# Public and Private Responses to Terrorist Events:

# A Laboratory Experiment

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**Abstract**

Previous research shows that insurance decisions are often based upon misperceptions of risk and affected by factors that include framing and context. We conduct a set of laboratory experiments that simulate terrorist attacks in order to understand individual preferences for public controls against terror threats alongside the option of private insurance. By inducing emotions through our simulations, we find that fear increases support for public controls as well as private insurance in response to the threat of terrorism. We also find no substitution of support for the public option when private insurance is made available. Our results demonstrate that people use insurance to address emotional as well as financial concerns. Implications generated by our experimental results include the conclusion that commitment of funds to insurance can be misplaced since other means such as terrorism prevention are much more efficient at minimizing the risks of losses due to terrorist attacks.

**Keywords:** Terrorism, Experiment, Emotion, Insurance, Decision making, Catastrophes.

**Highlights:**

+ We present experimental results concerning support for public programs that are designed to prevent terrorist attacks and private insurance to guard against losses.

+ We simulated the effect of terrorist attacks through audiovisual stimuli and financial loss and found a consistent pattern of emotions affecting support for actions to prevent terrorist attacks.

+ Fear induced by our simulations of terrorist attacks generated increases in support for public programs to prevent terrorist attacks as well as increases in the purchasing of private insurance.

+ The availability of an option to purchase private insurance did not affect support for public programs.

+ Implications of our findings include the conclusion that commitment of funds to insurance can be misplaced since other means such as terrorism prevention are much more efficient at minimizing the risks of losses due to terrorist attacks.

# 1. Introduction

The terrorist attacks on the U. S. on September 11, 2001 (hereafter 9/11) effected near-term losses that have been estimated at 80 to 90 billion dollars (e.g., (Kunreuther and Michel-Kerjan 2004b)) in addition to persistent costs that are required to prevent and insure against any comparable attacks in the future. Within the "portfolio of counterterrorism efforts" ((Mialon et al. 2012) that the U. S. has subsequently developed, (Siqueira and Sandler 2007) categorize the responses as "offensive" or "defensive" such as, respectively, the invasion of Afgahnistan and the creation of a cabinet-level Department of Homeland Security within the federal government. Notwithstanding the reduction in domestic crime that appears to be a positive effect of increased defense against terrorist threats (Gould and Stecklov 2009), researchers have noted that insurance commitments and payouts to guard against international terrorist attacks "dwarfs the aggregate of similar federal and state commitments for insurance against natural disasters" (Lakdawalla and Zanjani 2005). Against this backdrop, it is clearly important and relevant to understand preferences for programs designed to prevent any future terrorist attacks.

In this article, we build upon previous experiments concerning responses to terrorism (Arce et al. 2011) and focus on the role of context and emotion upon decision making associated with defensive counterterrorism activities. More specifically, while others have explored the effects of relying upon a mix of public and private forms of insurance for domains such as health care (Blomqvist and Johansson 1997), our experiments closely examine decisions to variably support public controls against terrorism and/or private insurance against potential losses incurred by individuals and firms. These questions are generally motivated by interests to understand why people contribute to public goods (Aim et al. 1992) and what effects government action might have upon private decision making (e.g., (Bergstrom et al. 1986). Given the extreme reactions generated by terrorist attacks, though, the domain is especially interesting to examine with respect to the role of context and emotion.

## *1.1 Influence of Emotions*

Research in psychology, behavioral economics, and neuroeconomics suggests that emotions such as fear and anger can play an important role in decision-making. These emotions are likely to be a major factor in the public response to terrorist events and that is important since cognitive evaluations of risks often diverge from emotional reactions to the same risks. When such divergence occurs, there is ample evidence that emotional reactions often drive behavior (Loewenstein 2000; Loewenstein et al. 2001).

## *1.2 Calculations of Risk*

Most generally, it is widely accepted that risk is perceived and acted upon through two routes: (1) feelings, which rely on individuals' fast, instinctive, and intuitive reactions to danger, and (2) analysis, which brings logic, reason, and scientific deliberation to bear on risk management (Hogarth and Portell 2011; Slovic et al. 2005). Examples of "fast" reactions are generated by laboratory experiments that show visceral

– and negative – responses when people are exposed to negatively valenced photographs and startled by 110 decibel (dB) sounds for 100 milliseconds (ms) (Filion et al. 1998). At the same time that the outcome of risk-danger is real, risk assessment is inherently subjective and represents a blending of science and judgment with important psychological, social, cultural, and political factors (Slovic 1999). In this sense, it is important to acknowledge that risk is, to some extent, socially constructed.

Focusing specifically on the nature and unpredictability of terrorist attacks, it is extremely difficult, if not impossible, to calculate risk-adjusted "insurance premiums" for policies that cover losses due to terrorism. Despite many studies showing that private insurance companies cannot effectively insure against risks associated with potential terrorist events and that government intervention is needed by the market (Brown et al. 2002; Hubbard et al. 2005; Kunreuther and Michel-Kerjan 2004a), insurance had been used as a tool to deal with risk and possible loss caused by potential terrorist attacks, especially after 9/11. On the one hand, empirical evidence shows that insurers sometimes make non-scientific decisions to insure during conditions of extreme uncertainty (non-calculability) and base such insurance decisions on intuitive, emotional, aesthetic, moral and speculative knowledge (Ericson and Doyle 2004). On the other hand, insurance companies have dramatically increased premiums for terrorism insurance (Michel-Kerjan and Pedell 2006). Due to the challenges of insurability against terrorism risks and market failure (Boardman 2005; Jaffee and Russell 2003), Congress approved the Terrorism Risk Insurance Act (TRIA) in 2002 with re-authorizations in 2005 and 2007 to help the insurance industry underwrite policies against possible loss caused by terrorist attacks by acting as reinsurer (Kunreuther and Michel-Kerjan 2004a). The two extensions of TRIA, which presently applies through the end of 2014, also show the increasing demand for terrorism insurance. These changes in the insurance industry all invite the question of why some people and corporations choose to pay large amounts to insure against possible terrorist attacks even though the expected loss is unpredictable.

### *1.3 Previous Field and Experimental Studies*

Previous field studies focusing on individual insurance decisions have found that people often pay too little to insure against low probability but high loss risks like hurricanes and floods (Kunreuther and Pauly 2006; Kunreuther and Pauly 2004) due to negligence or underestimation of small probabilities (Tversky and Kahneman 1992). In a field study involving the misperception of behavioral risks related to terrorist attacks, (Blalock et al. 2009) demonstrated that increased fear of flying led to more vehicular fatalities as people considered driving to offer relatively greater protection in the wake of 9/11's plane-based attacks. The common thread illustrated by these field studies is that people tend to respond to risk and uncertainty in ways that are economically suboptimal.

Laboratory studies permits much greater control over the type of information that people are expected to process before making decisions; however, experiments focused on insurance against low-probability, high-cost risks have nonetheless generated a diversity of findings. For example, in a study using hypothetical survey questions, experimenters found that people reduced their investments in insurance in response to reductions in the probability of a catastrophic loss even if the scale of the potential catastrophe remained constant (Slovic et al. 1977). Through incentivized experiments,

though, a reduction in the probability of a catastrophic loss did not generate a reduction in individual investments in private insurance (Laury et al. 2009). Additional research has demonstrated that people tend to split with respect to willingness to pay for insurance against small probability risks and either pay significant too little or significantly too much (McClelland et al. 1993)(Schade 2002) – a bimodal pattern that Schade (2002) attributes to concern level towards the risk. These dissimilar conclusions do not necessarily contradict each other because framing and contextual factors play important roles when people make insurance purchase decisions against large loss but small probability risks (Kunreuther et al. 2001; Laury et al. 2009).

Notably, previous studies did not examine how specific framing and contextual factors could affect insurance purchasing decisions. People could engage in either over or under payment on insurance policies against large loss but small probability risks. A field study (Lerner et al. 2003) conducted immediately after 9/11 indicated that emotions may help to predict insurance purchasing behaviors in the context of terrorism insurance. More specifically, Lerner and colleagues found that fear increased risk estimates and plans for precautionary measures while anger did the opposite. In addition, males had less pessimistic risk estimates and more anger than females. Although the emotional effects were significant, the findings were based on surveys and hypothetical questions. Inspired by their study, we conducted a series of controlled laboratory experiment to further demonstrate how different emotions affect behaviors when facing risks such as terrorist attacks. The current research also could help to better explain the observed anomalies in insurance purchasing decision that discussed above. Since researchers have established certain relations between framing, context, and emotions (Druckman and McDermott 2008; Gross and D'Ambrosio 2004), our study also has clear relevance for public policy debates.

## 2. Experimental design and procedures

All experimental sessions were conducted in the Laboratory for Experimental Economics and Decision Research (LEEDR) at Cornell University. Participants were undergraduate students recruited from introductory level classes or through the Lab's online recruitment system. Sessions ran from 45 minutes to an hour depending on treatment specifications. All participants who showed up received $5 show-up rewards. Participants who finished the whole experiment expected an average earning of $20 besides the show-up reward. Ten sessions were conducted[1] with exactly 16 participants in each.

Each participant was randomly assigned to a desk equipped with a desktop computer and headphones. Participants read instructions, made their decisions, and received feedback privately through a Visual Basic Application program that ran on their computers[2]. Subjects were able to ask questions at any point throughout the experiment but were not allowed to talk or discuss the experiment with each other given evidence that direct communication can significantly influence contributions to public goods (Messer et al. 2007). After each session, subjects were asked to finish a demographic

[1] Eleven sessions were conducted but one was excluded due to sampling problems.
[2] See appendix for screen shots.

survey before they were paid and then left the Lab. In addition to details specified here, standard economic experiment protocols applied.

To induce a startle response as well as emotions (Gross and Levenson 1995) in some of the sessions, a video clip of terrorist events that included explosive sounds measured at 110 db[3] was played to *all* subjects in those sessions. We prepared three versions of the video clips with exactly same content but different timings for the explosion sounds[4]. We randomly chose which version to play within each session so that subjects could not get prepared for the high-volume explosion sound. Subjects in sessions with the video were required to wear headphones whenever the video clip was played. All of the headphones connected to amplifiers, which then all connected to a server computer. When a simulated terrorist event happened, the experimenter played the video clip on the server computer. Participants watched the video through an overhead screen and listened to the high-volume sound through their own headphones. Each time after we played the video, subjects were asked to complete a questionnaire that measured their emotions.[5]

Importantly, we can highlight that participants were exposed to the video and sound, in relevant treatments, even if they did not individually suffer any financial loss as part of the terrorist event. We implemented this method to simulate the fact that members of a given community who do not directly suffer financial loss in a real-world terrorist event nonetheless are faced with the trauma of an attack on their community.

In all 10 sessions, subjects made decisions in each of 30 rounds, but they were only told that the experiment consists of a certain number of rounds to avoid any final-round effects. Before the first round, every participant was endowed with $20 in his/her account. In each of the following rounds, they received $1 as income. A possible "hazard event" was explained to all of the subjects before the first round. The hazard event had different consequences depending on treatments. In every session, a different subject drew a poker chip to decide if a hazard event would happen in that round. As indicated in Table 1, eight treatments were implemented, varying the hazard control program cost, the presence or absence of emotion stimuli, and the availability of private insurance from session to session

Table 1
[INSERT TABLE 1 HERE]

In treatments A1, A2, B1 and B2, the hazard event meant losing $5 and watching the video clip with the explosion sound. In other treatments, hazard event was defined as a $5 financial loss. In part A, participants made a decision if they want to vote for a hazard control program which lowered the probability of the hazard event. This program cost either $0.50 (treatments A1 and A3) or $0.75 (treatments A2 and A4) and was only applicable to the current round. Comparable to many government taxing programs as well as the Provision Point Mechanism described by Rondeau et al. (2005), if the

[3] Volume was calibrated with a sound meter in the Laboratory.

[4] One of the versions can be found at http://www.4shared.com/video/QwmOz0K9/1st_Blast.html.

[5] See appendix for the questionnaire. It might have been ideal to measure their emotions after each round of the experiment so we can better track emotional changes; however, measuring emotions after each round is very time consuming and likely would have induced fatigue among study participants.

majority voted yes (N>=9), *all* subjects needed to pay to fund the program. We prepared two bags with different numbers of colored chips in them. A green bag had 9 white chips and 1 red chip while a red bag had 8 white chips and 2 red chips. If the program was funded in a round, a chip was drawn from the green bag; otherwise, from the red bag. Subjects were informed that both bags have equal number of chips and there were many more white chips than red chips in both bags. In addition, they were told the red bag had twice as many red chips as the green bag. Once a red chip was drawn from either bag, all participants lost $5, which was deducted from their personal experimental accounts. The hazard control program reduced probability of the hazard event by 10 percent, which translated to a reduction of $0.50 of expected loss. Subjects were not informed of the probabilities and only knew that the program reduces the probability of an event by 50%.

Part B is similar to Part A, except that subjects made two decisions *simultaneously* in each round. They decided to vote for – or against – the hazard control program, which cost $0.50 in treatments B1 and B3 or $0.25 in treatments B2 and B4 and each subject decided whether to purchase insurance, which cost $1 and only insured him/her against the $5 financial loss. Those who purchased the insurance still watched the video clip whenever a hazard event happened given the rationale described above.

## 3. Results and Analysis

Data collected from Part A allows us to analyze the price effect and emotion effect induced by the video clip on funding the hazard control program. It is clear from Table 2 and Figure 1that both price and emotion stimuli were effective treatments in our experiment. When the price of the hazard control program was low and emotion stimuli were applied, the hazard control program was in effect in all rounds. On the contrary, when price was high and no emotion stimulus was applied, the hazard control program was only funded in the first eight rounds. Lines for the other two treatments A2 and A3 lie in between.

Data collected from Part B show a similar pattern but less voting in general, as is depicted in Table 3 and Figure 2. Note we decreased the hazard control cost by $0.25 in Part B. We added this adjustment after the pilot session to avoid losing variation in either vote or insurance purchase. More importantly, if a subject is risk neutral, then he or she now has the information that hazard control program and insurance have the same expected return in terms of protecting her money. The hazard control program, however, provides an extra benefit since it lowers the probability of exposure to the emotion stimuli. Since most people are risk averse in such situations, we lowered price of the hazard control program to attract more votes.

Table 2
[INSERT TABLE 2 HERE]
Table 3
[INSERT TABLE 3 HERE]
Figure 1
[INSERT FIGURE 1 HERE]
Figure 2
[INSERT FIGURE 2 HERE]

Although the above figures clearly show the effect of emotion stimuli, we are more interested in the emotion effect that is induced by the emotion stimuli. Table 4 shows the average emotion levels in different treatments and the pattern follows common sense.[6] Since we only measured emotion levels after each hazard event happened, we used a linear regression to predict emotion levels in all other rounds. In the following analysis, we use the predicted emotions in addition to the measured emotions to study the emotion effects. We started from using all relevant variables we collected to predict emotions. Many of them were very insignificant so those variables were then removed from the prediction model. Details can be found in Appendix B.

Table 4
[INSERT TABLE 4 HERE]

In order to investigate emotion effects on voting for public programs designed to prevent hazards, we employed a probit model to analyze data from Part A.

Table 5 shows results from the regressions: column (1) explains voting with two treatment variables—cost and video as well as several other control variables; column (2) explains voting with *measured* emotions in addition to cost and control variables; and, column (3) replaces measured emotion variables with *predicted* emotion variables. The video dummy variable was removed from both columns (2) and (3) since the video was used to invoke emotions. Standard errors are clustered by subject to account from possible correlation between rounds. Results in column (1) verify that our prepared video clip worked as expected and subjects were willing to pay to lower the probability of seeing it. This is not a surprising result; however, column (2) is interesting since it provides more detailed estimates on the effects of anger and fear. Specifically, it shows that subjects were more likely to fund the hazard control program when they were fearful but less likely to do so when they were angry, although the coefficient of fear is not significant at 5 percent level ($p$=0.87). These results are consistent with the field study (Lerner et al. 2003) except that the experiment was incentivized so subjects' decisions were consequential both emotionally and financially. Therefore, the correlations between anger and voting as well as fear and voting were observed from "real" behaviors not based on hypothetical survey questions.

It is noteworthy that an average of only three to four hazard events happened in each session so column (2) mostly captures between-subject effects. We ran the same regressions with emotion variables replaced by predicted ones to capture both within- and between-subject effects. Although we attempted to make the emotion prediction as accurate as possible, our linear models only explain 20% of the variation in anger and 18% of the variation in fear. Therefore, coefficients in column (3) should be interpreted with caution. As is shown, the signs of the coefficients remain unchanged from (2). Regarding the hazard control program, fear encourages supporting votes and anger discourages support. Demographic variables do not help to explain voting decisions when only the hazard control program is available. Only gender is significant at 5 percent level in

[6] Some have pointed out that the self-reported measurements that we used may have incurred demand effects. This, however, does not confound our result. Our focus is the relation between subjects' actual behavior and their self-reported emotions.

column (2). We expected Democrats and Republicans to have different attitudes towards the hazard control program since it is essentially a publicly funded program but the results disprove that hypothesis.

Table 5
[INSERT TABLE 5 HERE]

Aside from a public program aiming to reduce probabilities of terrorist attacks, insurance is also widely used in the real world to deal with terrorism risks. Usually, commercial insurance only insures people against possible financial losses, and they still suffer from emotions caused by the terrorist event. Therefore, any rational decision maker would not use insurance to fight against negative emotions. We added an insurance option in Part B of the experiment to investigate how subjects make their decisions in such a setting. Figure 3 shows insurance purchases in each treatment in Part B and should be explained together with Figure 2. Subjects were given two options at the same time and they might choose none of them, either of them or both of them. This then lead to four possible choices a subject could make. The four options, which we designate as choices 0, 1, 2, and 3 for the multinomial model that we used for analysis, are: (0) no hazard control program and no insurance, (1) hazard control program but no insurance, (2) no hazard control program but insurance, and (3) hazard control program and insurance.

Table 6 presents results from the multinomial probit model. In this model, we take choice 0 as the base choice so that the estimated coefficients are effects on the other three choices relative to choice 0. Following the same structure of Table 5, column (1) in Table 6 has the hazard control cost and the video dummy variable plus several control variables as independent variables. Column (2) has actual measured emotions and hazard control cost as independent variables. Column (3) uses predicted emotions to replace actual measured emotions in column (2) so column (3) has same number of observations as column (1). Since we kept the cost of insurance constant, we only used the cost of hazard control program in all regressions. By changing the cost of hazard control program, we essentially changed the relative cost of insurance.

Figure 3
[INSERT FIGURE 3 HERE]

Column (1) shows that watching the video increased the likelihood of funding the hazard control program, but its effect is limited to the hazard control program and does not affect insurance purchases. This, however, is not proof that emotions do not have an effect on insurance purchases. Since anger may decrease the willingness to pay for insurance and fear may increase it, these two effects could negate each other. Column (2) then provides estimates using measured emotions and we note that the coefficients of both anger and fear have expected signs. Anger again discouraged subjects to fund the hazard control program. In addition, anger also discouraged subjects to purchase insurance against financial loss. This effect is significant at the 1 percent level on choices 2 and 3 although it has a *p* value of 0.08 on choice 1. Fear, on the other hand, encouraged subjects to fund the hazard control program and to purchase insurance. Coefficients for all three choices are significant at 5 percent level and are significant at 1 percent level for

choices 1 and 3. With predicted emotions, column (3) indicates that coefficients of anger and fear have negative and positive signs respectively. This is again consistent with the patterns displayed in columns (1) and (2) in Table 6.

Table 6
[INSERT TABLE 6 HERE]

Notably, Table 6 shows that subjects' decisions on both choices 2 and 3 were insensitive to the hazard control program cost. In fact, the coefficients of cost for choices 2 and 3 in all three columns are insignificant even at the 10 percent level. This basically indicates that the hazard control program and insurance did not work as substitutes even though they both reduced expected financial loss. Reducing hazard control program cost attracted more subjects to vote for the program but did not significantly substitute away an insurance purchase. This observation helps us to understand the real-world phenomena whereby big companies pay large amounts of money to purchase insurance policies against possible financial loss caused by terrorist attacks. Although implementing more stringent measures to ensure security in fact helps to reduce expected loss, people may choose to ignore this when they make insurance purchase decisions. Unlike Part A, several demographic variables significantly affect decisions in Part B. Democrats are more likely to select choices 1 2 while Republicans do not behave differently from those not affiliated with any party. Males are less likely to choose choice 3 when compared with females but this does not hold for other choices.

To sum up, we employed a probit model and a multinomial probit model in this section to analyze decisions regarding the hazard control program and insurance. The stimuli we used in our experiments successfully induced emotions, especially anger and fear. In general, fear encouraged subjects to vote for hazard control program and to purchase insurance while anger did the opposite. One major finding is that although insurance did not protect subjects from the emotional stimuli, their purchasing decisions still react to the changes in emotions. The other major finding is that the hazard control program does not substitute for insurance purchases even though the program lowered probability of the simulated terrorist event.

## 4. Conclusion

In this article, we designed and conducted a controlled laboratory experiment to study factors that may affect decisions when facing terrorism risks. Results show the experimental design worked well to separate the effects of emotions to support public program and purchase insurance. The experiment also simulated real world terrorism risks in a laboratory setting by providing subjects with ambiguous probabilities and emotional stimuli. Consistent with field research (Lerner et al. 2003), we found anger decreases likelihood that a subjects vote for public program while fear increases the likelihood. Moreover, we found that anger and fear had the same effects on insurance purchasing decisions. Insurance only insures against financial loss and does not change probability of the simulated event (which is the source of emotions) so being affected by emotions is an irrational response. Besides the effects of emotions, the results also

indicate that subjects were insensitive to the relative prices and existence of hazard control program when they made insurance purchasing decisions.

These experimental results can help us to better understand behaviors regarding terrorism risks in the real world. Decisions affected by emotions such as anger and fear are not evidence of irrationality. On the contrary, our findings show how people utilize an "analytical system" and an "experiential system" to make optimal decisions in the face of terrorist events (Slovic et al. 2004). Therefore, when trying to analyze behavior or make any policy, we should keep the role of emotions in mind. Why do companies pay big amounts to purchase terrorism insurance? Why do some people not purchase insurance against small risks? This study presents evidence that emotions can play an important role in their decision process. When experiencing different emotions, attitudes on future events could be different (Chanel and Chichilnisky 2009; Lerner and Keltner 2000); however, our results support the view that economic agents make decisions using both external information *and* internal emotions.

Since we are now aware of the role that emotions play in the decision making process, possible policy implications should be based on this fact. Paying too much on insurance premiums may lead the industry to inefficiency since the probabilities of terrorist attacks are unknown by nature and committing funds to insurance can be misplaced since other means such as terrorism prevention could be much more efficient. As argued by Slovic (Slovic 1999), danger is real but risk is socially constructed, so "objective risk" does not exist. Instead, risk is subjective because it is influenced by a person's sex, worldview, emotions and many other individual factors. Our experimental findings reported in this article identify particular emotions that influence decisions when facing terrorism risks. In that sense, policies may focus more on ways to alter public attitudes towards terrorist attacks (and possibly other risks). For example, introducing more advanced techniques into airport screening process may not work as well as having more Transportation Security Agency (TSA) staff working at the airport to reduce the fear of taking airplanes. Likewise, our findings indicate that news that arouses anger in the public does not help to attract more funds for Homeland Security.

The extent to which our experimental results hold outside of the laboratory is unclear but our findings nonetheless provide a unique chance to study the effect of emotions on decisions regarding terrorism risk. In a more general setting, results from this experiment also shed some light on decision making regarding small probability risks such as floods and hurricanes. If natural experimental data could be observed, it would enhance the reliability of conclusions drawn from the laboratory experiment.

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**Table 1. Treatment design**

| Treatment | Hazard Control Cost | Video | Loss | Insurance Cost | N |
|---|---|---|---|---|---|
| A1 | $0.50 | Yes | $5 | -- | 16 |
| A2 | $0.75 | Yes | $5 | -- | 16 |
| A3 | $0.50 | No | $5 | -- | 16 |
| A4 | $0.75 | No | $5 | -- | 16 |
| B1 | $0.50 | Yes | $5 | $1 | 32 |
| B2 | $0.25 | Yes | $5 | $1 | 32 |
| B3 | $0.50 | No | $5 | $1 | 16 |
| B4 | $0.25 | No | $5 | $1 | 16 |

**Table 2. Votes in different treatments**

| **Votes in Different Treatments** | | | | |
|---|---|---|---|---|
| Treatment | Round 1 | Round 10 | Round 20 | Total |
| A1 | 14 | 13 | 9 | 11.767 (7.065) |
| A2 | 11 | 8 | 10 | 9.433 (7.879) |
| A3 | 11 | 8 | 11 | 11.167 (7.354) |
| A4 | 10 | 3 | 3 | 5.4 (7.574) |
| B1 | 6.5 | 4.5 | 3.5 | 3.17 (6.489) |
| B2 | 13 | 12 | 10 | 10.367 (7.646) |
| B3 | 9 | 8 | 2 | 4.733 (7.310) |
| B4 | 6 | 4 | 0 | 1.9 (5.181) |
| **Insurance Purchase in Different Treatments** | | | | |
| Treatment | Round 1 | Round 10 | Round 20 | Total |
| B1 | 8 | 8 | 10 | 9.95 (7.763) |
| B2 | 2 | 3 | 7 | 4.783 (7.329) |
| B3 | 6 | 6 | 5 | 8.367 (8.000) |
| B4 | 14 | 12 | 12 | 11.333 (7.280) |

Standard deviations in parentheses.

**Table 3. Average emotions in different treatments and ANOVA on treatment variables**

| | Part A | | Part B | | ANOVA | | |
|---|---|---|---|---|---|---|---|
| | No Video N=128 | Video N=80 | No Video N=176 | Video N=269 | Insurance | Video | Interaction |
| Fear | 3.59 (2.55) | 5.15 (2.59) | 2.33 (2.03) | 4.47 (2.57) | 21.37 (0.00) | 78.01 (0.00) | 1.88 (0.17) |
| Anger | 5.46 (2.79) | 5.86 (2.49) | 3.10 (2.71) | 5.57 (2.63) | 33.34 (0.00) | 39.18 (0.00) | 20.36 (0.00) |
| Sad | 4.94 (2.74) | 6.23 (2.33) | 2.49 (2.29) | 5.63 (2.64) | 48.31 (0.00) | 102.62 (0.00) | 17.94 (0.00) |
| Disgust | 3.66 (2.94) | 6.08 (2.09) | 2.25 (2.05) | 5.53 (2.57) | 21.05 (0.00) | 179.94 (0.00) | 4.12 (0.04) |
| Amused | 2.92 (2.19) | 2.24 (1.18) | 2.78 (2.23) | 1.63 (1.52) | 5.11 (0.02) | 31.22 (0.00) | 2.02 (0.16) |

Standard deviations in parentheses for reported means. P values in parentheses for ANOVA F statistics.

**Table 4. Regression results on voting decisions (part A). Standard probit model with standard errors clustered by subject.**

| | (1) | (2) | (3) |
|---|---|---|---|
| Hazard control cost | -2.490** (0.893) | -4.451*** (1.078) | -2.579** (0.898) |
| Video | 0.421 (0.219) | | |
| Anger | | -0.163** (0.0538) | |
| Fear | | 0.101 (0.0588) | |
| Predicted Anger | | | -0.225 (0.120) |
| Predicted Fear | | | 0.354** (0.134) |
| Democrat | 0.027 (0.235) | 0.206 (0.320) | 0.113 (0.255) |
| Republican | 0.525 (0.400) | 0.548 (0.482) | 0.516 (0.438) |
| Male | -0.243 (0.219) | -0.613* (0.285) | -0.284 (0.223) |
| Constant | 1.629* (0.649) | 3.734*** (0.803) | 1.599 (0.883) |
| Observations | 1920 | 208 | 1856 |

Hazard control cost is either \$0.5 or \$0.75. Video is a dummy variable (1 if required to watch the video clip when a hazard event happened, 0 otherwise). Anger and fear are predicted emotions ranging from 1 to 9. Clustered standard errors are in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

**Table 5. Regression results on joint decisions (part B). Standard multinomial probit model with standard errors clustered by subject.**

| | (1) | (2) | (3) |
|---|---|---|---|
| ***Choice 0 (base choice): no hazard control program and no insurance*** | | | |
| ***Choice 1: hazard control program*** | | | |
| Hazard control cost | -3.216$^{**}$ (1.174) | -2.747$^{*}$ (1.344) | -3.257$^{**}$ (1.220) |
| Video | 0.850$^{*}$ (0.335) | | |
| Anger | | -0.102 (0.060) | |
| Fear | | 0.182$^{**}$ (0.067) | |
| Predicted Anger | | | -0.414$^{**}$ (0.146) |
| Predicted Fear | | | 0.691$^{**}$ (0.217) |
| Democrat | 0.770$^{*}$ (0.315) | 0.752$^{*}$ (0.361) | 0.851$^{*}$ (0.336) |
| Republican | 0.250 (0.368) | 0.208 (0.373) | 0.337 (0.391) |
| Male | 0.0343 (0.294) | -0.404 (0.313) | 0.0355 (0.311) |
| Constant | 0.391 (0.489) | 0.658 (0.622) | 0.374 (0.695) |
| ***Choice 2: insurance*** | | | |
| Hazard control cost | 0.865 (1.060) | -0.837 (1.236) | 1.134 (1.009) |
| Video | -0.158 (0.275) | | |
| Anger | | -0.178$^{**}$ (0.064) | |
| Fear | | 0.168$^{*}$ (0.070) | |
| Predicted Anger | | | -0.827$^{***}$ (0.146) |
| Predicted Fear | | | 0.813$^{***}$ (0.199) |
| Democrat | 0.813$^{**}$ (0.289) | 0.906$^{**}$ (0.325) | 0.862$^{**}$ (0.270) |
| Republican | 0.303 (0.389) | 0.361 (0.456) | 0.282 (0.326) |
| Male | 0.502 (0.274) | 0.366 (0.321) | 0.427 (0.249) |
| Constant | -0.249 (0.505) | 0.143 (0.575) | 0.431 (0.596) |
| ***Choice 3: hazard control program and insurance*** | | | |
| Hazard control cost | -0.844 (1.419) | -0.209 (1.477) | -0.399 (1.402) |
| Video | 0.190 (0.370) | | |
| Anger | | -0.171$^{**}$ (0.059) | |
| Fear | | 0.219$^{**}$ (0.081) | |
| Predicted Anger | | | -0.515$^{*}$ (0.210) |
| Predicted Fear | | | 0.715$^{*}$ (0.278) |
| Democrat | 0.583 (0.374) | 0.557 (0.379) | 0.589 (0.370) |
| Republican | -0.400 (0.446) | -0.282 (0.541) | -0.426 (0.456) |
| Male | -1.003$^{**}$ (0.327) | -0.998$^{*}$ (0.395) | -1.051$^{**}$ (0.342) |
| Constant | -0.313 (0.603) | -0.690 (0.678) | -0.537 (0.837) |
| Observations | 2880 | 445 | 2784 |

Hazard control cost is either \$0.25 or \$0.5. Video is a dummy variable (1 if required to watch the video clip when a hazard event happened, 0 otherwise). Anger and fear are predicted emotions ranging from 1 to 9. Clustered standard errors are in parentheses. $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$.Standard errors in parentheses

**Figure 1 Votes for hazard control program (Part A)**

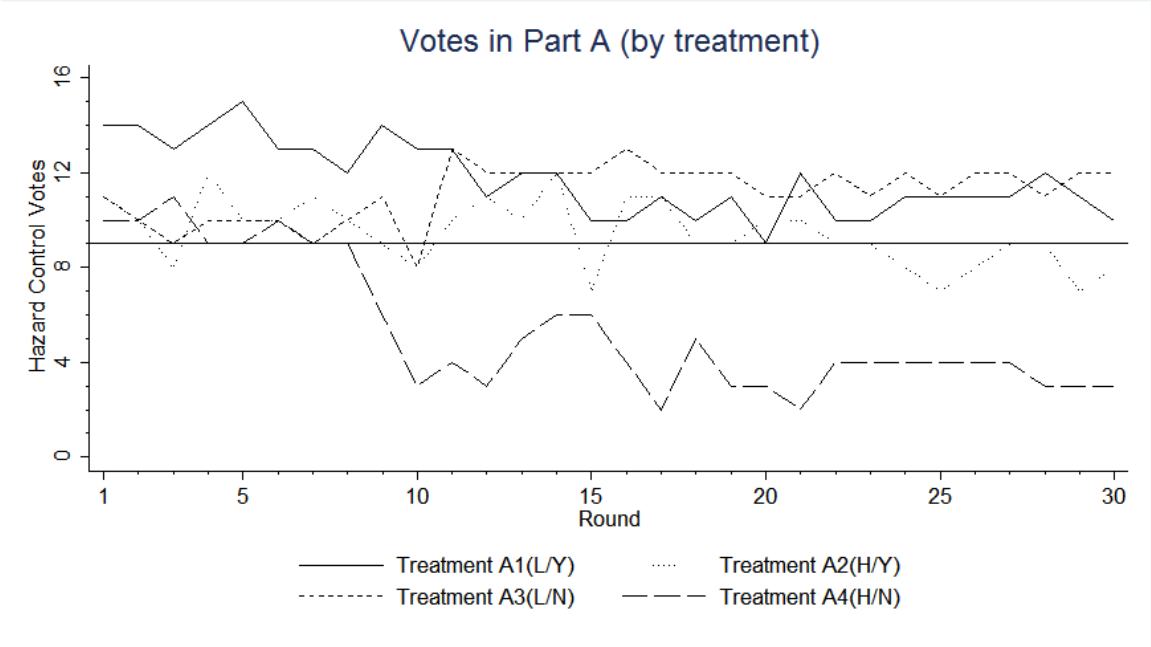



**Figure 2 Votes for hazard control program (part B)**

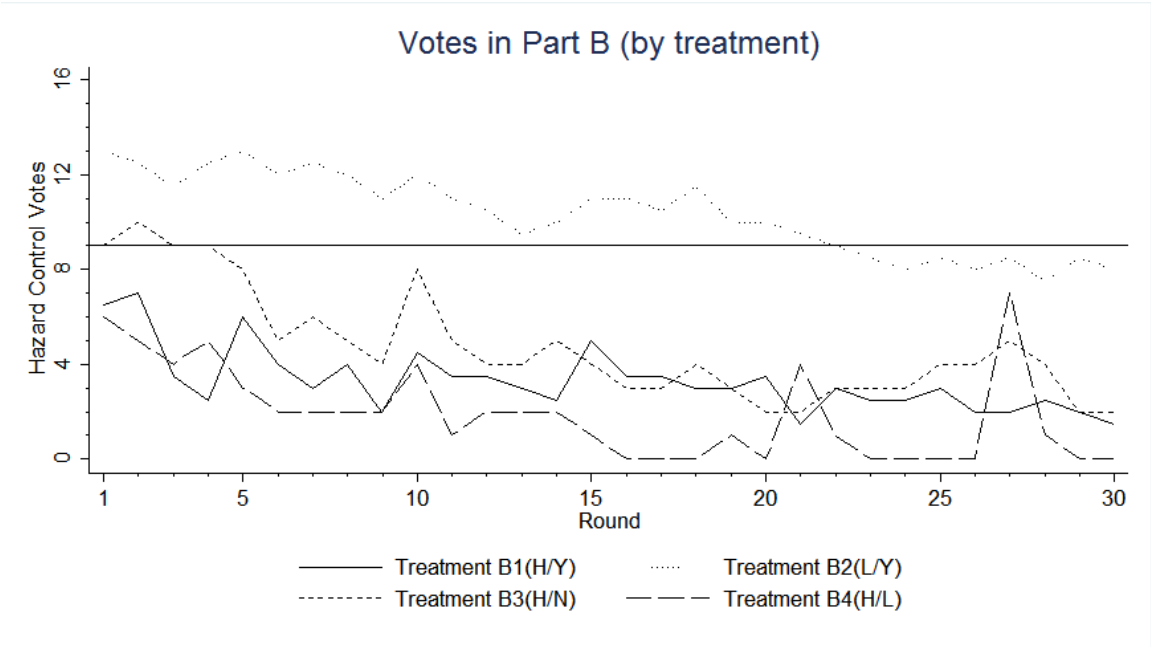
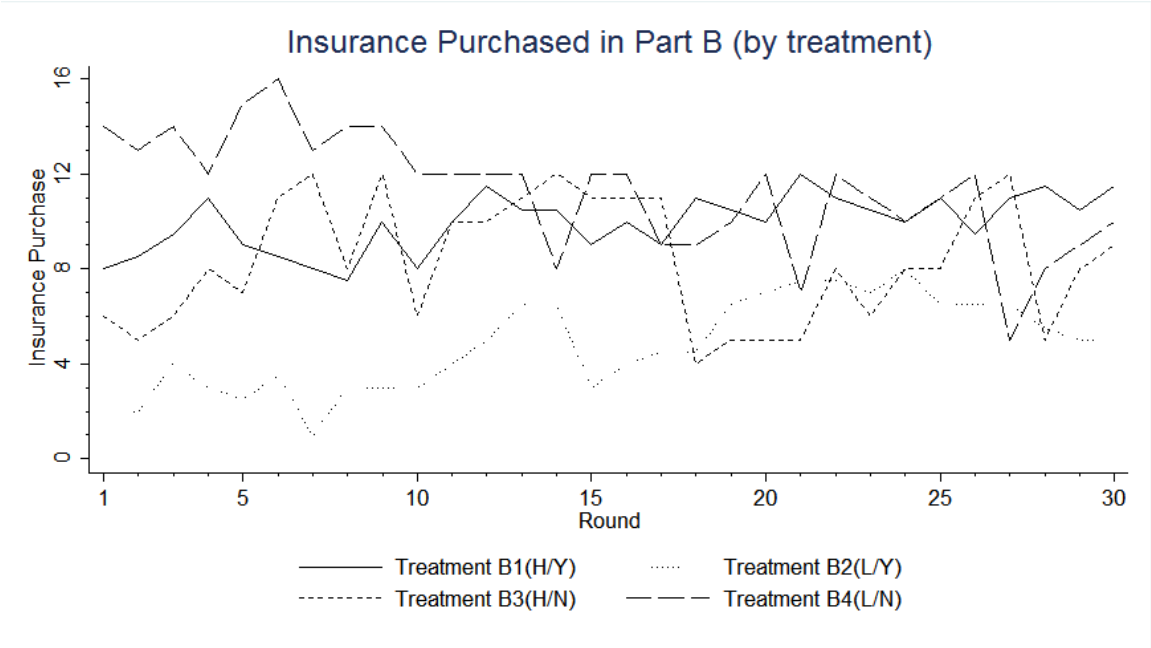



**Figure 3 Insurance purchases (Part B)**


Insurance Purchased in Part B (by treatment)
Insurance Purchase
0
4
8
12
16
1
5
10
15
20
25
30
Round
Treatment B1(H/Y)
Treatment B2(L/Y)
Treatment B3(H/N)
Treatment B4(L/N)

# Appendix A

Figure A.1

Subject 1

Round 1

Do you support hazard control where each paticipant pays $0.75 to draw from the green bag rather than the red bag?

○ YES ○ NO

SUBMIT RETRIEVE

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Round | | | | | | | | | | | | | | | | | |
| Income | | | | | | | | | | | | | | | | | |
| Hazard Control Cost | | | | | | | | | | | | | | | | | |
| Insurance Cost | | | | | | | | | | | | | | | | | |
| Wealth | | | | | | | | | | | | | | | | | |
| Hazard Event | | | | | | | | | | | | | | | | | |

# Figure A.2

Subject 1

Round 1

Do you support hazard control where each paticipant pays $0.50 to draw from the green bag rather than the red bag?

○ YES ○ NO

Do you want to purchase insurance where you need to pay $1.00 to prevent any financial loss caused by the hazard event?

○ YES ○ NO

SUBMIT RETRIEVE

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Round | | | | | | | | | | | | | | | | | |
| Income | | | | | | | | | | | | | | | | | |
| Hazard Control Cost | | | | | | | | | | | | | | | | | |
| Insurance Cost | | | | | | | | | | | | | | | | | |
| Wealth | | | | | | | | | | | | | | | | | |
| Hazard Event | | | | | | | | | | | | | | | | | |

**Figure A.3**

## Post Event Questions

Please answer following questions based on your feelings about the hazard event.

*On a scale from 1 to 9, please pick the best number to indicate what you feel from not at all (1) to very (9).*

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | ANGRY | ○ 1 | ○ 2 | ○ 3 | ○ 4 | ○ 5 | ○ 6 | ○ 7 | ○ 8 | ○ 9 |
| 2. | SAD | ○ 1 | ○ 2 | ○ 3 | ○ 4 | ○ 5 | ○ 6 | ○ 7 | ○ 8 | ○ 9 |
| 3. | FEARFUL | ○ 1 | ○ 2 | ○ 3 | ○ 4 | ○ 5 | ○ 6 | ○ 7 | ○ 8 | ○ 9 |
| 4. | DISGUST | ○ 1 | ○ 2 | ○ 3 | ○ 4 | ○ 5 | ○ 6 | ○ 7 | ○ 8 | ○ 9 |
| 5. | AMUSED | ○ 1 | ○ 2 | ○ 3 | ○ 4 | ○ 5 | ○ 6 | ○ 7 | ○ 8 | ○ 9 |

Submit Answers

## Appendix B

Table B.1 Predict emotions with linear model

| | (1)<br>Anger | (2)<br>Fear |
|---|---|---|
| Video | 1.489*** (0.235) | 1.715*** (0.217) |
| Insurance | -0.678* (0.271) | -0.860*** (0.249) |
| Financial loss | 0.118*** (0.0192) | 0.00695 (0.0177) |
| Number of past events | 0.144 (0.110) | 0.281** (0.101) |
| Round | -0.0501* (0.0198) | -0.0638*** (0.0182) |
| Age1 | 2.072 (1.066) | 0.401 (0.981) |
| Age2 | 3.036* (1.473) | 0.935 (1.355) |
| Asian | 0.914*** (0.243) | 1.275*** (0.224) |
| Constant | 1.724 (1.103) | 2.893** (1.015) |
| Observations | 653 | 653 |

Video is dummy variable (1 if required to watch the video clip when a hazard event happened, 0 otherwise). Insurance is a dummy variable (1 for part B and 0 for part A). Financial loss is a dummy variable (5 if no insurance was purchased AND a hazard event happened, 0 otherwise). Number of past events is the total number of hazard events that had happened before the current emotion measurement. Round number is the actual round number from 1 to 30. Age1 is a dummy variable (1 if falls in the smallest age group). Age2 is a dummy variable (1 if falls in the second smallest age group). Asian is a dummy variable. Standard errors are in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.