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Abstract

We carry out a large monetary stakes insurance experiment with very small probabilities of losses and ambiguous as well as exact probabilities. Many individuals do not want to pay anything for insurance whether the probabilities are given exactly or are ambiguous. Many others, however, are willing to pay surprisingly large amounts. With ambiguity, the percentage of those paying nothing is smaller and the willingness to pay (WTP) of the other individuals larger than with exact probabilities. Comparing elasticities with ambiguity, we find that worry is much more important than subjective probability in determining WTP for insurance. Furthermore, when the ambiguous loss probability is increased by a factor of 1000, it has almost no effect on WTP. Copyright © 2011 John Wiley & Sons, Ltd.

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Protecting against Low Probability Disasters: The Role of Worry

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Protecting against Low Probability Disasters: The Role of Worry

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We conducted a large stakes insurance experiment with small probabilities of losses and a realistic form of ambiguity. Our results demonstrate that worry plays a more important role in the decision to consider insurance against high losses that are rare than does subjective probability estimates. For those who do have an interest in buying insurance, worry is also positively related to the willingness to pay (WTP) for coverage. If faced with an ambiguous risk, an individual is more willing to consider insurance and pay higher amounts than when the probability of a loss is specified precisely. An approximately 1,000-fold increase in the ambiguous probability did not change the percentage of those who consider insurance and had a very small positive impact on WTP. Our results provide insights into the low probability insurance puzzle where some individuals are willing to pay too much and others nothing for coverage in relation to the risk associated with the specific event.

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Introduction

Imagine you are facing a risk that is characterized by a very small probability of occurrence but, if it occurs, will cause significant damage relative to your total wealth. Examples of such risks are floods and earthquakes, as well as fire and theft. If you were offered insurance coverage against such a risk would you try to estimate the probability and multiply this figure by the value or utility of the potential loss? What role would affect or emotional factors such as worry play in your decision with respect to specific outcomes?

Understanding insurance decisions with respect to low-probability disasters has been a challenge for psychologists as well as economists. Field studies and controlled laboratory experiments have posed the following *low probability insurance puzzle*: (1) many individuals do *not voluntarily purchase* coverage even when premiums are highly subsidized (Kunreuther, 1978; Slovic, Fischhoff, Lichtenstein, Corrigan, & Combs, 1978). (2) In a controlled experiment consistent with these earlier studies, McClelland, Schulze, and Coursey (1993) showed that most individuals are either unwilling to pay a penny for low-probability insurance or *far too much* when compared with the expected loss from the event. The early version of prospect theory (Kahneman & Tversky, 1979) takes this feature into account by having a discontinuity in the probability weighting function close to zero.

Most earlier studies in decision making including the above-mentioned ones have focused on explaining deviations from the predictions derived from normative models of choice such as (subjective) expected utility theory (Savage, 1954; von Neumann & Morgenstern, 1947). Only recently has behavioral decision theory concerned itself with the impact that affect and emotion have on decision making with respect to protective measures (see, e.g., Hogarth & Kunreuther, 1995; Baron, Hershey & Kunreuther, 2000; Hsee & Kunreuther, 2000; Rottenstreich & Hsee, 2001; Slovic, Finucane, Peters, & MacGregor, 2002; Loewenstein, Weber, Hsee, & Welsh, 2001). Affect and emotions seem to be especially important with respect to decisions involving uncertain outcomes with large consequences (Slovic et al., 2002; Loewenstein et al., 2001).

This paper analyzes how individuals' willingness to pay (WTP) for insurance against real high-stakes losses is related to calculations based on probabilities and/or emotional factors such as a person's *worry* regarding the outcome. Caplin and Leahy (2001) suggest that worry is a plausible anticipatory emotion associated with *potential losses*. MacLeod, Williams, and Bekerian (1991, p. 478) note that "worry is […being] concerned with future events where there is uncertainty about the outcome, the future being thought about is a negative one, and this is accompanied by feelings of anxiety". Both of these definitions of worry are relevant to the feeling someone may have when considering whether to purchase insurance coverage and if so how much to pay for a policy.

Krantz and Kunreuther (2007) have argued that an important goal that individuals pursue when making decisions on whether to buy insurance is *peace of mind*. The importance of this type of non-monetary utility has also been demonstrated in an earlier empirical study by Hogarth and Kunreuther (1995). When individuals where asked to report on the arguments they 'had with themselves' in deciding whether or not to buy a warranty, peace of mind proved to be the most important reason. Equating peace of mind with the absence of worry, we contend that the more worried an individual may be, the greater the interest is in purchasing insurance and the more one should be willing to pay as a way of reducing her worries and obtaining peace of mind in the process.

We examine these issues through a controlled experiment using an *incentive-compatible,* real payments mechanism: Individuals are asked to state their maximum willingness to pay for insurance facing an unknown selling price that is concealed in an envelope. Such a mechanism is expected to elicit a price that is equal to the utility of insurance for the individual because it is mathematically equivalent to a random-price mechanism (Becker, DeGroot, & Marschak, 1964). The probability of a loss is very low and it is either specified precisely or there is ambiguity regarding the estimate (i.e., number of rainy days in a particular city during a prespecified time period). By eliciting the degree of worry, our investigation enables one to take a small but important step towards solving the low probability insurance puzzle. Understanding why some people would not pay anything for insurance while others volunteer an amount far greater than their expected loss requires one to look at the two stages of the decision: (1) whether one has an interest in purchasing insurance (i.e. WTP> 0) and if so (2) how much one is willing to pay. Kunreuther (1978) has also referred to a two-stage decision when interpreting behavior with small probability disasters. Slovic and Lichtenstein (1968) demonstrate the existence of a two-stage process where individuals determine the general attractiveness of a lottery in the first stage and then decide on their exact bid or rating of the lottery in the second stage.

Two-stage explanations have also been suggested in consumer behavior where the decision on whether to purchase an item is influenced by different variables than the decision on how much to spend (Jones, 1989; Melenberg & van Soest, 1996). In analyzing individuals' cigarette consumption in the UK, Jones (1989) finds that the decision to smoke is qualitatively different from the decision on how much to smoke. Individuals who believe that smoking is more harmful than drinking are less likely to start smoking; for those who do smoke, this belief regarding the dangers of smoking relative to alcohol consumption does not significantly reduce average cigarette consumption. In a similar spirit, Melenberg and van Soest (1996) analyze vacation expenditures of Dutch families and find that a person's income level has a different effect on whether to take a vacation than on how much to spend if one decides to take a vacation.

Our results are consistent with earlier findings on decisions with respect to low probability disasters. A substantial percentage of individuals are not willing to pay anything for insurance. Those who consider buying coverage are willing to pay significantly more than the expected loss whether the likelihood of a loss of given amount is specified precisely or is ambiguous. We show that under conditions of ambiguity, worry is more important than subjective probability estimates for determining those individuals who are willing to pay a positive amount for insurance. For those who are interest in buying insurance, *worry* is the most important driver for understanding how much one is willing to pay for coverage. If we increase the ambiguous probability by a factor of approximately 1,000, the percentage of those who consider insurance does not change, and we observe only a minimal positive impact on their WTP, whilst worry remains an important driver of behavior. Finally, worry is an important factor when considering insurance and specifying WTP if the probability of a loss is specified precisely. Our study thus provides additional evidence on the impact of emotional factors as drivers of choices under conditions of risk and ambiguity. Moreover, the extreme behaviors positing the low probability insurance puzzle defined above can be partially attributed to differences in individuals' worry with respect to the possibility of a loss. When the probability is ambiguous rather than well-specified, an individual is more likely to consider insurance and be willing to pay a large amount for coverage.

The paper is organized as follows. The next section offers a detailed explanation of our experimental design. The following section reports our results. The last two sections contain a general discussion and implications of our findings for policy makers.

Experimental design and sample

Sample

A total of 263 students from a major German university participated in the experiment. They were recruited via email, posters, and short presentations in classrooms. They were told that the experiment would take 90 minutes, that all participants would receive 10 DM for sure, and that there was a small chance (not specified) that they would earn 2,000 DM at the end of the experiment.[1] The study was carried out in groups of six to ten students each of whom was situated in a separate booth. Nine of the 263 subjects had to be excluded because of nonsensical responses.[2,3]

Basic features and experimental conditions

Objects at stake: Participants were told that they had inherited either a painting or a sculpture and each received a small photo of the art object with an individual identification number. It was announced that only **one** painting and **one** sculpture were originals, worth 2,000 DM; if it was a forgery then it had zero value. All participants learned that one person in the

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[1] At the time of the experiment, the 2,000 DM was worth US $1,086.48.

[2] Of the 254 usable responses, 54.5% were female, 45.5% male. The largest groups were psychology (29.9%) and business (28.7%) majors followed by economics (5.1%), pedagogic sciences (4.7%), law and German (each group 3.9%), and sociology (3.5%) students. The remaining 20.3% of the subjects were majoring in 18 different fields of study. The average age of the participants was 25.6.

[3] Subjects were excluded from the analysis mostly because they wanted to pay more for insurance than the value of the object to be insured – an (inherited) painting or sculpture (see below) – or because they clearly misunderstood the experimental situation (derived from open-ended questions) i.e. assumed they were paying for the (inherited) painting (or sculpture) rather than the insurance policy.

experiment would have the original painting and one would have the original sculpture. These individuals would be determined by random draws. This is an extreme form of the random pay mechanism suggested and investigated by Bolle (1990).

Nature of the risks, experimental conditions, and timing: The original painting or sculpture was threatened by fire and theft. Participants were offered insurance protection against a potential loss of 2,000 DM. It was made clear that the insurer would only sell a policy to the owner of the original art object, and that insurance purchased by others would be hypothetical and not affect their final wealth level. In other words only the owner of the original painting or sculpture would have to pay for coverage. We made it clear that it was in everyone's best interest to anticipate being the owner of the respective original art object when determining the maximum amount they would be willing to pay for an insurance policy. In addition to providing written instructions a flow diagram was presented to subjects describing the key variables and the decisions they had to make. All questions were answered, and the procedure was explained again when necessary. The Appendix contains the most significant part of the instructions.[4]

In *part A* of the experiment each participant inherited a painting. The original was threatened by the following ambiguous risk: The painting was declared to be stolen if it would rain exactly 24 days in July in the current year at the Frankfurt Airport; a fire occurs and destroys the painting if it would rain exactly 23 days in August.[5] Subjects knew that the actual outcome would only be determined after data on the number of days with precipitation in July and August were obtained from the Frankfurt airport. The experiment was carried out in the spring of 1999.

[4] The complete set of instructions is available from the authors upon request

[5] Students were informed that a day is defined as a rain day by the weather station in Frankfurt if there is more than one millimeter of rain that day.

We define *ambiguity* as a state of mind in which the *decision maker* perceives difficulties in estimating the relevant probabilities.[6] Whereas rain frequencies may be precisely estimated by meteorologists, they will be ambiguous for most if not all the participants in the experiment. This situation was designed to resemble a real-life risk (e.g. of a fire or theft in one's home) where insurers estimate annual loss probabilities across all policyholders but the individual homeowner views these risks as ambiguous.

On the basis of actual Frankfurt weather data from the year 1870 to the present, we estimated the probability of each of these events occurring to be approximately 1 in 10,000.[7] In Group 1, respondents were informed about both hazards threatening the original painting: theft and fire, but were not told the chances that either theft or fire would occur except that it was equal to the chance of the above rain frequencies in July and August in Frankfurt respectively . Respondents were then asked to state their maximum WTP first for theft insurance and then for fire coverage. Group 2 differed only in that respondents were asked to state their maximum WTP for one insurance policy covering both fire and theft damage. Risks were however still presented separately.

[6] Ambiguity is defined as a subjective phenomenon in the spirit of work on comparative ignorance by Fox and Tversky (1995) and Fox and Weber (2002).

[7] Rain frequencies were analyzed for consistency with different distribution forms for random events, e.g. normal, binomial. Rain frequencies were consistent with a Poisson distribution (KS-test of deviation: not significant.). Lousy weather like this was fortunately never experienced in the period from 1870 to today in Frankfurt. Since the 'base rate' for rain in July and August is different, 24 days of rain in July have the same probability of occurrence than 23 days of rain in August.

In Group 3 respondents were informed that the risk of theft was based on 24 rainy days in July. They then had to state their maximum WTP for theft insurance. They only learned afterwards that a second risk, fire, was also threatening the painting and went through the same procedure with respect to this risk (based on 23 rainy days in August). This experimental manipulation between the three groups (bundling, unbundling, and stepwise selling) was designed to increase our understanding as to how insurance against very low-probability events might be marketed. It was unrelated to the research questions motivating this paper and will not be analyzed here.[8]

In *part B* of the experiment the participants in Groups 1 and 2 were subject to the same treatments as in Part A. The only difference was that a sculpture (instead of a painting) was threatened by theft and fire, each of which was specified as having a probability of 1 in 10,000 of occurring. To determine whether a fire had occurred two random draws with replacement were taken from a bingo cage containing 100 balls. The same procedure was followed to determine whether a theft occurred.[9] Group 3 had a 1 in 10 ambiguous chance of either fire or theft in part B. (i.e., theft occurs if there is rain during exactly 12 days in July; fire occurs if there is rain during exactly 11 days in August). We used this relatively high value to see whether or not there were differences in people's decision processes between this situation and the case where the probability was 1 in 10,000. The experimental design is depicted in Table 1.

8 The individuals in Group 3A only learned about a second risk after stating WTP for the first risk in contrast to Groups 1A and 2A where the individuals learned about both risks before stating their WTP. In group 3A, individuals were willing to pay a large amount for the first risk but then reduced their WTP for the second risk. The sum of WTP was significantly below what was observed in groups 1A and 2A. Hence it was inappropriate to merge group 3A with groups 1A and 2A.

9 A theft or fire was assumed to occur if the number 1 was pulled out twice from the bingo cage.

Insert table 1 about here

Note that the ambiguous low-probability situation is always presented first. If we had initially presented the exact probabilities scenario to some of the respondents, they might have anchored on this figure when estimating the likelihood of rain in Frankfurt, potentially distorting our results on ambiguity. There was no feedback at all between parts A and B of the experiment so that respondents could not learn anything from the situation presented in A when they made a decision in B.

Eliciting WTP for insurance: There were no fixed selling prices for the insurance policies. Instead, we utilized a modified Becker, DeGroot and Marschak (BDM) (1964) mechanism for eliciting maximum WTP values. This modified mechanism was first introduced in laboratory research by Schade and Kunreuther (2001) and has recently been used in the marketing literature to reveal reservation prices at the point of purchase (Wang, Venkatesh, & Chatterjee, 2007). Reservation prices reflect an individual's highest willingness to pay such that the net utility of purchasing is zero. In the original BDM-procedure, respondents face a random draw of selling prices for the respective object and are informed about the distribution of these prices. In theory it is incentive-compatible to state prices as being equal to reservation prices under these conditions, but there are practical problems in utilizing this method (Becker et al., 1964).

When utilizing the standard BDM procedure for eliciting reservation prices for insurance against our risky prospect, decision makers might have treated the resulting two-stage as a one-stage lottery but in an erroneous way as discussed by Safra, Segal, & Spivak (1990).[10] Pre-specified intervals of WTP in the original BDM may also serve as anchors, thus biasing individuals' estimates (Bohm, Lindén, & Sonnegard, 1997). Such a bias is precluded by our procedure since the actual selling prices for each of the insurance policies were inserted in sealed envelopes to be opened only after the experiment was conducted. This undisclosed price was selected before the start of the experiment on the basis of pretest results with respect to WTP, so that about one half of the respondent's bids could be expected to be higher than the pre-determined price.

The mechanism was carefully explained to the subjects so that they understood that it was designed to elicit their maximum willingness to pay. We noted that if they bid too high they might actually pay that price for insurance should they be the owner of the original art object and regret having made such a high offer. If they bid too low they may not qualify for insurance even though they would have been willing to purchase coverage at a higher price than their stated value. Respondents were then asked to write their maximum willingness to pay for the respective insurance policy on a piece of paper and place it in an envelope.

Eliciting subjective probability estimates: After stating maximum buying prices for insurance, respondents were then asked to estimate the probability of each of the ambiguous risks. We distributed tables with likelihoods of a loss ranging from certainty to 1 in 10,000,000. Respondents were first asked to mark the probability of a fire or theft causing a loss in one of 15 intervals (e.g. the chance was between 1 in 5,000 and 1 in 10,000). Respondents could also

10 According to standard expected utility theory, respondents are allowed to reduce a two-stage to a one-stage lottery by multiplying through the probabilities. However, individuals are known to make errors when doing this. In addition, behavior towards a two-stage lottery might differ from behavior towards a one-stage lottery.

indicate that the risk was less than 1 in 10,000,000. After they checked one of the intervals, they were then asked for their best point estimate of a probability of a loss. The probability table is included in the Appendix.

Eliciting the level of worry: As part of the experiment all subjects were asked the following question for parts A and B of the experiment:

"How worried were you to be the owner of the original painting (sculpture) and then lose the money again?"[11]

Worry was not defined, specified or decomposed into elements of the problem such as magnitude of loss or likelihood of loss. We kept the question more general so as to elicit the emotional state of the respondent – and hence indirectly measuring the importance of *peace of mind* when the person faced a given scenario. Answers were based on a 10-point rating scale with 1= *not worried at all*, to 10= *very worried*.

11 This is a translation of the following question in German: "Wie besorgt waren Sie, der Besitzer des echten Gemäldes zu sein und das Geld wieder zu verlieren?"

Experimental results

Basic considerations

We begin with a descriptive analysis of WTP for insurance for ambiguous and well-specified loss probabilities. We continue with descriptive and regression analyses of the impact of subjective probabilities and individuals' worry on their choices.

Distribution of WTP: inconsistent with expected utility maximization?

To determine the proportion of subjects who state a maximum WTP that is consistent with expected utility maximization, we divided the responses into three groups: (1) WTP = 0, (2) responses clearly consistent with what would be expected if individuals maximized expected utility: 0 < WTP ≤ 10 E(loss), and (3) WTP > 10 E(loss). With exact probabilities, the last group would have to be extremely risk averse to be consistent with an expected utility model. With ambiguity, individuals could also be overestimating the loss probability (see below). E(loss) is approximately 0.40 DM in our experiment for the small probabilities.[12] Therefore, the cutoff point between intervals (2) and (3) is 4.00 DM. With large ambiguous probabilities, E(loss) is approximately 380 DM.[13]

When the likelihood of the event was ambiguous, only 2 individuals (1.2% of N) were located in the interval between .5 and 5 E(Loss) and 137 individuals (81.5% of N) were willing to pay more than 5 times E(Loss). The values of WTP varied between 0 DM and 1690 DM.

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12 The exact value is 0.39998 DM since the aggregate probability of a loss of 2,000DM is 0.00019999 or 1 in 5000.25.

13 The aggregate probability of a loss of 2,000 DM is approximately 0.19 or 1 in 5.26.

The findings for ambiguous and exact loss probabilities (Groups 1 and 2) are reported in table 2. When the probability of the two events was 1 in 5,000, most respondents either do not want to pay anything for insurance or are willing to pay incredibly high premiums. For those individuals having a WTP greater than 10 times E(loss), the mean premium is approximately 588 times the E(loss) if probabilities are ambiguous and approximately 315 times the E(loss) if probabilities are known exactly. For Group B with a known risk of 1/5000, we can conclude that most respondents' behavior is *highly inconsistent with expected utility [E(U)] theory*.

Insert table 2 about here

The picture changes when the ambiguous risk is 1/5. There was still a group of individuals who had no interest in purchasing insurance (i.e. WTP =0) and this is hard to explain on the basis of expected utility theory. However, the remaining 84% all specified prices that were consistent with an E(U) theory. Note from Table 2 that with small probabilities, the mean WTP for insurance is more than double if the probability information is ambiguous rather than well-specified. In the same vein for the low probability case, only 17 percent of those with ambiguous probability information had WTP= 0 compared to 35 percent when the risk was specified. The differences in absolute WTP and proportion who were unwilling to pay anything for insurance differ significantly between ambiguous and precise probabilities (the t-values are 4.6 and 3.8, respectively).

We now analyze whether respondents in Groups 1 or 2 who specified WTP = 0 for at least one scenario differed when they were presented with ambiguous and exact probabilities. Each individual can only be situated in one of the four cells of table 3: WTP = 0 for ambiguous and exact probabilities; WTP = 0 for ambiguous probabilities and WTP > 0 for exact probabilities, WTP = 0 for exact probabilities and WTP > 0 for ambiguous probabilities and WTP > 0 in both situations.

As shown in Table 3, approximately twice as many individuals (59 versus 29) do not want to pay anything for insurance if the risk is precisely specified than if the risk is perceived to be ambiguous. Furthermore, only one person who specified WTP = 0 for an ambiguous risk has a WTP>0 for insurance with exact probabilities. The other 28 individuals in this group also specify WTP = 0 for the risk with exact probabilities. On the other hand, 31 of the 59 individuals with WTP = 0 for an exact probability specify WTP > 0 if the risk is ambiguous. Stated another way, having a positive WTP with exact probabilities implies (with one exception) having a positive WTP with ambiguous probabilities. On the other hand, WTP > 0 when the risk is ambiguous does not imply having WTP>0 with exact probabilities. This finding suggests that respondents are *ambiguity averse*.

Impact of loss probabilities versus worry on WTP for insurance

Descriptive analysis of the impact of worry and subjective probabilities: Can one ascribe the difference between individuals not interested in buying insurance (i.e. WTP=0) and those who want coverage (i.e. WTP>0) to differences between their subjective probability judgments and/or their level of *worry*? Table 4 reports on mean worry ratings for ambiguous and exact probabilities when the actual risk is very low and for ambiguous probabilities when the risk is high. Mean subjective probability judgments are compared between small and large ambiguous risks in Table 5.

Insert tables 4 and 5 about here

On average, worry is significantly higher for those individuals who are willing to purchase insurance (WTP>0) than those who had no interest in coverage (WTP =0) for both large and small perceived probabilities as well as for exact probabilities (Table 4). With respect to the ambiguous risks, probability judgments are higher for those with WTP>0, but this difference is only marginally significant (one-sided) when the ambiguous risk is low and almost identical when the ambiguous risk is high.[14] (Table 5). These findings already suggest that worry is more important than probability of a loss in determining whether a person is willing to purchase insurance. Furthermore, probability judgments are not significantly correlated with the decision of people to consider insurance[15] and only weakly correlated with their WTP, provided they consider insurance[16].

Table 5 also shows the immense difficulties people have in judging small probabilities. The low ambiguous risk of 1 / 5000 was on average believed to be a risk of 1 / 15. This is an overestimation by a factor of 333. The high ambiguous risk of 1 / 5 was, however, slightly underestimated with 1 / 7 on average. Although probability judgments are higher in the high risk treatment than in the low risk treatment by a factor of 2 on average, the actual risks differed by a factor of 1,000. Clearly, the subjects did a particularly poor job in judging the likelihood of a very small risk and were much better calibrated in estimating the high risk.

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14 The mean probabilities for the ambiguity high risk case was 15.3% when WTP=0 and 16.6% when WTP>0.

15 We constructed a dummy variable that takes a value of one if people have a WTP>0 and a value of zero otherwise. The Pearson correlation coefficient between this dummy and the subjective probability judgments is 0.08 (78% significance with N=243)

16 The Pearson correlation coefficient between subjective probability judgments and WTP for those subjects with WTP>0 is 0.14 (96% significant with N=208).

This pattern is consistent with Einhorn and Hogarth's (1985) ambiguity model that is based on the anchoring-and-adjustment heuristic and mental simulations. With very small probabilities, there is no room for downward adjustments but considerable room for overestimating probability. With large subjective ambiguous probabilities, however, downwards as well as upwards mental simulations are feasible, which is likely to produce a more accurate estimate of the probability.

Another explanation for this difference could be a person's past experience. Individuals should be better in estimating a probability when they have experienced the respective part of the distribution – 11 or 12 days of monthly precipitation in the summer is a normal event whereas 23 or 24 days would require an individual to have a lifespan (on average) of some 10,000 years to experience the event just once.

To be consistent with an E(U) model one could contend that individuals having a positive WTP significantly overestimate the probabilities for very low probability events that are ambiguous and actually use these estimates in their decisions. For large ambiguous probabilities individuals would also have to base their WTP for insurance partially on their subjective probability estimates of a loss to be consistent with expected utility theory and again use these estimates to determine WTP. We will examine whether individuals behave in this way by undertaking regression analyses with respect to their decisions regarding their interest in purchasing insurance and the amount they are willing to pay for coverage.

Comparing the impact of probabilities and worry using regression analysis

Before undertaking these regression analyses we checked to make sure that there was no multicollinearity between worry and subjective probabilities (i.e. worry could be the *consequence* of subjective probabilities or subjective probabilities could be *influenced* by different levels of worry). Table 6 reveals that neither of these relationships noted above is statistically significant for the group of individuals having a positive WTP for insurance and for individuals with WTP=0. The overall correlation between worry and subjective probability judgments is 0.08 (0.19 significance level with N=243).

Insert table 6 about here

In undertaking the regression analysis, we used so-called threshold models that separately analyze whether respondents consider insurance at all (i.e. if their WTP=0) and the magnitude of their WTP if they do consider insurance (i.e. regression on WTP for those with WTP >0). A simple OLS regression is not suitable because WTP is truncated at 0, and many observations are located at this extreme point. In practice, our strategy corresponds to estimating a Probit model for the participation decision with a binary dependent variable taking on a value of 0 if WTP=0 and a value of 1 if WTP>0. We then undertake an OLS regression on WTP for those subjects who consider insurance. Under certain plausible assumptions[17], this approach is consistent with the more general class of *threshold models* that are, in turn, based on the so-called Tobit model (Tobin, 1956; see also Melenberg & van Soest, 1996; Jones, 1989). Threshold models are more general than Tobit models because they allow parameters to have different effects on the two

17 One can estimate the two equations of a threshold model separately if the error term in the OLS regression is independent from the participation decision. The general requirement for the identification of both regression equations is that the error term has a mean of zero and is strictly independent of the variables on the right hand side of the equation. Our robustness checks using panel methods, for which these assumptions are not critical, lead to qualitatively identical results.

parts of the model. We choose this approach because we wanted to allow for different decision processes in each stage of the person's decision process.[18]

We are particularly interested in comparing the relative effects of probability judgments and worry. Hence, we estimated three different model specifications for each the binary probits and the OLS regressions. Model (1) only includes probability judgments (values range from 2/10,000,000 to 4/5). Model (2) only includes worry (values ranging from 1 to 9). Model (3) includes both probability judgments and worry. We always added a dummy labeled *separate policies* to control for the effect of our bundling manipulation and a *high risk* dummy which reflects the difference between high and low ambiguous risks. The results of the six regressions are reported in Table 7.[19]

Insert table 7 about here

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18 We ran Tobit models – not discriminating between the two stages – as a benchmark and found that they do not compare favorably with the more general threshold models in terms of model fit and explanatory power. Using the same parameters as in Table 7 (below), the R2 of the Tobit models ranged from 0.00 to 0.02 and the Akaike Information Criterion (AIC) ranged from 1,974 to 3,122. Both measures are very poor fits compared to the separate regressions. Without separating between the 'considering insurance' and WTP stages one loses most of the explanatory power with respect to characterizing the decision on whether to purchase insurance and how much to pay for coverage.

19 We also ran a random effects threshold model on Group 1 and Group 2, simultaneously analyzing the ambiguity and exact probability for the low risk treatments within-subjects. Such a model can be criticized on the grounds that exact probabilities provided by the experimenter and subjective probabilities provided by the respondents are treated as the same type of variable. This analysis, on the other hand, controls for unobserved heterogeneity of the individuals and confirms the findings reported here.

We compare the three ‘considering insurance’ models by examining their goodness of fit statistics (pseudo R^2), log likelihood and Akaike Information Criterion (AIC).[20] Explaining the decision on whether to purchase insurance on the basis of probability judgments (Model 1a) yields a very low pseudo R^2 and fails the most basic specification test for a regression which probes if all coefficients are jointly zero, i.e. the null hypothesis that the model does not explain the dependent variable at all. According to this test, probability judgments, an increase in the underlying risk by a factor of 1,000 and the way insurance is sold (separately or bundled) do not contribute to explaining why subjects consider buying insurance (Prob > Chi2 = 0.42).

Model (1b), which includes *worry* instead of *probability judgments*, has a much better explanatory power and the worry variable is statistically significant at the 99% confidence level. . The pseudo R^2 in this model is 10% versus only 1% in model 1a.[21] Incorporating *probability judgments* and *worry* (Model 1c) diminishes pseudo R^2 marginally, but improves the log likelihood and the AIC. The coefficients on probability judgments and the high ambiguity risk treatment remain insignificant, while the worry coefficient is highly significant. However, probability judgments do improve the model fit somewhat. Yet, the large improvement in model fit compared to model 1a comes from the inclusion of worry. Hence, worry is relatively more

20 An increase in pseudo R2 and the log-likelihood indicate an increase in model fit. Adding additional parameters in a regression model always increases the fit, independent of the true number of relevant parameters. In contrast, the AIC does not only consider the fit of a model, but also its parsimony and “punishes” for model complexity. The preferred model is the one with the lowest AIC and it optimizes the trade-off between parsimony and fit.

21 Log likelihood and AIC are, however, worse than in model 1a for the ‘technical’ reason that the constant in model 1a is closer to the sample mean than in model 2a.

important for determining insurance decisions than probability judgments or variations in the actual probability of a loss from 1/5000 to 1/5.

Regressions 2a-c look only at WTP for those who consider insurance. We compare model fit using adjusted R^2, which also penalizes for including additional parameters.[22] The worry model (2b) has a larger adjusted R^2 than the subjective probabilities model (2a), which implies that worry explains more variance than subjective probability judgments even if one focuses only on those individuals who consider purchasing insurance. However, in contrast to model 1a, the adjusted R^2 is 3% for the subjective probability model and probability judgments are statistically significant. In other words, probability judgments matter for WTP for those who consider buying insurance. The joint model 2c slightly improves the adjusted R^2 compared to 2b and both probability judgments at the 90% confidence level and worry remains statistically significant at the 95% confidence level.[23]

We conducted further robustness checks of our results by repeating all regression analyses using natural logs of probability judgments to see if the results are driven by extreme values. Doing so leaves our results qualitatively unchanged, except that probability judgments are also not significant anymore in the WTP regressions, also if natural logs of WTP are considered as

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22 Adjusted R2 measures are not available for models estimated by log-likelihood, e.g. logit or probit, and the AIC is not available for models estimated by OLS. However, both test statistics are similar in purpose.

23 Although not central to our analysis, Table 7 reveals that the 'separate policies' variable is statistically insignificant in the 'considering insurance' part, but is marginally significant and negatively impacts the value of WTP for those interested in purchasing insurance. Insurance policies that bundle coverage against different risks impacting on an object generate a larger WTP than the sum of WTP for policies that separately cover the risks.

dependent variable. Apparently, the explanatory power of probability judgments is very limited while worry is positively related to considering insurance and WTP.

Behavior with large ambiguous probabilities of losses: Another important result from the analyses reported in Table 7 is that the high risk dummy is not significant in any of the regressions and its sign is in the wrong direction. Increasing the ambiguous probability of a loss by a factor of approximately 1,000[24] does not significantly change the decision to consider insurance or the willingness to pay. We can rule out that the effect of enlarging the loss probability is fully captured in the worry and subjective probabilities variables based on additional regressions we ran that only included a dummy for the high-risk treatment as explanatory variable for considering insurance and WTP. The estimated coefficients in both models are insignificant and the models did not pass H0 that the coefficients are zero.

The descriptive statistics also show that this high increase in ambiguous loss probability does not have much of an effect. The percentage of those generally interested in insurance is 83% for the low and 84% for the high ambiguous probability, and average WTP of the interested individuals is 253 DM for the high and 230 DM for the low ambiguous probability. These differences are extremely small given that the expected value of the insurance policy increased from 0.4 DM to 380 DM. Such findings do not square with predictions by any model of choice where risk estimates play the central role. Despite the fact that the subjective probability estimates in the two cases differ significantly (see Table 5), neither WTP for insurance nor level of worry differ by very much from the small probability cases.

24 The exact increase is 950; from 1 in 5,000.25 to 1 in 5.26. This results from the probability calculus with disjoint events.

We have shown in the regressions that worry appears to be the dominant driver of WTP. Since individuals' worry is not different for Group 3B than Groups 1A and 2A, even though the loss probability is much larger, it is not surprising that mean WTP is approximately the same for both groups. Even though the subjective probability estimates are more than twice as high for Group 3B than Groups 1A and 2A, it has little impact on the mean WTP difference between the two groups.

Impact of worry with precise probabilities: One could argue that *worry* is only important if probabilities are ambiguous. If this would be the case, worry should lose its impact if exact probabilities are provided. This is not the case, as shown in Table 8 which uses only observations from the treatments with known small probabilities of a loss (groups 1B and 2B). The regressions reveal that *worry* remains an important driver of the decision to consider insurance and WTP. In fact, the Pseudo-R^2 and the AIC for consideration are very high.

Insert table 8 about here

Illustrating the impact of worry: We finish our results section by demonstrating that as a person's level of worry increases, he or she is willing to pay considerably more for insurance. Table 9 depicts the findings for those whose WTP >0 based on the following groupings of the worry variable which ranges from 1 to 10; 1: no worry, 2: very low worry,:3-5: low worry, 6-9: high worry, 10: very high worry. Of the 168 respondents in this group, 69 are not worried at all or have very low worry in the treatment with known risks and their mean WTP is 7 DM. This is still 18 times higher than the expected value of the insurance. So worry, although a strong determinant of WTP is still not the entire story. Instead, there appear to be some unobserved characteristics of people such as the need for insurance to satisfy other goals that accounts for the high values of

WTP. Turning to the *worry* variable, the mean WTP estimates for those in the high and extremely high *worry* groups are respectively 20 and 30 times higher than the mean WTP for the no and low worry group. Similarly, under ambiguous probabilities the group with the highest level of worry is willing to pay almost 5 times more for insurance than the group with no or very low worry.

Insert table 9 about here

General Discussion

The above experiments suggest that subjective estimates of ambiguous probabilities play a minor role in explaining when individuals may be interested in buying insurance and the amount they are willing to pay for coverage. Other authors have reported on findings that are consistent with this result. Huber, Wider, and Huber (1997) have experimentally demonstrated that in naturalistic decision tasks, probabilities are used far less than expected from classical decision theory. In their experiments, most individuals do not request probability information before making their decisions even though they could have obtained this information.

With small probabilities, there is strong evidence from the experimental literature that with very small exact probabilities, individuals have a hard time understanding their meaning and are considerably insensitive to variations of their level (Kunreuther, Novemsky, & Kahneman, 2001). In their experiments, individuals' perception of the safety of a chemical facility did not differ when the risks of a serious industrial accident varied between 1 in 100,000, 1 in 1,000,000, and 1 in 10,000,000 (Kunreuther et al., 2001). We extend this finding and demonstrate that at least for ambiguous risks, even large probabilities such as 1 in 5 may not lead to different insurance decisions than probabilities of 1 in 5,000. We cannot judge from our experiments, however, whether this would still hold for known probabilities of 1 in 5 vs. 1 in 5,000 since we did not vary known probabilities. With respect to the consideration of insurance and WTP for coverage, we would expect that variations of known probabilities in this interval would make a large difference in behavior.

Sunstein (2003) has coined the term probability neglect. He refers to a number of experimental studies where people are quite insensitive to changes of probabilities (with an overlap with those referenced, here) and adds evidence from a study on cancer risk he had carried out at the University of Chicago. In this study, individuals' WTP to eliminate the cancer risk only increased by a factor of about two when the probability was ten times higher. He also reports on anecdotal evidence for peoples' strong emotional reactions after terrorist acts; individuals seem to focus on the potential event rather than its likelihood. In his opinion, this is the main reason why the public demands a substantial governmental response to terrorist acts. Our results indicate that his view might also hold in settings were the stakes are high but clearly far below the potential consequences of a terrorist act.

Our results suggest that the *low probability insurance puzzle* can be explained by focusing on the role that worry plays in people's decisions. More specifically the data indicate that those who are more worried about suffering a loss will be more likely to purchase insurance and pay more for coverage than those who are less worried. Obtaining peace of mind is worth a lot if one is highly worried.

The effect of ambiguity on behavior has been studied systematically since Daniel Ellsberg's classic study (Ellsberg, 1961). However, to the best of our knowledge, we demonstrate for the first time that ambiguity has a remarkably different effect on behavior than known probabilities in a realistic high-stakes scenario where probabilities are very small. In our experiments individuals exhibit a stronger aversion to ambiguous than precise probabilities with more individuals considering insurance and indicating a larger WTP for coverage when the risk is ambiguous than when probabilities are specified precisely. Probabilities were not the primary driver of this behavior. Rather we believe that people are cognizant of their difficulties in judging probabilities of very rare events and hence tend to ignore their own probability judgments when deciding about the purchase of insurance. An alternative explanation that ambiguity leads to higher worry can be ruled out by looking at table 4. Worry is not higher on average in our treatments with ambiguity than with known probabilities.

Implications, limitations, and future research

We ran a laboratory experiment with the aim of implementing a real-life risk with high-stakes monetary consequences. Although we feel that our experimental design has the advantage of coming quite close to an actual protective decision for a low-probability-high consequence event, we are aware that generalizations based on laboratory evidence must be qualified even though our findings of extreme responses with many individuals having a WTP = 0 and many having a large WTP are supported by McClelland et al. (1993) in the laboratory and Kunreuther (1978) in the field.

Another potential limitation of our design is that individuals did not lose their own money and had the potential of gaining additional funds. We did our best to ensure that the loss was perceived as a real one: Individuals received pictures of the painting and the sculpture; there was real money at stake that was ‘attached’ to those objects and the person had the option to purchase insurance against a large loss. We also discussed the situation with each group after the experiment and their comments indicated that they had framed the problem as a potential loss rather than as a lottery. Hence, we feel that we have been successful in implementing a large stakes insurance experiment.

Our findings suggest that insurers can charge a premium considerably in excess of expected loss when probabilities are extremely low and still generate considerable demand for coverage. Interest in terrorism insurance coverage at extremely high prices supports this finding (General Accounting Office, 2002). For low-probability-high consequence events, consumer unions or financial test magazines might consider informing people about how to compute the expected loss so that comparisons between the actual premium and an actuarially fair one could be made.

Insurers could also be expected to take advantage of their knowledge that ambiguous probabilities lead to higher WTP than well-specified estimates when the likelihood of the event occurring is very small. This may be a principal reason why one rarely learns about the chances of making a claim at the time one purchases a policy. Future research might also want to look at a comparison of large known and ambiguous probabilities in a realistic large stakes scenario to complete the picture.

Not only insurers but also other companies or institutions such as politicians and the media who are interested in changing behavior may find ways to stir up individuals’ worries, sometimes for their own benefit but also for the benefit of those at risk. One current example where generating worry by the media has changed behavior is the swine flu concerns of 2009 where the probability of an infection was originally highly uncertain and one rarely obtained estimates of the probabilities and consequences of the illness. In the early phase of pandemic, the media succeeded in stirring up worries by those residing in many countries (e.g., BBC News, July 19, 2009), leading to calls for and large stake government purchases of vaccinations against the swine flu. Later, however, the risks of the swine flu became more transparent but there was now increasing uncertainty and worry about the side effects of the vaccinations, again stirred by the media (Focus Online, November 11, 2009). As a result, many people decided against vaccination and there was an oversupply of vaccinations in some countries such as Germany. Stirring up worry by the media apparently had a strong influence on the behavior of people.

Future research would benefit not only from manipulating the degree of worry in the laboratory but also by measuring the different dimensions of worry that are evoked by exposing individuals to different scenarios. In this way we would increase our understanding as to what makes individuals worry about one risk but not another. Future research might also want to look more closely at ‘trait’-like concepts such as optimism and pessimism etc. (Einhorn & Hogarth, 1985).

Special consideration should also be given to the decision processes of individuals who decide not to even consider insurance. As Slovic, Fischhoff, & Lichtenstein (1981) noted "people often attempt to reduce the anxiety generated in the face of uncertainty by denying the uncertainty, thus making the risk seem so small it can safely be ignored […]." (p.160). Although we would expect that worry is an even more accurate term for the emotion invoked with respect to potential high-stakes losses, the rationale and findings of the experiments reported in this paper are consistent with their view. Individuals with low levels of worry have a high propensity not to protect themselves. For these individuals, there is no monetary incentive for purchasing insurance. Hence, subsidies reducing the insurance premium may not be expected to work since they are not willing to even pay a penny for insurance. However, for those individuals deserving special treatment such as low income individuals, insurance stamps (like food stamps) might be provided for equity reasons; and for risks that have negative externalities when people fail to purchase insurance, such as disaster relief provided to uninsured flood victims, it may be necessary to require coverage for all those residing in these hazard-prone areas. (Kunreuther & Michel-Kerjan, in press).

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Table 1: Experimental design (Group 3, Part A not analyzed in this contribution)

		Within-subjects	
		Part A of experiment: **inherited painting**	Part B of experiment: **inherited sculpture**
Between-subjects	**Group 1 (n=87)**	**Rain frequencies** in July and August each with probability of **1 in 10,000 – separate insurance policies** for each risk	Two **precise risks** each with probability of **1 in 10,000 – separate insurance policies** for each risk
	Group 2 (n=81)	**Rain frequencies** in July and August each with probability of **1 in 10,000 – one insurance policy** for both risks	Two **precise risks** each with probability of **1 in 10,000 – one insurance policy** for both risks
	Group 3 (n=86)	**Rain frequencies** July and August each with probability **1 in 10,000 – first insurance sold** before **second risk introduced**	Rain frequencies in July and August each with probability of **1 in 10 – separate insurance policies** for each of the risks

Table 2: Distribution of WTP for insurance

	WTP = 0	**0 < WTP ≤ 10*E(loss)**	**WTP > 10*E(Loss)**			
	Percentage	**Percentage**	**Percen-tage**	**Mean**	**Std. Dev.**	**Mean/ E(Loss)**
Ambiguity and low risk (1/5000)$^{1)}$	17 %	2 %	81 %	235 DM$^{2)}$	310 DM	588
Known low risk (1/5000)$^{2)}$	35 %	8 %	57 %	126 DM$^{2)}$	198 DM	315
Ambiguity and high risk (1/5)$^{3)}$	16 %	84 %	-	-	-	-

1) Groups 1A and 2A, N=168. Expected value of loss was 0.4DM. WTP did not significantly differ between groups.
2) Groups 1B and 2B, N=168. Expected value of loss was 0.4DM. WTP did not significantly differ between groups.
3) Group 3B, N=86. Expected value of loss was 380DM. Mean WTP is 215DM, standard deviation is 294 DM.

Table 3: WTP = 0 on an individual level

		Exact probabilities		
		WTP=0	**WTP >0**	**Sum**
Ambiguity	**WTP = 0**	28	1	29
	WTP > 0	31	108	139
	Sum	59	109	168

Table 4: Mean levels of worry

	Ambiguity and low risk (1 / 5000)	**Known low risk (1 / 5000)**	**Ambiguity and high risk (1 / 5)**
WTP = 0	2.6	3.8	2.2
WTP > 0	5.0	5.3	4.9
Average	4.6	5.0	4.0
Pr (|T| > |t|)	0.00	0.05	0.00

Table 5: Mean probability judgments

	Ambiguity and low risk (1 / 5000)	**Ambiguity and high risk (1 / 5)**
WTP = 0	1 / 25	1 / 7
WTP > 0	1 / 14	1 / 7
Average	1 / 15	1 / 7
Pr (|T| > |t|)	0.14	0.81

Table 6: Pearson correlation coefficients between probability judgment and worry

	Ambiguity and low risk (1 / 5000)	**Ambiguity and high risk (1 / 5)**
WTP = 0	0.13 (0.54)	-0.36 (0.27)
WTP > 0	0.03 (0.69)	0.14 (0.25)
Average	0.07 (0.36)	0.05 (0.65)
Note: Significance levels are reported in parentheses.		

Table 7: Threshold model estimation results for insurance against disasters with large and small ambiguous probabilities

	considering insurance			***WTP if considering insurance***		
	1a	1b	1c	2a	2b	2c
	Coeff. (Std. Err.)	Coeff. (Std. Err.)	Coeff. (Std. Err.)	Coeff. (Std. Err.)	Coeff. (Std. Err.)	Coeff. (Std. Err.)
x_1 (prob)	1.0 (0.9)	- -	1.0 (1.0)	316* (167)	- -	280* (165)
x_2 (worry)	- -	0.2*** (0.0)	0.2*** (0.0)	- -	22*** (7)	21*** (8)
x_4 (separate policies)	-0.3 (0.2)	-0.2 (0.2)	-0.3 (0.3)	-84 (53)	-90* (51)	-87* (52)
x_5 (high risk)	-0.1 (0.3)	-0.2 (0.2)	-0.2 (0.3)	-44 (52)	-26 (50)	-49 (51)
Constant	1.1*** (0.2)	0.4* (0.2)	0.5** (0.2)	250*** (39)	162*** (51)	147*** (53)
Model diagnostics						
# observations	243	254	243	208	212	208
R2[++]	0.01	0.10	0.09	0.02	0.04	0.05
Prob > chi2	0.40	0.00	0.00			
Log likelihood	-100	-104	-93			
AIC	209 (df=4)	216 (df=4)	195 (df=5)			

* denotes marginal significance at 90% confidence
** denotes significance at 95% confidence
*** denotes significance at 99% confidence
[+] The number of observations is not twice the number of individuals because there are some missing values for the level of worry and the probability estimates in part A of the experiment.
++ Pseudo R2 for regression on *a* and adjusted R2 for regression on *y*.
Reference categories: joint policies (x_4) and low risk (x_5).

Table 8: Threshold model estimation results for insurance against disasters with small known probabilities

	considering insurance		***WTP if considering insurance***	
	Coeff. (Std. Err.)		Coeff. (Std. Err.)	
x_2 (worry)	0.3***	(0.1)	17***	(6)
x_4 (separate policies)	-0.1	(0.2)	-35	(36)
Constant	-0.6***	(0.2)	45	(40)
Model diagnostics				
# observations	167		108	
R2[++]	0.2		0.06	
Prob > chi2	0.00			
Log likelihood	-87			
AIC[1)]	180 (df=3)			

* denotes marginal significance at 90% confidence
** denotes significance at 95% confidence
*** denotes significance at 99% confidence
[+] The number of observations is not twice the number of individuals because there are some missing values for the level of worry and the probability estimates in part A of the experiment.
++ Pseudo R2 for regression on *a* and adjusted R2 for regression on *y*
1) The AIC criterion is based on log likelihood but also punishes model complexity.

Table 9: Impact of worry on average WTP with small exact and ambiguous probabilities

	Mean WTP for insurance in DM	
	Small exact probabilities	**Small ambiguous probabilities**
Worry	n=165	n=168
No/Very low	7	102
Low	54	120
High	148	278
Extremely/Very high	236	495
ANOVA: F-value (sig., 2-sd.)	9.621 (.000)	8.96 (.000)

Appendix

A.1 Experimental Instructions (translations of parts A and B of the experiment)

Group 1 (separate policies)

Part A: Ambiguity

- You inherited a small painting and have received a photograph of it. The photo carries an individual identification number. You do not know if the painting is an original or a reproduction. If it is an original it is worth 2,000 DM. If it is a reproduction it is worth nothing.
- One person in the entire group of respondents participating in our experiment (about 260 to 280 people) has an original painting. All others have reproductions. Which one of the paintings is the original will be determined by a random draw symbolizing the decision of an art appraiser at the end of the entire experiment. The person who has the original painting will actually receive the value of the painting: 2,000 DM (in real bills!).
- Theft and fire threaten your painting.
- Whether or not the painting will be stolen will be determined by the weather conditions in July. If it will rain on 24 days in July (not more but also not less), a theft will occur. More precisely, the painting will be stolen if the weather station at the Frankfurt Airport will report on exactly 24 days of rain. A day is defined as a rainy day if there is at least 1 mm of rain on this day.
- The weather conditions in August determine if a fire will destroy the painting. If it will rain on 23 days in August (not more but also not less), a fire will occur. More precisely, a fire will

destroy the painting if the weather station at the Frankfurt Airport will report exactly 23 days of rain. Here again a day is defined as a rainy day if there is at least 1 mm of rain on this day.

- You can buy insurance policies against either each or both of these risks. If you have an insurance policy against theft or fire and the painting will be stolen or destroyed by fire, respectively, the insurance will reimburse you for the loss of 2,000 DM. If you have an insurance policy against fire and the painting will be destroyed by fire, the insurance will reimburse you for the value of 2,000 DM.
- The insurance company will sell the insurance policy and charge the money for it only in case an art appraiser, represented by the random draw of the experimenter, finds out that your painting is an original. Thus, for all respondents having the reproduction the payments for the insurance policies will remain hypothetical. However, for the one having the original painting they will become true and have to be paid from his or her own money.

The selling procedure for the theft insurance policy is organized in the following way:

- Before the experiment, the experimenter selected a secret selling price for the theft insurance policy. He or she wrote it on a piece of paper and put it into the envelope on the front desk.
- You are now required to write a buying price equal to your maximum willingness to pay for the theft insurance policy on the form in front of you and to put it in the respective envelope.
- After the experiment, the experimenter will open the envelope with the selling price. If your buying price is equal to or higher than the secret selling price you will have bought or are able to buy the theft insurance policy should you be the person with the original painting.(if you are the one who has the original painting). If your buying price is lower than the secret price, you are not able to buy the theft insurance policy.

- Note that you have no information about the selling price for the theft insurance policy. The experimenter changes this price every time.
- In this situation, the best you can do is to state your true value, your maximum willingness to pay for the theft insurance policy.
- It does not make sense to state a buying price higher than your maximum willingness to pay since you may end up paying this high price.
- It does also not make sense to state a price lower than your maximum willingness to pay. If your stated price is lower than the selling price but you, in fact, would have been willing to pay that price you may end up without the theft insurance policy even if you would have liked to buy it for that price if you are the one who has the original painting.
- If you do not want to buy the theft insurance policy please state 0 DM on the respective form.
- Please do not announce your buying price to the others and do not raise questions that allow the other participants to guess your buying price.
- Again, note that you only have to actually pay the price for the insurance policy if you are the one who has the original painting. This is because the insurance company will only sell the insurance policy if the painting is verified as the original. In this case, the person who has the original painting is able to buy insurance. He or she has to pay for the coverage of the insurance policies from his or her own money.
- Basically, that means that you are buying insurance for the original and that you only pay for it in case you have it.
- Now, please put the form with your maximum buying price in the appropriate envelope and hand it over to the experimenter.

The selling procedure for the fire insurance policy is organized the following way:

- The selling procedure of the fire insurance policy is organized in exactly the same way as the selling procedure for the theft insurance policy, i.e. again there is a secret selling price in an envelope, and you again are supposed to state your maximum buying price.
- Now, please put the form with your maximum buying price in the appropriate envelope and hand it over to the experimenter.

Part B: Risk

- You inherited a small sculpture and have received a photograph of it. The photo carries an individual identification number. You do not know if the sculpture is an original or a reproduction. If it is an original it is worth 2,000 DM. If it is a reproduction it is worth nothing.
- One person in the entire group of respondents participating in our experiment (about 260 to 280 people) has an original sculpture. All others are reproductions. Which one of the sculptures is the original will be determined by a random draw symbolizing the decision of an art appraiser at the end of the entire experiment. The person who has the original sculpture will actually receive the value of the sculpture: 2,000 DM.
- Theft and fire threaten your sculpture. Both risks have a known chance of occurrence:

Hazard	Chance of occurrence
Theft	in one of 10.000 cases
Fire	in one of 10.000 cases

- A bingo cage with 100 balls will be used to determine whether or not the sculpture will be stolen and whether or not it will be destroyed by fire.
  - Whether or not the sculpture will be stolen will be determined by the following two-stage procedure: If a ball with a number between 2 and 100 is drawn, no theft will have occurred. We will continue drawing of the bingo cage with 100 balls after the first draw only if a ball carrying the number 1 is drawn. Otherwise nothing happened. In a second draw, another ball from the bingo cage with 100 balls will be taken. Theft occurs if the ball with the number 1 is drawn in the second stage. The chance that both these events occur is exactly 1 in 10,000.
  - Secondly we will determine the case if fire occurs. We will proceed with the same two-stage procedure as used for the theft situation.

- You can buy insurance policies against either each or both of these risks. If you have an insurance policy against theft or fire and the sculpture will be stolen or destroyed by fire, respectively, the insurance will reimburse you for the loss of 2,000 DM. If you have an insurance policy against fire and the fire destroys the sculpture, the insurance will reimburse you for the value of 2,000 DM.
- The insurance company will sell the insurance policy and charge the money for it only in case an art appraiser, represented by the random draw of the experimenter, finds out that the sculpture is an original. Thus, for all respondents having the reproduction, the payments for the insurance policies will remain hypothetical. However, for the one having the original sculpture they will become true and have to be paid from his or her own money.

The selling procedure for the theft insurance policy is organized the following way:

- The selling procedure of the theft insurance policy is organized in exactly the same way as the selling procedure for the theft and fire insurance policies in the first part of the experiment, i.e. there again is a secret selling price in an envelope, and you again are supposed to state your maximum buying price.
- Now, please put the form with your maximum buying price in the appropriate envelope and hand it over to the experimenter.

The selling procedure for the fire insurance policy is organized the following way:

- The selling procedure of the fire insurance policy is organized in exactly the same way as the selling procedure for the theft and fire insurance policy in the first and the theft insurance policy in the second part of the experiment, i.e. there again is a secret selling price in an envelope, and you again are supposed to state your maximum buying price.
- Now, please put the form with your maximum buying price in the appropriate envelope and hand it over to the experimenter.

Group 2 (one policy)

The only difference between groups 1 and 2 was that in group 2 we sold bundled rather than separate insurance in both parts A and B.

Therefore, the part of the instructions dealing with insurance was written up as follows in part A (B) of the experiment:

- You can buy an insurance policy against each of these two risks. If you have an insurance policy and your painting (sculpture) will be stolen or destroyed by fire, the insurance will reimburse you for the loss of 2,000 DM.

Moreover, the selling procedure was described in the following way in part A (B) of the experiment:

- Before the experiment, the experimenter selected a secret selling price for the insurance policy. He or she wrote it on a piece of paper and put it into the envelope on the front desk.
- In the following you are required to write a buying price equaling your maximum willingness to pay for the insurance policy on the form in front of you and to put it in the respective envelope.
- After the experiment, the experimenter will open the envelope with the selling price. If your buying price is equal to or higher than the secret selling price, you are able to buy the insurance policy (in case you are the one who has the original painting (sculpture)). If your buying price is lower than the secret price, you are not able to buy the insurance policy.
- Note that you have no information about the selling price for the insurance policy. The experimenter changes this price every time.

- In this situation, the best you can do is to state the true value of your maximum willingness to pay for the insurance policy.
- It does not make sense to state a buying price higher than your maximum willingness to pay since you may end up paying this high price.
- It does also not make sense to state a price lower than your maximum willingness to pay. If your stated price is lower than the selling price but you in fact would have been willing to pay that price you may end up without the insurance policy even if you would have liked to buy it for that price if you are the one who has the original painting (sculpture).
- If you do not want to buy the insurance policy please state 0 DM on the respective form.
- Please do not announce your buying price to the other participants and do not raise questions that allow others to guess your buying price.
- Again, note that you only have to actually pay the price for the insurance policy if you are the one who has the original painting. This is because the insurance company will only sell the insurance policy if the painting is verified as the original. In this case, the person who has the original painting is able to buy insurance. He or she has to pay for the coverage of the insurance policies from his or her own money.
- Basically that means that you are buying insurance for the original and that you only pay for it in case you have it.
- Now, please put the form with your maximum buying price in the appropriate envelope and hand it over to the experimenter.

A.2: Probability table

Please report how probable you have judged „exactly 24 rain days in July“ occurring. Please check an interval that covers the probability you are judging to be correct first. Afterwards please report the exact probability in the right column.

Explanation: A chance of 1 in 1.000.000 implies that a July with exactly 24 rain days occurs – on average – every 1.000.000 years.

Chance: 1 in	Please check:	Exactly:
1 to 5		1 in _______________
5 to 10		1 in _______________
10 to 50		1 in _______________
50 to 100		1 in _______________
100 to 500		1 in _______________
500 to 1.000		1 in _______________
1.000 to 5.000		1 in _______________
5.000 to 10.000		1 in _______________
10.000 to 50.000		1 in _______________
50.000 to 100.000		1 in _______________
100.000 to 500.000		1 in _______________
500.000 to 1.000.000		1 in _______________
1.000.000 to 5.000.000		1 in _______________
5.000.000 to 10.000.000		1 in _______________
Less probable		Exactly 1 in _____________