Do No Harm?
The Welfare Consequences of Behavioral Interventions

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[ Draft ]

ABSTRACT: We evaluate the consumer welfare implications of a wide range of behavioural interventions that are typically used in the promotion of insurance products. Based on laboratory experiments where subjects make risky choices, we estimate subject’s individual risk preferences, and then randomly assign subjects to our behavioural interventions before they make insurance purchase decisions. We estimate the expected consumer surplus gained or foregone from observed take-up decisions and compare these across the intervention arms. We also elicit measures of subjects’ cognitive functioning, and bias and confidence in their understanding of general financial questions and specific insurance purchase tasks and consider to which extent these explain heterogeneity in gains and losses in consumer surplus. We show that while our treatments typically increase take-up on average, they reduce consumer welfare.

JEL classification: D81, O2, D78, D90, D60
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I Introduction

The rapid expansion of access to finance, low levels of financial literacy, and increasing complexity of financial products raises serious concerns about the extent to which the demand for these products increases consumer surplus, or welfare, for consumers. Many studies suggest that households under-save, engage in excessive and expensive borrowing, and under-insure. Despite this, efforts to increase adoption of financial products appear to be more abundant than those that encourage the improvement of the quality of financial decisions. Welfare evaluations of interventions that promote financial products, rather than focusing on demand for the product or survey measures of wellbeing, ultimately require an understanding of consumers’ preferences and subjective beliefs. However, preferences and beliefs are latent, and cannot be directly observed from surveys or behavior. Since consumer preferences, such as attitudes to risk and time are heterogeneous, and there exist optimal financial decisions that maximize welfare in terms of these preferences, interventions that promote financial products should do justice to this heterogeneity and be evaluated in terms of effects on the sign and size of consumer welfare.

We evaluate the consumer welfare implications of a range of behavioural interventions that are widely used in the promotion of insurance products. These interventions are aimed at increasing subjects’ understanding of the insurance decision context, or specifically designed to allow us to investigate the impact of peer endorsement and nudging. Based on laboratory experiments where subjects make risky choices, we estimate subject’s individual risk preferences, and then randomly assign subjects to our behavioural interventions before they make insurance purchase decisions in which loss contingencies are objective. We then estimate the expected consumer surplus gained or foregone from observed take-up decisions and compare these across the intervention arms. We also elicit measures of subjects’ cognitive functioning, and bias and confidence in their understanding of general financial questions and specific insurance purchase tasks, and

1 For example, Van Rooij et al. (2012), Behrman et al. (2012), Lusardi and Mitchell (2014) and Choi et al. (2014).
2 For example, Stango and Zinman (2009), Gathergood (2012), Agarwal and Mazumder (2013), Gerardi et al. (2013) and Karlan et al. (2016).
3 For example, Gaurav et al. (2011), Drexler et al. (2014) and Sayinzoga et al. (2015).
4 For example, Banerjee et al. (2013), Cole et al. (2013), Bursztyn et al. (2014), Cole et al. (2014), Norton et al. (2014), Takahashi et al. (2016) and Casaburi and Willis (2018).
consider to which extent these explain heterogeneity in gains and losses in consumer surplus.

We conduct our experiments with 427 student subjects at Georgia State University. Subjects participate in an experiment where they make 54 choices to purchase index insurance or not, where one choice will be chosen for payment. The idea of an index contract is that the insured gets coverage for an idiosyncratic personal risk of loss that they face that is positively correlated with an observable and verifiable index. Payment of a claim depends solely on outcomes with respect to the index, not on personal losses. Index insurance can overcome asymmetric information problems and prevent costly state verification by claims adjusters, but the disadvantage is that the index is imperfectly correlated with personal losses. This leads to both downside basis risk, where the insured experiences a personal loss but the index is not triggered, and upside basis risk, where the insured does not experience a personal loss but the index is triggered and a claim paid. One classical motive for purchasing indemnity insurance is to reduce variability of risky outcomes, making it welfare enhancing for any risk averse subject with Expected Utility Theory (EUT) preferences. Index insurance could rationally reduce demand for insurance by comparison, and even make the index contract unattractive for individuals with a range of characterisations of risk preferences.

The conditional nature of the expected consumer welfare of index insurance makes the decision to purchase or not purchase this insurance an especially interesting financial decision to study given our objectives. For each individual, after characterisation of their risk preferences, we calculate their expected consumer welfare, and infer substantial variation in consumer welfare gained or lost after observing their actual purchase decisions. While financial decisions with respect to credit, savings, or pensions would have also been suitable to create sufficient variation in consumer welfare losses and gains, they would have involved payments over time, and measurement of beliefs about future outcomes, that

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1Index insurance is best known in the form of ‘area-yield’ index insurance, which defines the loss to the insured by the average yield in some geographic area. Area-yield insurance was first written in Sweden in 1961, in Quebec in 1977, in the United States on a small scale in 1993, and then significantly in 1994 (Skees et al., 1997). Halerow (1949) originally proposed the idea, which was resurrected and developed by Miranda (1991) and Mahul (1999). Recently, various forms of index insurance that use area-yield, rainfall, and more complex weather indices are being implemented in developing countries.

6Clarke (2016)
would have been more difficult to measure in the lab. Since this is a first attempt at
developing the methods to evaluate the consumer welfare of a wide range of behavioural
interventions to improve the use of index insurance, the control over the decision context in
the lab was deemed optimal.

Before subjects make their 54 insurance choices, they are randomly assigned to one of
our control or treatment interventions. In our control intervention subjects receive basic
information about the insurance product on offer. In our treatment interventions subjects
either:

• receive elaborate instructions;
• participate in two hypothetical insurance decisions where the personal and index
event are realised, and hypothetical payoffs for each decision are revealed;
• participate in an experiment that tests their understanding of the insurance
experiment;
• receive instructions that simulate a sales pitch by an insurance broker, or
• receive information about the choices that their peers made for each of the 54
insurance decisions.

Before subjects are randomly assigned to the treatment or control conditions, they
participate in a risk elicitation task that allows us to characterise them as behaving according
to EUT or Rank-Dependent Utility (RDU) risk preferences. This characterisation allows us
to predict the consumer welfare from the optimal choice for each of the 54 insurance
decisions, compare the subjects’ actual decision to the optimal decision, and calculate their
welfare gain or loss.

To better understand the manner in which subjects’ understanding of the decision
task effects their insurance decisions as well as consumer welfare, subjects engage in several
additional tasks. First, they participate in a cognitive functioning task based on Set I of the
Raven Advanced Progressive Matrices (RAPM), a popular test of fluid intelligence. Second,
they participate in a task that assesses subjects’ beliefs about their own answers to a set of
standard financial literacy questions to measure general financial literacy. Third, they
participated in a similar task to assess their beliefs about index insurance, to measure domain-specific literacy.

We find that, in the baseline, after receiving only basic information about the insurance decisions, subjects make decisions that only realize, on average, 50% of the potential welfare improvement that can be achieved. Roughly half the subjects could double their welfare gain from making decisions about insurance that are more in line with their risk preferences. We also find that only one of the interventions creates substantial improvements in welfare, while all of the interventions increase take-up. Two of the four informational interventions lead to significantly lower welfare on average. The peers intervention appears to be the only intervention to incentivise welfare-enhancing take-up. The nudging intervention has a strong impact on take-up, while exhibiting significant reductions in welfare.

Our core results are chilling. There is no evidence, under the best “wind tunnel” conditions, that behavioural interventions that meet their stated goal of increasing take-up, or for informational interventions increase insurance literacy, automatically improve individual welfare. The policy implications are twofold. First, before taking these policy interventions to the field, they should be modified to reliably generate average welfare gains. Second, we must search the distributions of welfare gains or losses to try to identify observable characteristics that allow the design of conditional behavioural interventions that would be expected to improve average welfare.7

Our research naturally connects to a literature that addresses the assessment of the quality of decision making in general8 and financial decision making specifically.9 Unlike existing measures of the quality of decision making that rely on revealed preference or framing, our measure is rooted in the principles of behavioural welfare economics. Those principles demand that we focus on interventions that are likely to improve expected consumer welfare, while respecting the evidence that individuals are heterogenous in terms of the risk preferences that best classify their behaviour.

7For example, Carter et al. (2019) and Banerjee et al. (2019).
8For example, Bernheim and Rangel (2009), Manzini and Mariotti (2014), Choi et al. (2014), Benkert and Netzer (2018) and Harrison (2019).
9For example, Ambuehl et al. (2014), Harrison and Ng (2016), Harrison and Ng (2018), Ambuehl et al. (2017, 2018), Harrison and Ross (2018) and Benkert and Netzer (2018).
Behavioural welfare economics also requires a refinement of the notion of revealed preference, such that it is possible to classify people’s choices as welfare reducing, either because of their misunderstanding of the choice context, or because of imperfect sophistication about their own preferences. In effect, we must have a general metric for the normative evaluation of choices other than those choices themselves. Many evaluations of interventions, however, focus on observable outcomes, such as take-up in the case of insurance\(^{10}\) despite recognition\(^{11}\) that these products may be of low quality or not rational to purchase for subjects whose decision making behaviour can be characterised by a plausible set of risk preferences. The ethical point is that we should not be taking products into the field if we *ex ante* haven’t considered if, in expectation, they will “do no harm.” We use a general method to assess the expected welfare of a product for an individual by first eliciting that individuals choices in a separate risky setting, estimating their individual utility function, and then measuring consumer welfare for each option in a financial decision. Welfare losses and gains can then be derived from a comparison of actual choices to optimal choices.

Our approach also links to a literature that evaluates the impact of behavioural interventions on financial decision making.\(^{12}\) Typically this literature focuses on take-up or subjective well-being to evaluate these interventions. We contribute to this literature by investigating the impact of a range of behavioural interventions on consumer welfare. We thereby avoid prevent the use of paternalistic views of the importance of specific financial behaviour, such as high saving or conservative risk taking. If we tinker with people’s choice architecture, the potential for harm is inherent in the belief in the empirical validity of the behavioral bias that is used to design the choice architecture nudge in the first place: that people tend to go where they are nudged, and not think more about it. This can be helpful when such behavioural interventions are clearly directed at unambiguously welfare reducing behaviour, such as violence (Green et al., 2019), but can be misused through peer pressure, authority, or perceived expert advise when they induce people to make decisions counter to their set of preferences and beliefs. We evaluate both take-up and consumer welfare of a range of interventions aimed at impacting financial decision making, of which some are

\(^{10}\)For example, Cole et al. (2013), Banerjee et al. (2014) and Casaburi and Willis (2018)

\(^{11}\)Clarke (2016)

\(^{12}\)For example, Bertrand et al. (2010), Takahashi et al. (2016), Berg and Zia (2017) and Casaburi and Willis (2018).
targeted at increasing the understanding of the decision context, while others are specifically designed to nudge people towards taking up the product.

2 Conceptual Framework

The decision to purchase insurance is just a decision to live with one risky lottery or a different risky lottery. Consider the canonical case of a full indemnity contract, where the individual does not select the level of indemnification. Further, assume zero deductibles and zero coinsurance. If the insurance is not purchased the individual faces some known risk of a loss from an endowment. To take an illustrative choice from the instructions, the endowment is $75, the loss is $45, and the personal loss probability is $0.1$: hence there is a 10% chance of ending up with $30 = $75 − $45 and a 90% chance of ending up with $75. If we assume that the individual is an EUT decision maker for now, and know her utility function, \( U^{EUT} \), we can calculate the expected utility of this outcome, \( EUT^0 \) and then find the certain amount of money that gives the same utility as that \( EU^0 \). This is just the Certainty Equivalent income, \( CE^0 \), defined by \( U^{EUT}(CE^0) = EUT^0 \). Of course, the Risk Premium of this no-purchase lottery is just the difference between \( CE^0 \) and the Expected Value of the lottery. If the decision-maker is risk averse, she will have a positive Risk Premium for avoiding the risk associated with not purchasing insurance.

Now consider the same steps when the index insurance contract is purchased. The EU in this case is just a bit more complicated. Assume a premium of $5.75. Assume further that there is an 80% probability that the index realization will be the same as the personal loss realization, so there is a 20% chance of basis risk. The lottery has four possible outcomes:

- There is a personal loss and the index matches, so the payoff is $75 − $5.75 − $39 + $39 = $69.25. With full indemnity, and a match between the personal and index loss, the individual is just worse off by the amount of the premium. The loss of -$39 is completely offset by the insurance payment of +$39.

- There is a personal loss and the index differs, so the payoff is $75 − $5.75 − $39 = $24.25. Without a match between the personal and index loss,

\[ \text{See Appendix B.1} \]
the individual is worse off by the amount of the premium as well as the loss amount.

- There is no personal loss and the index matches, so the payoff is $75 - $5.75 = $69.25. With a match between the personal and index loss, the individual is worse off by the amount of the premium, but incurs no loss and receives no insurance payment.

- There is no personal loss and the index differs, so the payoff is $75 - $5.75 + $39 = $114.25. With no match between the personal and index loss, the individual is worse off by the amount of the premium, does not incur a personal loss, but does receive an insurance payment of +$39.

It is easy to see that each of these outcomes occurs with a compound probability determined by the loss probability and the matching probability:

- The chance of a personal loss and the index matching is 0.1 \times (0.8) = 0.08.
- The chance of a personal loss and the index differing is 0.1 \times (1 - 0.8) = 0.02.
- The chance of no personal loss and the index matching is (1 - 0.1) \times 0.8 = 0.72.
- The chance of no personal loss and the index differing is (1 - 0.1) \times (1 - 0.8) = 0.18.

Hence the decision to purchase the insurance is a lottery defined by a 0.08 chance of $69.25, a 0.02 chance of $24.25, a 0.72 chance of $69.25 and a 0.02 chance of $114.25. Using the same utility function as for the evaluation of the decision not to purchase, we can calculate the EUT^1 of purchasing the insurance, and of course the CE^1 of that EUT^1. Again, a Risk Premium can be calculated by comparing CE^1 and the Expected Value of this low-outcome lottery. And if the decision-maker is risk averse she will have a positive Risk Premium for avoiding the risk associated with purchasing insurance.

It is immediate that the individual should purchase the insurance contract in this instance if CE^1 > CE^0, otherwise it is rational not to purchase when CE^1 < CE^0. Another way of saying the same thing is that the individual should purchase the insurance if the Risk Premium associated with not purchasing exceeds the Risk Premium association with purchasing. Yet another way of saying the same thing is to define the Expected
Consumer Surplus (CS) of purchasing the insurance as the difference between the CE of purchasing and the CE of not purchasing: \( CS = CE^1 - CE^0 \). Hence, if we actually observe this individual purchasing \textit{when they should purchase the insurance contract}, we can chalk up a positive CS for the individual from that decision. And, critically, if we actually observe this individual not purchasing \textit{when they should purchase the insurance contract}, we can flag a negative CS for the individual from that decision. Comparable possibilities of positive or negative CS arise if the prediction is that the individual should not purchase the insurance.

The same steps apply if the decision-maker actually has RDU risk preferences. In this case we evaluate the \( RDU^1 \) and \( RDU^0 \) of the lottery using the implied \( U^{RDU} \) utility function and the known probability weighting function. We can then evaluate the corresponding \( CE^1 \) and \( CE^0 \) using this \( U^{RDU} \) function. It is apparent, and illustrated for a simple indemnity contract by Harrison and Ng (2016, Table 1, p.105), that the RDU preferences could be quite different from the EUT preferences, even for the same individual. By “the same individual” we mean the same person that made the observed choices over risky lotteries that were used to infer risk preferences. In one case we find the maximum-likelihood estimate of the utility function assuming EUT, and the other case we find the maximum-likelihood estimate of the utility function and probability weighting function assuming RDU. We stress that this is just two models of risk preferences estimated from the same data from the same person.

As we vary the actuarial parameters facing the individual, the expected CS from making the correct decision varies. \textit{Ceteris paribus}, a lower premium means a higher CS if purchasing the product was the correct thing to do. For this reason, that some product offering are better than others, we often consider the percentage of the total CS that the individual realizes over all decision compared to the total CS that the same individual would have realized over all decisions if all decisions were correct. This is called Efficiency by experimental economists, and effectively normalizes across subjects for the different product offerings, since each individual faces the same set of 54 product offerings.

This simple \textit{Insurance 101} logic has important implications.\(^{14}\) First, even if we assume an individual is an EUT decision-maker, we need to know how risk averse she is to say if her

\(^{14}\text{Ericson and Sydnor (2017) spell out the same logic, but draw quite different behavioral implications.}\)
decision to “take-up” the product is the right one or not. The same point applies generally to the case in which she is an RDU decision maker. A pox on unconditional nudges to take up the insurance product that ignore risk preferences! Second, we need to know which type of risk preferences best characterizes her. It is easy to find examples where we get the sign of the realized CS wrong unless we know the type of decision-maker. Third, we see CS numbers in dollars, reflecting the equivalent variation in income from old-fashioned welfare economics. We can therefore distinguish what are “small” welfare effects from what are “large” welfare effects. Fourth, we see the CS from purchasing or not from purchasing. This might seem trivial, until one realizes that many observational data sets, not all, suffer from the selection bias of only seeing those that purchased insurance. Finally, we see how irrelevant observed take-up of insurance can be when assessing welfare effects.

We resist the temptation to add up the realized CS, or only report average CS over the distribution, for several reasons. First, economists always think “social welfare” whenever they hear the word welfare, and we want to stress that we have calculated individual welfare from a choice by a specific person. Second, we can keep attention firmly on the distribution of realized CS, avoiding the dangers of just focusing on the average (even if we are, inter alia, interested in the average). We discuss later why this focus on the distribution may be important for the normative design of policy.

We make the simplest possible assumption to undertake behavioral welfare analysis in the absence of assuming naïve revealed preference: that the risk task identifies the risk preferences for the individual, and that one can then use those estimated risk preferences to evaluate expected welfare gains or losses of that individual’s insurance choices. An alternative assumption, of course, is that risk preferences for the same individual differ between the risk task and the insurance task, for whatever “framing” reason one might think of. This assumption might be descriptively correct, and indeed would be implied conceptually if one found, as is the case, that risk preferences in the risk task do not explain every insurance choice. But note how our assumption, or something equivalent to it, is logically required if we are ever to declare some insurance purchase a mistake – we need to have some separate metric for declaring what is and is not a mistake than the choice itself.
3 Experiments

Our main financial decision task is an experiment where subjects make 54 choices in which they receive an endowment that is at risk of a loss from a personal risk event. In all 54 choices subjects can choose to purchase an index insurance or not, and at the end of the experiment one choice will be randomly selected for payment. In each choice a random personal event determines losses, and a correlated random index event determines insurance claim payments, if the subject chooses to purchase insurance.\textsuperscript{15} We consider an endowment of $60 for all choices. Loss amounts are either $39 or $30. Loss probabilities are either 0.1 or 0.2. Premium loadings on actuarially-fair premia are -50%, 0% or +8%. Finally, the correlation of the index event and the idiosyncratic loss event is 100%, 80%, 60%, 40%, 20% or 0%. Appendix C.1 displays the choice parameters for all 54 choices presented to each subject.

Before the subjects make these 54 insurance choices they are randomly assigned to one of our control or treatment interventions. In our control intervention (Baseline) subjects receive basic instructions about the insurance.\textsuperscript{16} On the computer screens, the probability of the index experiencing a loss, and the probability of the personal outcome matching that of the index, are presented separately to the subjects. The monetary outcomes are also presented based on the outcomes of the index event and personal event matching as separate events.\textsuperscript{17}

In our first treatment (Full) subjects receive the exact same instructions as in the control intervention, but a section is added where we work through some examples of choices, realisations of losses, and payments.\textsuperscript{18} The displays are exactly the same as the displays in the Baseline treatment. Assuming that subjects are sophisticated the proposition we are testing is that providing subjects with more details about the product increases their understanding and thereby allows them to make choices that are closer to their preferences. This intervention was designed after insurance interventions in Cole et al. (2013, 2014) and Takahashi et al. (2016).

\textsuperscript{15}Appendix B.1 provides the instruction sets to the index insurance experiment.
\textsuperscript{16}See Appendix B.1.1
\textsuperscript{17}Appendix B.1.1 displays a typical screenshot from this treatment, using an example from the instructions.
\textsuperscript{18}See Appendix B.1.2
In our second treatment (AE) the display on each computer screen for each of the 54 decisions is literally identical to the display for the Baseline treatment, with the addition of “pie displays” showing the actuarially equivalent lotteries implied. The instructions are the same as for the Baseline treatment but there is extra information introducing and explaining the display. The logic of the contract and underlying risk is still explained in the same manner in the instructions for the Baseline and AE treatments. The proposition in the AE treatment is that by applying a reduction of compound lotteries (ROCL) for the subject, violations of ROCL in the insurance decision will be avoided, leading the subject to make a more accurate comparison by the subject of the choice to purchase or not purchase insurance (Harrison et al., 2016).

In our third treatment (Practice), before subjects start with the 54 insurance choices they receive the same instructions and displays as in the Baseline treatment, but they get to experience two hypothetical practice rounds where they make decisions to purchase insurance or not, and the personal loss event and index event are realised. It is then announced to subjects what their earnings would have been if these rounds would have not been hypothetical. This treatment was designed after Norton et al. (2014) and Cole et al. (2014) to test if hypothetical experience of decisions and realizations increases understanding and thereby allows subjects to make choices that are closer to their preferences.

In our fourth treatment (Understand), subjects participate in an incentivized experiment that tests their bias and confidence in their own answers to a set of ten insurance choices randomly selected from the insurance experiment, described in detail below. This treatment tests the proposition that incentivizing subjects to better understand the insurance decision context aids their understanding and allows them to make decisions that are closer to their risk preferences.

In our fifth treatment (Sales Pitch) subjects receive the exact same displays and instructions as in the Baseline treatment, except that there is a preface and epilogue that explain why insurance is an important way to protect oneself against monetary losses, reduce stress, and have peace of mind. On the displays for each of the 54 decisions one sentence is added: “Recall that insurance is important to protect you against losses and reduce

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19 See the second figure in Appendix B.1.3.
20 See Appendix B.1.5.
your worries.” This treatment was designed after Gaurav et al. (2011) and Cole et al. (2013), to test if endorsement by an agent, through stressing the negative consequences of risk, “nudges” people to buy insurance.

In our sixth treatment (Peers), subjects receive the same instructions and displays as in the Baseline treatment, except that for each of the 54 choices they receive information about the average choices that their peers made. This information is presented to them in one sentence that is added on their display which states: “We already played several of these rounds of experiments with your peers in the last few weeks, and on average X% of your peers chose to purchase insurance when presented with this question.” The proposition is that the decisions of peers functions as an endorsement, as distinct from the peer informational channel, in the adoption decision Banerjee et al. (2013) and Bursztyn et al. (2014).

Before subjects are randomly assigned to the treatment or control conditions, they participate in a risk elicitation task that allows us to characterise the subjects as behaving according to EUT or RDU. This characterisation allows us to predict the consumer welfare from the optimal choice for each of the 54 insurance decisions, compare the subjects’ actual decision to the optimal decision, and calculate the welfare gain or loss. Each subject was asked to make choices for 100 pairs of lotteries. The battery is based on designs from Loomes and Sugden (1998) to test the Independence Axiom, designs from Harrison and Swarthout (2021) to evaluate EUT and RDU models of risk preferences, designs from Harrison et al. (2015) to test the ROCL axiom, and a series of lotteries that are actuarially-equivalent versions of some of our index insurance choices. Appendix B explains the first two design components in detail. Each subject faced a randomized sequence of choices from this battery of 100. The analysis of risk attitudes given these choices follows Harrison and Rutström (2008).

To better understand the manner in which subjects’ understanding of the decision task effects their insurance decisions as well as consumer welfare, subjects engage in several additional tasks.

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21 See Appendix B.2
22 The typical interface used is shown in the first figure in Appendix B.2, for instances of two simple lotteries. For compound lotteries we used a “Double or Nothing” option, illustrated in the second figure in Appendix B.2.
First, they participate in a cognitive functioning task based on Set I of the RAPM, a popular test of fluid intelligence due to Raven et al. (1998).

Second, subjects participate in a Cognitive Reflection Test (CRT), due to Frederick (2005), which measures a person's unincentivised tendency to override an incorrect “gut” response and engage in further reflection to find a correct answer. A typical example of a CRT question is: “A bat and a ball cost $1.10. The bat costs $1.00 more than the ball. How much does the ball cost?” The intuitive answer or “gut” response that people typically give to this question is 10 cents, while the correct answer is 5 cents.

Third, they participate in two tasks that assess subjective beliefs about their own answers to a set of standard financial literacy questions (Financial Literacy Beliefs), in the spirit of Lusardi and Mitchell (2007)(2008)(2014), as well as a set of ten insurance decisions randomly selected from the 54 insurance choices (Index Insurance Beliefs). An example of a Financial Literacy Belief question is: “Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?” An example of an Index Insurance Belief question is: “What is your outcome if you decided not to purchase insurance, experienced a bad personal event, and the index outcome differs?” We elicit these beliefs following the method by Di Girolamo et al. (2015) and Harrison et al. (2017), who use an incentivized Quadratic Scoring Rule for payment: for each question subjects’ responses are elicited over a continuous range of possible answers presented in terms of ten intervals or ‘bins,’ where one bin represents the correct answer. A computer interface is used to present the belief elicitation tasks to subjects and record their choices, allowing them to allocate tokens in accordance with their subjective beliefs. For each set of questions (financial literacy questions or insurance decision questions) one question is selected for payment. From the belief elicitation task we produce a Literacy Score that takes into account both the bias and confidence of beliefs. It is hypothesised that, in the Baseline treatment, those subjects with higher scores on the RAPM, the CRT, the Financial Literacy Beliefs questions, and the Index Insurance Beliefs questions will have lower welfare losses than those with lower scores on these measures.

See Appendix B.3 and Appendix B.4
Finally, and only for those subjects participating in the Peers treatment, we also elicit their beliefs about their performance in the insurance task relative to their peers’ performance in the insurance task (Peer Beliefs). We ask the question “In the past several weeks we organized multiple sessions where your peers participated in the same insurance task. The minimum earnings in this task are $0 and the maximum earnings are $97. We would now like to ask you how you think you performed relative to your peers. How much more or less do you expect to earn in the insurance task, in comparison to the average of the earnings of your peers?” No specific hypotheses are developed for the predicted welfare gains and losses based on the Peer Beliefs task, because these Peer Beliefs will depend on the subjects’ accuracy and confidence in their own understanding of the tasks, as well as their beliefs about the performance of their peers.

The objective of the treatments is to investigate the extent to which they impact the demand for the insurance products and consumer welfare for individual subjects. The treatments II, AE, Practice, and Understand are all informational treatments. The objective of these treatments is to vary the nature of the information provided to the subjects, either through more elaborate instructions, through additional information on each of the 54 displays, or through focused practice before starting with the 54 decisions. It is hypothesised that these information treatments will create a better understanding among the subjects about the decision context, and thereby better align their insurance purchase decisions with their risk preferences, and hence increase consumer welfare. It is therefore hypothesized that these treatments will increase welfare for all subjects, but that they will be especially effective in terms of decreasing welfare losses or increasing welfare gains for those who score low on the RAPM, and the Literacy Score of the Financial Literacy Beliefs and Index Insurance Beliefs.

The Sales Pitch instructions are specifically designed to nudge people towards purchasing insurance by addressing their worries about risks. The treatment is designed from examples of marketing tools from insurance companies and insurance brokers. It is hypothesised that this treatment will increase the take up of insurance, but not necessarily increase consumer welfare. It is also hypothesized that those subjects with lower scores on the RAPM, and the scores of the Financial Literacy Beliefs and Index Insurance Beliefs are more susceptible to this treatment, increasing demand for insurance without regard to risk preferences, and hence reducing their own welfare.
The Peers treatment is designed to mimic the fact that many individuals, when they make purchasing decisions, will ask family and friends for advice. It is hypothesised that treatment effects in the Peers treatment will be heterogenous, based on people’s beliefs about their own understanding of the insurance decision task (as elicited in the Index Insurance Beliefs task), as well as their beliefs about their own performance relative to their peers’ performance (as elicited in the Peer Beliefs task). More specifically, it is hypothesised that subjects with lower confidence in their answers to the Index Insurance Beliefs task will have a larger treatment effect, whether it be positive or negative, in the Peers treatment compared to the Baseline treatment. Similarly, it is hypothesised that subjects who believe that they performed worse than their peers did on average will also have a larger treatment effect in the Peers treatment compared to the Baseline treatment.

4 Descriptives and Risk Preferences

Table 1 shows the means of key characteristics of the subjects in our sample by treatment status. The statistic in brackets gives the \( t \)-statistic for a regression of the specific treatment compared to the baseline on each covariate. Overall, our treatments appear balanced.

Figure 1 presents a histogram of the fraction of subjects that were classified as either EUT, RDU Power, RDU Inverse-S or RDU Prelec based on a hypothesis test that the probability weights are not significantly different from the objective probabilities used in the experiment, as well as a log likelihood test to distinguish between the RDU models. Approximately 50% of our subjects are classified as EUT and 40% as RDU Prelec, while only 5% and 1% behave consistently with RDU Inverse-S and RDU Power, respectively.
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<th>Baseline (1)</th>
<th>Full (2)</th>
<th>Sales Pitch (3)</th>
<th>AE (4)</th>
<th>Understand (5)</th>
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<td><strong>Age</strong></td>
<td>19.68</td>
<td>20.90</td>
<td>20.39</td>
<td>19.10</td>
<td>19.85</td>
<td>19.34</td>
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<tr>
<td></td>
<td>(1.85*)</td>
<td>(1.40)</td>
<td>(-1.43)</td>
<td>(0.32)</td>
<td>(-0.64)</td>
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<td><strong>Female</strong></td>
<td>0.62</td>
<td>0.61</td>
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<td>(0.40)</td>
<td>(1.56)</td>
<td>(0.13)</td>
<td>(0.58)</td>
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<td><strong>African American</strong></td>
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<td>(1.18)</td>
<td>(-0.81)</td>
<td>(0.11)</td>
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<td><strong>BA expected</strong></td>
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<td>0.46</td>
<td>0.39</td>
<td>0.35</td>
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<td></td>
<td>(0.72)</td>
<td>(0.60)</td>
<td>(-0.32)</td>
<td>(-0.66)</td>
<td>(0.37)</td>
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<tr>
<td><strong>High GPA</strong></td>
<td>0.31</td>
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<td>0.36</td>
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<td>0.50</td>
<td>0.29</td>
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</tr>
<tr>
<td></td>
<td>(0.46)</td>
<td>(0.68)</td>
<td>(0.53)</td>
<td>(1.78***)</td>
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<tr>
<td><strong>High Raven score</strong></td>
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<td>0.68</td>
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<tr>
<td></td>
<td>(0.62)</td>
<td>(-0.82)</td>
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<td><strong>High CRT</strong></td>
<td>0.64</td>
<td>0.55</td>
<td>0.70</td>
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<td>0.59</td>
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<td>(-1.00)</td>
<td>(0.86)</td>
<td>(-0.29)</td>
<td>(-0.60)</td>
<td>(-0.13)</td>
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<td>0.42</td>
<td>0.60</td>
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<td>0.50</td>
<td>0.48</td>
<td>0.58</td>
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<tr>
<td></td>
<td>(1.47)</td>
<td>(1.47)</td>
<td>(0.95)</td>
<td>(0.51)</td>
<td>(1.27)</td>
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<td><strong>EUT</strong></td>
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<td>0.52</td>
<td>0.71</td>
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<td>(1.83)</td>
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<td>0.09</td>
<td>0.06</td>
<td>0.00</td>
<td>0.00</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(0.99)</td>
<td>(0.22)</td>
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<td>(-1.40)</td>
<td>(-0.05)</td>
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<td><strong>RDU Power</strong></td>
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<td>0.00</td>
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<td>0.03</td>
<td>0.03</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td>(-0.77)</td>
<td>(-1.15)</td>
<td>(0.38)</td>
<td>(0.30)</td>
<td>(-1.09)</td>
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<tr>
<td><strong>RDU Prelec</strong></td>
<td>0.39</td>
<td>0.48</td>
<td>0.42</td>
<td>0.26</td>
<td>0.32</td>
<td>0.43</td>
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<tr>
<td></td>
<td>(0.92)</td>
<td>(0.36)</td>
<td>(-1.42)</td>
<td>(-0.79)</td>
<td>(0.42)</td>
<td>(1.47)</td>
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<tr>
<td><strong>ROCL violations (%)</strong></td>
<td>0.28</td>
<td>0.29</td>
<td>0.29</td>
<td>0.27</td>
<td>0.33</td>
<td>0.26</td>
<td>0.28</td>
</tr>
<tr>
<td></td>
<td>(0.58)</td>
<td>(0.63)</td>
<td>(-0.29)</td>
<td>(2.23**)</td>
<td>(-0.66)</td>
<td>(0.27)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Significance levels $p < 0.10^*$, $p < 0.05^{**}$, $p < 0.01^{***}$. The first column presents the means in the baseline sample, while the second through to the seventh column present the means in the treatment samples. Column (2) through Column (7) also present, below the mean and in brackets, the $t$-statistic for regressions of the specific treatment compared to the baseline on each covariate. "High GPA" represents a GPA score of 5 or 6. "High Raven score" is a medium split of the score based on 12 questions from Set I of the Raven Advanced Progressive Matrices test. "High CRT" is a median split of a score of correct answers out of a maximum score of 6 on the "Cognitive Reflection Test." "High fin. literacy" is a median split of the financial literacy score which ranges from 0 to 10 on hypothetical financial literacy questions. "EUT,” “RDU Inverse-S,” “RDU Power,” and “RDU Prelec”; are binary indicators for the risk preferences model estimated for the subject. "ROCL violations" represents the percentage of choices where subjects violated ROCL.
We classify a subject as being best characterized as having EUT or RDU risk preferences, in order to make it clear that it is not just the level of risk aversion that matters, but the type of risk preference that matters as well. This characterization is operationalized by a subject needing to have RDU estimates that indicate statistically significant evidence of probability weighting. Specifically, we undertake a Wald test of the hypothesis that the probability weighting parameters (γ for the Power and Inverse-S specifications, and η and φ for the Prelec specification) take on values that imply no probability weighting (γ = 1 and η = φ = 1). If we reject this null hypothesis of EUT risk preferences at the 5% significance level, we characterize an individual as having RDU risk preferences.

Figure 1: Type of Risk Preference

Note: Hypothesis test that \( \omega(p) = p \). Significance level of 5% or less to reject EUT.

Unless we say otherwise, however, we always use the estimated utility function from the preferred RDU estimates for every subject when evaluating the CS for each subject. Why do this, if we have characterized an individual as EUT? The statistical reason, stressed by Monroe (2021), is that those subjects that are characterized as EUT by the test for “no probability weighting” still have standard errors around the probability weighting parameters, and potentially large ones.\(^\text{24}\) And, perhaps surprisingly, these standard errors

\(^{24}\text{Indeed, larger standard errors makes it easier to fail to reject the null hypothesis of EUT risk preferences.}\)
Figure 2: Violations of Reduction of Compound Lotteries Axiom per Subject

![Bar chart showing violations of ROCL per subject.]

Note: “Violations of ROCL” measures the number of times, out of 10, that each subject changes their binary preferences in choices over lottery pairs in which the compound lottery is replaced with the actuarially-equivalent simple lottery.

... (rest of the text follows)
classified as EUT, she would be moderately risk averse with a modestly concave utility function \( r = 0.58 \). However, the preferred model is selected based on the hypothesis test that \( \omega(p) = p \), and for subject #2 the preferred model is RDU with the Prelec probability weighting function. Classifying subject #2 as RDU (Prelec) means the utility function is actually less concave \( r = 0.44 \).

Panel B and C of Figure 3 show the importance of this classification for the welfare calculations for subject #2. Each chart shows the CS calculated for each insurance choice made. Light blue bars indicate that the subject had chosen to purchase insurance and red bars indicate that the subject had chosen not to purchase insurance. Panel B shows the CS distribution if we had assumed subject #2 had EUT risk preferences, and Panel C shows the CS distribution assuming subject #2 had RDU risk preferences with the Prelec probability weighting function. Different models of risk preference type can lead to different insurance decisions being recommended. For choices 28 and 29 under EUT, the subject chose to purchase insurance, but that resulted in a negative CS. Under RDU, however, the same choices resulted in a positive welfare gain. There are several such examples. Using a different model of risk preference type can also impact the size of the expected welfare gain from an insurance choice, and not just the sign. Choices 3 and 4 becomes less harmful when subject #2 is correctly classified as RDU compared to EUT.
Figure 3: Estimated Risk Parameters and Consumer Surplus for Subject #2

A. Subject#2 is classified RDU with EUT $p$-value = 0.038 (<0.05)

B. Consumer Surplus of Choices of Subject #2 under EUT

C. Consumer Surplus of Choices of Subject #2 under RDU (Prelec)
5 Results

5.1 Main Results

Figure 4 presents the distribution of Efficiency for each of 157 subjects that participated in the Baseline condition. The range of Efficiency is between 0% and 100%, reflecting the percentage of Expected Consumer Surplus the subject extracted from their observed choices divided by the maximum Expected Consumer Surplus they could have extracted if they had made decisions to purchase or not purchase insurance consistent with their risk preferences. The fact that we do not have a significant spike at, or close to, 100% tells us that there is room for welfare improvement in the decisions that subjects make. The average is 50%, and the median is 47%, so roughly half the subjects could double the welfare gain from making decisions about index insurance that are more in line with their risk preferences.

Figure 4: Baseline Distribution of Efficiency of Choice

Note: Efficiency is between 0% and 100%. One observation per individual (N = 157). Efficiency reflects the percentage of Expected Consumer Surplus the subject extracted from their observed 54 insurance choices divided by the maximum Expected Consumer Surplus from their 54 insurance choices that they could have extracted if they had made these insurance decisions consistent with their risk preferences.
This distribution sets the stage for examining the effect of the treatment arms. Figure 5 shows the change in the distribution of efficiency compared to the distribution in the Baseline condition shown above. Hence these changes range between -100% and +100%, with 0% being no change compared to Baseline. There are three insights from these distributions. First, none of them exhibit the negative skew that would point to a treatment that significantly moves Efficiency to 100%. Second, all of them include significant fractions of subjects that do worse with the treatment compared to the Baseline, as shown by the fraction of each distribution to the left of 50%. Third, three out of six treatments exhibit a tendency to lower welfare on average in comparison to Baseline (Sales Pitch, Understand, and Practice), and only one appears to exhibit a tendency to raise welfare on average in comparison to Benchmark (Peers). Even though the Peers treatment appears to reduce efficiency for those who achieve slightly more than 50% of potential welfare in the Baseline, the treatment leads to a substantial reduction in the left tail of the distribution and an increase in the right tail. Additional observations are that the Understand treatment had the bulk of its impact, to reduce welfare, in the top tail of the efficiency distribution. In other words, those that were more relatively efficient to begin with suffered the most from this intervention.

The statistical model of Efficiency, at the level of the individual, is a beta regression. The statistical model of the purchase decision is a panel probit regression, recognizing that each subject contributed 54 purchase decisions. The unobserved heterogeneity of each subject is accommodated in the panel regression with a random effects specification, allowing us to examine the effects of characteristics that are associated with the individual (e.g., literacy measures, demographics). We cluster standard errors at the session level, to correct for potential session-level heteroskedasticity. In each regression we control for a long list of demographics, and focus on the average marginal effects of covariates of interest.\textsuperscript{27}

\textsuperscript{27}The demographics we control for are the respondents' age, the number of household members living with them, the amount of money in USD the respondent typically spends each day in cash or via debit card, and binary indicators of whether the respondent is female, whether the respondent expects to complete a bachelor (versus higher than bachelor), whether the respondent is black, owns a business, is single, has a full-time or part-time job, has a high or very high income (versus low or very low), whether the respondents' parents have a high or very high income (versus low or very low), and whether the respondent is Christian.
Figure 5: Distribution of Efficiency in Treatments Compared to Baseline

Note: Solid black lines show the kernel density of Efficiency for the Baseline, and the dashed red line shows Efficiency for the indicated treatment. The Baseline distributions are the same, as shown in Figure 4. These distributions are based on one Efficiency measure per subject. All treatments are between-subjects. Efficiency is not conditional here on covariates.
Figure 6: Treatment Effects on Individual-Level Efficiency

Note: Average Treatment Effect and 90% confidence intervals for Beta regressions of the treatments (compared to the Baseline) on Efficiency. For the Full treatment $N=188$, for the AE treatment $N=226$, for the Understand treatment $N=191$, for the Practice treatment $N=194$, for the Sales Pitch treatment $N=218$, and for the Peers treatment $N=195$. Standard errors are clustered at the session level.
Figure 6 and 7 present the Average Treatment Effects (ATE) and 95% confidence intervals of regressions of the treatments on efficiency and take-up respectively. Figure 6 replicates the results in Figure 5, namely that none of the treatments leads to substantial improvements in welfare. Figure 7 shows, however, that all but one of the treatments significantly increases the probability of take-up by approximately 5 to 10 percentage points.

Figure 7: Treatment Effects on Decision-Level Probability of Take-up

![Diagram showing treatment effects on take-up probability](image)

Note: Average Treatment Effect and 90% confidence intervals for panel Probit regressions of the treatments (compared to the Baseline) on take-up, with random individual effects. Each of the subjects makes 54 decisions to purchase insurance or not. For the Full treatment N = 10,152, for the AE treatment N = 12,204, for the Understand treatment N = 10,314, for the Practice treatment N = 10,476, for the Sales Pitch treatment N = 11,772, and for the Peers treatment N = 10,530. Standard errors are clustered at the session level.

Some initial intuition into the general determinants of good quality and bad quality purchase decision can be obtained by just focusing on the purchases made in the Baseline.²⁸

²⁸A detailed analysis of the determinants of the Baseline purchase decisions is provided by Harrison.
The median CS is virtually zero, so roughly 50% of the purchase decisions reduced welfare and 50% of the purchase decisions improved welfare. Define “great decisions” as those generating a CS (gain) in excess of the 75th centile, and define “terrible decisions” as those generating a CS (loss) below the 25th centile. For all 119 subjects the purchase decision was made 57% of the time. But for those making terrible decisions, it was a purchase decision 83% of the time, and for those making great decisions it was a purchase decision only 26% of the time. So the stylized fact is that the terrible decisions tended to reflect excessive take-up, and the great decisions tended to reflect some caution when deciding to purchase the product. Intuitively, the contracts with a negative loading of 50% below the actuarially fair premium would be the ones that should have been taken up by most subjects, and the contracts with a positive loading of 8% above the actuarially fair premium would be the ones to scrutinize more carefully. 

With this background, Figure 7 provides the first clue as to why all but one of the interventions led to welfare losses compared to the baseline: increased take-up. In all cases the increase in purchase rate for the positive loading of 8% was statistically significant, with the largest increase predictably in the Sales Pitch treatment. The positive loading products are the instances where one would want to see some caution in purchasing, depending carefully on one’s risk preferences, and we observe exactly the opposite on average.

The largest welfare loss is from the Understand treatment, where subjects were checked on their domain-specific literacy about the index insurance product prior to making the decisions. This treatment arguably alerted many subjects to the fact that they really did not understand the index insurance product. This conclusion is a deeper one than it might seem: does it indicate a failure of the experimental design to explain the task, or an inability of subjects to comprehend the way in which an index insurance contract works, and how can one tell the two apart? The fact that the subject was “scored,” and with financial incentives for being correct and confident in the answer, arguably drove home the realization that the normal passive learning that goes on when insurance products are

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29 et al. (2020). In general they find that incentivized measures of literacy are more reliable indicators of purchase behavior, and that for the higher quality decisions a key role is played by domain-specific literacy about the index insurance product.

29 A reminder that for index insurance products the familiar Insurance Economics 101 theorem, that any risk averse EUT agent should purchase any full indemnity product for actuarially fair premiums, or lower, does not apply: see Clarke (2016)
marketed did not translate into a deep understanding. Every professor is familiar with the puzzled student that does poorly on an exam but is certain that they understood the material when it was presented in class.

Figure 8 pursues this question by examining the effect of each treatment on domain-specific literacy about the index insurance contract. The “effect” here is again compared to Baseline, and excludes the Understanding treatment for the obvious reason. We observe some improvements in domain-specific literacy, particularly for the AE and Practice treatments. The AE treatment provides an additional visual display to help “triangulate” the logic by which the index insurance contract leads to four distinct outcomes that take on three distinct payoff levels. And the Practice treatment, of course, provides a worked example with hypothetical payoffs, akin to the familiar “learning by doing” that one encounters so much with (good) modern software.

5.2 Heterogeneous Treatment Effects

Figure 9 shows the effect heterogeneous treatment of the Peers intervention on Efficiency and Purchase by the subject’s beliefs about own and other’s earnings. These beliefs about own and other’s earnings were elicited as part of the incentivized experiment where index insurance beliefs were elicited, after subjects took part in the treatments and the index insurance purchase decisions. The beliefs about other’s earnings were incentivized based on the true average earnings in a prior session. The beliefs about own earnings were not incentivized.

Panel A and C of Figure 9 show the heterogeneous treatment effect by beliefs about other’s earnings. Panel A shows that in the Baseline, Efficiency does not significantly differ by the expectation of other’s earnings, which is to be expected because in the Baseline the outcomes for the subject are independent of their peers’ performance. However, in the Peers treatment group, those who expect their peers to do relatively better have a larger treatment effect. This is consistent with subjects being more likely to align their own purchase decisions with those of their peers when they believe their peers will do relatively

\(^{30}\)Figure 8 also excludes the Full treatment because we did not have the index insurance literacy experiment in those sessions.
Figure 8: Treatment Effects on Individual-Level Insurance Literacy Score

Note: Average Treatment Effect and 90% confidence intervals for Beta regressions of the treatments (compared to the Baseline) on index insurance literacy. For the AE treatment N = 226, for the Understand treatment N = 191, for the Practice treatment N = 194, for the Sales Pitch treatment N = 218, and for the Peers treatment N = 195. No data was collected on index insurance literacy in the Full treatment. Standard errors are clustered at the session level.
better. Panel C of Figure 9 shows that indeed those who believe their peers will do relatively better do purchase more insurance.

Panel B and D of Figure 9 shows the heterogeneity by beliefs about own earnings. Panel B shows that in the Baseline there is a positive and significant effect of higher beliefs about own earnings, where those who think they will earn an amount close to the maximum possible earnings, where the beliefs score is 1, achieve higher Efficiency than those who think they will earn lower amounts. This suggests that subjects exhibit some sophistication about their “ability to make welfare enhancing choices or not.” For the subjects in the treatment group we see, however, that those who expect their own earnings to be lower, the Peers treatment effect is higher. This suggests that those people were sophisticated about the fact that they would do worse than their peers. Based on this realisation they may have been able to enhance their welfare by making purchase decisions that were more in line with average purchase decisions by their peers. Even though not significant, Panel D shows that those who believe they will earn comparatively less actually purchased more insurance.

6 Robustness, Extensions and Limitations

6.1 Isn’t EUT More Normatively Attractive than RDU?

We have used the best descriptive model of an individual’s risk preferences to make normative evaluations of the insurance purchase choices of the same individual. In effect this assumes *periculum habitus non est disputandum* (risk preferences are not to be disputed), as proposed by Harrison and Ng (2016). This approach allows that there might be some normative rationale for individuals to hold RDU preferences.

However, many would claim that EUT is somehow “more normatively attractive” than RDU. Although we do not automatically agree with this position, it is certainly worthy of examination because some economists view it as self-evident. However, there are some subtleties that arise when implementing it properly.

Bleichrodt et al. (2001) maintain that EUT is the appropriate normative model, and
Figure 9: Heterogeneous Treatment Effect of Peers Treatment on Efficiency and Purchase by Subject’s Beliefs about Own and Other’s Earnings

Note: Panel A and B present the predicted marginal effect and 90% confidence intervals for Beta regressions of the Peers treatment (compared to the Baseline) on percent Efficiency by the subject’s beliefs about other’s and own earnings respectively. For Panel A and B N = 195. Panel C and D present the predicted marginal effect and 90% confidence intervals for panel probit regressions with random individual effects of the Peers treatment (compared to the Baseline) on probability of purchase by the subject’s beliefs about other’s and own earnings respectively. Each of the 195 subjects made 54 decisions so the total number of decisions is 10530. In all regressions the controls are the respondents’ age, the number of household members living with them, the amount of money in USD the respondent typically spends each day in cash or via debit card, and binary indicators of whether the respondent is female, whether the respondent expects to complete a bachelor (versus higher than bachelor), whether the respondent is black, owns a business, is single, has a full-time or part-time job, has a high or very high income (versus low or very low), whether the respondents’ parents have a high or very high income (versus low or very low), and whether the respondent is Christian. Standard errors are clustered at the session level.
correctly note that if an individual is an RDU or Cumulative Prospect Theory
decision-maker, then recovering the descriptive utility function from observed lottery
choices requires allowing for probability weighting and/or sign-dependence. They then
implicitly propose using that descriptive utility function to infer the CE of a risky prospect
using EUT.

To add to potential (and realized) confusion, there is a correct statement in the
position of Bleichrodt et al. (2001) and an incorrect statement, and these must be kept
distinct. The correct statement is that an estimated utility function under a descriptive
RDU model of risk preferences will not in general be the same as the estimated utility
function under a descriptive EUT model of risk preferences, assuming the same individual
and the same observed choices. The incorrect statement is that if one believes that EUT is
the normatively appropriate metric then one should use that RDU-consistent estimate of
the utility function. In fact, one should then just impose EUT risk preferences on the
observed choices, and use the estimated utility function under that assumption, which in
general will be contrary to the descriptively best model of risk preferences.

Some notation will help. Let $RDU(x)$ denote the evaluation of a risky lottery $x$
using the RDU risk preferences of the individual, including the probability weighting
function. As explained earlier, one can calculate the CE by solving $U^{RDU}(CE) = RDU(x)$
for CE, where $U^{RDU}$ is the utility function from the RDU model of risk preferences for
that individual. But Bleichrodt et al. (2001) evaluate the $CE$ by solving
$U^{RDU}(CE) = EUT(x)$ where $EUT(x)$ uses that utility function in an EUT manner,
assuming no probability weighting. This seems normatively illogical. The logical
approach$^{11}$ here would be to estimate the “best fitting EUT risk preferences” for the
individual from their observed lottery choices, and then use the resulting utility function
$U^{EUT}$ as the basis for evaluating the $CE$ using $U^{EUT}(CE) = EUT(x)$.

The main effect of using the EUT-consistent risk preferences for every individual’s

$^{11}$We are not running afoul of the valid concern that Infante et al. (2016) have when they complain
that behavioral welfare economists typically follow Hausman (2011) in “purifying” empirically
observed preferences. Infante et al. (2016) argue that purification reflects an implicit philosophy
according to which an inner Savage-rational agent is trapped within a psychological, irrational
shell from which best policy should try to rescue her. Although they provide no general
philosophical framework within which they motivate their skepticism about “inner rational
agents,” such a framework is presented in Harrison and Ross (2018, §§).
evaluation of the quality of their decisions is that we find that all of the interventions do harm to the average subject. In general we also see more heterogeneity in the welfare effects, consistent with the fact that some relatively extreme utility function estimates are required to capture the risk premium that is better characterized by a mix of utility functions and probability weighting functions. These results can be seen in Figure 10, which is to be directly compared to Figure 6. The greater heterogeneity in risk preferences is reflected in the wider confidence intervals.

Figure 10: Treatment Impact on Individual-Level Efficiency
Assuming EUT for All Subjects

Note: Average Treatment Effect and 90% confidence intervals for Beta regressions of the treatments (compared to the Baseline) on Efficiency. For the Full treatment N = 188, for the AE treatment N = 226, for the Understand treatment N = 191, for the Practice treatment N = 194, for the Sales Pitch treatment N = 218, and for the Peers treatment N = 195. Standard errors are clustered at the session level.
The most striking result is that the welfare gains from the Peers treatment are now wiped out, and we find a statistically significant welfare loss on average. This is an interesting result because the Peers treatment is the only treatment that uses information about the average of the distribution of purchases amongst peers, which represents about 60% RDU decision-makers and 40% EUT decision-makers. Subjects who are RDU and probability weight may have positive welfare effects from purchase. If we then assume that everyone is EUT, those decisions by those RDU subjects are suddenly bad for them, leading to welfare losses. This result alone demonstrates why it is critical to think carefully about which normative models of risk preferences are being applied to evaluate interventions.

The welfare gains for the Full treatment are roughly the same, although the added heterogeneity just leads to the upper bound of the welfare effect including zero. The welfare losses for the AE treatment, on the other hand, are now statistically significant. There is a noticeable reduction in the welfare loss from the Understand treatment, although it remains statistically significant. The welfare losses from the Practice treatment are the same, apart from the effect of heterogeneity. The Sales Pitch treatment now has a larger average loss, and little change in the precision.

In summary, our qualitative results really only change for the Peers treatment when one insists on using EUT as the normative metric for welfare evaluation. And that change for the Peers treatment only makes our “Do No Harm” alarm even more serious, since it then applies to every intervention.

6.2 Risk Preferences that Relax ROCL

One conceptual limitation of the current methodology for calculating the expected welfare benefits from insurance purchase decisions is that we assume the subject evaluates CS by using ROCL. This is true whether the subject is classified as having EUT or RDU preferences, since both assume ROCL. We therefore consider variants of the EUT and RDU models that do not assume ROCL.

For the variant of EUT we follow Harrison et al. (2015) and consider a “Source-Dependent” model in which the individual has one risk attitude for simple lotteries and potentially another risk attitude for compound lotteries. In historical context, Smith
(1969) proposed this specification as one that was consistent with the evidence from several of the thought experiments underlying the (two-color) Ellsberg paradox. If we view these types of lotteries as defining different sources of risk, this specification deviates from ROCL to the extent that these risk attitudes differ.

For the variant of RDU we apply the methodology from (Segal, 1990, 1992) to relax the ROCL assumption, leading to what is often referred to as the Recursive RDU model. The basic idea is to assume that the second-stage lotteries of any compound lottery are replaced by their certainty-equivalent, “throwing away” information about the second-stage probabilities before one examines the first-stage probabilities at all. Hence one cannot then define the actuarially-equivalent simple lottery, by construction, since the informational bridge to that calculation has been burnt. If this CE is generated by RDU, then one can apply RDU to evaluate the first-stage lottery using those CE as final outcomes. The Recursive RDU model assumes one set of RDU preference parameters, just applied recursively in this manner.32

The overall distribution of risk preferences of subjects is similar whether or not we assume ROCL.33 In this case the classification employs non-nested hypothesis tests, since the Source-Dependent EUT model and Recursive RDU model are not nested.34 The classification of type of risk preference are similar in the sense that the “EUT counterpart characterizes around 50% of the subjects in each case,” but of course the models are in principle quite different. In fact they are not all that different in practice. The EUT model is nested in the Source-Dependent EUT model, and at the 5% significance level 89.9% of the

32 It would be a simple matter to also consider a Source-Dependent Recursive RDU, or just a Source-Dependent RDU model. There is only one way for ROCL to be valid, but an infinite number of ways for it to be invalid.
33 See Figure A.8 in the appendix.
34 Nested hypothesis tests are not appropriate to use to determine if the Source-Dependent EUT (sdEUT) and Recursive RDU (rRDU) models would be a better fit for each subject’s choices, since the sdEUT model is not nested in the rRDU model. For the non-nested model comparisons we use the Vuong test and the Clarke test, described in Harrison and Rutström (2009). The Vuong test compares the observation-specific likelihoods of each model, rather than using the sum of the likelihoods of each model as in nested hypothesis tests. The ratio of the sdEUT likelihood to the rRDU likelihood at the observation level is calculated, then the average log of that test statistic for each subject is tested against the null hypothesis that it is zero. If the test statistic is not asymptotically distributed standard normal, the non-parametric Clarke test is more suitable. Not only does each test tell us which model is a better fit, but it also provides some statistical confidence in the rejection of the null in the direction of the favored model.
subjects classified as having risk preferences consistent with Source-Dependent EUT are actually EUT subjects. The same is not true of the Recursive RDU models, which in turn nests RDU. But the upshot is that just over 40% of our subjects behave consistently with EUT, whether or not one imposes ROCL, and hence would have no change in their welfare evaluations compared to when we assumed ROCL.

Figure 11: Treatment Impact on Individual-Level Efficiency
Not Assuming ROCL Axiom

Note: Average Treatment Effect and 90% confidence intervals for Beta regressions of the treatments (compared to the Baseline) on Efficiency. For the Full treatment N = 188, for the AE treatment N = 226, for the Understand treatment N = 191, for the Practice treatment N = 194, for the Sales Pitch treatment N = 218, and for the Peers treatment N = 195. Standard errors are clustered at the session level.

The welfare results of using models of risk preferences that do not assume ROCL are roughly the same as our default results. These results can be seen clearly in Figure 11, which is to be directly compared to Figure 6.
The welfare gains for the Full treatment are roughly the same, suggesting a larger welfare loss and even more clearly statistical significance. The welfare losses for the AE and Understand treatments are virtually the same. The welfare losses from the Practice treatment are reduced slightly, and the upper bound of the 95% confidence interval now (just) spans zero. The Sales Pitch treatment now has a slightly larger average loss. And the Peers treatment has roughly the same welfare gain on average, and with a smaller confidence interval.

In summary, our qualitative results do not change when one considers relaxing the assumption of ROCL for the models of risk preferences that underlie the normative metric for welfare evaluation.

### 6.3 Observed Heterogeneity is Your Friend

Evidence that there is an average welfare loss for all but one of the interventions we consider does not mean that we should assign all but one of these interventions to the policy scrap heap. What if the Full treatment was associated with a significant welfare gain for women and an equally significant welfare loss for men, and the AE treatment was associated with exactly the opposite pattern? Then one could target the Full treatment for women, and the AE treatment for men, with some expectation of average welfare gain. Of course, life is more subtle than this, with other observable characteristics in play, but the general message is clear. By focusing on the average treatment effect, whether it is take-up or welfare, one misses information in the tails of the very distributions of effects that one has worked so hard to see. Our proposal is to “connect the tails” of the distributions for each intervention to design conditional interventions.

For practical reasons, to do with inferential power and the scalability of insights from any project, we would “connect the tails” normatively by identifying sub-groups of individuals that are statistically likely to respond to specific interventions. We naturally define sub-groups in terms of observable characteristics, but also potentially in terms of latent characteristics such as preferences and beliefs. We then use statistical methods, such as quantile regression, or even machine-learning algorithms to generate “random forests,” to link sub-group X with treatment Y: see Carter et al. (2019) for an extended example. We
would then test these predictions to see if they do lead to improved distributions of welfare.

The recognition that heterogeneity of welfare impact might be the basis for normatively designing better, conditional interventions is one that has tremendous promise in general. Rather than just providing one-size-fits-all interventions, these behavioral interventions are tailored to provide specific advice or information designed for the behavioral characteristics of those making insurance decisions. These are “behaviorally smart” conditional interventions, not unconditional “nudges” in the spirit of Thaler and Sunstein (2003).

7 Conclusion

One theme lies at the heart of a rigorous evaluation of policy using the insights of behavioral welfare economics: how to judge if some policy is encouraging good decisions or bad decisions. One approach, which drives the “nudge” movement and most “randomized evaluations,” is to assume that judgment away, and simply assert that some change in an observable must be good for all preferences and beliefs. Isn’t it obvious that people should save more, eat less fatty foods, drink less wine, and take-up insurance? Of course not: economics teaches us that the demand for these behaviors depends on preferences and beliefs, and hence the expected consumer surplus from these behaviors is also conditional on preferences and beliefs. Even if we have some theoretical structure that tells us about the welfare effects at the margin, those effects rarely apply qualitatively to the discrete policy interventions under study without strict “path independence” conditions being met. Further, no sensibly realistic economics that recognizes heterogeneity of preferences and beliefs even tells us that this would be good behavior on average. And even if it is good behavior on average, are you willing to lash your policy advice to the social welfare function mast that this entails? Not clearly, and definitely not for us.

Our approach takes a position on how one judges good and bad decisions, and there are other approaches that policy makers should be aware of. We come to a major conclusion when applied to the canonical tool of risk management, insurance: that blindly encouraging take-up may lead to welfare losses. Blind watchmakers typically end up making a lot of terrible watches before they come across one good watch. Hence studies that evaluate the
impact on take-up of policy interventions that promote index insurance, such as Giné et al. (2008), Gaurav et al. (2011), Cole et al. (2013), Dercon et al. (2014), Hill et al. (2016) and Casaburi and Willis (2018), should be extended to include an analysis of the welfare of index insurance purchase decisions so that future policies “Do No Harm.”
References


Risk Preferences: Descriptive and Normative Challenges. Bingley, UK: Emerald, Research in Experimental Economics.


A Additional Figures

Figure A.1: Treatment Effect on Decision-level Efficiency

Note: Average Treatment Effect and 90% confidence intervals for Probit regressions of the treatments (compared to the Baseline) on a binary variable which indicates a decision as either efficient or not efficient, with random individual effects. For the Full treatment N = 10,152, for the AE treatment N = 12,204, for the Understand treatment N = 10,314, for the Practice treatment N = 10,476, for the Sales Pitch treatment N = 11,772, and for the Peers treatment N = 10,530. Standard errors are clustered at the session level.
Note: Average Treatment Effect and 90% confidence intervals for regressions of the treatments (compared to the Baseline) on consumer surplus, with random individual effects. For the Full treatment \( N = 10,152 \), for the AE treatment \( N = 12,204 \), for the Understand treatment \( N = 10,314 \), for the Practice treatment \( N = 10,476 \), for the Sales Pitch treatment \( N = 11,772 \), and for the Peers treatment \( N = 10,530 \). Standard errors are clustered at the session level.
Figure A.3: Test of Significant Differences between Baseline and Treatment Distributions

Note: Comparison of distributions of Consumer Surplurs using methods of Goldman and Kaplan (2018) and Kaplan (2019). Blue lines at the bottom of each panel show the ranges of Consumer Surplus at which one can reject the hypothesis of equality between Baseline and treatment distributions.
Figure A.4: Distribution of Efficiency in Treatments compared to Baseline Assuming EUT for All Subjects

Note: Solid black lines show the kernel density of Efficiency for the Baseline, and the dashed red line shows Efficiency for the indicated treatment. The Baseline distributions are the same, as shown in Figure 4. These distributions are based on one Efficiency measure per subject. All treatments are between-subjects. Efficiency is not conditional here on covariates.
Figure A.5: Treatment Impact on Decision-Level Efficiency
Assuming EUT for All Subjects

Note: Average Treatment Effect and 90% confidence intervals for Probit regressions of the treatments (compared to the Baseline) on a binary variable which indicates a decision as either efficient or not efficient, with random individual effects. For the Full treatment N = 10,152, for the AE treatment N = 12,204, for the Understand treatment N = 10,314, for the Practice treatment N = 10,476, for the Sales Pitch treatment N = 11,772, and for the Peers treatment N = 10,530. Standard errors are clustered at the session level.
Figure A.6: Treatment Impact on Decision-Level Consumer Surplus
Assuming EUT for All Subjects

Note: Average Treatment Effect and 90% confidence intervals for regressions of the treatments (compared to the Baseline) on consumer surplus, with random individual effects. For the Full treatment $N = 10,152$, for the AE treatment $N = 12,204$, for the Understand treatment $N = 10,314$, for the Practice treatment $N = 10,476$, for the Sales Pitch treatment $N = 11,772$, and for the Peers treatment $N = 10,530$. Standard errors are clustered at the session level.
Figure A.7: EUT is Nested in Source-Dependant EUT

Note: Kernel density of $p$-value testing the null hypothesis that the Source-Dependent EUT is different from EUT. Dashed red lines at the 5% and 10% significance level. One $p$-value per subject ($N = 610$)
Figure A.8: Classification of Risk Preferences
Not Assuming the ROCL Axiom

Note: Non-nested hypothesis tests used to clarify subjects to one of the indicated models of risk preference. For these displays a 5% significance level used.
B  Instructions

B.1  Instructions for the insurance purchase task

B.1.1  Baseline treatment

Choices Over Insurance Prospects

In this task you will make choices about whether to insure against possible monetary loss. In each choice you will start out with an initial amount of money and, in the event of a loss, the loss amount will be taken from this initial stake. In each choice you will have the option to buy insurance to protect you against the possible loss, although you are not required to buy the insurance.

You will make 54 choices in this task. You will actually get the chance to play one of the choices you make, and you will be paid in cash according to the outcome of that choice. So you should think carefully about how much each insurance choice is worth to you.

Each choice has two random events: a Personal Event and an Index Event. Each event has two possible outcomes: Good or Bad. If the Personal Event outcome is Bad, then you will suffer a loss. Before you know the outcome of the Personal Event, you must decide whether to purchase insurance against this possible loss. However, the insurance only pays a claim if the Index Event outcome is Bad.

If you do not purchase insurance, then only the outcome of the Personal Event will decide your earnings:

<table>
<thead>
<tr>
<th>Personal Event</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td>Initial stake - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Initial stake</td>
</tr>
</tbody>
</table>

If you do purchase insurance, it is important for you to understand that an insurance claim is not paid according to whether you actually suffer a loss. Instead, an insurance claim is paid only according to the Index Event. Both events will decide your earnings:
So there are four possible outcomes if you purchase insurance. You might suffer a loss and receive an insurance claim payment. Or you might suffer a loss but not receive an insurance claim payment. You might not suffer a loss and also receive no insurance claim payment. Finally, you might receive an insurance claim payment even when you do not suffer a loss.

Each event is determined by randomly drawing a colored chip from a bag. In general, each draw will involve two colors, and each decision you make will involve different amounts and mixtures of two colors. When making each decision, you will know the exact amounts and mixtures of colored chips associated with the decision. After you have decided whether or not to purchase insurance, the two events will be determined as follows.

First, the Personal Event will be determined with blue and red chips.

- If you draw a **blue** chip, then the Personal Event outcome is **Good** and you do not suffer a loss.
- If you draw a **red** chip, then the Personal Event outcome is **Bad** and you suffer a loss.

Next, if you purchased insurance, the Index Event will be determined with green and black chips.

- If you draw a **green** chip, then the Index Event outcome **Matches** the Personal Event outcome
- If you draw a **black** chip, then the Index event outcome **Differs** from the Personal Event outcome
Here is an example of what your decision would look like on the computer screen. The display on your screen will be bigger and easier to read.

In this example you start out with an initial stake of $75. If the outcome of the Personal Event is Bad you will lose $45, and if the outcome of the Personal Event is Good you will not lose any money. If you faced the choice in this example and chose to purchase insurance, you would pay $5.75 from your initial stake. You would pay this $5.75 before you drew any chips, so you would pay it regardless of the outcomes of your draws.

You will be drawing colored chips from bags to determine the outcomes of both events. First, you will draw a chip to determine the Personal Event outcome. The image on the left shows that there is a 10% chance that the Personal Event outcome is Bad, and a 90% chance that the Personal Event outcome is Good. This means there will be 9 blue chips and 1 red chip in a bag, and the color of the chip you randomly draw from the bag represents the outcome of the Personal Event. If a blue chip is drawn, the Personal Event outcome is Good, and if a red chip is drawn the Personal Event outcome is Bad.

Next, you will draw a chip to determine the Index Event outcome. There is an 80% chance that the Index Event outcome Matches the Personal Event outcome and a 20% chance
that the Index Event outcome *Diffs* from the Personal Event outcome. This means there will be 8 green chips and 2 black chips in a bag. If a green chip is drawn the Index Event outcome *Matches* the Personal Event outcome, and if a black chip is drawn the Index Event outcome *Diffs* from the Personal Event outcome.

You will indicate your choice to purchase, or not purchase, the insurance by clicking on your preferred option on the computer screen.

There are 54 decisions like this one to be made, each shown on a separate screen on the computer. Each decision might have different chances for the Personal Event outcome, the Index Event outcome, the initial stake, or the cost of insurance, so pay attention to each screen. After you have worked through all of the insurance decisions, please wait in your seat and an experimenter will come to you. You will then roll two 10-sided dice to determine which insurance decision will be played out. Since there are only 54 decisions, you will keep rolling the dice until a number between 1 and 54 comes up. There is an equal chance that any of your 54 choices will be selected, so you should approach each decision as if it is the one that you will actually play out to determine your payoff. Once the decision to play out is selected, you will draw chips from the Index bag and the Personal bag to determine the outcome.

In summary:

- You will decide whether or not to purchase insurance in each of the 54 scenarios.
- One of your decisions will be randomly selected to be played for cash.
- You will suffer the specified monetary loss only if the **Personal Event** outcome is *Bad*.
- If you purchase insurance, it will pay a claim payment only if the **Index Event** outcome is *Bad*. This can happen in two ways:
  1. Your Index draw *Matches* a bad Personal Event outcome;
  2. Your Index draw *Diffs* from a good Personal Event outcome.

Whether or not you prefer to buy the insurance is a matter of personal taste. You may choose to buy insurance on some or all of your 54 choices, or none of the choices. The
people next to you may be presented with different choices, insurance prices, and may have different preferences, so their responses should not matter to you. Please work silently, and make your choices by thinking carefully about each prospect.

Your payoff from this task is in cash and is in addition to the show-up payment that you receive just for being here, as well as any other earnings in other tasks. If you have a question, raise your hand and someone will come over and answer it.
B.1.2 Full treatment

**Choices Over Insurance Prospects**

In this task you will make choices about whether to insure against possible monetary loss. In each choice you will start out with an initial amount of money and, in the event of a loss, the loss amount will be taken from this initial stake. In each choice you will have the option to buy insurance to protect you against the possible loss, although you are not required to buy the insurance.

You will make 54 choices in this task. You will actually get the chance to play one of the choices you make, and you will be paid in cash according to the outcome of that choice. So you should think carefully about how much each insurance choice is worth to you.

Each choice has two random events: a **Personal Event** and an **Index Event**. Each event has two possible outcomes: *Good* or *Bad*. If the Personal Event outcome is *Bad*, then you will suffer a loss. Before you know the outcome of the Personal Event, you must decide whether to purchase insurance against this possible loss. However, the insurance only pays a claim if the Index Event outcome is *Bad*.

If you do not purchase insurance, then only the outcome of the Personal Event will decide your earnings:

<table>
<thead>
<tr>
<th>Personal Event</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Bad</em></td>
<td>Initial stake - Loss</td>
</tr>
<tr>
<td><em>Good</em></td>
<td>Initial stake</td>
</tr>
</tbody>
</table>

If you do purchase insurance, it is important for you to understand that an insurance claim is not paid according to whether you actually suffer a loss. Instead, an insurance claim is paid only according to the Index Event. Both events will decide your earnings:
<table>
<thead>
<tr>
<th>Personal Event</th>
<th>Index Event</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td>Bad</td>
<td>Initial stake - Insurance cost - Loss + Insurance Coverage</td>
</tr>
<tr>
<td>Bad</td>
<td>Good</td>
<td>Initial stake - Insurance cost - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Good</td>
<td>Initial stake - Insurance cost - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Bad</td>
<td>Initial stake - Insurance cost + Insurance Coverage</td>
</tr>
</tbody>
</table>

So there are four possible outcomes if you purchase insurance. You might suffer a loss and receive an insurance claim payment. Or you might suffer a loss but not receive an insurance claim payment. You might not suffer a loss and also receive no insurance claim payment. Finally, you might receive an insurance claim payment even when you do not suffer a loss.

Each event is determined by randomly drawing a colored chip from a bag. In general, each draw will involve two colors, and each decision you make will involve different amounts and mixtures of two colors. When making each decision, you will know the exact amounts and mixtures of colored chips associated with the decision. After you have decided whether or not to purchase insurance, the two events will be determined as follows.

First, the Personal Event will be determined with blue and red chips.

- If you draw a **blue** chip, then the Personal Event outcome is **Good** and you do not suffer a loss.
- If you draw a **red** chip, then the Personal Event outcome is **Bad** and you suffer a loss.

Next, if you purchased insurance, the Index Event will be determined with green and black chips.

- If you draw a **green** chip, then the Index Event outcome **Matches** the Personal Event outcome
- If you draw a **black** chip, then the Index event outcome **Differs** from the Personal Event outcome
Here is an example of what your decision would look like on the computer screen. The display on your screen will be bigger and easier to read.

In this example you start out with an initial stake of $75. If the outcome of the Personal Event is \textit{Bad} you will lose $45, and if the outcome of the Personal Event is \textit{Good} you will not lose any money. If you faced the choice in this example and chose to purchase insurance, you would pay $5.75 from your initial stake. You would pay this $5.75 before you drew any chips, so you would pay it regardless of the outcomes of your draws.

You will be drawing colored chips from bags to determine the outcomes of both events. First, you will draw a chip to determine the Personal Event outcome. The image on the left shows that there is a 10\% chance that the Personal Event outcome is \textit{Bad}, and a 90\% chance that the Personal Event outcome is \textit{Good}. This means there will be 9 blue chips and 1 red chip in a bag, and the color of the chip you randomly draw from the bag represents the outcome of the Personal Event. If a blue chip is drawn, the Personal Event outcome is \textit{Good}, and if a red chip is drawn the Personal Event outcome is \textit{Bad}.

Next, you will draw a chip to determine the Index Event outcome. There is an 80\% chance that the Index Event outcome \textit{Matches} the Personal Event outcome and a 20\% chance...
that the Index Event outcome *Differs* from the Personal Event outcome. This means there will be 8 green chips and 2 black chips in a bag. If a green chip is drawn the Index Event outcome *Matches* the Personal Event outcome, and if a black chip is drawn the Index Event outcome *Differs* from the Personal Event outcome.

The possible outcomes if you **choose not to purchase insurance** are therefore as follows:

<table>
<thead>
<tr>
<th>Personal Event outcome</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red (<em>Bad</em>)</td>
<td>$75 - $45 = $30</td>
</tr>
<tr>
<td>Blue (<em>Good</em>)</td>
<td>$75 - $0 = $75</td>
</tr>
</tbody>
</table>

- If a red chip is drawn from the Personal bag your Personal Event outcome is *Bad*. You will lose $45 and be left with $30.
- If a blue chip is drawn from the Personal bag your Personal Event outcome is *Good*. You will lose nothing and be left with $75.

You can choose to purchase insurance, which will cost you $5.75, and if you chose to purchase insurance you would pay this $5.75 regardless of the outcomes of your draws. The possible outcomes if you **choose to purchase insurance** are therefore as follows:

<table>
<thead>
<tr>
<th>Personal Draw</th>
<th>Index Draw</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red (<em>Bad</em>)</td>
<td>Green (<em>Matches → Bad</em>)</td>
<td>$75 - $5.75 - $45 + $45 = $69.25</td>
</tr>
<tr>
<td>Red (<em>Bad</em>)</td>
<td>Black (<em>Differs → Good</em>)</td>
<td>$75 - $5.75 - $45 = $24.25</td>
</tr>
<tr>
<td>Blue (<em>Good</em>)</td>
<td>Green (<em>Matches → Good</em>)</td>
<td>$75 - $5.75 = $69.25</td>
</tr>
<tr>
<td>Blue (<em>Good</em>)</td>
<td>Black (<em>Differs → Bad</em>)</td>
<td>$75 - $5.75 + $45 = $114.25</td>
</tr>
</tbody>
</table>

- If a red chip is drawn from the Personal bag and a green chip from the Index bag, you will lose $45 but the insurance claim payment will cover the loss. You will keep $69.25.
- If a red chip is drawn from the Personal bag and a black chip from the Index bag, you will lose $45 but you will *not* receive an insurance claim payment from insurance. You will keep $24.25.
• If a blue chip is drawn from the Personal bag and a green chip from the Index bag, you will not lose any money. You will keep $69.25.

• If a blue chip is drawn from the Personal bag and a black chip from the Index bag, you will not lose any money, but you receive a claim payment from insurance. You will keep $114.25.

You will indicate your choice to purchase, or not purchase, the insurance by clicking on your preferred option on the computer screen.

There are 54 decisions like this one to be made, each shown on a separate screen on the computer. Each decision might have different chances for the Personal Event outcome, the Index Event outcome, the initial stake, or the cost of insurance, so pay attention to each screen. After you have worked through all of the insurance decisions, please wait in your seat and an experimenter will come to you. You will then roll two 10-sided dice to determine which insurance decision will be played out. Since there are only 54 decisions, you will keep rolling the dice until a number between 1 and 54 comes up. There is an equal chance that any of your 54 choices will be selected, so you should approach each decision as if it is the one that you will actually play out to determine your payoff. Once the decision to play out is selected, you will draw chips from the Index bag and the Personal bag to determine the outcome.

In summary:

• You will decide whether or not to purchase insurance in each of the 54 scenarios.

• One of your decisions will be randomly selected to be played for cash.

• You will suffer the specified monetary loss only if the Personal Event outcome is Bad.

• If you purchase insurance, it will pay a claim payment only if the Index Event outcome is Bad. This can happen in two ways:
  1. Your Index draw Matches a bad Personal Event outcome;
  2. Your Index draw Differs from a good Personal Event outcome.
Whether or not you prefer to buy the insurance is a matter of personal taste. You may choose to buy insurance on some or all of your 54 choices, or none of the choices. The people next to you may be presented with different choices, insurance prices, and may have different preferences, so their responses should not matter to you. Please work silently, and make your choices by thinking carefully about each prospect.

Your payoff from this task is in cash and is in addition to the show-up payment that you receive just for being here, as well as any other earnings in other tasks. If you have a question, raise your hand and someone will come over and answer it.
B.1.3 AE treatment

Choices Over Insurance Prospects

In this task you will make choices about whether to insure against possible monetary loss. In each choice you will start out with an initial amount of money and, in the event of a loss, the loss amount will be taken from this initial stake. In each choice you will have the option to buy insurance to protect you against the possible loss, although you are not required to buy the insurance.

You will make 54 choices in this task. You will actually get the chance to play one of the choices you make, and you will be paid in cash according to the outcome of that choice. So you should think carefully about how much each insurance choice is worth to you.

Each choice has two random events: a Personal Event and an Index Event. Each event has two possible outcomes: Good or Bad. If the Personal Event outcome is Bad, then you will suffer a loss. Before you know the outcome of the Personal Event, you must decide whether to purchase insurance against this possible loss. However, the insurance only pays a claim if the Index Event outcome is Bad.

If you do not purchase insurance, then only the outcome of the Personal Event will decide your earnings:

<table>
<thead>
<tr>
<th>Personal Event</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td>Initial stake - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Initial stake</td>
</tr>
</tbody>
</table>

If you do purchase insurance, it is important for you to understand that an insurance claim is not paid according to whether you actually suffer a loss. Instead, an insurance claim is paid only according to the Index Event. Both events will decide your earnings:
<table>
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<tr>
<th>Personal Event</th>
<th>Index Event</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td>Bad</td>
<td>Initial stake - Insurance cost - Loss + Insurance Coverage</td>
</tr>
<tr>
<td>Bad</td>
<td>Good</td>
<td>Initial stake - Insurance cost - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Good</td>
<td>Initial stake - Insurance cost - Loss</td>
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<tr>
<td>Good</td>
<td>Bad</td>
<td>Initial stake - Insurance cost + Insurance Coverage</td>
</tr>
</tbody>
</table>

So there are four possible outcomes if you purchase insurance. You might suffer a loss and receive an insurance claim payment. Or you might suffer a loss but not receive an insurance claim payment. You might not suffer a loss and also receive no insurance claim payment. Finally, you might receive an insurance claim payment even when you do not suffer a loss.

Each event is determined by randomly drawing a colored chip from a bag. In general, each draw will involve two colors, and each decision you make will involve different amounts and mixtures of two colors. When making each decision, you will know the exact amounts and mixtures of colored chips associated with the decision. After you have decided whether or not to purchase insurance, the two events will be determined as follows.

First, the Personal Event will be determined with blue and red chips.

- If you draw a **blue** chip, then the Personal Event outcome is **Good** and you do not suffer a loss.
- If you draw a **red** chip, then the Personal Event outcome is **Bad** and you suffer a loss.

Next, if you purchased insurance, the Index Event will be determined with green and black chips.

- If you draw a **green** chip, then the Index Event outcome **Matches** the Personal Event outcome
- If you draw a **black** chip, then the Index event outcome **Differs** from the Personal Event outcome
Here is an example of what your decision would look like on the computer screen. The display on your screen will be bigger and easier to read.

In this example you start out with an initial stake of $75. If the outcome of the Personal Event is *Bad* you will lose $45, and if the outcome of the Personal Event is *Good* you will not lose any money. If you faced the choice in this example and chose to purchase insurance, you would pay $5.75 from your initial stake. You would pay this $5.75 before you drew any chips, so you would pay it regardless of the outcomes of your draws.

You will be drawing colored chips from bags to determine the outcomes of both events. First, you will draw a chip to determine the Personal Event outcome. The image on the left shows that there is a 10% chance that the Personal Event outcome is *Bad*, and a 90% chance that the Personal Event outcome is *Good*. This means there will be 9 blue chips and 1 red chip in a bag, and the color of the chip you randomly draw from the bag represents the outcome of the Personal Event. If a blue chip is drawn, the Personal Event outcome is *Good*, and if a red chip is drawn the Personal Event outcome is *Bad*.

Next, you will draw a chip to determine the Index Event outcome. There is an 80% chance that the Index Event outcome *Matches* the Personal Event outcome and a 20% chance...
that the Index Event outcome *Differs* from the Personal Event outcome. This means there will be 8 green chips and 2 black chips in a bag. If a green chip is drawn the Index Event outcome *Matches* the Personal Event outcome, and if a black chip is drawn the Index Event outcome *Differs* from the Personal Event outcome.

You will indicate your choice to purchase, or not purchase, the insurance by clicking on your preferred option on the computer screen. There are 54 decisions like this one to be made, each shown on a separate screen on the computer. Each decision might have different chances for the Personal Event outcome, the Index Event outcome, the initial stake, or the cost of insurance, so pay attention to each screen.

The screen that you will actually see has one additional piece of information, shown in this display. In this case you should note that the initial stakes are now $60, that the loss is now $35, and that the cost of the insurance is now $14.50. This shows how these values might change from screen to screen, as mentioned earlier. The additional information is contained in the two “pie displays” on the right hand side. These additional displays are just another way to view the same information, and may or may not help you make your choice to purchase insurance or not to purchase insurance.
In this example you start out with an initial stake of $60. If the outcome of the Personal Event is Bad you will lose $35, and if the outcome of the Personal Event is Good you will not lose any money. If you faced the choice in this example and chose to purchase insurance, you would pay $14.50 from your initial stake. You would pay this $14.50 before you drew any chips, so you would pay it regardless of the outcomes of your draws.

In this example there is a 20% chance that the outcome of the Personal Event is Bad, and an 80% chance that the Personal Event outcome is Good. There is an 80% chance that the Index Event outcome Matches the Personal Event outcome and a 20% chance that the Index Event outcome Differs from the Personal Event outcome. Based on these probabilities, the pie charts show the overall probabilities of the possible earnings and their respective amounts.

The top pie chart shows the possible earnings if you choose not to purchase insurance. Without insurance, the payouts depend only on the outcome of the Personal Event. Given that there is a 20% chance that the Personal Event outcome is Bad and an 80% chance that the Personal Event outcome is Good, the pie chart shows that there is a 20% chance you earn $25 (= $60 - $35) and an 80% chance that you earn $60.

The bottom pie chart shows the possible earnings if you choose to purchase insurance. Since the insurance claim is only paid out according to the outcome of the Index Event, outcomes from both the Index Event and the Personal Event will decide your earnings. There is an 80% chance that the Index Event outcome Matches the Personal Event outcome. Hence there is an 80% chance you will either receive a claim payment when you suffer a loss or not receive a claim payment when you do not suffer a loss. If either of these happen your payout will be $45.50: your initial stake of $60 less the $14.50 cost of insurance. In the case in which you receive a claim payment when you suffer a loss the payout of $35 completely offsets the loss of $35.

According to the bottom pie chart the chance that the Personal Event outcome is Bad, but the Index Event outcome Differs, is 4% (= 20% × 20%). This means that there is a 4% chance that the Personal Event outcome is Bad without receiving an insurance claim payment. In this case you will receive $10.50: your initial stake of $60 less the $14.50 cost of insurance less the $35 loss. The chance that the Personal Event outcome is Good, and the Index Event outcome Differs, is 16% (= 80% × 20%). This means that there is a 16% chance
that the Personal Event outcome is Good and you still receive an insurance claim payment. In this case you will receive $80.50: your initial stake of $60 less the $14.50 cost of insurance plus the $35 claim payment from the insurance.

There are 54 decisions like this one to be made, each shown on a separate screen on the computer. Each decision might have different chances for the Personal Event outcome, the Index Event outcome, the initial stake, or the cost of insurance, so pay attention to each screen. After you have worked through all of the insurance decisions, please wait in your seat and an experimenter will come to you. You will then roll two 10-sided dice to determine which insurance decision will be played out. Since there are only 54 decisions, you will keep rolling the dice until a number between 1 and 54 comes up. There is an equal chance that any of your 54 choices will be selected, so you should approach each decision as if it is the one that you will actually play out to determine your payoff. Once the decision to play out is selected, you will draw chips from the Index bag and the Personal bag to determine the outcome.

In summary:

- You will decide whether or not to purchase insurance in each of the 54 scenarios.
- One of your decisions will be randomly selected to be played for cash.
- You will suffer the specified monetary loss only if the Personal Event outcome is Bad.
- If you purchase insurance, it will pay a claim payment only if the Index Event outcome is Bad. This can happen in two ways:
  1. Your Index draw Matches a bad Personal Event outcome;
  2. Your Index draw Differs from a good Personal Event outcome.

Whether or not you prefer to buy the insurance is a matter of personal taste. You may choose to buy insurance on some or all of your 54 choices, or none of the choices. The people next to you may be presented with different choices, insurance prices, and may have different preferences, so their responses should not matter to you. Please work silently, and make your choices by thinking carefully about each prospect.
Your payoff from this task is in cash and is in addition to the show-up payment that you receive just for being here, as well as any other earnings in other tasks. If you have a question, raise your hand and someone will come over and answer it.
B.1.4 Understand treatment

Participants in the Understand treatment received the same instruction set as the Baseline treatment, provided in Appendix B.1.1. Immediately after the Baseline insurance instructions, participants were given the instructions for the index insurance beliefs, provided in Appendix B.4. Subjects then completed the index insurance beliefs task first and then finished with the baseline insurance task. In all other treatments, the insurance task was conducted first and then followed by the insurance belief task.
B.1.5 Sales Pitch treatment

Choices Over Insurance Prospects

In this task you will make choices about whether to insure against possible monetary loss. Insurance is an important way to protect yourself against monetary losses. In each choice you will start out with an initial amount of money and, in the event of a loss, the loss amount will be taken from this initial stake. In each choice you will have the option to buy insurance to protect you against the possible loss, although you are not required to buy the insurance.

Some people believe that they can save enough money to replace their assets should anything happen to them. The problem is that, in most cases, the expenses incurred after an accident, the death of a loved one, or a disability, are beyond any savings or wealth that a person has accumulated. For this reason, insurance has become an important component of the financial planning for most people.

You will make 54 choices in this task. You will actually get the chance to play one of the choices you make, and you will be paid in cash according to the outcome of that choice. So you should think carefully about how much each insurance choice is worth to you.

Each choice has two random events: a Personal Event and an Index Event. Each event has two possible outcomes: Good or Bad. If the Personal Event outcome is Bad, then you will suffer a loss. Before you know the outcome of the Personal Event, you must decide whether to purchase insurance against this possible loss. However, the insurance only pays a claim if the Index Event outcome is Bad.

If you do not purchase insurance, then only the outcome of the Personal Event will decide your earnings:

<table>
<thead>
<tr>
<th>Personal Event</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td>Initial stake - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Initial stake</td>
</tr>
</tbody>
</table>

If you do purchase insurance, it is important for you to understand that an insurance claim is not paid according to whether you actually suffer a loss. Instead, an
insurance claim is paid only according to the Index Event. Both events will decide your earnings:

<table>
<thead>
<tr>
<th>Personal Event</th>
<th>Index Event</th>
<th>Your Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bad</td>
<td>Bad</td>
<td>Initial stake - Insurance cost - Loss + Insurance Coverage</td>
</tr>
<tr>
<td>Bad</td>
<td>Good</td>
<td>Initial stake - Insurance cost - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Good</td>
<td>Initial stake - Insurance cost - Loss</td>
</tr>
<tr>
<td>Good</td>
<td>Bad</td>
<td>Initial stake - Insurance cost + Insurance Coverage</td>
</tr>
</tbody>
</table>

So there are four possible outcomes if you purchase insurance. You might suffer a loss and receive an insurance claim payment. Or you might suffer a loss but not receive an insurance claim payment. You might not suffer a loss and also receive no insurance claim payment. Finally, you might receive an insurance claim payment even when you do not suffer a loss.

Each event is determined by randomly drawing a colored chip from a bag. In general, each draw will involve two colors, and each decision you make will involve different amounts and mixtures of two colors. When making each decision, you will know the exact amounts and mixtures of colored chips associated with the decision. After you have decided whether or not to purchase insurance, the two events will be determined as follows.

First, the Personal Event will be determined with blue and red chips.

- If you draw a blue chip, then the Personal Event outcome is Good and you do not suffer a loss.
- If you draw a red chip, then the Personal Event outcome is Bad and you suffer a loss.

Next, if you purchased insurance, the Index Event will be determined with green and black chips.

- If you draw a green chip, then the Index Event outcome Matches the Personal Event outcome
• If you draw a black chip, then the Index event outcome Differs from the Personal Event outcome

Here is an example of what your decision would look like on the computer screen. The display on your screen will be bigger and easier to read.

In this example you start out with an initial stake of $75. If the outcome of the Personal Event is Bad you will lose $45, and if the outcome of the Personal Event is Good you will not lose any money. If you faced the choice in this example and chose to purchase insurance, you would pay $5.75 from your initial stake. You would pay this $5.75 before you drew any chips, so you would pay it regardless of the outcomes of your draws.

You will be drawing colored chips from bags to determine the outcomes of both events. First, you will draw a chip to determine the Personal Event outcome. The image on the left shows that there is a 10% chance that the Personal Event outcome is Bad, and a 90% chance that the Personal Event outcome is Good. This means there will be 9 blue chips and 1 red chip in a bag, and the color of the chip you randomly draw from the bag represents the outcome of the Personal Event. If a blue chip is drawn, the Personal Event outcome is Good, and if a red chip is drawn the Personal Event outcome is Bad.
Next, you will draw a chip to determine the Index Event outcome. There is an 80% chance that the Index Event outcome Matches the Personal Event outcome and a 20% chance that the Index Event outcome Differs from the Personal Event outcome. This means there will be 8 green chips and 2 black chips in a bag. If a green chip is drawn the Index Event outcome Matches the Personal Event outcome, and if a black chip is drawn the Index Event outcome Differs from the Personal Event outcome.

You will indicate your choice to purchase, or not purchase, the insurance by clicking on your preferred option on the computer screen.

There are 54 decisions like this one to be made, each shown on a separate screen on the computer. Each decision might have different chances for the Personal Event outcome, the Index Event outcome, the initial stake, or the cost of insurance, so pay attention to each screen. After you have worked through all of the insurance decisions, please wait in your seat and an experimenter will come to you. You will then roll two 10-sided dice to determine which insurance decision will be played out. Since there are only 54 decisions, you will keep rolling the dice until a number between 1 and 54 comes up. There is an equal chance that any of your 54 choices will be selected, so you should approach each decision as if it is the one that you will actually play out to determine your payoff. Once the decision to play out is selected, you will draw chips from the Index bag and the Personal bag to determine the outcome.

In summary:

- You will decide whether or not to purchase insurance in each of the 54 scenarios.
- One of your decisions will be randomly selected to be played for cash.
- You will suffer the specified monetary loss only if the Personal Event outcome is Bad.
- If you purchase insurance, it will pay a claim payment only if the Index Event outcome is Bad. This can happen in two ways:
  1. Your Index draw Matches a bad Personal Event outcome;
  2. Your Index draw Differs from a good Personal Event outcome.
Insurance is important because:

1. **It protects individuals and their families**
   Your family depends on financial support to enjoy a decent standard of living, which is why insurance is particularly important once you start a family. It means that the people who matter most in your life will be protected from financial hardship if the unexpected happens.

2. **It reduces stress during difficult times**
   None of us know what lies around the corner. Unforeseen tragedies, such as illness, injury, or permanent disability, even death, can leave you and your family facing tremendous emotional stress, and even grief. For most people, with insurance in place, their financial stress will be reduced so that they can focus on recovery and rebuilding their lives.

3. **To enjoy financial security**
   No matter what your financial position is today, an unexpected event can see it all unravel very quickly. Buying insurance offers the certainty of a claim payment so that if there is an unforeseen event you can hopefully continue to move forward.

4. **Peace of mind**
   No amount of money can replace your health and wellbeing – or the role you play in your family. Because of insurance, most people can have peace of mind knowing that if anything happened to them, at least their family’s financial security is assisted by insurance.

For each of the 54 choices you decide if you want to purchase insurance or not, knowing that insurance is important to protect yourself against the risk of monetary loss. The people next to you may be presented with different choices, insurance prices, and may have different preferences, so their responses should not matter to you. Please work silently, and make your choices by thinking carefully about each prospect.

Your payoff from this task is in cash and is in addition to the show-up payment that you receive just for being here, as well as any other earnings in other tasks. If you have a question, raise your hand and someone will come over and answer it.
B.1.6 Peers treatment

Participants in the peers treatment received the same instruction set as the Baseline treatment, provided in Appendix B.1.1. In addition, on each of the decision screens, subjects were provided with information on how other students have responded to the same decision. On each decision screen participants saw the added text: “Over the last few weeks other students like yourself participated in this experiment. On average, X% chose 'Do Not Buy Insurance' and Y% chose 'Buy Insurance' for this question.” Here X and Y updated with the actual percentages for each decision. These percentages were calculated from actual purchase decisions from 86 subjects that participated in the first several sessions of the Baseline treatment. Figure B.1 displays where the additional text was inserted on the subject’s screen.

Figure B.1: Subject’s Screen for Peer Treatment of the Insurance Purchase Task

Note:
B.2 Instructions for the risk preference elicitation task

Choices Over Risky Prospects

This is a task where you will choose between prospects with varying prizes and chances of winning each prize. You will be presented with a series of pairs of prospects where you will choose one of them. For each pair of prospects, you should choose the prospect you prefer. You will actually get the chance to play one of these prospects for earnings, and you will be paid according to the outcome of that prospect, so you should think carefully about which prospect you prefer on each decision screen.

Here is an example of what the computer display of such a pair of prospects will look like.
The outcome of the prospects will be determined by the draw of a random number between 1 and 100. Each number between, and including, 1 and 100 is equally likely to occur. In fact, you will be able to draw the number yourself using two 10-sided dice.

You might be told your cash endowment for each decision at the top of the screen. In this example it is $35, so any earnings would be added to or subtracted from this endowment. The endowment may change from choice to choice, so be sure to pay attention to it. The endowment you are shown only applies for that choice.

In this example the left prospect pays twenty-five dollars ($25) if the number drawn is between 1 and 5, pays negative five dollars ($-5) if the number is between 6 and 55, and pays negative thirty-five dollars ($-35) if the number is between 56 and 100. The blue color in the pie chart corresponds to 5% of the area and illustrates the chances that the number drawn will be between 1 and 5 and your prize will be $25. The orange area in the pie chart corresponds to 50% of the area and illustrates the chances that the number drawn will be between 6 and 55 and your prize will be $-5. The green area in the pie chart corresponds to 45% of the area and illustrates the chances that the number drawn will be between 56 and 100. When you select the decision screen to be played out the computer will confirm the die rolls that correspond to the different prizes.

Now look at the pie on the right. It pays twenty-five dollars ($25) if the number drawn is between 1 and 15, negative five dollars ($-5) if the number is between 16 and 25, and negative thirty-five dollars ($-35) if the number is between 26 and 100. As with the prospect on the left, the pie slices represent the fraction of the possible numbers which yield each payoff. For example, the size of the $25 pie slice is 15% of the total pie.

Even though the screen says that you might win a negative amount, this is actually a loss to be deducted from your endowment. So if you win $-5, your earnings would be $30 = $35 – $5.

Each pair of prospects is shown on a separate screen on the computer. On each screen, you should indicate which prospect you prefer to play by clicking on one of the buttons beneath the prospects.

Some decision screens could also have a pair of prospects in which one of the prospects will give you the chance for “Double or Nothing”. For instance, the right
prospect in this screen image pays “Double or Nothing” if the Green area is selected, which happens if the number drawn is between 51 and 100. The right pie chart indicates that if the number is between 1 and 50 you get $10. However, if the number is between 51 and 100 we will flip a coin with you to determine if you get either double the amount or $0. In this example, if it comes up Heads you get $40, otherwise you get nothing. The prizes listed underneath each pie refer to the amounts before any “Double or Nothing” coin toss.

After you have worked through all of the pairs of prospects, please wait quietly until further instructions. When it is time to play this task out for earnings, you will then roll two 10-sided dice until a number comes up to determine which pair of prospects will be played out. If there are 40 pairs we will roll the dice until a number between 1 and 40 comes
up, if there are 80 pairs we will roll until a number between 1 and 80 comes up, and so on. Since there is a chance that any of your choices could be played out for real, you should approach each pair of prospects as if it is the one that you will play out. Finally, you will roll the two ten-sided dice to determine the outcome of the prospect you chose, and if necessary we will then toss a coin to determine if you get “Double or Nothing”.

Here is an example: suppose your first roll was 81. We would then pull up the 81st decision that you made and look at which prospect you chose – either the left one or the right one. Let’s say that the 81st lottery was the same as the last example, and you chose the left prospect. If the random number from your second roll was 37, you would win $0; if it was 93, you would get $20.

If you picked the prospect on the right and drew the number 37, you would get $10; if it was 93, we would have to toss a coin to determine if you get “Double or Nothing”. If the coin comes up Heads then you would get $40. However, if it comes up Tails you would get nothing from your chosen prospect.

It is also possible that you will be given a prospect in which there is a “Double or Nothing” option no matter what the outcome of the random number. This screen image illustrates this possibility.
In summary, your payoff is determined by five things:

- by your endowment, if there is one, shown at the top of the screen;
- by which prospect you selected, the left or the right, for each of these pairs;
- by which prospect pair is chosen to be played out in the series of pairs using the two 10-sided dice;
- by the outcome of that prospect when you roll the two 10-sided dice; and
- by the outcome of a coin toss if the chosen prospect outcome is of the “Double or Nothing” type.
Which prospects you prefer is a matter of personal choice. The people next to you may be presented with different prospects, and may have different preferences, so their responses should not matter to you or influence your decisions. Please work silently, and make your choices by thinking carefully about each prospect.

All payoffs are in cash, and are in addition to the $5 show-up fee that you receive just for being here, as well as any other earnings in other tasks from the session today.
B.3 Instructions for the financial literacy belief elicitation

Instructions

This is a task where you will be paid according to how accurate your beliefs are about certain things. You will be presented with some questions and asked to place some bets on your beliefs about the answers to each question. You will be rewarded for your answer to one of these questions, so you should think carefully about your answer to each question. The question that is chosen for payment will be determined after you have made all decisions, and that process is explained below.

Here is an example of what the computer display of a question might look like. We pick a question that is not going to be asked of you, just for illustration.

The display on your computer will be larger and easier to read. You have 10 sliders to adjust, shown at the bottom of the screen, and you have 100 tokens to allocate across the sliders. Each slider allows you to allocate tokens to reflect your belief about the answer to
this question. You must allocate all 100 tokens, and in this example we start with 0 tokens allocated to each slider. As you allocate tokens, by adjusting sliders, the payoffs displayed on the screen will change. Your earnings are based on the payoffs that are displayed after you have allocated all 100 tokens.

You can earn up to $50 in this task.

Where you position each slider depends on your beliefs about the correct answer to the question. Note that the bars above each slider correspond to that particular slider. In our example, the tokens you allocate to each bar will naturally reflect your beliefs about the proportion of left-handed Presidents. The first bar corresponds to your belief that the proportion is between 0% and 9%. The second bar corresponds to your belief that the proportion is between 10% and 19%, and so on. Each bar shows the amount of money you could earn if the true proportion is in the interval shown under the bar.

To illustrate how you use these sliders, suppose you think there is a fair chance the true answer is just under 50%. Then you might allocate the 100 tokens in the following way: 50 tokens to the interval 40% to 49%, 40 tokens to the interval 30% to 39%, and 10 tokens to the interval 20% to 29%. So you can see in this picture that if indeed the proportion of left-handed Presidents is between 40% and 49% you would earn $39.50. You would earn less than $39.50 for any other outcome. You would earn $34.50 if the proportion of left-handed Presidents is between 30% and 39%, $19.50 if it is between 20% and 29%, and for any other proportion you would earn $14.50.
You can adjust the allocation as much as you want to best reflect your personal beliefs about the proportion of left-handed Presidents.

Your earnings depend on your reported beliefs and, of course, the true answer. For instance, suppose you allocated your tokens as just shown. The true answer is that there are 8 left-handed Presidents out of 44, so the true proportion is 18.2%, and we would round that to 18%. So if you had reported these beliefs, you would have earned $14.50.

Suppose you had put all of your eggs in one basket, and allocated all 100 tokens to the interval corresponding to a proportion between 10% and 19%. Then you would have faced the earnings outcomes shown here:
Note the “good news” and “bad news” here. Since the proportion of left-handed Presidents is between 10% and 19%, you earn the maximum payoff, shown here as $50. But if the true proportion had been 20%, you would have earned nothing in this task.

It is up to you to balance the strength of your personal beliefs with the possibility of them being wrong. There are three important points for you to keep in mind when making your decisions:

- First, your belief about the correct answer to each question is a personal judgment that depends on the information you have about the topic of the question.
- Second, depending on your choices and the correct answer you can earn up to $50.
- Third, your choices might also depend on your willingness to take risks or to
gamble.

The decisions you make are a matter of personal choice. Please work silently, and make your choices by thinking carefully about the questions you are presented with.

When you are satisfied with your decisions, you should click on the Submit button and confirm your choices. When you are finished we will roll dice to determine which question will be played out. The experimenter will record your earnings according to the correct answer and the choices you made.

All payoffs are in cash, and are in addition to the show-up fee that you receive just for being here, as well as any other earnings in the session today.
B.4 Instructions to the index insurance beliefs

Beliefs over Potential Outcomes, Monetary Endowments, and Insurance Purchases

In this task you will be presented with possible outcomes of monetary endowments that are exposed to random events that can be protected through insurance or not. In this task you will be paid according to how accurate your beliefs are about the outcomes of these endowments, shocks, and insurance purchases. In this task you will not be asked to make any insurance purchases yourself. You will be presented with some questions and asked to place some bets on your beliefs about the answers to each question. You will be rewarded for your answer to one of these questions, so you should think carefully about your answer to each question. The question that is chosen for payment will be determined after you have made all decisions, and that process is explained below.

Here is an example of the outcomes that will be presented to you on paper. The paper display will be bigger and easier to read. From the top left corner, note that this display refers to Figure X.

![Figure X](image)

We will ask you 10 questions about potential outcomes of initial stakes, the personal
Examples of the questions we might ask you are:

- **Consider Figure X. What is your outcome if you decided not to purchase insurance, experienced a good personal event, and the index outcome matches?** There will be 10 categories of possible answers: $0-$9; $10-$19; $20-$29; $30-$39; $40-$49; $50-$59; $60-$69; $70-$79; $80-$89; $90-$100.

- **Consider Figure X. What is your outcome if you decided to purchase insurance, experienced a bad personal event, and the index outcome differs?** There will be 10 categories of possible answers: $0-$9; $10-$19; $20-$29; $30-$39; $40-$49; $50-$59; $60-$69; $70-$79; $80-$89; $90-$100.

We will then ask you to place some bets on your beliefs about the answers to each question.
Here is an example from the first question shown above. You will probably recall this task from a previous session. You have 10 sliders to adjust, shown at the bottom of the screen, and you have 100 tokens to allocate across the sliders. Each slider allows you to allocate tokens to reflect your belief about the answer to this question. You must allocate all 100 tokens, and in this example we start with 0 tokens allocated to each slider. As you allocate tokens, by adjusting sliders, the payoffs displayed on the screen will change. Your earnings are based on the payoffs that are displayed after you have allocated all 100 tokens.

You can earn up to $10 in this task.

Where you position each slider depends on your beliefs about the correct answer to the question. Note that the bars above each slider correspond to that particular slider. Each bar shows the amount of money you could earn if the true outcome is in the interval shown under the bar.

To illustrate how you use these sliders, you might make these choices:
Your earnings depend on your reported beliefs and, of course, the true answer. For instance, suppose you allocated your tokens as just shown. If the true answer had been $13, you would have earned $2.78. If the true answer had been $33, you would have earned $8.78, and so on. If the true answer contains cents, we will round it to the nearest whole dollar. So if the true answer had been $13.26, we would have rounded it to $13.

Suppose you had put all of your eggs in one basket, and allocated all 100 tokens to the interval corresponding to an outcome between $80 and $89. Then you would have faced the earnings outcomes shown here:

Note the “good news” and “bad news” here. If the true answer had been $85, you would have earned $10. But if the true answer had been $15, or even $79, you would have earned nothing in this task.

It is up to you to balance the strength of your personal beliefs with the possibility of them being wrong. There are three important points for you to keep in mind when making
your decisions:

- First, your belief about the correct answer to each question is a personal judgment that depends on the information you have about the topic of the question.
- Second, depending on your choices and the correct answer you can earn up to $10.
- Third, your choices might also depend on your willingness to take risks or to gamble.

The decisions you make are a matter of personal choice. Please work silently, and make your choices by thinking carefully about the questions you are presented with.

When you are satisfied with your decisions, you should click on the Submit button and confirm your choices. When you are finished we will roll dice to determine which question will be played out. The experimenter will record your earnings according to the correct answer and the choices you made. All payoffs are in cash, and are in addition to the show-up fee that you receive just for being here, as well as any other earnings in the session today.
B.5 Supplement to the index insurance beliefs task

Reference Materials

The following five figures are the reference materials for the upcoming beliefs task. Please start by watching the video and reviewing the accompanying instructions provided in print, and then refer back to this handout once you begin the task.
Figure B

Your initial stakes are $60.00.
You may lose $39.00 if the outcome of your PERSONAL EVENT is BAD.
You have the option to purchase insurance for $11.00. This insurance will pay $39.00 only if the outcome of the INDEX is BAD.
You have the option to not purchase insurance. In this case you lose $39.00 if the outcome of your PERSONAL EVENT is BAD.

PERSONAL EVENT Probability

10% BAD
90% GOOD

INDEX MATCHING Probability

60% MATCHES
40% DIFFERS

Figure C

Your initial stakes are $60.00.
You may lose $39.00 if the outcome of your PERSONAL EVENT is BAD.
You have the option to purchase insurance for $4.00. This insurance will pay $39.00 only if the outcome of the INDEX is BAD.
You have the option to not purchase insurance. In this case you lose $39.00 if the outcome of your PERSONAL EVENT is BAD.

PERSONAL EVENT Probability

20% BAD
80% GOOD

INDEX MATCHING Probability

100% MATCHES
0% DIFFERS
Your initial stakes are $60.00.
You may lose $30.00 if the outcome of your PERSONAL EVENT is BAD.
You have the option to purchase insurance for $7.75. This insurance will pay $30.00 only if the outcome of the INDEX is BAD.
You have the option to not purchase insurance. In this case you lose $30.00 if the outcome of your PERSONAL EVENT is BAD.

PERSONAL EVENT Probability

10% BAD
90% GOOD

INDEX MATCHING Probability

60% MATCHES
40% DIFFERS

Your initial stakes are $60.00.
You may lose $30.00 if the outcome of your PERSONAL EVENT is BAD.
You have the option to purchase insurance for $4.00. This insurance will pay $30.00 only if the outcome of the INDEX is BAD.
You have the option to not purchase insurance. In this case you lose $30.00 if the outcome of your PERSONAL EVENT is BAD.

PERSONAL EVENT Probability

10% BAD
90% GOOD

INDEX MATCHING Probability

60% MATCHES
40% DIFFERS
B.6 Instructions for the Raven Advanced Progressive Matrices Test

Matrices Task

The first task today will involve completing a series of 12 matrices. For each item, you will be asked to identify the missing element that completes a pattern. Each matrix consists of 8 visual geometric designs with a missing 9th piece in the bottom right corner. You are asked to identify the missing element that completes the pattern from eight choices provided.

The figure below is representative of a matrix that you will encounter. You will notice in the bottom-right portion of the top figure that there is a section cut out of it. Look at the pattern in that top figure and think what piece is needed to complete the pattern correctly. Then find the right piece of out of the eight choices shown below.
Only one of these pieces is correct. In this case, number 8 completes the diagonal, but not going downwards or across. We see that each geometric shape is getting smaller, whether going down, across, or diagonally. Can you see the choice that completes the matrix? If you said Number 4, you are correct.

You will be presented with 12 of these matrices and asked to find the missing piece in each. You may find the problems easy at first and then becoming more difficult. Please work quietly and independently until all 12 matrices are completed.
B.7 Questions and Correct and Heuristic Answers Cognitive Reflection Test

Table B.1: Cognitive Reflection Test

<table>
<thead>
<tr>
<th>Question</th>
<th>Correct Answer</th>
<th>Heuristic Answer</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?</td>
<td>(correct answer: 5 cents; heuristic answer: 10 cents)</td>
<td>Frederick (2005)</td>
<td></td>
</tr>
<tr>
<td>If it takes 5 minutes for five machines to make five widgets, how long would it take for 100 machines to make 100 widgets?</td>
<td>(correct answer: 5 minutes; heuristic answer: 100 minutes)</td>
<td>Frederick (2005)</td>
<td></td>
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<tr>
<td>In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?</td>
<td>(correct answer: 47 days; heuristic answer: 24 days)</td>
<td>Frederick (2005)</td>
<td></td>
</tr>
<tr>
<td>If three elves can wrap three toys in one hour, how many elves are needed to wrap six toys in two hours?</td>
<td>(correct answer: 3 elves; heuristic answer: 6 elves)</td>
<td>Primi et al. (2016)</td>
<td></td>
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<tr>
<td>Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are there in the class?</td>
<td>(correct answer: 29 students; heuristic answer: 30 students)</td>
<td>Primi et al. (2016)</td>
<td></td>
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<tr>
<td>In an athletics team, tall members are three times more likely to win a medal than short members. This year the team has won 60 medals so far. How many of these have been won by short athletes?</td>
<td>(correct answer: 15 medals; heuristic answer: 20 medals)</td>
<td>Primi et al. (2016)</td>
<td></td>
</tr>
</tbody>
</table>
B.8 Questions and Correct Answers Hypothetical Financial Literacy Questions

Correct answers listed in bold

1. An investment with a high return is likely to be high risk.
   - True
   - False
   - Don’t know
   - Refuse to answer

2. High inflation means that the cost of living is increasing rapidly.
   - True
   - False
   - Don’t know
   - Refuse to answer

3. It is usually possible to reduce the risk of investing in the stock market by buying a wide range of stocks and shares.
   - True
   - False
   - Don’t know
   - Refuse to answer

4. If interest rates rise, what will typically happen to bond prices?
   - They will rise
   - They will fall
   - They will stay the same
   - There is no relationship between bond prices and the interest rate
   - Don’t know
5. A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less.

- True
- False
- Don’t know
- Refuse to answer

6. Suppose you owe $1,000 on a loan and the interest rate you are charged is 20% per year compounded annually. If you didn’t pay anything off, at this interest rate, how many years would it take for the amount you owe to double?

- Less than 2 years
- 2 to 4 years
- 5 to 9 years
- 10 or more years
- Don’t know
- Refuse to answer

7. Suppose that you receive $20 in interest on your savings account during a year. At the same time, prices increase so that something that cost $100 at the beginning of the year now costs $120 at the end of the year. What will the $20 in interest earnings allow you to do?

- Buy more things at the end of the year than I did at the beginning of the year
- Buy the same things at the end of the year that I did at the beginning of the year
- Buy fewer things at the end of the year than I did at the beginning of the year
- Don’t know
- Refuse to answer

8. Which of the following is an accurate statement about investment returns?
• Usually, investing $5,000 in shares of a single company is safer than investing $5,000 in a fund which invests in shares of many companies in different industries

• Usually, investing $5,000 in shares of a single company is less safe than investing $5,000 in a fund which invests in shares of many companies in different industries

• Usually, investing $5,000 in shares of a single company is equally as safe as investing $5,000 in a fund which invests in shares of many companies in different industries

• Don’t know

• Refuse to answer

9. Suppose you are a member of a stock investment club. This year, the club has about $200,000 to invest in stocks and the members prefer not to take a lot of risk. Which of the following strategies would you recommend to your fellow members?

• Put all of the money in one stock

• Put all of the money in two stocks

• Put all of the money in a stock index fund that tracks the behavior of 500 large firms in the USA

• Don’t know

• Refuse to answer
## Parameters Experiment

### C.1 Choice parameters insurance purchase task

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<th>Premium</th>
<th>Loading</th>
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<th>Personal loss probability</th>
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## C.2 Choice parameters risk preference task

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|------|------|------|------|------|------|------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
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| redm | 0    | 1    | 0    | 0    | 0.5  | 0.5  | 0    | 0    | 0   | $0  | $10 | $36 | $0  | $0  | $5  | $18 | $0  |
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| redm | 0    | 0.5  | 0    | 0    | 0.5  | 0.5  | 0    | 0    | 0   | $0  | $20 | $35 | $0  | $0  | $20 | $35 | $0  | $0  |
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| race | 0    | 0    | 0    | 0.25 | 0.25 | 0    | 0.25 | 0    | 0   | $0  | $10 | $35 | $0  | $0  | $10 | $35 | $0  | $0  |
| race | 0    | 0    | 0    | 0.25 | 0.25 | 0    | 0.25 | 0    | 0   | $0  | $10 | $35 | $0  | $0  | $10 | $35 | $0  | $0  |
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For the rest of the table, please refer to the original document.