoption?

5.2.1 Empirical specification

I investigate here whether fear of injuries and police threat actually make motorcyclists adopt safer road behaviors, in particular toward helmet use.

Dependent variables

As already mentioned, in our survey, two traveling dimensions were considered for helmet use: the type of roads and the length of the motorbike trip. More precisely, three different circumstances were presented to the respondents: trips (i) in residential neighborhoods, (ii) on the main roads for short distances and (iii) on the main roads for long distances. While the first situation refers to narrow streets in residential or market areas, the two last cases correspond to travels on large boulevards where the traffic is often heavy. The richness of the data collected allows me to look at the role of different types of subjective expectations (medical expenditures vs. fines) and in particular whether some beliefs have more impact on specific trip situations.

Variables of interest

My variables of interest are the products of the subjective probabilities of being hurt or stopped by the police if not wearing a helmet and the related subsequent expected costs. In addition to the argument presented in the previous section, this choice is motivated by the fact that no information regarding expected outcomes is available for people who gave a zero probability for the negative event to occur. I set the unconditional expected costs to zero for those individuals. For the subsample of individuals who gave a non zero probability of being injured and stopped by the police if they are not wearing a helmet, I decompose the unconditional expected cost in order to see if there is one of its dimensions ("frequency" vs. "severity") which drive the results I found. Furthermore, one may also argue that the variance in potential financial consequences is important in the motorcyclist's decision process. I thus include the interquartile range in the decomposition analysis. Finally, in my robustness checks, I consider higher values of the expected outcomes (75^{th} percentile and maximum) as the conduct adopted by motorcyclists might be rather related to the worst case scenario.

Local effects

When studying the relation between beliefs and behaviors, one may argue that local specificities may be correlated with individual's subjective expectations and eventually bias the estimates.[22] While some variables, such as the quality of roads, the incidence of road crash or the police presence, may impact helmet use only through their effect on subjective expectations; others

[22] This issue is actually not relevant when looking at the influence of risk aversion on road safety efforts (helmet use and choice of speed), as done in Grimm and Treibich (2014). Indeed, in that case, it is rather the interviewers themselves who potentially influence the declared helmet use and the elicited risk aversion and not the local environment.

may also have a direct effect on helmet use. For instance, the presence of private emergency services in the area is likely to be associated with the expected medical costs but may as well partly influence the consequences of an accident, impacting directly the helmet use. As for neighbor's attitudes (social norms), they are likely to be correlated with one's behavior regardless of his subjective expectations but they may also induce a modification regarding the perceived consequences of helmet use.

Therefore, living, for instance, in a neighborhood where no one uses a helmet, may lower simultaneously helmet adoption by motorcyclists in the area and their subjective expectations of being caught by the police. This would lead to an underestimation of the true relation existing between subjective expectations and helmet adoption. On the contrary, the presence of private health centers may increase the medical expenditures individuals expect to pay in case of road injury but also decreases the helmet adoption as individuals may expect to receive particularly high quality care. This in turn would lead to an overestimation of the true coefficient. In other words, some unobservable characteristics at the geographical level are likely to be correlated with the independent regressors of interest and have a direct effect on the behaviors we attempt to explain. However, the direction of this bias is ambiguous.

Identification strategy

Similar to what I did to study the formation of subjective expectations, I take advantage of the administrative organization of Delhi to capture the local effects. Yet, before implementing this kind of empirical strategy, it is important to make sure that there is enough variation within circles; this, in order to avoid making hasty conclusions. Based on the analysis of the intra circle heterogeneity, it seems that dependent and independent variables vary quite substantially, even within one area (cf. Table 12 in Appendix A).

I therefore estimate the following specification:

$$\text{Helmet use}_{it} = \beta_m \cdot \text{UEC}_i^{med} + \beta_f \cdot \text{UEC}_i^{fine} + \sum_j \gamma_j \cdot X_{ij} + \mu_c + \varepsilon_{ict}$$

with i referring to the individual and t to the type of trip. Helmet use$_{it}$ is a binary variable. UEC_i^{med} and UEC_i^{fine} are the unconditional expected medical costs and the unconditional expected fines respectively. X is a set of socio demographic characteristics. Finally, μ_c corresponds to the respondent's circle of residence.

I run fixed effect linear probability estimations, I thus obtain the effect of the variations in subjective expectations on helmet use within each police zone. I clustered all standard errors at that level to control for potential autocorrelation in the error terms. My variables of interest are the unconditional expected costs. I include several individual characteristics which are likely to be correlated with both subjective expectations and helmet adoption and which thus may bias my estimates. More precisely, I introduce gender, age, education level, marital status, number of children, household monthly income, personal contribution to the family revenues, religious beliefs, preferences toward risk and health insurance. Indeed, as pointed out in the section discussing the underlying mechanisms, these variables are likely to be correlated with helmet adoption (through the expected costs and gains of helmet use) and with individuals' beliefs regarding risk of injury and fine (through the likelihood that the person has already experienced a road crash or a police arrest). Introducing police zone fixed effects in the estimations allows me to capture the previously mentioned specificities of each area along with the behaviors adopted by respondents' neighbors and the socio economic status of each residential locality. However, as Manski (1993) pointed out, these various effects are difficult to disentangle. Indeed, people with similar tastes and characteristics may select themselves into the same circles. Therefore, the absence of significant impact of some of the explanatory variables might be actually due to their too limited variation within a circle. From Table 12 (cf. Appendix A), we note that for some of the socio demographic characteristics this may be a concern. Furthermore, while circle effects pick up part of the differences in actual risks faced by individuals in different neighborhoods, it does not annihilate them completely. This because of, for instance, different traveling hours, different routes taken or different driving skills of motorcyclists living in the same police zone.

5.2.2 Results

Table 5 presents the results found for the three types of trips considered. Police threat and fear of injuries appear to impact helmet use in different ways depending on the traveling situation considered. Indeed, it seems that subjective expectations with respect to fines increases helmet use on short distance trips. On the contrary, higher expected medical expenditures lead to a greater helmet adoption on long distance trips only.[23] More precisely a raise of 1,000 INR in the unconditional expected medical costs increases by 0.5 percentage points the probability that the person wears a helmet for long trips on main roads. A raise of 100 INR in the unconditional expected fines increases by respectively 7.7 and 4.9 percentage points the probability of using a helmet for short trips on main roads and trips in residential neighborhoods. From the Hausman test's results, it seems that the fixed effect specification should always be preferred to the ordinary least square estimation. When looking at helmet use on short distance trips on main roads, the random effect specification appears to provide more efficient estimates. One issue with linear probability estimations is that predicted value may be out of the probability range. This is actually the case for only 40 (6%), 13 (2%) and 11(1.7%) observations regarding respectively the helmet use on long distance trips on main roads, short distance ones and trips in residential areas.

[23]The results on the significance of unconditional expected medical costs on helmet use for long distance trips without and with robust standard errors differ very marginally, but the latter specification makes the coefficient passes above the 10% significance level.

Table 13 (cf. Appendix B) reports the results obtained for the additional explanatory variables inroduced in the regressions presented in Table 5. Men are significantly more likely to use a helmet than women, while Sikhs are significantly less likely than motorcyclists belonging to other religious communities to use such protective device. More precisely, when considering long distance trips, the probability of using a helmet increases by 41 percentage points if the motorcyclist is a man and decreases by 27 percentage points if he or she is a Sikh. These findings are not surprising given that the Sikhs successfully lobbied against the use of helmet on the ground that it goes against their religious beliefs. They managed to be exempted from this obligation by the Delhi government. De facto, the helmet law has not been enforced for any women due to the difficulty to distinguish a Sikh from a Hindu or a Muslim.[24] Having a health insurance has a significant and negative impact on helmet use only for long distance trips when not controlling for the circle of residence (Table not shown). The absence of effect of access to health care on helmet use may actually be explained by the inefficiency of ambulatory services. According to Hsiao et al. (2013), 58% of all road traffic injury deaths in India occur on the scene of the collision, either immediately or while waiting for the emergency ambulance to come. No effect of income or impact of education are detected. Finally, preferences toward risk don't appear to significantly influence motorcyclists behaviors.[25]

[24]This softness in the helmet mandatory law implementation came to an end since Septembre 2014. Indeed, traffic police began to prosecute women riding two-wheelers without a helmet, Sick women being exempted only if they were able to prove their identity (source: The Times of India, September 11, 2014).

[25]In a previous paper (Grimm and Treibich, 2014), the effect of risk aversion on helmet adoption was detected only in the sample of drivers. Contrary to the analysis made then, I gather in this analysis all types of motorcyclists.

Table 5: Influence of expectations on helmet use - using unconditional expected costs (UEC)

Helmet use	**on main roads**		**trips in the**
	long trips	**short trips**	**neighborhoods**
	(1)	(2)	(3)
UEC medical expenditures (th. INR)	0.005^{+}	-0.000	0.001
	(0.003)	(0.004)	(0.004)
UEC fines (hund. INR)	0.011	$0.077^{\star\star\star}$	$0.049^{\star\star}$
	(0.018)	(0.018)	(0.023)
R^2	0.296	0.261	0.243
Observations	*670*	*673*	*665*
Hausman test (p-value)			
OLS vs. FE	0.000	0.000	0.000
FE vs. RE	0.000	0.161	0.000
Predicted values			
1^{st} percentile	0.248	0.047	-0.002
99^{th} percentile	1.071	1.024	0.094

Notes: *** 1%, ** 5%, * 10% and $^{+}$ 15% significance.
Fixed effect linear probability estimations with clustered standard errors reported in parentheses. Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income, Sikh, caste, risk aversion, health insurance and existence of a superior force.

5.2.3 Differentiated influence of expectations on helmet use

Some socio demographic characteristics of individuals are likely to modify the influence of subjective expectations on helmet adoption. In particular, women may be more sensitive to health issues and react more strongly to a given level of expected medical costs. Furthermore, absolute amounts of medical expenditures and fines have been elicited, nevertheless poorer individuals may be more responsive to a given level of costs as it represents a bigger share of their income. Finally, more risk averse individuals may adopt safer behaviors than less risk averse motorcyclists to avoid the same amount of costs. In order to study such differentiated effects, I interact the unconditional expected costs with gender, level of income and preferences toward risk. Results are reported in Table 6. Interestingly, when including these interaction terms, I find that the probability of wearing a helmet in long distance trips increases by 2.3 percentage points if the level of unconditional expected medical costs raises by 1,000 INR. The net effect of injury expectations almost vanishes among men. Similarly, for a same level of subjective medical costs women are more likely to use a helmet in short trips on main roads. An income gradient is found when introducing interaction terms between subjective expectations and levels of income. More precisely, poor and middle income individuals are less likely to wear a helmet than individuals belonging to a wealthier household. Moreover, a raise of 1,000 INR in the unconditional expected medical costs increases the probability of wearing a helmet in short distance trips on main roads by 1.6 percentage points more among the poorest individuals (31% of the sample) compared to individuals who belong to the wealthiest families (17% of the sample). Similarly, a given level of unconditional expected fines induces a significant difference in the use of head protection between middle income individuals and welathier individuals. Finally, the impact of unconditional expected fines on helmet use for short trips on main roads decreases with the level of risk aversion of motorcyclists. While one might expect that risk preferences and beliefs reinforce one another, this finding may be explained by the fact that preferences toward risk already partly influence the behavior of more risk averse motorcyclists, or that extremely risk averse individuals with high expected medical costs simply do not use this mode of transport and are de facto excluded from our survey.

Table 6: Differentiated influence of expectations on helmet use by gender, income and risk aversion

Helmet use	**on main roads**					**trips in the neighborhoods**
	long trips		**short trips**			
	(1)	(2)	(3)	(4)	(5)	(6)
UEC medical expenditures (th. INR)	0.005^{+}	0.023*	-0.000	0.002	0.001	0.014
	(0.003)	(0.013)	(0.004)	(0.012)	(0.004)	(0.015)
UEC fines (hund. INR)	0.011	-0.005	0.077***	0.180***	0.049**	0.003
	(0.018)	(0.074)	(0.018)	(0.062)	(0.023)	(0.066)
Male (=1)	0.409***	0.430***	0.414***	0.480***	0.390***	0.393***
	(0.052)	(0.059)	(0.061)	(0.059)	(0.070)	(0.062)
Male × UEC medical expenditures		-0.019*		-0.019**		-0.014
		(0.009)		(0.009)		(0.011)
Male × UEC fine		0.024		-0.008		0.030
		(0.046)		(0.039)		(0.033)
Household monthly income, *ref: Rich (above 20,000 INR)*						
Poor (less than 10,000 INR)	-0.013	-0.066	-0.095^{+}	-0.180**	-0.092	-0.165*
	(0.042)	(0.062)	(0.064)	(0.071)	(0.078)	(0.091)
Middle (between 10,000 and 20,000 INR)	-0.019	-0.044	-0.097**	-0.090*	-0.062	-0.162***
	(0.038)	(0.046)	(0.040)	(0.053)	(0.049)	(0.057)
Poor × UEC medical expenditures		0.001		0.016**		0.012
		(0.007)		(0.008)		(0.012)
Middle × UEC medical expenditures		0.002		0.002		0.012
		(0.007)		(0.007)		(0.009)
Poor × UEC fines		0.044		0.038		0.043
		(0.031)		(0.029)		(0.043)
Middle × UEC fines		0.016		-0.008		0.076***
		(0.032)		(0.030)		(0.026)
Risk aversion (average, 8 points)	-0.009	-0.009	0.002	0.020	0.001	0.005
	(0.015)	(0.022)	(0.013)	(0.019)	(0.014)	(0.018)
Risk aversion × UEC medical expenditures		-0.000		0.001		-0.002
		(0.001)		(0.002)		(0.003)
Risk aversion × UEC fine		-0.003		-0.021**		-0.003
		(0.012)		(0.010)		(0.012)
R^2	0.296	0.317	0.261	0.287	0.243	0.255
Observations	*670*	*670*	*673*	*673*	*665*	*665*

Notes: *** 1%, ** 5%, * 10% and $^{+}$ 15% significance. Fixed effect linear probability estimations with clustered standard errors reported in parentheses. Controls are marital status, # of children, head of household, age, education level, contribution to income, Sikh, caste, health insurance and existence of a superior force.

5.2.4 Decomposing the unconditional expected costs

In the previous analysis, my variables of interest were the products between the subjective probabilities of being hurt or being stopped by the police when not using a helmet and their related subsequent costs. This choice was mainly driven by the fact that individuals who think that injury or police arrest will never occurred were not questionned about the possible financial consequences of these events. Nonetheless, for the subsample of respondents who provided a strictly positive probability of injury and fine, I am able to investigate the respective roles of subjective probabilities and subsequent outcomes on helmet adoption. This corresponds to excluding 104 individuals from the sample. Furthermore, one may argue that the variance of potential financial consequences is also a dimension which motivates the conduct adopted by motorcyclists. Therefore, I also included the interquartile range in the specification to study the influence of variance and lack of information regarding possible losses on individuals' risky behaviors.

Table 7 presents the results found. When comparing coefficients of unconditional expected costs obtained with the full sample (Table 5) and the restricted one (cf. Table 7 – columns 1, 4 and 7), we see that stronger effects are obtained with the latter sample either in terms of significance of the coefficient (for long distance trips) or in terms of its magnitude (for short distance trips). When looking at the respective effect of "frequency" (subjective probabilities) and "severity" (expected costs) dimensions (cf. columns 2, 5 and 8), we note that expected costs actually drive the relations previously detected between subjective expectations of injury and fine and helmet use in different types of trips. Finally, when introducing the dispersion dimension in the regression (cf. columns 3, 6 and 9), I find that an increase of 1,000 INR in the expected medical expenditures increases by 1.5 percentage points the probability of wearing a helmet in long distance journeys. On the contrary, a similar increase in the variance regarding such costs decreases by 0.7 percentage points the probability that the motorcyclist adopt a safe behavior. Similar relation between subjective medical costs and helmet use are found in short distance trips on main roads. Regarding expected fines, in both short distance trips on main roads and trips in residential neighborhoods, the lack of information regarding the amount to pay drives the individual's behavior. More precisely, an increase in 100 INR of the dispersion in the fine boosts the probability of using a helmet by around 6 percentage points. The coefficient of expected financial cost is then no longer significant.

5.2.5 Robustness checks

In order to provide evidence for the reliability of my results, I implement different robustness checks, the results of which are reported hereinafter.

Table 7: Influence of expectations on helmet use - non zero probability sample

Helmet use	**on main roads**						**trips in the neighborhoods**		
	long trips			**short trips**					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UEC medical expenditures (th. INR)	0.005*			0.000			0.002		
	(0.003)			(0.003)			(0.004)		
UEC fines (hund. INR)	0.001			0.085***			0.059***		
	(0.016)			(0.020)			(0.022)		
subjective probability of injury		0.077	0.085		-0.164	-0.158		0.064	0.051
		(0.062)	(0.065)		(0.142)	(0.141)		(0.120)	(0.116)
expected medical costs (th. INR)		0.003*	0.015**		0.002	0.017**		-0.000	-0.012
		(0.002)	(0.007)		(0.003)	(0.007)		(0.003)	(0.008)
IQR of medical costs (th. INR)			-0.007*			-0.008**			0.007
			(0.004)			(0.004)			(0.004)
subjective probability of arrest		-0.001	-0.003		0.163	0.163		-0.004	-0.003
		(0.052)	(0.050)		(0.103)	(0.102)		(0.071)	(0.073)
expected fine (hund. INR)		-0.013	-0.020		0.065***	0.013		0.075***	0.028
		(0.023)	(0.033)		(0.014)	(0.030)		(0.022)	(0.034)
IQR of fine (hund. INR)			0.008			0.061**			0.056**
			(0.026)			(0.026)			(0.024)
R^2	0.262	0.264	0.269	0.244	0.253	0.265	0.223	0.231	0.239
Observations	*589*	*589*	*589*	*591*	*591*	*591*	*583*	*583*	*583*

Notes: *** 1%, ** 5% and * 10% significance. Fixed effect linear probability estimations with clustered standard errors reported. Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income caste, risk aversion, health insurance and existence of a superior force. IQR stands for interquartile range and captures the dispersion in the outcome.

Considering alternative information of the expected outcomes' distribution

One may argue that it is the highest possible values with respect to potential financial consequences (i.e. the costs corresponding to the worst case scenario the individual has in mind), rather than its expected level, which motivates the conduct adopted by motorcyclists. When replacing expected costs by the 75^{th} percentile or the maximum value, I find similar results regarding the influence of subjective expectations on helmet use (cf. Table 14, Appendix C).

Tackling the reverse causality issue

One main concern regarding the previous results is the possibility that individuals who decide not to wear a helmet may report lower expectations of negative consequences in order to reduce the stress induced by the behaviors they choose to adopt. This effect is known as cognitive dissonance and has been first highlighted by Akerlof and Dickens (1982). In order to tackle the reverse causality issue previously mentioned, I try to show that helmet use does not cause subjective expectations regarding injury or fine. I take advantage of a regulation implemented in Delhi since July 2009 that makes it compulsory to provide a helmet with every new motorbike that is sold. I regress helmet use on unconditional expected costs instrumenting the former variable by mandatory helmet provision. More precisely, the instrument takes value one if the respondent is a driver and rides a motorbike purchased first hand less than two years ago. I assume that this variable is indeed exogenous and unrelated with any omitted variable. Results presented in Table 15 (Appendix D) show that the instrumental variable (helmet provision) is positively and significantly correlated with the endogenous regressor (helmet use) and that helmet adoption does not explain fine or injury expectations.

Individual omitted characteristics

I acknowledge that some individual's characteristics (such as optimism, overconfidence regarding one's driving skills, preference for present, level of speed or road habits) still remain unobserved and might bias my results. Optimism, for instance, is likely to reduce the subjective probability of accident and the size of injury. Similarly, overconfident drivers are likely to think they are able to avoid both police officers and road crashes. These two characteristics, so far unobserved, are negatively correlated with subjective expectations regarding the usefulness of a helmet. On the contrary, the velocity at which motorcyclists travel may influence both subjective expectations of medical expenditures and helmet adoption. Speed certainly increases the probability of accident and the severity of injuries. If low speed and helmet use are substitutes,[26] individuals with high subjective expectations of injuries may decide to reduce their speed instead of wearing a helmet. The estimates would in that case be an overestimation of the true relation between beliefs and head protection use. As for the absence, in the formulation of the question, of a clear time horizon to be considered by the respondent when answering to the likelihood of being hurt in a road crash, I acknowledge that comparability between individuals may be problematic. As pointed before, some may refer to the next trip while others think about their entire life time. The absence of time horizon would jeopardize my results if individuals who refer to a really short time horizon are different than those who consider their whole life. One may argue that present oriented individuals may be more likely to refer to the next motorbike trip and then may report lower probabilities of injuries. If preference for the present is negatively correlated with subjective expectations (and not included in the analysis) then the estimate of unconditional expected medical costs on helmet use will be an underestimation of the true relation.

In Table 16 (Appendix E), I add the following variables to the previous specifications: average speed (Panel 1), road habits (Panel 2), preference for present (Panel 3) and confidence on one's driving skills (Panel 4 for the drivers subsample).

A significant relation between subjective expected medical costs and helmet use in long distance trips appears when average speed is introduced in the specification. In addition, we note that subjective expectations of fines also increase helmet use on long distance trips when average speed or confidence are included in the regressions. Similar results as the ones previously presented are found regarding the influence of subjective expectations of fines on helmet adoption in the two types of short distance journeys. One issue raised when discussing the re-

[26] In the previous article Grimm and Treibich (2014), we provide evidence regarding the relation between these two safety behaviors.

lation between subjective expectations regarding injuries and safety effort was the possible link between individuals' preferences for present and the time horizon they considered when answering to the probability of being hurt in a road crash. Nonetheless, when introducing preference for present in the regression as additional control, results found previously are not modified. Regarding the impact of the previously omitted variables on helmet adoption, speed appears to be positively correlated with helmet use on long travels. Individuals who frequently use a motorbike are significantly more likely to wear a helmet when traveling on main roads. Finally, drivers who believe they drive better than others are less likely to use a helmet for long trips or trips in neighborhoods. In this latter case, risk aversion is found to be positively correlated with helmet use on main roads. To conclude, adding these different characteristics leads to a reduction of the sample but findings are consistent with the previous results providing that my attempts to control for omitted local environmental variables have already given reliable estimates.

Excluding individuals who did not seem to understand the probability scale
The understanding, by all respondents, of the probability scale used to derive subjective probabilities may be questioned. Before eliciting subjective expectations of probabilities and outcomes regarding injury and fine, several questions were asked to interviewees in order to be able to verify whether they properly understood the probability scale (cf. Appendix F). I compare the results reported in Table 5 to the coefficients obtained if excluding individuals who did not correctly answered to the check questions (see Table 18). Similar findings of the influence of subjective expectations on helmet adoption are found for the different samples considered (excluding individuals who answered incorrectly to one or several check questions). The magnitude of the effects are quite constant across samples: a raise of 100 INR in the unconditional expected fines increases by around 7 percentage points (from 6.3 to 7.9) the probability of wearing a helmet in short distance trips on main roads and by 5 percentage points (from 4.8 to 5.2) the probability of using a helmet in residential neighborhoods.

5.2.6 On the direct influence of experiences on helmet use

When studying the formation of subjective expectations, I have assumed that previous experiences related to road risks only influence helmet adoption through expectations, these being updated based on the new information the individual gets from a road traffic accident or a police arrest.

Nonetheless, the event *per se* is likely to impact the safety conduct adopted by motorcyclists. Haselhuhn et al. (2012) used data on video rental fines and showed that, controlling for the level of information regarding the financial sanctions of a delay in returning the video, previous experience with a fine significantly improved the future compliance rate. Using the same specification as the one presented in Table 5, I introduce road crash and police arrest as explanatory variables along with interaction terms between (i) road accident and unconditional expectated medical costs and (ii) police arrest and unconditional expected fines. From Table 8, we note that the effect of injury expectations on helmet use for short trips appears to be lower among individuals who have been involved in a traffic accident. The effect of fine expectations on helmet use for trips in the residential neighborhoods among individuals who have been caught by the traffic police doubles compared to its effect among those who have never been in that situation. This last result shows the importance of combining information and enforcement to make motorcyclists adopt safe behaviors.

Table 8: Differentiated influence of expectations on helmet use by previous experiences

Helmet use	**on main roads**				**trips in the neighborhoods**	
	long trips		**short trips**			
	(1)	(2)	(3)	(4)	(5)	(6)
UEC medical expenditures (th. INR)	0.005	0.005	-0.000	0.000	0.001	0.002
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.005)
UEC fines (hund. INR)	0.010	0.007	0.076***	0.085***	0.050**	0.031
	(0.018)	(0.023)	(0.018)	(0.021)	(0.023)	(0.026)
Road crash (=1)		-0.049		-0.015		-0.097
		(0.059)		(0.061)		(0.064)
Road crash × UEC medical expenditures		-0.002		-0.010**		0.002
		(0.005)		(0.004)		(0.005)
Police arrest (=1)		0.030		0.047		-0.112
		(0.050)		(0.072)		(0.095)
Police arrest × UEC fines		0.009		-0.041		0.080**
		(0.026)		(0.031)		(0.030)
R^2	0.287	0.289	0.259	0.262	0.242	0.248
Observations	*662*	*662*	*665*	*665*	*657*	*657*

Notes: *** 1%, ** 5% and * 10% significance.
Fixed effect linear probability estimations with clustered standard errors reported.
Controls are gender, marital status, # of children, head of household, age, education level, income, contribution to income, Sikh, caste, risk aversion, health insurance and existence of a superior force.

6 Policy implications

In order to be able to formulate policy recommendations, I now consider different road safety policies which are likely to influence individuals' expectations of injuries and fines when not wearing a helmet, and estimate their impact with respect to helmet use.

6.1 Raising expectations of fines

I first study policies which impact expectations of fines if infringing the helmet law, either through the information on the official level of fine, its perceived enforcement or its level *per se*.

In order to simulate policies and estimate their impact on helmet adoption, I run probit specifications with circle dummies clustering standard errors at the police zone. Results obtained, both in terms of significance and magnitude, are very similar to those obtained with the fixed effect linear probability model. I report them in the Appendix G, Table 19. Based on these probit estimations, Table 9 reports the estimated impact on helmet use if motorcyclists perfectly know the current level of fine (Scenario 1), if the official fine is raised up to 500 INR (Scenario 2), if individuals perfectly know the current level of fine and expect to always be caught by the police when not wearing a helmet (Scenario 3), and if perfect enforcement and information is associated with a higher official fine of 500 INR (Scenario 4). The chosen multiplicator factor of fines ($\times 5$) coincides with an amendment of the Motor Vehicle Act currently under discussion in the Indian Parliament. As expected from the empirical analysis, larger gains regarding helmet adoption are obtained on short distance trips, in particular on main roads. The limited increase in helmet use for longer trips can be explained both by a bigger role of expected injuries in this particular decision and by the smaller room for improvement in this type of trip. A larger impact is found when raising the official fine substantially. More precisely, scenarios 2 and 4 lead to an increase of 25% to 40% of helmet use for short distance trips.

When comparing previous police arrests experienced by respondents with administrative traffic police data, we note that the number of offences for not using a helmet in 2011 per police zone is positively correlated with the share of respondents living in that area who declare they have been stopped by the police for infringing the helmet law. Nonetheless, traffic offence data is negatively correlated with the subjective probability of being checked by the police. According to these figures, it seems important not only to publicize the financial penalties individuals may face when not using a helmet but also to increase the actual enforcement of helmet legislation. Similar findings are found by Lu et al. (2012). These authors implemented a randomized experiment in China and showed that telling drivers that they have been catched by the electronic devices deters them from infringing the road rules in the future while providing them with information on the likelihood of punishment does not.

Table 9: Estimated helmet use for changes in expectations of fines

Helmet use	on main roads: for long trips	on main roads: for short trips	for trips in the neighborhood
observations	*610*	*663*	*660*
Current UEC fines (INR)	90	93	93
Observed helmet use (%)	78.20	59.58	53.03
Observed - predicted helmet use (average)	-0.003	-0.004	-0.005
% change in helmet use			
Scenario 1 EC = 100 INR	+ 0.14%	- 3.12%	- 1.36%
Scenario 2 EC = 500 × info. coeff.	+ 2.33%	+ 23.36%	+ 25.12%
Scenario 3 UEC = 100 INR	+ 0.41%	+ 2.55%	+ 1.53%
Scenario 4 UEC = 500 INR	+ 2.85%	+ 49.56%	+ 32.43%
Δ in percentage points			
Scenario 1 EC = 100 INR	+ 0.11	-1.86	-0.72
Scenario 2 EC = 500 × info. coeff.	+ 1.82	+17.49	+13.32
Scenario 3 UEC = 100 INR	+0.32	+1.52	+0.81
Scenario 4 UEC = 500 INR	+2.23	+29.53	+17.20

Notes: Computations based on probit regression with circle dummies (cf. Table 19).
Scenario 1: perfect information, individuals expect to pay 100 INR, i.e. the official fine.
Scenario 2: raising the official fine up to 500 INR, but keeping enforcement and information level as it is.
Scenario 3: perfect information and enforcement with current level of fine.
Scenario 4: perfect information and enforcement with an official fine at 500 INR.

6.2 Raising expectations of medical expenditures

I now focus on different scenarios of expectations of medical costs and relate them to policies such as awareness campaigns regarding the road mortality rate or the usefulness of a helmet.

I unfortunately don't have access to any official data regarding the actual health expenditures road victims have to pay. I therefore simply consider different scenarios with increasing unconditional expected medical costs and estimate the helmet use associated to each of these levels of expenditures for different motorbike trips. Table 10 reports the simulated change in percentage of use. While no increase in the share of motorcyclists wearing a helmet is found on short distance trips, doubling the expectations of injury costs (from 2,400 to 5,000 INR) raises the use of a head protection device for long distance trips by 0.5 percentage points. A share of 98.2% of motorcyclists using a helmet in long distance trips, implying an increase of 20 percentage points, is obtained when multiplying by 20 the individuals' beliefs. These results suggest that awareness campaigns stressing the high cost of road injuries in case of an accident and in particular if not using a helmet might be useful to increase helmet use among motorcyclists in Delhi. Lewis et al. (2007) summarized the literature on road safety media campaigns and concluded that the impact of shocking advertisement is rather mixed and inconsistent. Fear campaigns must therefore be used with caution. Using factual information or humor might be alternative options.

Finally, highlighting the risk one faces even in short distance trips could raise the use of helmets among individuals who use a motorbike only in the vicinity of their homes. When imputing the estimated impact of unconditional expected medical costs found for long trips to helmet use on short distance ones (scenario 8), it appears that if individuals thought that short distance journeys imply similar health risks as longer trips, an increase of around 6% in the share of individuals who use a helmet would be observed.

Table 10: Estimated helmet use for changes in expectations of medical expenditures

Helmet use	on main roads for long trips	on main roads for short trips	for trips in the neighborhood
observations	*610*	*663*	*660*
Current UEC medical expenditures (INR)	2,408	2,704	2,755
Observed helmet use (%)	78.20	59.58	53.03
Observed - predicted helmet use (average)	-0.003	-0.004	-0.005
% change in helmet use			
Scenario 5 UEC = 5,000 INR	+3.04%	+0.82%	+1.21%
Scenario 6 UEC = 10,000 INR	+7.40%	+0.99%	+1.79%
Scenario 7 UEC = 50,000 INR	+25.63%	+2.40%	+6.56%
Scenario 8 $\hat{\beta}^{long}_{UECinj}$	-	+4.63%	+6.54%
Δ in percentage points			
Scenario 5 UEC = 5,000 INR	+2.38	+0.49	+0.64
Scenario 6 UEC = 10,000 INR	+5.79	+0.59	+0.95
Scenario 7 UEC = 50,000 INR	+20.04	+1.43	+3.48
Scenario 8 $\hat{\beta}^{long}_{UECinj}$	-	+2.76	+3.47

Notes: Computations based on probit regression with circle dummies (cf. Table 19).

7 Conclusion

Road mortality is a growing burden in many developing countries. To counteract this trend, an increasing number of low and middle income countries have started to implement mandatory helmet regulations. Yet, helmet use remains low in a majority of African and Asian countries, where motorcyclists represent an important share of both traffic mix and road casualties. Understanding the mechanisms leading to the adoption of a helmet by motorcyclists is therefore key to implement efficient safety measures in these regions.

This paper studies motorbike users' decisions whether to wear a head protection or not, using original data collected in a low income country metropolitan city, New Delhi.

I first explore the factors which may explain the observed differences in beliefs across individuals and show that road exposure and previous experiences of road related risks impact the formation of motorcyclists' beliefs. Nonetheless, differences across individuals seem also to come from differences in actual health hazards and police enforcement intensity.

In a second step, I study the impact of subjective expectations of injury and fine on helmet adoption; this, in various traveling situations differing by the length of the trip and the type of roads taken. Both fear of injuries and police threat are indeed likely to play a role in the safety conduct adopted by motorcyclists.[27] I therefore investigate whether one type of belief is more likely to be associated with the adoption of a helmet for a specific type of travel. In the empirical analysis, I find that while expectations regarding medical expenditures increase the adoption of helmet on long distance trips on main roads, it is rather the threat of police sanctions which explains helmet use on short distance journeys. Differentiated effects are found for helmet use on short distance trips on main roads between gender and income groups. In particular, expected medical costs impact the decision of using a helmet for women but not for men. Moreover, the influence of financial penalties varies across income groups, this is not surprising as sanctions represent a smaller share of wealthier individuals' revenues.

In view of designing policies, various measures impacting expectations of injury or fine have been considered and their impact on helmet use have been assessed. Based on these predictions, different policy directions can be suggested. First, the increase of police threat through enforcement, information or fine levels should increase helmet use in short distance journeys. As a matter of fact, combining these measures should be even more effective. Second, information campaigns stressing the usefulness of a helmet to avoid severe injuries (implying important health expenditures) even for motorbike trips nearby one's home are also likely to make motorcyclists adopt safer conducts.

[27] By using the slogan *"Protect yourself from hefty fines and serious injuries. Wear a helmet."* in its 2012 road safety campaign, the Cambodian government actually intented to impact both dimensions.

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8 Appendices

Appendix A. Variation within circles

Table 11: Variation within circles - previous experiences and expectations

	Observations			Mean	Standard deviation			# of circles without
	N	n	T-bar	overall	overall	between	within	variation†
EXPECTATIONS								
probability of injury◇	836	32	26.13	0.58	0.31	0.20	0.26	0
expected medical costs (in INR)	772	32	24.13	5,189	9,012	4,217	8,013	0
IQR of medical costs (in INR)	772	32	24.13	6,718	15,039	6,162	13,763	0
probability of police arrest◇	878	32	27.44	0.65	0.34	0.20	0.29	1
expected fines (in INR)	760	32	23.75	129	103	60	85	0
IQR of fines (in INR)	760	32	23.75	112	109	67	92	0
PREVIOUS EXPERIENCES								
Experienced a road crash (%)	836	32	26.13	7.04	26.22	7.46	25.44	11
Has a relative involved in a road crash (%)	836	32	26.13	6.70	25.01	12.39	23.39	15
Has been sanctionned by the police (%)	867	32	27.09	7.04	25.59	9.81	24.85	11
Discretionnary power of police◇	841	32	26.28	0.36	0.30	0.19	0.25	1
Police officers can be bribed (%)	869	32	27.16	36.48	48.16	21.86	44.59	1
ROAD HABITS								
Uses the moto to commute to work (%)	833	32	26.03	65.07	47.70	14.35	46.09	0
Uses the moto frequently (%)	835	32	26.09	44.55	49.73	20.27	46.70	0
RELIGIOUS PRACTICES								
Prays daily (%)	832	32	26	71.80	44.93	16.80	42.21	1

Notes: T-bar is the average number of respondents per circle (N/n). † Total number of circles is 32.
◇ This variable takes values from 0 to 1.

Table 12: Variation within circles - expectations and helmet use

	Observations			**Mean**	**Standard deviation**			# of circles without variation†
	N	n	T-bar	overall	overall	between	within	
HELMET USE								
Long trips on main roads (%)	670	32	20.94	80.15	39.92	12.62	38.03	4
Short trips on main roads (%)	673	32	21.03	59.44	49.14	24.05	44.86	2
Trips in neighborhoods (%)	664	32	20.75	53.46	49.92	21.36	46.56	2
EXPECTATIONS								
UEC medical costs (INR)	673	32	21.03	2,729	5,087	2,357	4,636	0
UEC fines (INR)	673	32	21.03	93	102	58	86	0
SOCIO-DEMOGRAPHICS								
Male (%)	673	32	21.03	69.54	46.06	14.78	44.18	2
Age (in years)	673	32	21.03	36.01	12.86	4.42	12.48	0
Level of education (3 groups)	673	32	21.03	2.26	0.65	0.40	0.60	2
Household monthly income								3
less than 10,000 INR (%)	673	32	21.03	32.84	47.00	28.96	41.66	
10,000 to 20,000 INR (%)	673	32	21.03	34.47	47.56	20.85	43.99	
above 20,000 INR (%)	673	32	21.03	16.94	37.54	18.80	33.78	
Share of one's contribution to income$^{\diamond}$	673	32	21.03	0.38	0.38	0.13	0.37	0
Head of HH (%)	673	32	21.03	38.48	48.69	14.90	47.73	1
Married (%)	673	32	21.03	72.96	44.45	11.70	43.21	0
Number of children	673	32	21.03	1.47	1,32	0.47	1.27	0
Sikh (%)	673	32	21.03	4.31	20.32	11.04	18.68	22
Belongs to a low caste (%)	673	32	21.03	37.30	48.40	26.85	43.91	5
Believes his life is in god's hands (%)	673	32	21,03	89.90	30.16	9.93	28.77	15
Risk aversion score$^{\diamond\diamond}$	673	32	21.03	2.72	0.78	0.43	0.70	0
Has a health insurance (%)	673	32	21.03	12.93	33.58	14.71	31.76	7

Notes: T-bar is the average number of respondents per circle (N/n). This table shows the statistics for the sample used in my analysis. $^{\diamond}$ this variable takes values from 0 to 0.9. $^{\diamond\diamond}$ the risk aversion score takes values from 1 to 4. † Total number of circles is 32.

Appendix B. Additional explanatory variables

Table 13: Influence of expectations on helmet use - complete set of independent variables

Helmet use	**on main roads**		**trips in the**
	long trips	**short trips**	**neighborhoods**
	(1)	(2)	(3)
UEC medical expenditures (th. INR)	0.005^{+}	-0.000	0.001
	(0.003)	(0.004)	(0.004)
UEC fines (hund. INR)	0.011	0.077***	0.049**
	(0.018)	(0.018)	(0.023)
Risk aversion (average, 8 points)	-0.009	0.002	0.001
	(0.015)	(0.013)	(0.014)
Male (=1)	0.409***	0.414***	0.390***
	(0.052)	(0.061)	(0.070)
Married (=1)	-0.002	0.044	0.014
	(0.045)	(0.057)	(0.072)
# of children	0.003	-0.007	-0.014
	(0.016)	(0.016)	(0.019)
Head of the household (=1)	0.004	0.043	0.059
	(0.042)	(0.048)	(0.050)
Age (in years)	-0.003	-0.002	-0.002
	(0.002)	(0.002)	(0.001)
Level of education (3 groups)	-0.009	0.047^{+}	0.053^{+}
	(0.028)	(0.029)	(0.032)
Household monthly income, *ref: less than 10,000 INR*			
between 10,000 and 20,000 INR	-0.006	-0.002	0.030
	(0.041)	(0.046)	(0.053)
more than 20,000 INR	0.013	0.095+	0.092
	(0.042)	(0.064)	(0.078)
Share of one's contribution to income	0.045	0.004	0.055
	(0.072)	(0.086)	(0.079)
Sikh (=1)	-0.272*	-0.221^{+}	-0.217^{+}
	(0.141)	(0.142)	(0.133)
Belongs to a low caste (=1)	-0.034	-0.080*	-0.063
	(0.042)	(0.045)	(0.054)
Has health insurance (=1)	-0.010	-0.018	-0.048
	(0.025)	(0.046)	(0.053)
Believes fate is in god's hands (=1)	0.006	-0.061	-0.126
	(0.030)	(0.077)	(0.085)
R^2	0.296	0.261	0.243
Observations	*670*	*673*	*665*

Notes: *** 1%, ** 5%, * 10% and $^{+}$ 15% significance. Clustered standard errors are reported in parentheses.

Appendix C. Highest values of expected costs

Table 14: Influence of expectations on helmet use - using alternative distribution's information

Helmet use	**on main roads**		**trips in the**
	long trips	**short trips**	**neighborhoods**
	(1)	(2)	(3)
UP75 medical expenditures (th. INR)	0.002	-0.001	0.002
	(0.002)	(0.002)	(0.002)
UP75 fines (hund. INR)	0.106	0.591***	0.377*
	(0.134)	(0.148)	(0.157)
Risk aversion (average, 8 points)	-0.010	0.001	0.000
	(0.015)	(0.013)	(0.014)
R^2	0.295	0.265	0.246
Observations	*670*	*673*	*665*
Hausman test (p-value)			
OLS vs. FE	0.000	0.000	0.000
FE vs. RE	0.000	0.224	0.000
UMAX medical expenditures (th. INR)	0.001+	0.000	-0.000
	(0.001)	(0.001)	(0.001)
UMAX fines (hund. INR)	0.072	0.478***	0.287***
	(0.107)	(0.127)	(0.123)
Risk aversion (average, 8 points)	-0.010	0.000	-0.000
	(0.015)	(0.013)	(0.014)
R^2	0.298	0.268	0.244
Observations	*670*	*673*	*665*
Hausman test (p-value)			
OLS vs. FE	0.000	0.000	0.000
FE vs. RE	0.000	0.015	0.000

Notes: *** 1%, ** 5%, * 10% and + 15% significance. Clustered standard errors are reported in parentheses. Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income, Sikh, caste, risk aversion, health insurance and existence of a superior force.

Appendix D. Tackling reverse causality

Table 15: Reverse causality tests

	UEC inj. (1)	UEC fine (2)	UEC inj. (3)	UEC fine (4)	UEC inj. (5)	UEC fine (6)
Helmet use						
Long trips on main roads	1.860	1.188				
	(9.388)	(1.796)				
Short trips on main roads			0.7309	0.404		
			(3.213)	(0.595)		
Trips in the neighbourhood					2.335	0.905
					(6.993)	(1.298)
observations	*670*	*670*	*673*	*673*	*665*	*665*

	on main roads for long trips	on main roads for short trips	for trips in neighborhoods
First stage			
Helmet provision (=1) †	0.062***	0.182***	0.092*
	(0.021)	(0.044)	(0.054)
Weak identification test ‡	8.901	16.900	2.861
F statistic	12.08***	15.985***	17.95***
R^2	0.281	0.236	0.252
observations	*670*	*673*	*665*

Notes: *** 1%, ** 5% and * 10% significance. Controls are marital status, # of children, head of hh, gender, age, income, education level, contribution to income caste, risk aversion, health insurance and existence of a superior force. † helmet provision is a dummy variable which takes value 1 if the respondent is a driver and rides a moto purchased in first hand less than 2 years ago and 0 otherwise. ‡ Kleibergen-Paap rk Wald F statistic.

Appendix E. Individual omitted variables

Table 16: Influence of expectations on helmet use - using alternative distribution's information

Helmet use	**on main roads**		**trips in the**
	long trips	**short trips**	**neighborhoods**
	(1)	(2)	(3)
Panel 1 - adding average speed			
UEC medical expenditures (th. INR)	0.007**	-0.001	0.001
	(0.003)	(0.004)	(0.005)
UEC fines (hund.INR)	0.038***	0.085***	0.058**
	(0.013)	(0.016)	(0.028)
Average speed	0.002***	-0.001	0.000
	(0.001)	(0.001)	(0.001)
R^2	0.317	0.267	0.237
Observations	*525*	*527*	*522*
Panel 2 - adding road habits			
UEC medical expenditures (th. INR)	0.005^{+}	-0.000	0.001
	(0.003)	(0.004)	(0.004)
UEC fines (hund.INR)	0.010	0.075***	0.048**
	(0.018)	(0.018)	(0.023)
Uses the moto frequently (=1)	0.064*	0.092*	0.050
	(0.032)	(0.047)	(0.045)
Uses the moto to commute to work (=1)	0.028	0.018	0.022
	(0.031)	(0.048)	(0.037)
R^2	0.299	0.267	0.244
Observations	*668*	*671*	*663*
Panel 3 - adding preference for present			
UEC medical expenditures (th. INR)	0.004	0.001	0.002
	(0.003)	(0.004)	(0.005)
UEC fines (hund.INR)	0.005	0.072***	0.045**
	(0.017)	(0.019)	(0.021)
Present oriented (=1)	-0.023	0.080*	0.015
	(0.037)	(0.040)	(0.040)
R^2	0.328	0.274	0.243
Observations	*626*	*629*	*621*
Panel 4 - adding confidence on one's skills (sample of drivers)			
UEC medical expenditures (th. INR)	0.003	-0.002	0.001
	(0.002)	(0.004)	(0.005)
UEC fines (hund.INR)	0.012+	0.069***	0.064**
	(0.008)	(0.022)	(0.027)
Risk aversion (8 point scale)	0.023*	0.022^{+}	0.024
	(0.011)	(0.013)	(0.017)
Thinks he has a better driving skills than	-0.043**	-0.027	-0.073*
other drivers (=1)	(0.020)	(0.040)	(0.041)
R^2	0.244	0.148	0.148
Observations	*393*	*393*	*389*

Notes: *** 1%, ** 5%, * 10% and $^{+}$ 15% significance. Clustered standard errors are reported in parentheses. Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income, Sikh, caste, risk aversion, health insurance and existence of a superior force.

Appendix F. Excluding individuals who did not undestand the probability scale

Five general questions were asked to respondents in order to control for their understanding of the scale.

First, we check the understanding of the probability concept:

1. *"Imagine I have 5 balls, one of which is red and four of which are blue. If you pick one of these balls without looking, how likely it is that you will pick the red ball?"* - variable named "red ball" below.

Two nested questions were also asked:

2. *"How likely are you to go to the market sometime in the next two days?"* - variable named "2 days" below.

3. *"How likely are you to go to the market sometime in the next two weeks?"* - variable named "2 weeks" below.

The variable called "nested" takes value 1 if the individual gave consistent answers to above two questions.

Finally, we aimed at check whether the entire scale was used by the respondent and therefore asked about events for which everybody should reply the extreme values of the scale:

4. *"How likely do you think it is that you will go out of the house for any reason in the next month?"* - variable named "outside" below. This question turned out to be misleading, while we meant outside the house, some respondents understood out of the city. This confusion explain the unexpected results presented in Table 18.

5. *"How likely is it that Christmas will fall in the month of June?"* - variable named "christmas" below.

Only 4 respondents have no correct answer. 52% of interviewees provided only one or no inconsistent answer. 36% gave two consistent replies out of four.

Table 17: Check questions

	probability concept	**nested questions**		**extreme values**	
	red ball	2 days	2 weeks	outside	christmas
event will not happen (%)	3.05	2.83	1.36	6.59	**96.06**
1	8.77	3.28	1.36	6.14	0.48
2	**24.24**	4.87	1.25	4.89	0.48
3	9.99	3.74	3.28	2.05	0
4	15.35	3.96	2.60	1.14	0.48
5	26.55	12.46	6.46	7.61	1.08
6	5.97	4.53	4.19	3.07	0
7	2.68	7.47	8.61	6.02	0
8	1.34	8.04	9.29	8.07	0.36
9	0.37	4.87	6.91	6.59	0.12
event will happen	1.71	43.94	54.7	**47.84**	0.96
Share of correct answers	24.24	84.60		47.84	96.06
observations	*821*	*883*	*883*	*880*	*837*

Notes: In bold are indicating the share of individuals who provide the expected answer to each question. *Remark:* 84.60% of respondents said that the probability that they will go to the market in the next two weeks was higher or equal as the probability they will go within two days.

Table 18: Keeping individuals who understood the probability scale

Sample	all (1)	christmas (2)	nested (3)	outside (4)	christmas OR nested (5)	christmas AND nested (6)
Panel A: Helmet use for long trips on main roads						
UEC medical expenditures (th. INR)	0.005^{+}	0.005	0.005	0.001	0.005	0.005^{+}
	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
UEC fines (hund. INR)	0.011	0.006	0.006	0.011	0.006	0.000
	(0.018)	(0.018)	(0.019)	(0.032)	(0.018)	(0.018)
R^2	0.296	0.280	0.287	0.441	0.290	0.279
Observations	*670*	*629*	*552*	*306*	*647*	*521*
Panel B: Helmet use for short trips on main roads						
UEC medical expenditures (th. INR)	-0.000	-0.000	-0.000	-0.001	-0.000	-0.001
	(0.004)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)
UEC fines (hund. INR)	0.077^{***}	0.073^{***}	0.067^{***}	0.079^{***}	0.072^{***}	0.063^{***}
	(0.018)	(0.018)	(0.014)	(0.038)	(0.018)	(0.014)
R^2	0.261	0.267	0.288	0.352	0.266	0.298
Observations	*673*	*632*	*555*	*308*	*650*	*524*
Panel C: Helmet use for trips in residential neighbordhoods						
UEC medical expenditures (th. INR)	0.001	0.002	0.001	0.005	0.002	0.002
	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.005)
UEC fines (hund. INR)	0.049^{**}	0.049^{**}	0.052^{**}	0.050^{**}	0.048^{**}	0.052^{**}
	(0.023)	(0.023)	(0.025)	(0.026)	(0.024)	(0.026)
R^2	0.243	0.252	0.253	0.359	0.248	0.267
Observations	*665*	*625*	*548*	*304*	*642*	*518*

Notes: *** 1%, ** 5%, * 10% and $^{+}$ 15% significance. Controls are marital status, # of children, head of hh, gender, age, income, education level, contribution to income caste, risk aversion, health insurance, helmet ownership and existence of a superior force. Estimations in column (1) corresponds to regressions presented in Table 5.

Appendix G. Probit estimations

Table 19: Influence of expectations on helmet use - using unconditional expected costs (UEC)

Helmet use	**on main roads**		**trips in the**
	long trips	**short trips**	**neighborhoods**
	(1)	(2)	(3)
Coefficients			
UEC medical expenditures (th. INR)	0.042	0.001	0.002
	(0.031)	(0.016)	(0.015)
UEC fines (hund.INR)	0.027	0.359***	0.154*
	(0.117)	(0.123)	(0.084)
Pseudo R^2	0.374	0.342	0.279
Observations	*610*	*660*	*663*
Marginal effects			
UEC medical expenditures (th. INR)	0.008	0.000	0.001
	(0.005)	(0.004)	(0.004)
UEC fines (hund.INR)	0.005	0.090***	0.044**
	(0.021)	(0.030)	(0.023)

Notes: *** 1%, ** 5%, * 10% and + 15% significance.
Probit estimations with circle dummies and clustered standard errors reported in parentheses.
Controls are marital status, # of children, head of household, gender, age, income, education level, contribution to income, Sikh, caste, risk aversion, health insurance and existence of a superior force.
Remark: The difference in the number of observations between probit and linear probability estimations is due to the use of dummies in the former specification: observations being dropped in case of an absence of variation in the variable of interest among respondents belonging to the same area.