Compulsory versus Voluntary Insurance: A real Experiment

Peilu Zhang (3rd year Ph.D) Marco Palma∗

1 Introduction

Insurance can be classified into two categories: Compulsory (government/public) Insurance and Voluntary Insurance (market/private). People can freely choose to take voluntary insurance or not, but they are unable to refuse to take compulsory insurance. Agricultural insurance, for example, the US Crop and livestock insurance programs are voluntary; however, they are compulsory for producers who want to be eligible for crop disaster assistance payments. Since there is no adverse selection in compulsory insurance, Arrow (1963) strongly suggests that the government should provide insurance in all contexts, against all risks.

In practice, the vast majority of compulsory insurance are partially compulsory. This means the public insurance provides only partial coverage, and it allows supplemental voluntary purchases, such as the Supplemental Coverage Option (SCO) for Federal Crop Insurance. In this case compulsory and voluntary insurance coexist.

The literature about insurance has recently focused on the comparison between Compulsory and Voluntary Insurance in terms of adverse selection, moral hazard and social welfare, and also the effects of partial compulsory insurance on the residual voluntary part. Our objective in this paper is therefore to use one simple experiment to address all these problems.

It is not easy to establish a lab situation which can simulate a real insurance market very well. Hence, most insurance experiments use hypothetical situations. For example, Hill and Viceiszsa (2012) simulated a fertilizer purchase situation to study moral hazard in weather-index insurance; Kunreuther and Pauly (2014) asked participants to imagine that they owned a house that was worth US $100,000, and then asked them to make an insurance purchasing decision.

In our experiment, we use the Balloon Analogue Risk Task (BART)1 as both the assessment of risk-taking and economics paradigm. Our experiment has two important advantages: first the environment is not hypothetical, but a real economic environment, which may have accidents (explosions) and then they need to make real decisions about insurance purchases; second since BART has been proved a valid way to assess risk-taking behaviors (measured by average wanted pumps) in real world, we can use the performance of participants with and without insurance to test for adverse selection and moral hazard. In other settings, adverse selection and moral hazard are difficult to measure. Our paper is the first to use BART to study insurance mechanisms, and also the first to comprehensively study insurance in one simple experiment.

2 Experimental design

We use a between subject design with three treatments in total. The experiment were conducted on Amazon Mturk. In total there were 305 subjects, with about 100 subjects per treatment. The subjects first need to sign the consent form, and take the experiment in the order of BART, sensation seeking scale questionnaire(Zuckerman, Kolin, Price, and Zoob, 1964), DOPERT2(Blais and Weber, 2006) questionnaire, gamble choice(Eckel and Grossman, 2008a) and a post demographic survey.

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1BART is a computerized measure of risk taking behavior. In the task, participants are presented with a balloon and they receive a monetary rewarded for each successful pump on the balloon. More pumps yield more potential earnings, but also higher risk of explosion.In case of an explosion participants lose all the money.

2Domain-Specific Risk-Taking Scale
In the BART section, all subjects play with 30 sequential balloons which have a maximum number of 128 pumps each; the reward for each pump is 1 cent. To avoid an endowment effect, only three randomly selected balloons determine their final payment.

Treatment 1: the “voluntary insurance”. For the first and last balloon (subjects do not know this information until they play with that balloon), subjects need to decide whether to buy an insurance or not before they pump the balloon. For the other 28 balloons, they just play normally without insurance choice. The insurance is voluntary. If the insured balloon explodes, the insurer will give the subject 64 cents, and the premium is 40 cents.

Treatment 2: the “compulsory insurance”. This treatment is the same as the first one except that the insurance for the first and last balloon is compulsory.

Treatment 3: the “partial compulsory insurance”. This treatment is the same as the second, except that compulsory insurance is partial. This means the compulsory insurance only pays 32 cents to the subject if the insured balloon explodes, and the subject is allowed to buy voluntary insurance to get the full coverage. The premium is 20 cents for compulsory insurance. The premium and coverage for the voluntary part are also 20 cents and 32 cents respectively.

3 Results (potential discussions)

Adverse selection: There is adverse selection in voluntary insurance, but we don’t find it in partial compulsory insurance. This means the partial compulsory part in partial compulsory insurance can reduce the adverse selection of the residual voluntary part. Specifically, our results show that the partial compulsory and voluntary part are substitutes for risk lovers, but complements for risk averters. Hence, there is no crowd out effect of partial compulsory insurance overall in our experiment, which is different from some previous literature suggest (Ehrlich and Becker, 1972).

Moral hazard: We do find the moral hazard problem with all three types of insurance. Our experiment shows that participants become significantly more risk taking than without insurance.

The only one exception is the first balloon in the compulsory insurance treatment. Our result suggests that in the compulsory treatment, people don’t take more risk behavior after they choose insurance in the first balloon. However, in the last balloon, the moral hazard problem arises. One explanation may be that people easily ignore compulsory insurance at the beginning (first balloon) since they don’t need to make any decisions. However after learning (last balloon), they realize they are under insurance.

Social welfare: Although there is no adverse selection in compulsory insurance, severe moral hazard makes its final social welfare be the lowest.

References


Compulsory versus Voluntary Insurance: A real Experiment

Peilu Zhang∗ Marco A. Palma†

Abstract

Insurance can be classified into two broad categories: Compulsory (government/public) Insurance and Voluntary Insurance (market/private). In practice, the vast majority of compulsory insurance is partially compulsory, where compulsory and voluntary insurance coexist. In this paper, we use the Balloon Analogue Risk Task (BART) as both the assessment of risk-taking and economics paradigm to conduct a real insurance experiment. The main objective is to compare purely compulsory, voluntary and mixed insurance in terms of adverse selection, moral hazard and social welfare. We also test for the effects of the compulsory part on the residual voluntary part in mixed insurance. We find adverse selection in purely voluntary insurance, but not in mixed insurance in that when the compulsory and voluntary insurance coexist they are substitutes for more risk-seeking individuals, but complements for more risk-averse individuals. Overall there’s no crowd-out effect of compulsory insurance on the residual voluntary purchases. Moral hazard exists in all three types of insurance, but it is smaller in mixed insurance. Finally, our results suggest that even though there is no adverse selection in purely compulsory insurance, significant moral hazard makes it the insurance type with the lowest welfare.

Keywords: Compulsory Insurance, Voluntary Insurance, Mixed Insurance, BART

JEL Codes: G22, C90, D81

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I Introduction

Insurance plays an important role in society and in public policy. Insurance can be classified into two broad categories: Compulsory (government/public) Insurance and Voluntary Insurance (market/private). People can freely choose to purchase voluntary insurance or not, but they are unable to refuse compulsory insurance. For example, in many countries, national medical insurance, national health care insurance, as well as specific insurance plans, such as the U.S. Federal Crop Insurance and the Flood Insurance on properties that are located in areas at high risk of flooding, are all compulsory. Compulsory insurance is usually provided and required by the government in order to guarantee benefits or to help solve the private insurance market failure problem. The other category -voluntary insurance- is normally provided by private insurance companies. Many kinds of insurance, such as life insurance, house insurance, fire insurance, and many others, belong to this category. In practice, the vast majority of compulsory insurance is partially compulsory (i.e., mixed insurance). In this case, compulsory and voluntary insurance coexist in the market. This means that public insurance provides only partial coverage, and it allows for supplemental voluntary purchases. For example, the U.S. Medicare program covers only half of all health expenditures for Americans aged 65 and older, and younger people with some disabilities; but it still leaves them exposed to substantial health expenditure risk. In this case, people can freely choose to buy additional insurance from the private market to increase their coverage. The voluntary part can also be provided by government programs: such as the Supplemental Coverage Option (SCO) for Federal Crop Insurance.

According to the U.S. Budget (2016), Medicare and general health spending were estimated to be about 28% of all outlays in 2016, and spending on Social Security, unemployment, and labor is about 37%. The Federal Government total exposure for crop insurance is currently around $110 billion, up from $67 billion in 2007. Most of these programs are partially compulsory. It is not unfair to say that the role of insurance has become a central theme for the welfare of the country. However, the question as to what kind of insurance
is the most efficient still has no exact answer from economists. In order to investigate this question, adverse selection, moral hazard, and social welfare are three main issues that need to be carefully addressed.

Adverse selection is a well-known phenomenon in the insurance market. Due to the state of asymmetric information, insurers are not able to distinguish risk averters from risk lovers. Under the same premium and coverage, there is a tendency of insurance to be more differentially demanded by high-risk rather than low-risk individuals. Chiappori and Salanie (2000), Cardon and Hendel (2001), Cohen et al. (2005), Kolstad and Kowalski (2016) use empirical evidence to test the adverse selection model, and find adverse selection in the private insurance market. In contrast, in the case of compulsory insurance, there is no adverse selection, as it forces all individuals, including risk averters and risk lovers, into the consumer pool. This is why Arrow (1963) strongly suggests that the government should provide insurance in situations where the market, for whatever reason, has failed to emerge. Since Arrow (1963), there are plenty of studies that have considered the efficiency of compulsory insurance through theoretical studies and empirical evidence. Akerlof (1970), Pauly (1974), Johnson (1977), Johnson (1978), Dahlby (1981), align with Arrow and argue that compulsory insurance may result in a Pareto improvement, with net gains to society if the government were to overcome problems of adverse selection. However, there is other research denying the efficiency of compulsory insurance (e.g., Harrington and Doerpinghaus (1993), Homburg (2000), Chivers and Flores (2002)).

Moral hazard is another main factor that influences the efficiency of insurance. Adverse selection is caused by hidden information, but moral hazard is caused by hidden actions. Moral hazard arises when an individual incurs in riskier behavior after purchasing insurance because the insurance company bears the cost of the risks. Since insurance companies do not perfectly observe their clients’ actions, they can not deny coverage to clients engaging in riskier actions after being insured. Previous literature has shown that moral hazard is present in different insurance markets. Pauly (1968) and Sapelli and Vial (2003) evaluate
moral hazard in health insurance by studying individual’s medical care expenses and health care services utilization; [Horowitz and Lichtenberg(1993)] show moral hazard in crop insurance by studying chemical use. The government as insurer seldom makes efforts to control moral hazard. However, private insurance companies often carry direct controls of moral hazard through the insurance benefit design. In previous theoretical studies of social welfare comparison between insurance schemes, adverse selection and moral hazard are usually considered separately [Dionne and Doherty(1992); Hansen and Keiding(2002)]. This is due to the model having to be extended from a one-period to a multi-period context to study moral hazard. However, in real life, adverse selection and moral hazard usually come together, and therefore the comparison of efficiency between insurance schemes is still uncertain. Our experimental design allows us to test both adverse selection and moral hazard simultaneously. Compared to voluntary and mixed insurance, we find even though there is no adverse selection in compulsory insurance, significant moral hazard makes it the insurance type with the lowest welfare.

Since the majority of compulsory insurance is partial, investigating the effects of compulsory insurance on the residual voluntary part and social welfare analysis under such interaction are also main topics in the insurance literature [Briys et al.(1988); Petretto(1999); Hindriks(2001); Chetty and Saez(2010)]. For example, the universal health insurance proposed by President Obama in 2010 has generated heated debates. It raised questions about the necessity of mandatory health insurance, not only because it may raise the insurance cost, but also because it may negatively affect the whole health care market and particularly the residual private market. According to [Ehrlich and Becker(1972)], compulsory and voluntary insurance are substitutes when they coexist. This means that there is a crowd-out effect\(^1\) of compulsory insurance on the residual private market. [Finkelstein(2004)] studied the U.S. Medicare program and found that Medicare does not have substantial effects on the coverage in the residual private insurance market. [Brown and Finkelstein(2008)] applied

\(^1\)Crowd-out effect here indicates that increased government involvement in insurance markets substantially reduces purchases from private insurance.
the U.S. Medicaid program and showed that incomplete public insurance crowds out private
isurance demand. Sakai et al. (2012) find that crowd-out depends on the coverage rate of
government insurance; Pannequin et al. (2015) suggest that while compulsory insurance and
voluntary insurance are substitutes for risk averters, they are complements for risk lovers
by theoretical models. In our paper, we call this scheme of insurance where compulsory
and voluntary insurance coexist, mixed insurance. Our results show that in mixed insur-
ance, the compulsory part eliminates adverse selection in the supplemental voluntary part,
and in particular, we find that they are complements for more risk-averse individuals, but
substitutes for more risk-seeking individuals. Overall there is no crowd-out effect of compul-
sory insurance on the residual voluntary purchases. Our result about social welfare under
such interaction, which is different from Besley (1989), Selden (1993) and Blomqvist and
Johansson (1997) whose models focus on the moral hazard problem alone, suggests there is
no difference between the social welfare of mixed insurance and purely voluntary insurance,
but both of them have higher social welfare than purely compulsory insurance as mentioned
above.

Our objective in this paper is to use one simple experiment to address adverse selection,
moral hazard and social welfare simultaneously. Although there has been considerable exper-
imental work on insurance (Schoemaker and Kunreuther 1979; Newhouse et al. 1981; Giné
and Yang 2009; Hennig-Schmidt et al. 2011; Norton et al. 2014), it is not easy to establish
a laboratory situation which can simulate a real insurance market very well. Hence, most
insurance experiments use hypothetical situations. For example, Hill and Viceisza (2012)
simulated a fertilizer purchase situation to study moral hazard in weather-index insurance;
Kunreuther and Pauly (2014) asked participants to imagine that they owned a house that
was worth US $ 100,000, and then asked them to make insurance purchasing decisions.

In our experiment, we use the Balloon Analogue Risk Task (BART) as both the assess-
ment of risk-taking and economics paradigm. Our experiment has two important advantages.
First, the environment is not hypothetical, but a real economic environment, which may have
accidents (explosions). In our experiment, participants had to make real decisions about insurance purchases. Second, since BART has been proved to be a valid measure to assess risk-taking behavior (measured by the average number of desired pumps) in the real world [Lejuez et al. (2002)], we can use the performance of participants with and without insurance to test for adverse selection and moral hazard. In other settings, adverse selection and moral hazard are difficult to measure jointly. Our paper is the first to use BART to study insurance mechanisms, and also the first to comprehensively study insurance in one simple experiment.

Our findings contribute to three main branches of the insurance literature: testing for adverse selection and moral hazard; a social welfare (efficiency) comparison between different insurance schemes; and the effect of compulsory insurance on the remainder voluntary insurance when they coexist. Our results suggest that there is adverse selection in voluntary insurance, but not in mixed insurance. All three types of insurance have moral hazard. Even though there is no adverse selection in compulsory insurance, the severe moral hazard problem in compulsory insurance results in the lowest social welfare. In our experiment, there are no net social gains of making insurance compulsory. The compulsory and voluntary parts in mixed insurance are substitutes for more risk-seeking individuals, but complements for more risk-averse individuals in our experiment, and hence, there’s no crowd-out effect of partially compulsory insurance on the remainder voluntary purchases overall.

The rest of paper is organized as follows. Section II introduces the Balloon Analogue Risk Task. In section III we present our experimental design and procedures. The analysis and results are in section IV. Section V shows individual and gender differences; section VI concludes.

II The Balloon Analogue Risk Task (BART)

To prevent potential negative outcomes associated with risk-taking behavior, researchers have devoted significant attention to the development of reliable and accurate assessment
approaches for measuring riskiness. Lejuez et al. (2002) show that BART can successfully predict naturalistic risk-taking behavior in the real world. BART is now one of the most widely used behavioral measures of risk-taking in both clinical and psychological settings. BART itself is an economic risk task. In this paper we use BART as both the economic paradigm and assessment of risk-taking.

BART is a computerized measure of risk-taking behavior. In the task, participants are presented with a balloon and they receive a monetary reward for each successful pump of the balloon. However, if the balloon explodes, they receive nothing. More pumps yield more potential earnings, but also a higher risk of explosion. The participant does not know the number of pumps that can be made before any balloon explodes. The probability of explosion of a balloon is arranged by constructing an array of N numbers. In our experiment, the array of the balloons is 1-128. Thus, the probability that a balloon will explode at the first pump is 1/128. The probability of explosion at the second pump is 1/127 if the balloon does not explode after the first pump, 1/126 at the third pump, and so on up until the 128th pump, at which the probability of an explosion is 1/1. According to this arrangement, the expected break point for each balloon is the 64th pump. The expected break point is also the optimal response to maximize expected earnings. More pumps indicate more risk-taking. Assuming a linear utility function, a risk neutral participant will maximize his expected utility at the expected break point. A risk loving participant whose utility function is convex would choose more than 64 pumps; a risk averse participant with concave utility function would choose less than 64 pumps. The insurance premium and coverage in our experiment are designed based on this algorithm of BART (explained in detail in the experimental design section).

Pleskac et al. (2008) developed the Automatic BART version, in which participants just input their desired number of pumps into a box for each balloon and the balloon is pumped automatically. If a balloon explodes before the indicated number of pumps is reached, participants lose all their potential winnings for the current balloon. Pleskac et al. (2008) also show this version does not change the validity of BART as the assessment of risk-taking.
In order to have more observations\footnote{In the original BART version, we can only observe risk-taking of balloons that did not explode.}, we use the Automatic Version of BART, and risk-taking is quantified by the number of desired pumps.

III Experimental design

The experiment was conducted using Amazon Mechanical Turk. We use a between subject design with three treatments in total. The treatments are the three types of insurance: purely voluntary, purely compulsory, and mixed insurance. The subjects first signed a consent form and then proceeded to the experiment in the following order: BART, DOSPERT \cite{blais2006} questionnaire\footnote{Domain-Specific Risk-Taking Scale is designed to elicit the domain-specific nature of risk preferences.}, Sensation Seeking Scale questionnaire \cite{zuckerman1964}, gamble-choice task \cite{eckel2008} and a demographic survey. The Sensation Seeking Scale and DOSPERT are used to check whether participants in different treatments have different original risk preferences; it is also used to evaluate whether the riskiness in BART is significantly and positively associated with self-reported risk-taking behavior; the gamble choice, as the traditional method of elicitation of risk preferences in laboratory experiment serves the same purpose here.

In the BART section, all subjects play with 30 sequential balloons which have a maximum number of 128 pumps each; the reward for each pump is 1 cent. Subjects are asked to indicate the number of pumps they want to select for each balloon. Subjects are told that only three randomly selected balloons determine their final payment.

**Treatment 1: Purely Voluntary Insurance.** For the first and last balloon, subjects are allowed to voluntarily buy insurance or not at a premium of 40 cents before they pump the balloon. Subjects do not know this information until they play with that particular balloon. For the other 28 balloons, they play BART normally without the insurance choice. The insurance in this case is voluntary. If the insured balloon explodes, the insurer will give the subject 64 cents, and the premium is 40 cents. In order to ensure understanding of the
procedure and the insurance scheme, subjects must answer a quiz correctly before they start
the BART task.

In our experiment, the maximum possible pumps of a balloon is 128, which means the
balloon will surely explode by the 128th pump. According to the algorithm of BART, the
optimal number of pumps in terms of expected rewards is 64. Thus, we set the insurance
coverage equal to the actual earnings at the optimal pump which is 64 cents. Now suppose
the premium of insurance is Y cents and the subject chooses X pumps after buying the
insurance. His expected earning will be \((64-Y)\times X/128+(X-Y)\times(127/128\times126/127\times\cdots\times (128-X)/(129-X))\), which is the sum of the expected earnings under explosion and not explosion.
We then take the first order condition and get \(X=96\). Thus, after buying the insurance,
the optimal number of pumps becomes 96. The probability of a balloon exploding at the
96th pump is \(1-(127/128\times126/127\times\cdots\times 32/33)=96/128\), and hence, the expected benefits from
insurance are \(64\times96/128=48\). If we set the insurance as actuarially fair, the premium should
be 48 cents. However, to attract more risk averters whose utility function is concave, we
set the premium to be less than the expected benefits as it is usually the case in real life.
This is why we set the premium at 40 cents. Under these settings of insurance premium and
coverage, each rational individual can theoretically have net gains by purchasing insurance.

We only set the insurance option for the first and last balloon because we view partici-
pants’ decisions about insurance purchases in the first balloon as a reflection of home grown
risk-taking before learning; the last balloon can be used to test for risk-taking after learning.
All others serve as comparison without insurance allocation.

**Treatment 2: Purely Compulsory Insurance.** This treatment is the same as the
first treatment, except that the insurance is compulsory, which means subjects have to buy
the insurance at a cost of 40 cents for the first and last balloon.

**Treatment 3: Mixed Insurance.** This treatment is the same as the second treatment,
except that the insurance is partially compulsory. This means the compulsory insurance only
pays 32 cents to the subject if the insured balloon explodes, and the subject is allowed to
buy additional voluntary insurance to get the full coverage. The premium is 20 cents for the compulsory part. The premium and coverage for the voluntary part are also 20 cents and 32 cents respectively.

The logic of calculations of the premium and coverage is the same as in treatment 1, and we just split the premium and coverage into the same two parts.

Table 1: Insurance Features for each Treatment.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>First &amp; Last balloon</th>
<th>Ins coverage (if explodes)</th>
<th>Ins premium</th>
<th>2-29th balloon</th>
<th>No. Subjects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purely Voluntary</td>
<td>Vol insurance</td>
<td>64 cents</td>
<td>40 cents</td>
<td>Normal BART</td>
<td>97</td>
</tr>
<tr>
<td>Purely Compulsory</td>
<td>Com insurance</td>
<td>64 cents</td>
<td>40 cents</td>
<td>Normal BART</td>
<td>103</td>
</tr>
<tr>
<td>Mixed</td>
<td>Vol+Com</td>
<td>32+32 cents</td>
<td>20+20 cents</td>
<td>Normal BART</td>
<td>99</td>
</tr>
</tbody>
</table>

The experiment was computerized using Inquisit [Inquisit, 2016]. In total there were 305 subjects, with about 100 participants per treatment. After deleting subjects with incomplete information, the final sample consists of 299 subjects. Table 1 summarizes the Insurance features for each treatment. The instructions, screenshots, questionnaires and demographic survey questions are available in the Appendix.

IV Results

In this experiment, we are interested in comparing the three schemes of insurance. Since only the first and last balloon have an insurance option, we mainly focus on the performance of these two balloons for the analysis of social welfare and the effects of the compulsory part on the residual voluntary part in the mixed insurance; the other 28 balloons without insurance options are mainly used for the analysis of adverse selection and moral hazard.

Observation 1: There is an adverse selection in purely voluntary insurance, but not in mixed insurance.

Support: Figure I depicts the average number of selected pumps in the 2-29th balloons for those who chose to buy insurance in the first or last balloon and those who did
not purchase insurance at all. In the purely voluntary insurance (Figure 1a), the line for participants who purchased insurance lies above the line for those who did not purchase insurance. Using a two-tailed Mann-Whitney $U$-Test with 28 observations for each subgroup, we find the average number of pumps in the 2-29th balloons for those who “buy insurance” to be significantly higher than those who “do not buy insurance” ($p < 0.001$). Additionally, the difference between the two lines expands in the 11-29th balloons. For the initial 2-10th balloons, it is possible that subjects are still affected by the insurance option in the first balloon, or some subjects misunderstand that they are still under insurance, so the 11-29th balloons may better reflect subjects’ risk-taking behavior without insurance. Thus, the figure indicates the presence of adverse selection in purely voluntary insurance, as it is more attractive to more risk-seeking individuals.

![Figure 1a](image)

![Figure 1b](image)

**Figure 1:** Adverse selection: Average number of pumps in the 2-29th balloon by insurance purchasing decision. *Note:* The black line is the 64th pump which theoretically maximizes the expected earnings. In our experiment, except for the first and last balloon, the average number of pumps per balloon per subject is 56 for both purely voluntary and mixed insurance, and 57 for purely compulsory insurance, which is close to the result of Pleskac et al. (2008): 61.

In mixed insurance (Figure 1b), the result, however, is opposite: the average number of pumps in the 2-29 balloons for those who chose to buy insurance in the first or last balloon is significantly lower than for those who did not choose to buy insurance at all (Mann-Whitney $U$-Test, $p < 0.001$). In Figure 1b, for mixed insurance, the diamond and square lines swap positions. This means that in mixed insurance, the compulsory part eliminates the adverse selection of the residual voluntary part. Specifically, when compulsory and voluntary insurance coexist, they are substitutes for more risk-seeking individuals but complements for more risk-averse individuals. This also explains why in our experiment there is no crowd-out
effect of the compulsory part on the residual voluntary part in mixed insurance overall. Using a two-sided Mann-Whitney $U$-test, we cannot not reject the hypothesis of equal number of subjects choosing to buy insurance between voluntary and mixed insurance ($p=0.546$ for the first balloon; $p=0.975$ for the last balloon).

Income may also affect people’s decision on insurance purchase in the last balloon: people’s choices of insurance purchases may be decided by their income instead of their risk preferences. To test for the income effect, we calculate the sum of earnings in the 1-29th balloon for each participant. However, in both purely voluntary and mixed insurances, we do not find difference in the earnings between participants who choose to buy insurance in the last balloon and participants who choose not to buy insurance in the last balloon (Mann-Whitney $U$-tests, $p=0.127$; $p=0.094$). This result helps us rule out the income effect in our experiment.

We further do a horizontal comparison, and we find that the average number of pumps in the 2-29th balloons for those who chose to buy insurance in purely voluntary insurance are significantly higher than that of those who chose to buy insurance in mixed insurance (Mann-Whitney $U$-Test, $p=0.001$); the average number of pumps in the 2-29th balloons for those who did not choose to buy insurance in purely voluntary insurance are significantly lower than that of those who did not choose to buy insurance in mixed insurance (Mann-Whitney $U$-Test, $p < 0.001$). This further confirms our result that there is adverse selection in purely voluntary insurance, but not in mixed insurance.

**Observation 2:** There is moral hazard in all three insurance schemes, but moral hazard in mixed insurance is the lowest.

**Support:** To consider moral hazard we compare the average number of pumps with and without insurance for each treatment. We find that people have significantly higher average

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4It is possible that even the more risk-averse ("Buy insurance") subjects in mixed insurance are riskier than more risk-seeking ("Buy insurance") subjects in purely voluntary insurance, which may weaken our results about adverse selection. Thus, we do a horizontal comparison and find more risk-seeking ("Buy insurance") subjects in purely voluntary insurance are riskier than more risk-averse ("Buy insurance") subjects in mixed insurance, and more risk-seeking ("Do not buy insurance") subjects in mixed insurance are riskier than more risk-averse ("Do not buy insurance") subjects in purely voluntary insurance.
number of pumps when buying insurance in the first or last balloon compared to the average number of pumps in the 2-29th balloons. For those who did not buy insurance in voluntary or mixed insurance, we don’t find a significant difference. This result suggests that this effect is not due to the insurance itself, but to the endogenous decision of choosing to buy insurance.

Figure 2 depicts the average number of pumps in purely voluntary insurance. First we take the average number of pumps over all the insured subjects, and we find that in Figure 2a the average number of pumps in the 2-29th balloons is significantly lower than in the first and last balloon (Mann-Whitney \( U \)-tests, \( p < 0.001 \); \( p < 0.001 \)). The difference between the first and last balloon is not statistically significant (Mann-Whitney \( U \)-Test, \( p=0.203 \)). Figure 2b shows moral hazard more clearly. From figure 2b we can see that for nearly all insured subjects, the average number of pumps in the first or last balloon are higher than the average number of pumps in the 2-29th balloons. In order to show the figure clearly, we
average the number of pumps in the first and last balloon instead of showing them separately as in Figure 2a. The results are consistent when using the average number of pumps in the first and last balloons or separately.

Figure 2c and Figure 2d show that uninsured subjects who did not buy insurance neither in the first nor the last balloon, there’s no statistically significant difference in the average number of pumps between the 2-29th balloons and the first & last balloons (Mann-Whitney $U$-Test, p=0.635). Figure 3 shows the same result for mixed insurance. Using Mann-Whitney $U$-Tests we find the difference for the insured subjects in mixed insurance is significant as well ($p < 0.001$), and no difference for uninsured subjects ($p=0.768$). Figure 4 shows the result for purely compulsory insurance. There’s only one exception, we find a statistically significant difference in the average number of pumps between the first and last balloon (Mann-Whitney $U$-tests, $p < 0.001$). One possible explanation could be that it is easy for

\footnote{For those who buy insurance only in one of the two balloons, we directly keep the number of pumps in that balloon; for those who buy insurance in both the first and last balloon, we take the average of the number of pumps for the first and last balloons.}
some subjects to ignore the compulsory insurance as they don’t need to make any decisions in purely compulsory insurance, especially in the first balloon. This exception does not affect our results of moral hazard. We find the average number of pumps in the first or last balloon to be significantly higher than the average number of pumps in the 2-29th balloons (Mann-Whitney U-tests, p=0.001 for the first balloon; p < 0.001 for the last balloon). Additionally, in purely compulsory insurance everyone is required to buy insurance, so there are no uninsured subjects in this treatment.

![Figure 4: Moral Hazard: Comparison of the average number of pumps between the 2-29th balloon and first & last balloon in purely compulsory insurance.](image)

We further compare the degree of moral hazard for the three insurance schemes. The degree of moral hazard is quantified as the difference in the average number of pumps of insured subjects between the first & last balloons and the 2-29th balloons. Given in purely compulsory insurance there is a statistically significant difference in the number of pumps between the first and last balloon, and in real life there are very few situations in which people do not realize that they are insured when they have insurance, even though the insurance is compulsory, we only use the number of pumps in the last balloon to reflect the degree of moral hazard in purely compulsory insurance\textsuperscript{6}. Table 2 shows that the degree of moral hazard in mixed insurance is the lowest, while we find no difference between purely voluntary and compulsory insurance. Thus far, we can conclude that there exists moral hazard in all three insurance types, but comparatively mixed insurance reduces moral hazard.

\textsuperscript{6}In purely voluntary insurance and mixed insurance, we use the same way in Figure 2a to take the average of number of pumps for the first and last balloons.
Table 2: Comparison of the degree of moral hazard for each treatment

<table>
<thead>
<tr>
<th></th>
<th>Mann-Whitney Z, Prob &gt;</th>
<th>Mann-Whitney Z, Prob &gt;</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>[z] =</td>
<td>Mean</td>
</tr>
<tr>
<td>Purely Voluntary Mixed</td>
<td>40.14 0.021</td>
<td></td>
<td>Purely Voluntary</td>
</tr>
<tr>
<td>Purely Compulsory Mixed</td>
<td>39.84</td>
<td></td>
<td>Mixed Mixed</td>
</tr>
</tbody>
</table>

**Observation 3:** The social welfare of purely compulsory insurance is the lowest.

![Figure 5: Social welfare in the last balloon by insurance type](image)

**Support:** The efficiency of each insurance type is determined by social welfare. Social welfare in our experiment consists of three parts: government, insurer, and consumer, and it is indicated by wealth (earnings). In the first balloon, we do not find difference in social welfare between any two insurance schemes; in the last balloon, we find purely compulsory insurance has the lowest social welfare. Given the statistically significant difference in risk-taking between the first and last balloon in purely compulsory insurance and the performance in the last balloon is participants’ risk-taking behavior after learning, we view the comparison of social welfare in the last balloon as the valid one. Figure 5 shows that average social welfare of both purely voluntary and mixed insurance significantly exceed the social welfare of purely compulsory insurance (Mann-Whitney U-tests, p=0.013; p=0.034). There is no difference in terms of social welfare, between voluntary and mixed insurance (Mann-Whitney U-Test, p=0.725). As mentioned in the introduction, the efficiency of purely compulsory insurance has no exact answer from economists. Although there is no adverse selection in

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7Some compulsory insurances in real life are paid by employers or the insured, but for simplicity, we assume in our experiment all compulsory insurances are paid by the government.

8The result is consistent when using the average social welfare in the first and last balloon in purely voluntary and mixed insurance.
purely compulsory insurance, our results show that the higher degree of moral hazard still makes it less efficient than purely voluntary and mixed insurance.

V Individual Differences in Behavior

We now turn to an analysis of individual and gender differences across insurance treatments. We consider risk-taking measured by an incentivized gamble-choice task (Eckel and Grossman, 2008), questionnaire measures of self-reported behavioral risks (SSS and DOSPERT), and demographic survey measures of backgrounds in order to better understand risk-taking similarities in BART. Cross-insurance heterogeneity in the characteristics of the participants might help explain the sources of risk-taking differences.

First, by testing the background characteristics which may affect risk-taking behavior, we find no significant differences by age, education, gender composition, the number of people in the household, and income across the three schemes of insurance, with only one exception, participants in purely voluntary insurance are significantly older than participants in mixed insurance (see Appendix. A1). We conclude the differences in risk-taking behavior across insurance types are due to the different insurance treatments, rather than different backgrounds.

<table>
<thead>
<tr>
<th></th>
<th>SSS-all</th>
<th>SSS-bor</th>
<th>SSS-dis</th>
<th>SSS-exp</th>
<th>SSS-thr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of pumps in 2-29th</td>
<td>.100+</td>
<td>.096+</td>
<td>.029</td>
<td>.158**</td>
<td>.057</td>
</tr>
<tr>
<td>Do-all</td>
<td>Do-ethics</td>
<td>Do-gamle</td>
<td>Do-invest</td>
<td>Do-health</td>
<td>Do-recreational</td>
</tr>
<tr>
<td>Average number of pumps in 2-29th</td>
<td>.078</td>
<td>.039</td>
<td>.029</td>
<td>.156**</td>
<td>.027</td>
</tr>
<tr>
<td>GC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average number of pumps in 2-29th</td>
<td>.027</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: * Significant at p < 0.1; +significant at p < 0.05; **significant at p < 0.01.

Second, we address the remaining individual measures: Sensation Seeking Scale, DOSPERT9

9The SSS yields one total score and primary scales: Disinhibition (SSS-DIS)-This scale represents the
and gamble-choice task\textsuperscript{10}. Using Mann-Whitney $U$-tests, we find no differences in the participants’ performances among all these three measures of risk-taking and no differences in their average number of pumps in the 2-29th balloons across treatments (see Appendix). This confirms our results about adverse selection, moral hazard and social welfare in the way that participants in the three treatments are not significantly different in terms of original risk preferences, and their different decisions on insurance purchases and selected pumps under different insurance schemes are due to the insurance treatment. We also consider Spearman rank correlations among risk-taking in BART and the other three measures\textsuperscript{11}. Considering all the three treatments, table 3 represents the Spearman’s $\rho$ and it suggests that risk-taking behavior in BART in our experiment is highly correlated with DOSPERT-investing and SSS-experience measures. Risky behavior collected by SSS-total scores and SSS-bor are positively correlated with BART at the 10% level. Correlation between risk-taking in BART and gamble-choice in our experiment is not statistically significant at conventional levels. We conclude that risk-taking behavior collected in our experiment has some predictive power of self-reported risk-taking behavior in real life, and this further confirms the validity of our analysis about adverse selection and moral hazard using the average number of pumps in BART as quantified risk-taking behavior. Based on these robustness checks, we have the following two other observations.

**Observation 4:** “The ignorant is fearless.”

**Support:** Figure 6 shows that there are significantly more people choosing to buy insurance in the last balloon than in the first balloon in purely voluntary and mixed insurance.

desire for social and sexual disinhibition as expressed in social drinking, partying, and a variety of sexual partners; Boredom Susceptibility (SSS-BOR)-This scale represents an aversion to repetition, routine, and dull people, and restlessness when things are unchanging; Thrill and Adventure Seeking (SSS-THR)-This scale contains items expressing a desire to engage in sports or other activities involving speed or danger; Experience Seeking (SSS-EXP)-This scale represents the seeking of experiences through the mind and senses, travel, and a nonconforming life-style. DOSPERT assesses risk taking in five content domains: financial decisions (separately for investing versus gambling), health/safety, recreational, ethical, and social decisions.\textsuperscript{10}In the incentivized gamble-choice task, participants are asked to choose one out of six lottery options with option 1 extreme risk aversion, option 6 risk-loving. We code the option 1 to 6 as 1, 2, 3, 4, 5, 6.\textsuperscript{11}We only use the average number of pumps in the 2-29th balloon as risk-taking in BART when testing for the correlations with other measures, as the pumps in the first and last balloon were affected by insurance options.
Using Wilcoxon signed-rank tests we can reject the null hypothesis that the difference in the number of participants choosing to buy insurance between the first and last balloon equals zero for both purely voluntary insurance ($p < 0.001$) and mixed insurance ($p=0.002$). In voluntary insurance, 39% of subjects choose to buy insurance in the first balloon while 61% choose to buy insurance in the last balloon; in mixed insurance, 43% of participants choose to buy insurance in the first balloon, and 61% choose to buy insurance in the last balloon. This suggests that when people have no experience in a task or situation, they are more risk-seeking; but after learning, people become more cautious and risk averse, i.e., the ignorant is fearless. Additionally, most participants in our experiment are consistent. Around 87% of subjects who buy insurance in the first balloon in purely voluntary insurance, also buy insurance in the last balloon; in mixed insurance, 84% subjects who buy insurance in the first balloon also buy insurance in the last balloon. Such consistency confirms our data analysis of adverse selection and moral hazard.

**Observation 5:** There are no gender differences in moral hazard, but males reduce adverse selection in mixed insurance.

**Support:** The topic of gender differences in risk preference has been widely addressed; however there are only a few papers addressing gender differences in adverse selection and moral hazard in insurance. We view our experiment as a good opportunity to study this research question. First, we test for differences in overall risk behavior by gender using the average number of pumps per balloon per subject. Considering all the three treatments.
together, we find females are more risk averse than males (Mann-Whitney U-Test, p=0.020).

Second, using a similar framework as in Observation 1, we find that in purely voluntary insurance adverse selection exists in both genders by using Mann-Whitney U-tests: participants who chose to buy insurance had significantly more pumps in the 2-29th balloons than participants who did not buy insurance (female p=0.002; male \( p < 0.001 \)). (See Figure 7a and Figure 7b)

![Figure 7a](image1.png) ![Figure 7b](image2.png)

Figure 7: Gender differences in adverse selection by treatment.

However, in mixed insurance, adverse selection is not present in males or females. For females, we find no difference in the average number of pumps in the 2-29th balloons between those who bought insurance and those who did not buy insurance (Mann-Whitney U-Test, p=0.367); for males, our result suggests that men who buy insurance selected significantly less pumps in the 2-29th balloon than men who did not choose to buy insurance (Mann-Whitney U-Test, \( p < 0.001 \)). This indicates that mixed insurance has asymmetric effects on males. The elimination of adverse selection in mixed insurance found in Observation 1 is mainly contributed by males (See Figure 7c and Figure 7d).

![Figure 7c](image3.png) ![Figure 7d](image4.png)
Third, we find moral hazard in both genders in all three insurance types, and the degrees of moral hazard are not statistically different by gender for any insurance treatment.

VI Conclusion

This is the first experimental study to comprehensively compare three main schemes of insurance in a real setup. We use a simple experiment to address three main issues in insurance markets: adverse selection and moral hazard, social welfare and the effects of compulsory insurance on the residual voluntary purchases when the compulsory insurance is partial. We set insurance options in some balloons in BART so that we can take advantage of the validity of BART as an assessment of real risk-taking behavior to study adverse selection and moral hazard simultaneously in real insurance markets. First, by comparing risk-taking behaviors with no insurance options for people who buy and people who do not buy insurance, we find an adverse selection in purely voluntary insurance but not in mixed insurance. Specifically, our results suggest that mixed insurance is more attractive to more risk-averse individuals, and when compulsory and voluntary insurance coexist, they are substitutes for more risk-seeking individuals but complements for more risk-averse individuals. We further find the elimination of adverse selection is mainly contributed by males. Overall, there’s no crow-out effect of compulsory insurance on the residual voluntary insurance market when they coexist.

Our results help answer questions about the combined effects of adverse selection and moral hazard on compulsory insurance. A purely compulsory insurance can avoid adverse selection but it may worsen the moral hazard problem (Sepehri et al., 2006); what is the combined effect? Most previous studies have focused on the single effect of compulsory insurance on individuals and society; the comprehensive effects are not well addressed, which makes the overall efficiency of purely compulsory insurance ambiguous. The results from our experiment clearly suggest purely compulsory insurance has a higher degree of moral hazard
compared to mixed insurance; overall it is the least efficient insurance scheme in that it has the lowest social welfare, i.e. the combined effect is negative. For simplicity, we don’t set any control methods of moral hazard in our experimental design as insurance providers do in real life. Private insurance companies usually try to control moral hazard by making insurance premiums dependent on the risk of the insured. The government, as insurer, seldom controls moral hazard such as in the case of universal health insurance. Thus, moral hazard in purely compulsory insurance in our experiment represents a lower bound and social welfare the upper bound compared to the other two insurance schemes.

These results imply that mixed insurance is the preferred insurance scheme in that it not only reduces adverse selection, but it also has the lowest degree of moral hazard, and in addition its final social welfare is higher than purely compulsory insurance (although we do not find differences with purely voluntary insurance in terms of social welfare). The results of our experiment provide valuable insights to developing countries where the insurance industry is not yet well developed and there are very few schemes of insurance that implement some kind of mixed insurance. Our findings can also give some guidance to policy makers regarding national insurance reforms in developed countries. Future studies can set more specific insurance scheme with variable premiums and coverage such as health insurance, financial insurance and so on. Our paper also provides a possible way to study insurance subsidies.

References


Appendix.

A1. Background characteristics and measures of risk-taking

Table A1: Background characteristics and measures of risk-taking across treatments.

<table>
<thead>
<tr>
<th></th>
<th>Voluntary</th>
<th>Partially Compulsory</th>
<th>Compulsory</th>
<th>p-value, purely voluntary vs mixed</th>
<th>p-value, purely voluntary vs compulsory</th>
<th>p-value, purely compulsory vs mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gamble Choice (mean)</td>
<td>3.5</td>
<td>3.3</td>
<td>3.5</td>
<td>0.551</td>
<td>0.984</td>
<td>0.498</td>
</tr>
<tr>
<td>Pumps in 2-29th (mean)</td>
<td>56.20</td>
<td>56.20</td>
<td>57.66</td>
<td>0.624</td>
<td>0.628</td>
<td>0.864</td>
</tr>
<tr>
<td>SSS-all (mean)</td>
<td>15.12</td>
<td>17.25</td>
<td>16.90</td>
<td>0.045</td>
<td>0.087</td>
<td>0.90</td>
</tr>
<tr>
<td>DOSPERT-all (mean)</td>
<td>91.00</td>
<td>91.13</td>
<td>91.46</td>
<td>0.033</td>
<td>0.224</td>
<td>0.330</td>
</tr>
<tr>
<td>Age (mean)</td>
<td>38</td>
<td>36</td>
<td>38</td>
<td>0.002</td>
<td>0.434</td>
<td>0.145</td>
</tr>
<tr>
<td>Gender</td>
<td>51.5% (F)</td>
<td>51.5% (F)</td>
<td>44.7% (F)</td>
<td>0.699</td>
<td>0.334</td>
<td>0.587</td>
</tr>
<tr>
<td></td>
<td>48.5% (M)</td>
<td>48.5% (M)</td>
<td>55.3% (M)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Household (mean)</td>
<td>2.6</td>
<td>2.7</td>
<td>2.8</td>
<td>0.448</td>
<td>0.163</td>
<td>0.564</td>
</tr>
<tr>
<td>Education (median)</td>
<td>2 year/ Associates Degree</td>
<td>2 year/ Associates Degree</td>
<td>2 year/ Associates Degree</td>
<td>0.048</td>
<td>0.432</td>
<td>0.284</td>
</tr>
<tr>
<td>Income (mean)</td>
<td>40,000-49,999</td>
<td>40,000-49,999</td>
<td>40,000-49,999</td>
<td>0.433</td>
<td>0.139</td>
<td>0.515</td>
</tr>
</tbody>
</table>

Notes: The last three columns show the p-values from two-sided Mann-Whitney U-Tests.

A2. Experimental Instructions

1. General Instructions (Purely Voluntary)

Now you will be presented with 30 balloons in the computer screen.

You have to decide how many times you want to pump each balloon. For every successful pump you will earn money. However, the explosion point for each balloon is random. The maximum possible number of pumps for each balloon is 128. The explosion point is random and it can be anywhere in the range from the first (1st) to the last (128th) pump.

For each balloon, you will be asked to select how many times you want to pump it up. You get a MONETARY reward of $0.01 for every successful pump. HOWEVER, if a balloon explodes before it reaches the number of pumps you indicated, you earn $0.00 for that balloon.

After each trial, a new balloon will appear.

For SOME balloons, you have an opportunity to buy an Insurance to protect yourself against the risk of an explosion for that particular balloon. Please make your decisions carefully. At the end of the experiment, 3 balloons will be RANDOMLY SELECTED, and you will be paid the amount of money earned for these three balloons.
2. Summary
* You write the number of times you want to pump up each balloon in a provided textbox.
* Remember: each balloon can be pumped up to 128 times (it will surely pop at 128th pump).
* Each balloon is then pumped up until a) that number is reached or b) it pops. Whatever occurs first.
* If it does not explode, you make $0.01 for each pump.
* If it does explode, you will not make any money on that balloon.
* There are a total of 30 balloons.
* Only some balloons have the opportunity to purchase insurance.
* At the end, you will be paid the exact amount you earned on THREE randomly selected balloons.

Continue when you are ready to start.

3. Insurance
On the following balloon, you have an opportunity to buy an insurance to protect yourself against the risk of explosion. The price of the insurance is $0.40.

If the balloon does explode, the insurance will pay you $0.64; if the balloon does not explode, the insurance will pay you nothing, and the cost is not refunded. However, you will keep the earnings you make in that balloon if it is selected at the end of the experiment.

Remember: each balloon can be pumped up to 128 times;
The insurance is only valid for this balloon.

Before proceeding to make your choices, you have to correctly answer the following three questions.

(1). If you choose to buy the insurance, and you pump 128 times, then how much would you earn for this balloon?
A. $0  B. $64  C. $24  D. $40

(2). If you choose NOT to buy the insurance, and you pump 64 times, and the balloon
does not explode, then how much would you earn for this balloon?

A. $64  B. $24  C. $0  D. $40

(3). If you choose to buy the insurance, and you pump 70 times, and the balloon does not explode, then how much would you earn for this balloon?

A. $70  B. $30  C. $0  D. $40

4. Insurance choice

Now please indicate your decision by Clicking the options below.

Yes, I buy the insurance at a cost of $0.40.

No, I do not buy the insurance.
5. BART

Enter how many times you want to pump up this balloon
Remember: anything higher than 127 and the balloon SURELY pops

Number of wanted pumps: 0
Potential earnings: $0.00
Balloon number: 1 of 30
Number of current pumps: 0
Total Winnings: $0.00

Figure A1: Screenshot of BART.

6. Earnings in BART

Congratulations!

Your earnings on 1-30 balloons are(),(),()...respectively, by randomly selecting three of them, your payment of this part is $().

The balloon task is now complete. Please Click continue to go to the next part.
7. DOSPERT (Figure A2)

For each of the following statements, please indicate the likelihood that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from Extremely Unlikely to Extremely Likely.

(1). Admitting that your tastes are different from those of a friend.
(2). Going camping in the wilderness.
(3). Betting a day’s income at the horse races.
(4). Investing 10% of your annual income in a moderate growth mutual fund.
(5). Drinking heavily at a social function.
(6). Taking some questionable deductions on your income tax return.
(7). Disagreeing with an authority figure on a major issue.
(8). Betting a day’s income at a high-stake poker game.
(9). Having an affair with a married man/woman.
(10). Passing off somebody else’s work as your own.
(11). Going down a ski run that is beyond your ability.
(12). Investing 5% of your annual income in a very speculative stock.
(13). Going whitewater rafting at high water in the spring.
(14). Betting a day’s income on the outcome of a sporting event.
(15). Engaging in unprotected sex.
(16). Revealing a friend’s secret to someone else.
(17). Driving a car without wearing a seat belt.
(18). Investing 10% of your annual income in a new business venture.
(19). Taking a skydiving class.
(20). Riding a motorcycle without a helmet.
(21). Choosing a career that you truly enjoy over a more prestigious one.
(22). Speaking your mind about an unpopular issue in a meeting at work.
(23). Sunbathing without sunscreen.
(24). Bungee jumping off a tall bridge.
(25). Piloting a small plane.
(26). Walking home alone at night in an unsafe area of town.
(27). Moving to a city far away from your extended family.
(28). Starting a new career in your mid-thirties.
(29). Leaving your young children alone at home while running an errand.
(30). Not returning a wallet you found that contains $200.

8. Sensation Seeking Scale (Figure A3)

Each of the items below contains two choices, A and B. Please click the letter of the choice which most describes your likes or the way you feel. In some cases you may find items in which both choices describe your likes or feelings. Please choose the one which better describes your likes or feelings. In some cases you may find items in which you do not like either choice. In these cases mark the choice you dislike least. Do not leave any items blank.

In this part, there are not right or wrong answers. Be frank and give your honest appraisal of yourself.

(1) A. I like “wild” uninhibited parties
B. I prefer quiet parties with good conversation
(2) A. There are some movies I enjoy seeing a second or even a third time
B. I can’t stand watching a movie that I’ve seen before
(3) A. I often wish I could be a mountain climber
B. I can’t understand people who risk their necks climbing mountains
(4) A. I dislike all body odors
B. I like some for the earthly body smells
(5) A. I get bored seeing the same old faces
B. I like to comfortable familiarity of everyday friends
(6) A. I like to explore a strange city or section of town by myself, even if it means getting lost
B. I prefer a guide when I am in a place I don’t know well

(7) A. I dislike people who do or say things just to shock or upset others

B. When you can predict almost everything a person will do and say he or she must be a bore

(8) A. I usually don’t enjoy a movie or play where I can predict what will happen in advance

B. I don’t mind watching a movie or a play where I can predict what will happen in advance

(9) A. I have tried marijuana or would like to

B. I would never smoke marijuana

(10) A. I would not like to try any drug which might produce strange and dangerous effects on me

B. I would like to try some of the new drugs that produce hallucinations

(11) A. A sensible person avoids activities that are dangerous

B. I sometimes like to do things that are a little frightening

(12) A. I dislike “swingers” (people who are uninhibited and free about sex)

B. I enjoy the company of real “swingers”

(13) A. I find that stimulants make me uncomfortable

B. I often like to get high (drinking liquor or smoking marijuana)

(14) A. I like to try new foods that I have never tasted before

B. I order the dishes with which I am familiar, so as to avoid disappointment and unpleasantness

(15) A. I enjoy looking at home movies or travel slides

B. Looking at someone’s home movies or travel slides bores me tremendously

(16) A. I would like to take up the sport of water skiing

B. I would not like to take up water skiing

(17) A. I would like to try surf boarding
B. I would not like to try surf boarding

(18) A. I would like to take off on a trip with no preplanned or definite routes, or timetable
B. When I go on a trip I like to plan my route and timetable fairly carefully

(19) A. I prefer the “down to earth” kinds of people as friends
B. I would like to make friends in some of the “far out” groups like artists or “punks”

(20) A. I would not like to learn to fly an airplane
B. I would like to learn to fly an airplane

(21) A. I prefer the surface of the water to the depths
B. I would like to go scuba diving

(22) A. I would like to meet some persons who are homosexual (men or women)
B. I stay away from anyone I suspect of being “gay or lesbian”

(23) A. I would like to try parachute jumping
B. I would never want to try jumping out of a plane with or without a parachute

(24) A. I prefer friends who are excitingly unpredictable
B. I prefer friends who are reliable and predictable

(25) A. I am not interested in experience for its own sake
B. I like to have new and exciting experiences and sensations even if they are a little frightening, unconventional, or illegal

(26) A. The essence of good art is in its clarity, symmetry of form and harmony of colors
B. I often find beauty in the “clashing” colors and irregular forms of modern paintings

(27) A. I enjoy spending time in the familiar surroundings of home
B. I get very restless if I have to stay around home for any length of time

(28) A. I like to dive off the high board
B. I don’t like the feeling I get standing on the high board (or I don’t go near it at all)

(29) A. I like to date members of the opposite sex who are physically exciting
B. I like to date members of the opposite sex who share my values

(30) A. Heavy drinking usually ruins a party because some people get loud and boisterous
B. Keeping the drinks full is the key to a good party

(31) A. The worst social sin is to be rude
B. The worst social sin is to be a bore

(32) A. A person should have considerable sexual experience before marriage
B. It’s better if two married persons begin their sexual experience with each other

(33) A. Even if I had the money I would not care to associate with flight rich persons like those in the “jet set”
B. I could conceive of myself seeking pleasures around the world with the “jet set”

(34) A. I like people who are sharp and witty even if they do sometimes insult others
B. I dislike people who have their fun at the expense of hurting the feelings of others

(35) A. There is altogether too much portrayal of sex in movies
B. I enjoy watching many of the “sexy” scenes in movies

(36) A. I feel best after taking a couple of drinks
B. Something is wrong with people who need liquor to feel good

(37) A. People should dress according to some standard of taste, neatness, and style
B. People should dress in individual ways even if the effects are sometimes strange

(38) A. Sailing long distances in small sailing crafts is foolhardy
B. I would like to sail a long distance in a small but seaworthy sailing craft

(39) A. I have no patience with dull or boring persons
B. I find something interesting in almost every person I talk to

(40) A. Skiing down a high mountain slope is a good way to end up on crutches
B. I think I would enjoy the sensations of skiing very fast down a high mountain slope
9. Gamble Choice

See Figure A4 screenshot of gamble-choice task.

10. Demographic survey

Please answer the following survey questions.

(1) Please enter your age in years.

(2) Please indicate the HIGHEST level of education you have completed.

Some High School or less
High School Diploma
Some College
2 year/Associates Degree
4 year/Bachelor’s Degree
Some Graduate School
Graduate Degree

(3) Including yourself, how many people live in your household?

(4) Please indicate your gender.

Male
Female

(5) Please indicate your race.

Asian/ Pacific Islander
African American
Caucasian/ White
Native American/ Indigenous
Hispanic
Other (Please list below)

(6) Please indicate your household yearly income for 2016. (Include all forms of income, including salary, interest and dividend payments, tips, scholarship support, student loans, parental support, and allowance)
(7) Do you think the Insurance Option in the balloon task is clear?

Yes.

No.
Please answer the following questions. You will earn 10 cents for completing the two parts of the questionnaire. All answers will be completely anonymous and unrelated to your payoffs.

Your honest answers will be greatly appreciated as real responses will help to improve our research. Thank you!

(a)

PART 1: For each of the following statements, please indicate the likelihood that you would engage in the described activity or behavior if you were to find yourself in that situation. Provide a rating from Extremely Unlikely to Extremely Likely.

1. Admitting that your tastes are different from those of a friend.

   Extremely Unlikely  Moderately Unlikely  Somewhat Unlikely  Not Sure  Somewhat Likely  Moderately Likely  Extremely Likely

2. Going camping in the wilderness.

   Extremely Unlikely  Moderately Unlikely  Somewhat Unlikely  Not Sure  Somewhat Likely  Moderately Likely  Extremely Likely

3. Betting a day’s income at the horse races.

   Extremely Unlikely  Moderately Unlikely  Somewhat Unlikely  Not Sure  Somewhat Likely  Moderately Likely  Extremely Likely

4. Investing 10% of your annual income in a moderate growth diversified fund.

   Extremely Unlikely  Moderately Unlikely  Somewhat Unlikely  Not Sure  Somewhat Likely  Moderately Likely  Extremely Likely

(b)

Figure A2: Screenshot of DOSPERT
PART 2: Each of the items below contains two choices, A and B. Please click the letter of the choice which most describes your likes or the way you feel. In some cases you may find items in which both choices describe your likes or feelings. Please choose the one which better describes your likes or feelings. In some cases you may find items in which you do not like either choice. In these cases mark the choice you dislike least. Do not leave any items blank.

In this part, there are not right or wrong answers. Be frank and give your honest appraisal of yourself.

1.
- A. I like “wild” uninhibited parties.
- B. I prefer quiet parties with good conversation.

2.
- A. There are some movies I enjoy seeing a second or even a third time.
- B. I can’t stand watching a movie I’ve seen before.

3.
- A. I often wish I could be a mountain climber.
- B. I can’t understand people who risk their necks climbing mountains.

4.
- A. I dislike all body odors.
- B. I like some of the earthy body smells.

Figure A3: Screenshot of SSS.
In this part, please make a choice among the following six gamble choices. Each choice has two events A and B, and each event’s chance of occurring is 50%. After you make your choice, the system will randomly choose an event and depending on your choice, you will get the corresponding payoff for that event. If you select a gamble with a negative payoff for outcome B, negative payoffs will be deducted from your payment in previous parts of the experiment.

<table>
<thead>
<tr>
<th>Gamble choice</th>
<th>The event</th>
<th>Probability</th>
<th>Payoff (cents)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>A</td>
<td>50%</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>50%</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>A</td>
<td>50%</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>50%</td>
<td>6</td>
</tr>
<tr>
<td>3.</td>
<td>A</td>
<td>50%</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>50%</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>A</td>
<td>50%</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>50%</td>
<td>-2</td>
</tr>
<tr>
<td>5.</td>
<td>A</td>
<td>50%</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>50%</td>
<td>-6</td>
</tr>
<tr>
<td>6.</td>
<td>A</td>
<td>50%</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>50%</td>
<td>-8</td>
</tr>
</tbody>
</table>

Figure A4: Screenshot of gamble-choice task.