Uncertainty Motivates Morality

Yiting Chen Songfa Zhong*

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Abstract

We propose an uncertainty-motivated morality hypothesis whereby individuals behave more morally under uncertainty than under certainty, as if moral behavior will yield a better outcome as the result of uncertainty. We test this hypothesis in a series of experiments and observe that individuals are more honest under uncertain situations than degenerate deterministic situations. We further show that this pattern is best explained by our hypothesis and is robust and generalizable. These results are incompatible with standard models and consistent with quasi-magical thinking and related notions. Our study contributes to the literature of decision-making under uncertainty and with moral considerations.

Keywords: uncertainty, moral behavior, lying aversion, social preference, experiment.
JEL Classification C91, D81, D91

*Chen: School of Economics, Xiamen University, yitingchen26@gmail.com. Zhong: Department of Economics, National University of Singapore, Singapore 117570; Division of Social Science, New York University Abu Dhabi, zhongsongfa@gmail.com. We thank the helpful comments and discussions of Soo Hong Chew, Syngjoo Choi, Itzhak Gilboa, Lorenz Goette, Yoram Halevy, Jian Li, Yucheng Liang, Wooyoung Lim, Bin Miao, Xiangyu Qu, Emanuel Vespa, Peter Wakker, Chen Zhao, and seminar participants at CUHK-HKU-HKUST Joint Theory Seminar Series, Hong Kong University of Science and Technology, Tsinghua University, and Virtual East Asia Experimental and Behavioral Economics Seminar Series. First version: November 2020.

As long as man was unable by means of the arts of practice to direct the course of events, it was natural for him to seek an emotional substitute; in the absence of actual certainty in the midst of a precarious and hazardous world, men cultivated all sorts of things that would give them the feeling of certainty.

John Dewey (1929), *The Quest for Certainty*

1 Introduction

Individuals are almost constantly exposed to uncertainty, ranging from job insecurity and marital instability to natural disasters and pathogen threats. As John Dewey observed, fear, anxiety, and stress in an uncertain world often motivate human behavior. For example, to reduce uncertainty about themselves and their surroundings, individuals exhibit a tendency to identify with social and religious groups (Hogg, 2007). In the face of uncertainty that is uncontrollable, individuals also behave as if their actions can affect the resolution of uncertainty—for instance, throwing the dice harder for larger numbers, tolerating cold for long periods to diagnose a longer life expectancy, and voting to "induce" other like-minded persons to vote (Henslin, 1967; Langer, 1975; Quattrone and Tversky, 1984; Stefan and David, 2013). Given these observations, we propose an uncertainty-motivated morality hypothesis. Specifically, we suggest that uncertainty motivates individuals to behave morally, as if their moral behavior will yield the better outcome as a result of uncertainty. By acting in ways that align with moral principles, individuals may feel more in control of their environment and better equipped to cope with uncertainty.[1]

This hypothesis is reflected in widespread beliefs. For example, individuals tend to believe in a just world, in which moral behavior will be rewarded with a desirable fate and immoral conduct will be punished with a negative fate (Lerner, 1980; Bénabou and Tirole, 2006). Religious individuals may believe that moralistic gods

[1]To clarify our terminology, in this paper we do not differentiate risk and uncertainty in the sense of known and unknown probability distributions. We also do not provide a definition of morality, and instead assume that individuals share some beliefs based on perceived social norms—for example, it is more moral to tell the truth than to lie and to share than not to share.

would reward the righteous and punish wrongdoers (Purzycki et al., 2016; Enke, 2019). According to the principle of karma, current actions will have consequences in the uncertain future (Converse, Risen, and Carter, 2012). Whereas some people explicitly hold such beliefs and act accordingly, others may unconsciously conform to these beliefs and deny holding them (Shafir and Tversky, 1992; Risen, 2016). Such beliefs are rooted in many cultures, but little research has examined their behavioral consequences, particularly with respect to the link between uncertainty and morality.

This paper examines the uncertainty-motivated morality hypothesis in the following setting. Individuals make a binary choice: whether to act morally with a cost or not. In the uncertain situation, individuals receive a lottery $(h, p; l)$ that yields high outcome h with probability p and low outcome l otherwise. We compare the uncertain situation with two degenerate deterministic situations: high outcome h in one and low outcome l in the other. Based on our hypothesis, individuals may be more likely to choose moral behavior in the uncertain situation than in either deterministic situation. However, such behavior violates the principle of dominance, which dictates that if individuals choose immoral behavior in all possible situations, they will continue to do so when uncertain about which situation will occur. Compliance with the principle of dominance is a fundamental feature of most standard models in decision-making under uncertainty. Therefore, if the proposed behavioral pattern does exist, it would contradict those models and lend strong support to our hypothesis. To comprehensively investigate this hypothesis, we conduct a series of experiments.

Our main experiment incorporates uncertainty in the dice game paradigm proposed by Fischbacher and Föllmi-Heusi (2013), which is widely adopted to examine truth-telling behavior in experiments. In our experiment, subjects receive a lottery $(h, \frac{n}{6}; l)$ in the form of six boxes numbered from 1 to 6 with n box(es) containing h and $6 - n$ box(es) containing l. Subjects roll a die in their mind—randomly choosing a number between 1 and 6—to select one of the six boxes (Kajackaite and Gneezy, 2017). Subsequently, subjects are informed of the presence of an additional 4 yuan (in Chinese currency, referred to as RMB4 hereafter) in one exact box out of the six. Subjects are asked to report their initial box selection to receive the corresponding payoff in that box. Reporting the box containing the RMB4 (reporting +4) indicates either the truth based on die-rolling with a $\frac{1}{6}$ chance or a lie to maximize payoffs. Although lying cannot be observed individually, it can be measured at the aggregate level by the difference between the actual proportion of reporting +4 and $\frac{1}{6}$. We include three spreads between h and l—$(40, \frac{n}{6}; 0)$, $(30, \frac{n}{6}; 10)$, and $(22, \frac{n}{6}; 18)$—and seven levels of winning probability, $\frac{n}{6} \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$, which gives rise to 21 decisions in our within-subject experiment. Our design allows us to test the hypothesis, based on the comparison of lying behavior between an uncertain situation and both degenerate deterministic situations, and on whether the degree of uncertainty, measured by the spread between h and l, matters.

We observe that subjects exhibit uncertainty-motivated truth-telling behavior: They are more likely to tell the truth in the uncertain situation than in either degenerate deterministic situation. Specifically, the proportions of reporting +4 are 59.1 percent under uncertainty and 74.8 percent (78.2 percent) under certainty with high (low) outcomes. This pattern is consistent with our uncertainty-motivated morality hypothesis. Moreover, the uncertainty-motivated truth-telling behavior is more pronounced when the lottery $(h, \frac{n}{6}; l)$ is riskier. Namely, the pattern is significant for $(40, \frac{n}{6}; 0)$ and $(30, \frac{n}{6}; 10)$, but not for $(22, \frac{n}{6}; 18)$. This difference shows the importance of uncertainty in motivating truth-telling behavior, which provides further support for our hypothesis.

Next, we conduct two experiments to shed light on the underlying mechanism that subjects behave morally under uncertainty as if moral behavior will lead to a good outcome of the uncertainty. This proposed mechanism hinges on two key factors: the moral concern in choice behavior and the subject's desire for a favorable resolution of the uncertainty. To strengthen our hypothesis, we test whether the observed pattern is sensitive to changes in these two factors.

First, we reduce the moral considerations in one experiment. This new design is based on the "no dice" condition in Fischbacher and Föllmi-Heusi (2013), in which subjects directly choose their preferred payoff without relying on a die. Fischbacher and Föllmi-Heusi find that some subjects do not choose the highest payoff, which could be due to their aversion to greed, and greed in the "no dice" condition involves a weaker moral concern than lying in the dice condition. In our new design, subjects receive a lottery $(h, \frac{n}{6}; l)$ in the six-box frame and are informed which box contains an additional RMB4. Instead of rolling a mental die and reporting the number, subjects directly choose their preferred box. We find that subjects are less likely to choose the box with +4 under uncertainty than under certainty, but this difference is substantially smaller than the difference in reporting +4 in the main experiment. These results suggest that the diminished moral implication indeed weakens the effect of uncertainty, and thus strengthens our proposed mechanism.

Second, in another experiment we reduce the subject's desire for a favorable resolution of uncertainty. This experiment involves anonymously paired partners. We impose uncertainty on these partners rather than subjects themselves. Specifically, partners receive the lottery $(h, \frac{n}{6}; l)$ in the six-box frame, and subjects receive a fixed amount of money in all six boxes with one exact box containing an additional RMB4. Similar to the main experiment, subjects decide whether to lie for the additional RMB4 through the mental-die-rolling and reporting process. Different from the main experiment whereby subjects face uncertainty by themselves, subjects are unlikely to have a strong desire for a good outcome from uncertainty for their partners. We thus expect the uncertainty-motivated truth-telling behavior to be weaker or disappear. Our findings confirm this prediction: We observe a significantly weaker effect of uncertainty on motivating honesty than in the main experiment, and the effect is also inconsistent across different payoff conditions. These results suggest that the desire for a favorable resolution of uncertainty plays a crucial role and lend further support for the proposed mechanism.

Last, we conduct two experiments to investigate the robustness and generalizability of the uncertainty-motivated morality hypothesis. The first experiment is a dice game in which subjects decide whether to tell the truth after the uncertainty of $(h, \frac{n}{6}; l)$ is resolved (but kept unknown)—instead of before the uncertainty is resolved as in the main experiment. We replicate the uncertainty-motivated truth-telling behavior: Subjects are more likely to tell the truth under uncertain situations than in the two deterministic situations with high and low outcomes. The second experiment goes beyond honesty to explore the domain of other-regarding behavior and adopts a modified dictator game, in which subjects receive the lottery $(h, \frac{n}{6}; l)$ and decide whether to share half of the realized payoff with an anonymously paired recipient. We document a pattern of uncertainty-motivated sharing behavior, in which subjects are more likely to share under uncertainty than certainty.

To summarize, our main experiment shows that subjects are more likely to be honest when faced with uncertain payoffs than with certain payoffs. This pattern is incompatible with standard models that respect dominance and lends strong support to our hypothesis. We further examine two conditions that underlie our hypothesis. First, choice behavior involves moral implications, and second, decision makers have a desire for a favorable resolution of the uncertainty. After weakening these two conditions in two additional experiments, we observe a substantially weaker difference between uncertainty and certainty. Results from these two experiments not only strengthen our hypothesis, but also help exclude some alternative explanations based on general effects of uncertainty such as complexity and confusion. Moreover, we conduct two more experiments and find that the observed pattern is robust regardless of whether uncertainty is resolved before or after subjects' choices, and can be further generalized to a new domain: sharing behavior in the dictator game. Taken together, these experiments support the uncertainty-motivated morality hypothesis.

1.1 Related Literature

This paper adds to the literature on anomalies in decision-making under uncertainty. Standard models commonly assume the following scheme: Decision makers think through each of the possible outcomes and balance them according to their (weighted) probabilities. Although this assumption is appealing both normatively and descriptively, it has been challenged by a growing body of anomalies documented in the literature. For example, individuals may fail to think through each contingency and make suboptimal decisions in a systematic manner (Charness and Levin, 2009; Cason and Plott, 2014; Esponda and Vespa, 2014; Li, 2017; Martínez-Marquina, Niederle, and Vespa, 2019).[2] Esponda and Vespa (2021) further propose that a failure of contingent thinking may underpin some well-known anomalies such as the Allais paradox, the Ellsberg paradox, and overbidding in a second-price auction. The observed pattern in this study broadens the scope of these phenomena to moral decision-making under uncertainty.

Our proposed mechanism can be viewed as a form of a failure of contingent thinking, and provides a complementary perspective to understand these phenomena. More specifically, in our setting, when individuals have difficulties thinking through uncertainty in moral decisions, they behave as if they believe that their moral behavior can lead to good outcome. Relatedly, in their decomposition of contingent reasoning, Martínez-Marquina, Niederle, and Vespa (2019) suggest that "one reason for the difficulties in the probabilistic treatment may come from the subject's belief that her actions can influence which state of the world realizes." In their study of the disjunction effect, Tversky and Shafir (1992) show that students choose to have a vacation to celebrate (seek consolation) if they pass (fail) the exam but choose not to have the vacation if they do not know the outcome of the exam. Similarly, one could argue that students choose not to go on vacation when they do not know the outcome of the exam, as if going on vacation can jinx their exam results. This intuition is closely related to the notions of illusion of control, tempting fate, magical thinking, and quasi-magical thinking (e.g., Henslin, 1967; Langer, 1975; Quattrone

[2]Relatedly, individuals also exhibit the uncertainty effect by valuing a lottery lower than its worst possible outcome (Gneezy, List, and Wu, 2006), and display the disjunction effect whereby they choose the same option after knowing that an event happens or the complementary event happens, but choose a different option before knowing which one happens (Shafir and Tversky, 1992; Tversky and Shafir, 1992).

and Tversky, 1984; Shafir and Tversky, 1992; Tversky and Shafir, 1992; Risen and Gilovich, 2008; Stefan and David, 2013). These studies suggest that individuals may, whether consciously or not, perceive a connection between their actions and the outcomes of uncertainty in individual choice settings, or between their actions and the actions of others in strategic environments. Building on this intuition, we conduct a comprehensive investigation linking uncertainty and morality.[3]

Our experiments also contribute to studies on moral decision-making under uncertainty. One strand of the literature is about moral wiggle room, whereby the uncertainty faced by others offers individuals some wiggle room or excuse to behave selfishly (Dana, Weber, and Kuang, 2007; Haisley and Weber, 2010; Exley, 2016; Gino, Norton, and Weber, 2016; Garcia, Massoni, and Villeval, 2020). We observe that exogenous uncertainty about individuals themselves, in contrast, motivates them to act morally. Another strand of the literature is about the ex ante and ex post considerations in terms of fair allocations (Machina, 1989; Karni and Safra, 2002; Trautmann and Wakker, 2010; Fudenberg and Levine, 2012; Saito, 2013). In the experimental studies, individuals allocate the winning odds between themselves and others or decide the probabilities of two payoff distributions, in which uncertainty induces a trade-off between ex ante and ex post fairness considerations (Krawczyk and Le Lec, 2010; Brock, Lange, and Ozbay, 2013; Sandroni, Ludwig, and Kircher, 2013; Andreoni et al., 2020).[4] In this regard, our study distinguishes itself from these

[3]Kellner, Reinstein, and Riener (2019) compare the donation after winning a lottery with the commitment to donate conditional on winning and observe that subjects are more willing to donate in the latter case. Whereas the authors present a similar misperception as a possible explanation, their observations cannot exclude other alternatives, including the preference for ex ante fairness, loss aversion, and signalling. Chew and Li (2021) suggest that sin stock aversion can in part be due to a belief in karma whereby investing in sin stock may lead to bad outcomes, but social preference may also play a role.

[4]Our hypothesis sheds light on some observations in this literature. For example, in Brock, Lange, and Ozbay (2013), the dictator decides the number of tokens to share with the recipient in different treatments with uncertainty. They observe that the dictator gives more in the treatments in which both players face uncertainty, compared with treatments in which only the recipient faces uncertainty. While this observation is not consistent with standard models, including ex ante and ex post fairness (see Krawczyk and Le Lec (2016) for discussions), it can be rationalized by our hypothesis that uncertainty with the dictator gives rise to an additional incentive to give.

studies with respect to the role of uncertainty in moral decision-making.

The rest of the paper is organized as follows. Section 2 details the design of our experiments and Section 3 reports the experimental results. We provide further discussions of theoretical implications, mechanisms, and alternative explanations in Section 4 and offer concluding remarks in Section 5.

2 Experimental Design

We conduct a series of experiments to test our uncertainty-motivated morality hypothesis. In this section, we describe the design for our main experiment, two experiments to test the mechanisms, and two experiments to examine robustness and generalizability.

2.1 Main Experiment

We test our hypothesis in a modified dice game experiment based on Fischbacher and Föllmi-Heusi (2013), which provides a paradigm to examine truth-telling behavior. In their experiment, subjects report the outcome of a die that they roll privately and receive a monetary payoff based on their report. If subjects only care about the monetary payoff, they report the outcome with the highest monetary payoff regardless of the actual result of the die roll. If subjects have a strong preference for truth-telling, they report the actual outcome regardless of the resulting monetary payoff. Moreover, subjects can partially lie by reporting an outcome that delivers a falsely higher, but not the highest, payoff. A notable feature of this paradigm is that while lying behavior is undetectable at the individual level, it can be inferred at the aggregate level. In a meta-analysis of 90 experimental studies based on this paradigm, Abeler, Nosenzo, and Raymond (2019) show that individuals exhibit a preference for being honest and for being seen as honest. To test our hypothesis, we conduct a *Dice Game* experiment as our main experiment in which we incorporate exogenous uncertainty in this paradigm.

Design. We endow subjects with a lottery $(h, p; l)$ that pays high outcome h with probability p and low outcome l otherwise. We refer to p as the winning probability hereafter. We examine whether and how the endowed lottery affects lying behavior in four steps: Subjects receive a lottery, randomly choose a number between 1 and 6 in their mind, learn which number carries an additional payoff a, and report the number they randomly chose in their mind. If they report the number with a, they receive both the lottery and a—that is,$(h + a, p; l + a)$; otherwise, they only receive the lottery $(h, p; l)$. If subjects are perfectly honest, approximately $\frac{1}{6}$ of them will report the number with a. The deviation from the expected probability $\frac{1}{6}$ reveals the prevalence of dishonesty at the aggregate level.

We vary the parameters of the lotteries $(h, p; l)$ in two ways. First, we include seven levels of the winning probability $p \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$. Subjects make decisions under degenerate deterministic situations when $p = 1$ and $p = 0$ (certainty conditions), and under uncertain situations when $p \in \{\frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}\}$ (uncertainty conditions). This allows us to test whether uncertainty motivates truth-telling behavior compared with certainty. Moreover, we are also interested in whether the effect of uncertainty varies with the winning probability, from $\frac{1}{6}$ to $\frac{5}{6}$. Because the absolute monetary cost of truth-telling is fixed to be a regardless of the winning probability, we expect the effect of uncertainty to be similar across these five uncertainty conditions. Second, we include three pairs of high payoff h and low payoff l—$(40, p; 0)$, $(30, p; 10)$, and $(22, p; 18)$ and set $a = 4$. This enables us to examine the effect of the spread between high and low payoffs, which reflects a sense of riskiness. We expect a limited effect of uncertainty under the payoff pair $(22, p; 18)$, due to its relatively weak sense of riskiness. The combination of varying winning probabilities and payoff pairs gives rise to 21 lotteries. Correspondingly, in our within-subject design, each subject makes 21 rounds of decisions.[5]

[5]In the meta-analysis, Abeler, Nosenzo, and Raymond (2019) find that there is no strong trend of lying behavior over rounds in experiments with repeated reports.

Note that we modify the dice game design in several aspects to facilitate implementation. First, with respect to the privately observed outcome that underpins lying decisions, we employ a setting of two states. One state occurs with probability $\frac{1}{6}$ and delivers an additional payoff, and the other state occurs with probability $\frac{5}{6}$ and carries no extra monetary incentive. This is to simplify the choice environment and help avoid vagueness in the moral evaluation of partial lies. Second, we adopt a mental die-rolling process rather than a physical one (Kajackaite and Gneezy, 2017). Specifically, subjects are asked to randomly choose a number between 1 and 6 in their minds, before they learn about which number carries the additional payoff. This is in part to facilitate implementation of the online experiments, as we will explain in more detail below. Kajackaite and Gneezy (2017) show that the tendency to lie is stronger under the mental die-rolling process than in Fischbacher and Föllmi-Heusi's (2013) setting. However, the potential difference between using a mental die and a physical die should not impact the test of our hypothesis, because our focus is the comparison between uncertainty and certainty. In addition, we include an experiment to examine the robustness with respect to using a physical die, as introduced in Section 2.3.

Implementation. We implement each round of decisions in four steps (see Figure A.1 for the interface). First, subjects receive the endowed lottery $(h, p; l)$ in a frame of six boxes numbered 1 to 6. Specifically, the process is described as "*There are x box(es) containing h and $6-x$ box(es) containing l.*" We construct the winning probability $p \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$ using different values of x from 0 to 6, which is matched with different spreads of h and l. Second, subjects are asked to randomly choose a number between 1 and 6 as the box they choose in their mind and write the number on a piece of paper. This process is to strengthen the sense of dishonesty if subjects choose to report a different number later. However, to address the potential effect of observability, we make it clear to subjects that they will not be asked to display this record at any time. Third, subjects are explicitly informed that one of the six boxes has an additional payoff RMB4—i.e., "*This box is box y.*" Box y, with the additional payoff, varies from round to round. Last, subjects are asked to report the box they chose in their mind in the second step.

It is important to emphasize to subjects that the experimenter does not manipulate the experiment and has little room to do so. We inform subjects that the distribution of h and l will be determined randomly and independent of the additional payoff a. Specifically, the distribution of a is predetermined and revealed in the third step of the decision-making process, while the distribution of h and l among the boxes will be resolved randomly in front of subjects at the end of the experiment. Subjects make 21 decisions presented in random order without feedback. One of the 21 decisions is randomly selected to pay each subject. To induce segregation of decisions, we include a 10-second blank screen after each round.

We recruited subjects to join an online experiment at the scheduled time and date. After subjects entered the online meeting room, the experimenter shared the screen and read the instructions aloud to subjects (see the Online Appendix D for the instructions). At the beginning of the experiment, subjects answered eight comprehension questions with feedback and explanations. This was to familiarize them with the tasks and to reduce potential misunderstanding. Next, subjects started the 21 rounds of decisions. The whole study ended with a short survey. After all subjects in the same session finished the experiment, the experimenter randomly chose one round to implement to pay each subject, and randomly drew box(es) to contain the high payoff h for the chosen round. The randomization was done using the RANDBETWEEN function of Excel, and the randomization process was displayed in real time to subjects through the shared screen.

We conducted the online experiment between September and October 2022 with 107 university student subjects in China.[6] The experiment consisted of 9 sessions, with 10 to 20 subjects each session. On average, the experiment took around 45 min-

[6]This experiment and the two experiments on mechanisms below were conducted online because of the COVID-19 restrictions in China during the period in which we conducted the experiments. Two experiments on robustness and generalizability were conducted in person because there were no COVID-19 restrictions in Singapore at that time.

utes, which included reading the instructions and real time randomization. Payment for each subject included a show-up fee of RMB20 plus the payoff from one of the 21 decisions. The average payment was RMB44.1 ($\approx$ USD6.4).

2.2 Two Experiments on Mechanisms

We propose that uncertainty motivates individuals to behave morally, as if their moral behavior will lead to a better outcome as a result of the uncertainty. The experimental framework of the Dice Game offers an approach to test our hypothesis in truth-telling behavior. Nevertheless, it is widely acknowledged that uncertainty can heighten the complexity of decision-making and result in a failure in contingent thinking, which may in part contribute to the pattern documented in the Dice Game experiment. To further strengthen our hypothesis, we conduct two additional experiments to examine the proposed mechanism. The first experiment weakens the moral implications of choice behavior, which illuminates whether morality is critical to the effect of uncertainty. The second experiment imposes uncertainty on others rather than the decision makers themselves. This sheds light on whether the observed pattern, if any, relies on the condition whereby decision makers themselves face uncertainty and thus desire a favorable outcome.

Direct Choice Experiment. We conduct a *Direct Choice* experiment in which the moral implication of the choice behavior is weakened. This experiment is based on the "no dice" condition in Fischbacher and Föllmi-Heusi (2013), whereby subjects are given several alternative payoffs and they directly choose one payoff to receive without rolling a die. Their results show that although choosing the highest payoff does not involve lying, a proportion of subjects choose to avoid this payoff-maximizing option. This phenomenon is interpreted as an aversion to being greedy or being seen as greedy (see Arad (2014) and Tjøtta (2019) for related evidence). While greed is a common aspect of moral sentiment, it arouses a weaker moral implication than dishonesty (Fischbacher and Föllmi-Heusi, 2013). Therefore, we conduct a Direct Choice experiment to investigate whether uncertainty-motivated morality is weaker under the possible morality of greed aversion, compared with that under lying aversion, which helps identify the role of morality in the effect of uncertainty.

Without the die-rolling requirement, the experiment consists of three steps. First, subjects are endowed with a lottery $(h, p; l)$ in a frame of six boxes and told that "*There are x box(es) containing h and* $6 - x$ *box(es) containing l.*" Second, subjects are informed which box carries an additional payoff of RMB4. Third, subjects choose their preferred box. Similar to the Dice Game experiment, there are seven levels of the winning probability $p \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$; three payoff pairs $(40, p; 0)$, $(30, p; 10)$, and $(22, p; 18)$; and a total of 21 rounds of decisions. For this experiment and the next experiment on mechanisms, we closely follow implementation of the Dice Game experiment in other aspects.

Second Party Experiment. We conduct a *Second Party* experiment in which subjects themselves do not face uncertainty. The target of uncertainty is changed from our subjects to anonymous partners paired with them. Put differently, subjects face uncertainty as a second party or bystander. Our hypothesis suggests that subjects in the Dice Game experiment, as receivers of the lottery, are motivated to act morally for a better resolution of uncertainty. If others are endowed with the lottery, despite the possibility of other-regarding motivation, subjects have diminished or no desire for a good outcome of uncertainty for others. Hence, we hypothesize that uncertainty about others has limited or no effect on motivating subjects toward moral behavior. We test this in the Second Party experiment.

This design involves two players. Player A is given a lottery $(h, p; l)$ but makes no decisions. Player B, as the second party, receives a fixed payoff and makes decisions with honesty concerns. For the lottery received by Player A, we include six payoff pairs: $(40, p; 0)$, $(30, p; 10)$, $(22, p; 18)$, $(20, p; 0)$, $(15, p; 5)$, and $(11, p; 9)$, with seven levels of the winning probability $p \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$. Player B is endowed with a fixed amount of RMB21 and may need to decide whether to lie for an additional payoff RMB4 for herself. We adopt this set of parameters with consideration for social preferences (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Andreoni and Miller, 2002; Charness and Rabin, 2002). In the first three payoff pairs, Player B faces disadvantageous (advantageous) inequality when the high (low) payoff of the lottery occurs. In the last three payoff pairs, Player B always faces advantageous inequality regardless of the outcome of the lottery. Correspondingly, in our within-subject design, each Player B makes 42 rounds of decision.

Similar to the Dice Game experiment, there are four steps for each round of decision. First, subjects, as Player B, are informed that an anonymously paired Player A receives a lottery $(h, p; l)$, which is described in the frame of six boxes: "*There are x box(es) containing h and $6 - x$ box(es) containing l.*" Second, subjects randomly choose a number between 1 and 6 in their mind and write this number on a piece of paper. Third, subjects learn that their own payoffs are also in these six boxes; specifically, "*Box y contains RMB25 and the remaining five boxes contain RMB21.*" Last, subjects are asked to select the numbered box they chose in their mind in the second step.[7]

2.3 Two Experiments on Robustness and Generalizability

Ex Ante Resolution Experiment. We conduct an *Ex Ante Resolution* experiment to examine the robustness of uncertainty-motivated truth-telling behavior, which differs from the Dice Game experiment in two respects. First, in this experiment, when subjects make decisions, uncertainty has been resolved but kept unknown. This allows us to examine whether subjects would continue to behave as if their moral behavior could influence the outcome of the uncertainty.[8] Second, instead of asking

[7] In the experiment, all subjects were asked to make decisions as Player B. After all subjects in the same session finished the experiment, the experimenter randomly assigned a role for each subject using the RANDBETWEEN function. Next, subjects were randomly paired and the payoffs of each pair were determined by Player B's decisions and chances. The remaining randomization followed the Dice Game experiment.

[8] To reduce suspicion that the experimenter manipulated the uncertainty, we recorded a video of how we predetermined the distribution of h, l, and the additional payoff across the six boxes. Our random device was an urn with six balls numbered from 1 to 6. Subjects received a sealed envelope with information on all outcomes of uncertainty before the experiment, and were supposed to keep

subjects to roll a mental die (randomly choose a number in mind), as in the online experiments, we provide subjects with a physical die and a cup in an in-person laboratory environment.

For the lottery $(h, p; l)$, there are three payoff pairs, $(20, p; 0)$, $(15, p; 5)$, and $(11, p; 9)$, and seven levels of the winning probability $p \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$. Each of the 21 rounds of decisions consists of three steps. First, subjects are endowed with the lottery $(h, p; l)$ in a frame of six boxes. Second, subjects learn which box contains the additional payoff SGD2. Last, subjects are asked to throw the die once in private and select the box whose number is the one shown on the die.

We conducted the experiment in September and October 2019 at the National University of Singapore with 191 student subjects. Payment for each subject included a show-up fee plus the payoff from one of the 21 decisions. On average, the experiment took around 40 minutes, which included reading the instructions and receiving payment. The average payment was SGD19.8 ($\approx$ USD14.8).[9]

Dictator Game Experiment. We conduct a *Dictator Game* experiment to test the generalizability of the uncertainty-motivated morality hypothesis in the domain of other-regarding behavior. We extend our experimental framework to the dictator game, which is a classic paradigm to examine sharing behavior. In a standard dictator game, two players are anonymously paired: The dictator is endowed with a fixed sum of money and the recipient is endowed with nothing. The dictator decides any amount between 0 and the fixed sum to share with the recipient, which captures the degree of departure from narrowly defined selfishness. In our experiment, we endow the dictator with lotteries in the form of $(h, p; l)$. Instead of allowing the dictator

it sealed during the experiment. The link for the recorded video was provided at the end of the experiment. Moreover, we used the prior incentive system proposed by Johnson et al. (2020) to predetermine which decision was chosen for payment.

[9] Both the Ex Ante Resolution and Dictator Game experiments, as introduced below, were conducted at the National University of Singapore, and hence the payments were in Singapore dollars. We adjusted the payment according to the local norm for hourly wage when we considered payments in Singapore and China.

to share any proportion of the payoff, we use a binary design: The dictator chooses to share evenly or to share nothing with the recipient. If the dictator chooses to share evenly, both the dictator and the recipient receive the same amount, $\frac{h}{2}$ with probability p and $\frac{l}{2}$ otherwise. If the dictator chooses to share nothing, he receives the originally endowed lottery and the recipient receives nothing. Compared with a continuous set of choices, the binary design helps enhance the perception of equality for the even-split option (Bolton, Brandts, and Ockenfels, 2005). In addition, a meta-analysis of dictator game experiments reveals sharing evenly and sharing nothing as two modal choices (Engel, 2011).

Each round consists of three steps. First, subjects are endowed with the lottery $(h, p; l)$ in the six-box frame. Second, subjects learn that one exact box contains the sharing ratio 5:5 and the remaining five boxes contain the sharing ratio 10:0. Last, subjects decide whether to share by choosing a box: If subjects choose to share, they choose the box indicating the sharing ratio 5:5. The structure of the lotteries $(h, p; l)$ follows our previous experiments. There are three payoff pairs, $(19, p; 1)$, $(15, p; 5)$, and $(11, p; 9)$, with seven levels of the winning probability $p \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$.

The experiment was conducted between February and March 2020 at the National University of Singapore with 296 student subjects; 148 played the role of dictator. With a show-up fee and the payment from one of the 21 choices, subjects received SGD17.5 ($\approx$ USD13.1) on average.

2.4 Summary of the Experimental Design

We summarize these five experiments in Table 1. Our Dice Game experiment combines the standard truth-telling paradigm of Fischbacher and Föllmi-Heusi (2013) with endowed lotteries $(h, p; l)$. The six-box setting provides a natural context for this combination, and it helps intensify the sense of uncertainty when subjects make decisions about honesty. This main experiment provides a direct test of the uncertainty-motivated morality hypothesis. Building on the Dice Game experiment, we design four additional experiments, which vary the choice environment with respect to uncertainty or morality. The first two additional experiments provide supplementary evidence for our mechanism and help exclude alternative explanations, and last two additional experiments investigate the robustness and generalizability of the hypothesis. More details of these experiments are presented in the appendices (see Table A.1 for summary statistics, Online Appendix A for interfaces, and Online Appendix D for instructions).

Table 1: Overview of Experiments

Experiment	# Subjects	Uncertainty	Morality	Purpose
Dice Game	107	Subjects	Lie to get RMB4	Test of hypothesis
Direct Choice	102	Subjects	Choose to get RMB4	Mechanism: morality
Second Party	107	Partners	Lie to get RMB4	Mechanism: uncertainty
Ex Ante Resolution	191	Subjects	Lie to get SGD2	Robustness
Dictator Game	148	Subjects	Share with recipients	Generalizability

3 Results

This section reports our main results based on the Dice Game experiment, evidence on the underlying mechanism from the Direct Choice and the Second Party experiments, and further support of the uncertainty-motivated morality hypothesis from the Ex Ante Resolution and the Dictator Game experiments.

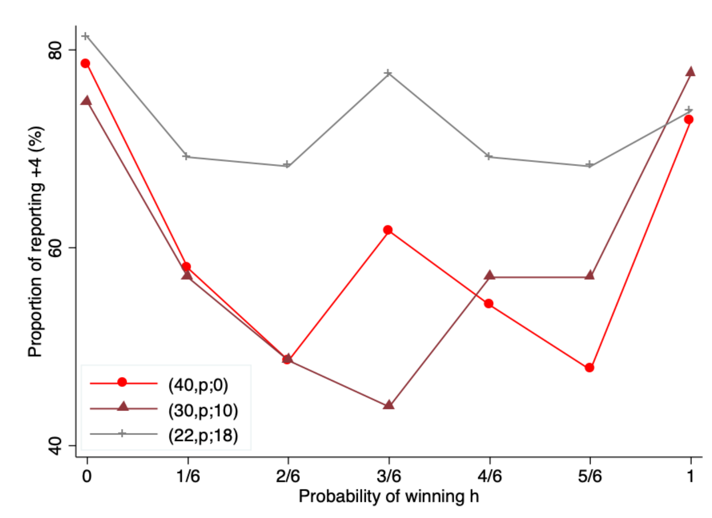
3.1 Main Experiment

Figure 1 presents the proportion of subjects who report a result that yields the additional RMB4 (also referred to as the proportion of reporting +4 below). Since individual lying behavior is not observable, we infer the tendency to lie at aggregate level. The x-axis is the winning probability, and the y-axis is the proportion of reporting +4. For each of the 21 decisions, this proportion is substantially higher than the full truth-telling rate of $\frac{1}{6}$ and thus provides a measure of dishonesty (see Table

A.1 for summary statistics). Based on Figure 1, we observe two patterns.

First, subjects are less likely to lie under uncertainty than under certainty. The proportion of reporting +4 is 59.1 percent in uncertainty conditions, which is lower than in certainty conditions with high payoffs (74.8 percent) and low payoffs (78.2 percent).

Figure 1: Truth-telling Behavior in the Dice Game Experiment



Second, the observed difference between certainty and uncertainty conditions is larger when the spread between high and low payoffs is larger, and is constant with respect to the winning probability. Under $(40, p; 0)$, the proportions of +4 are 54.0 percent for the five lotteries and 72.9 percent (78.5 percent) for certain payoff 40 (certain payoff 0). The effect of uncertainty diminishes for a small spread: Under $(22, p; 18)$, the proportions are 70.5 percent for the five lotteries and 73.8 percent (81.3 percent) for certain payoff 22 (certain payoff 18). Moreover, we observe a stable effect of uncertainty across different winning probabilities. For example, the proportions of reporting +4 are between 47.7 percent and 61.7 percent for the five lotteries under $(40, p; 0)$, each of which is significantly lower than those in the two certainty conditions. For more details, Table A.2 presents the statistical tests of pairwise comparisons between conditions within each payoff pair.

Regression Analyses. We test these two observations through OLS regression analyses. The dependent variable, as a measure of dishonesty, equals 1 if subjects report +4 and 0 otherwise, and the main independent variables are two dummies for the two degenerate certainty conditions, with uncertainty conditions being the reference. We consider a set of control variables and cluster standard errors at the individual level.

Table 2 presents our main results. The coefficients of the two dummies are significantly positive without and with controls (Panel A, columns 1-2). On average, subjects under uncertainty show a 15.5 and a 19.0 percentage point decrease in the probability of reporting +4, compared with the certainty of high and low payoffs, respectively (Panel A, column 2). In the regressions using subsamples by payoff pairs, the effect of uncertainty is sizeable and significant under $(40, p; 0)$ and $(30, p; 10)$. However, under $(22, p; 18)$, the coefficients become smaller and one becomes insignificant, which suggests a null effect of uncertainty when the gap between high and low payoffs is small (Panel A, columns 3-5). In Panel B, we separately examine the effect of uncertainty by winning probabilities and find that the coefficients of the two dummies are significantly positive under all five probabilities. The regression results confirm our observations from Figure 1.

Robustness Checks and Additional Analyses. First, we find that the observations are robust to the use of probit regression analyses (Table A.3) and to the inclusion of detailed demographic characteristics and session fixed effects as controls instead of directly controlling for the individual fixed effect (Table A.4).

Second, we examine potential spillover between rounds. Although we include a 10-second blank screen after each round to induce choice segregation, subjects may believe that honest behavior in the previous round leads to a good outcome in the current round, and thus they would be less responsive to uncertainty in the current

Table 2: Regression Analyses of the Dice Game Experiment

	OLS: 1_{+4}				
	(1)	(2)	(3)	(4)	(5)
Panel A. Full sample and subsamples by payoff pairs					
	All	All	(40, p; 0)	(30, p; 10)	(22, p; 18)
1_h	0.157***	0.155***	0.188***	0.247***	0.030
	(0.028)	(0.029)	(0.046)	(0.044)	(0.040)
1_l	0.191***	0.190***	0.242***	0.218***	0.108***
	(0.025)	(0.026)	(0.044)	(0.043)	(0.039)
Controls	N	Y	Y	Y	Y
Constant	0.591***	0.299***	0.385***	0.232***	0.381***
	(0.029)	(0.029)	(0.030)	(0.050)	(0.049)
Observations	2,247	2,247	749	749	749
R-squared	0.027	0.383	0.447	0.451	0.424
Panel B. Subsamples by winning probabilities					
	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$
1_h	0.131***	0.195***	0.135***	0.142***	0.171***
	(0.032)	(0.039)	(0.036)	(0.040)	(0.035)
1_l	0.166***	0.230***	0.170***	0.176***	0.206***
	(0.031)	(0.033)	(0.034)	(0.038)	(0.033)
Controls	Y	Y	Y	Y	Y
Constant	0.120***	0.180***	0.357***	0.330***	0.140***
	(0.046)	(0.050)	(0.052)	(0.048)	(0.047)
Observations	963	963	963	963	963
R-squared	0.470	0.465	0.424	0.415	0.470

Notes: 1_{+4} equals 1 if subjects choose the box with the additional RMB4 and 0 otherwise. 1_h (1_l) equals 1 if the condition gives certain high (low) payoff and 0 otherwise. In Panel A, column 1 uses all data without controls. Column 2 further controls for the payoff pair fixed effect, the individual fixed effect, the duration of the decision (in seconds), and the order of the decision (between 1 and 21). Columns 3-5 report results using data on the seven choices under the payoff pair $(40, p; 0)$, $(30, p; 10)$, and $(22, p; 18)$, respectively. In Panel B, each of columns 1-5 uses the data on the nine choices, including six choices under certainty and three under uncertainty with the winning probability being $\frac{1}{6}$ to $\frac{5}{6}$, respectively. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

round. To examine this possibility, we regress the reporting +4 decision on the two dummies of certainty conditions, the choice in the previous round, and their interaction terms, with full controls, and find that the coefficients of two dummies of certainty conditions are significant and similar in size (Table A.5). An extreme case of spillover effect happens if subjects believe that their good behavior is generally connected with uncertainty resolution, both inside and outside the lab. This type of spillover effect would reduce subjects' responsiveness to the difference between certainty and uncertainty in the laboratory, which would cause a downward bias in our estimation of the effect of uncertainty.

Third, we examine whether the size of the endowed lottery affects the tendency to lie and how to control for this potential effect in different regression specifications. We regress the decision to report +4 on the amount of payoff under certainty (Table A.6, column 1), and on the winning probability with controls for payoff pairs under uncertainty (Table A.6, column 2). We find no evidence of the effect of endowment size on lying behavior, which is in accordance with the findings in a meta-study of preference for truth-telling (Abeler, Nosenzo, and Raymond, 2019).[10] Next, we regress the decision to report +4 on a dummy variable that indexes uncertain payoffs and the winning probability (Table A.6, column 3), and on the mean and variance of lotteries (Table A.6, column 4). The result shows that subjects are less likely to report +4 under uncertainty and when the variance of the lotteries gets larger.

Last, we conduct an individual-level analysis and classify subjects into different types according to their tendency to report +4 in different conditions. In particular, a subject is classified as Uncertainty-motivated type if her proportion of reporting +4 under uncertainty conditions is strictly lower than those under both certainty conditions. Table A.7 displays the standard of classification, the proportion, and the descriptive characteristics of each type. We show that 54 out of 107 subjects are classified as Uncertainty-motivated type, in support of the observed pattern at aggregate level.

Taken together, results from these robustness checks and additional analyses indicate that the uncertainty-motivated truth-telling behavior is robust.

[10] Abeler, Nosenzo, and Raymond (2019) find that preference for truth-telling is invariant with the incentive to lie. In our experiment, the absolute incentives for lying are fixed to be RMB4, while the relative incentives vary with the size of the endowed lottery. Our finding of the absence of this effect suggests that the preference for honesty is also insensitive to relative incentives to lie.

3.2 Two Experiments on Mechanisms

Direct Choice Experiment. Table 3 reports the results of the Direct Choice experiment, whereby subjects choose their preferred payoff without honesty concern. We are interested in examining whether the difference between uncertainty and certainty diminishes when the moral implication of the choice behavior is weakened. In the OLS regression analyses, the dependent variable equals 1 if subjects report +4 and 0 otherwise, which can be viewed as a measure of greediness. The main independent variables are the two dummies that index the two degenerate certainty conditions. We observe, first, that subjects are less willing to take the additional payoff under uncertainty than under certainty. On average, uncertainty leads to a 7.0 and a 6.7 percentage point decrease in the probability of taking +4, compared with high and low payoffs, respectively (column 1). This suggests that subjects exhibit a stronger degree of greed aversion under uncertainty than certainty. Second, this pattern is significant only if the spread between high and low payoffs is large enough (columns 2-4), which is similar to the observation in the Dice Game experiment. Third, the effect of uncertainty is weaker in this Direct Choice experiment than the Dice Game experiment, since the magnitudes of the two main coefficients are less than half of those in the original estimation (Table 3, column 1 vs. Table 2, column 2). Moreover, after pooling the data on these two experiments in the regression, we include a dummy to index the Dice Game experiment and its interactions with the two main independent variables. We find that these two interaction terms are both significantly positive, which suggests a stronger uncertainty effect in the Dice Game experiment than the Direct Choice experiment.

In summary, the Direct Choice experiment documents a pattern that uncertainty motivates greed aversion. However, the effect of uncertainty is weaker in motivating greed aversion in the Direct Choice experiment than in motivating lying aversion in the Dice Game experiment. Put differently, weaker moral concern drives a weaker effect of uncertainty, which lends support to our uncertainty-motivated morality hypothesis.

Table 3: Regression Analyses of the Direct Choice Experiment

	OLS: 1_{+4}				
	All	(40, p; 0)	(30, p; 10)	(22, p; 18)	+ Dice Game
	(1)	(2)	(3)	(4)	(5)
1_h	0.070***	0.096***	0.107***	0.006	0.070***
	(0.012)	(0.021)	(0.022)	(0.009)	(0.012)
1_l	0.067***	0.081***	0.109***	0.006	0.067***
	(0.013)	(0.022)	(0.022)	(0.013)	(0.013)
1_{DiceGame}					-0.476***
					(0.010)
$1_h \times 1_{\text{DiceGame}}$					0.086***
					(0.031)
$1_l \times 1_{\text{DiceGame}}$					0.124***
					(0.029)
Controls	Y	Y	Y	Y	Y
Constant	0.918***	0.989***	0.790***	1.001***	0.775***
	(0.018)	(0.024)	(0.025)	(0.014)	(0.020)
Observations	2,142	714	714	714	4,389
R-squared	0.205	0.336	0.305	0.248	0.435

Notes: 1_{+4} equals 1 if subjects choose the box with the additional RMB4 and 0 otherwise. 1_h (1_l) equals 1 if the condition gives certain high (low) payoff and 0 otherwise. Columns 1-4 use data from the Direct Choice experiment. Column 5 combines data from the Dice Game experiment and the Direct Choice experiment. 1_{DiceGame} equals 1 if subjects are in the Dice Game experiment. We control for the payoff pair fixed effect, individual fixed effect, duration of the decision, and order of the decision. Standard errors are clustered at the individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Second Party Experiment. Table 4 reports the results of the Second Party experiment, whereby subjects face uncertainty for their partners as the second party but no uncertainty for themselves. We are interested in examining whether the difference between uncertainty and certainty is specific to uncertainty about oneself as opposed to uncertainty in general. We conduct OLS regression analyses. The dependent variable measures dishonesty, which equals 1 if subjects report +4 and 0 otherwise. The main independent variables are the two dummies, which index the two degenerate certainty conditions of the partner. First, we find a weak pattern whereby subjects are less willing to lie under uncertainty than under certainty. On average, uncertainty about others leads to a 5.8 and 3.5 percentage point decrease in the probability of reporting +4, compared with two certainty conditions (column 1). However, the signs and significance of the two dummies reveal no systematic pattern

Table 4: Regression Analyses of the Second Party Experiment

	OLS: 1_{+4}							
	All	(40, p; 0)	(30, p; 10)	(22, p; 18)	(20, p; 0)	(15, p; 5)	(11, p; 9)	+ Dice Game
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1_h	0.058***	0.061	0.082*	0.077*	0.009	0.096**	0.025	0.058***
	(0.019)	(0.042)	(0.044)	(0.043)	(0.044)	(0.041)	(0.037)	(0.019)
1_l	0.035*	-0.011	0.147***	0.024	0.077*	-0.025	-0.002	0.036**
	(0.018)	(0.040)	(0.044)	(0.039)	(0.046)	(0.037)	(0.036)	(0.018)
1_{DiceGame}								-0.119***
								(0.015)
$1_h \times 1_{\text{DiceGame}}$								0.098***
								(0.034)
$1_l \times 1_{\text{DiceGame}}$								0.155***
								(0.031)
Constant	0.467***	0.011	0.675***	0.069**	0.812***	0.805***	0.576***	0.417***
	(0.021)	(0.027)	(0.043)	(0.030)	(0.084)	(0.073)	(0.093)	(0.024)
Observations	4,494	749	749	749	749	749	749	6,741
R-squared	0.513	0.562	0.544	0.580	0.565	0.613	0.611	0.471

Notes: 1_{+4} equals 1 if subjects choose the box with RMB25 and 0 if subjects choose the box with RMB21. 1_h (1_l) equals 1 if the condition gives certain high (low) payoff for Player A and 0 otherwise. Columns 1-7 use data from the Second Party experiment. Column 8 combines data from the Dice Game experiment and the Second Party experiment. 1_{DiceGame} equals 1 if the subject is in the Dice Game experiment. We control for the fixed effect of payoff pairs, individual fixed effect, duration of the decision, and order of the decision. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

across the six payoff pairs (columns 2-7). Second, the effect of uncertainty is weaker in this experiment than the original Dice Game experiment. Pooling the data on these two experiments, we include a dummy to index the Dice Game experiment in the regression, as well as the interactions between this dummy and the main independent variables. We find that the two interaction terms are significantly positive, in support of a stronger uncertainty effect in the Dice Game experiment than the Second Party experiment.

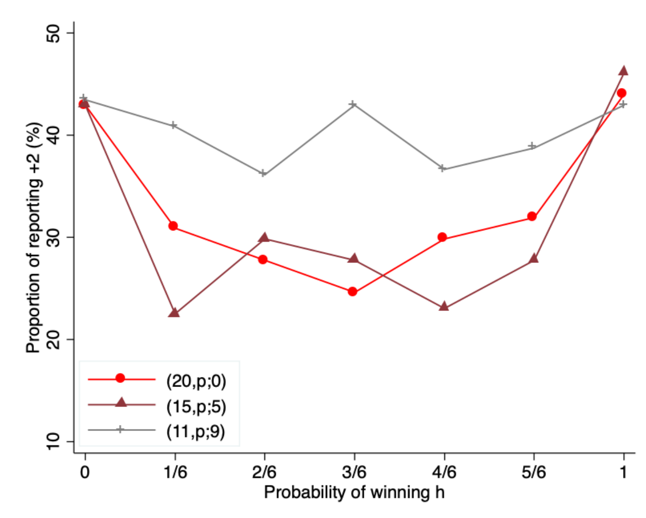
Overall, when uncertainty concerns other people, it has no systematic effect on motivating decision makers' truth-telling behavior. This indicates that the desire for a good uncertainty resolution for oneself is crucial. Note that the design of the Second Party experiment shares some features with the literature on moral wiggle room. Online Appendix B reports another experiment, in which we further modify our experiment to incorporate the original paradigm of moral wiggle room in Dana, Weber, and Kuang (2007). The new piece of evidence provides further support for our finding that uncertainty about others does not motivate decision makers' truth-telling behavior; contrarily, it can lead to dishonesty and information avoidance, which is in line with the notion of moral wiggle room.

3.3 Two Experiments on Robustness and Generalizability

Ex Ante Resolution Experiment. Figure 2 displays the proportions of reporting +2 in the Ex Ante Resolution experiment in which subjects make the decision after the uncertainty has been resolved but kept unknown. We obtain two findings in this experiment, which are both consistent with the Dice Game experiment with an ex post resolution design. First, uncertainty motivates truth-telling behavior. The proportion of reporting +2 is 31.4 percent under uncertainty, compared with 44.3 percent and 43.1 percent under high and low payoffs, respectively. Second, the effect of uncertainty is significant when the spread between high and low payoffs is large enough and is invariant with the winning probability. When the payoff pair is $(20, p; 0)$, the proportions of reporting +2 are 29.0 percent, 44.0 percent, and 42.9 percent under the five lotteries, certain payoff 20, and certain payoff 0, respectively. Specifically, the proportions are between 24.6 percent and 31.9 percent for the five lotteries. However, when the payoff pair is $(11, p; 9)$, all seven conditions are statistically indifferent. These findings are supported by OLS regression analyse (Table A.8).[11]

[11] One question of interest is whether uncertainty-motivated honesty would differ between the Dice Game and the Ex Ante Resolution experiments. Similar to the previous analyses reported in Tables 3 and 4, we pool the data of both experiments and include a dummy to index the Dice Game experiment in the regression, as well as the interaction terms between this dummy and the main independent variables. We find that the interaction terms are both positive, but one of them is insignificant. This suggests that the uncertainty effect is marginally stronger in the Dice Game experiment than that in the Ex Ante Resolution experiment. Apart from whether moral decisions are made before or after the uncertainty resolution, these two experiments differ in several ways including online verse in-person environment, Chinese verse Singaporean samples, and so on. Therefore, we do not want to overinterpret the comparison between the two experiments; Instead, we use the Ex Ante Resolution experiment to examine whether the uncertainty-motivated honesty is robust.

Figure 2: Truth-telling Behavior in the Ex Ante Resolution Experiment

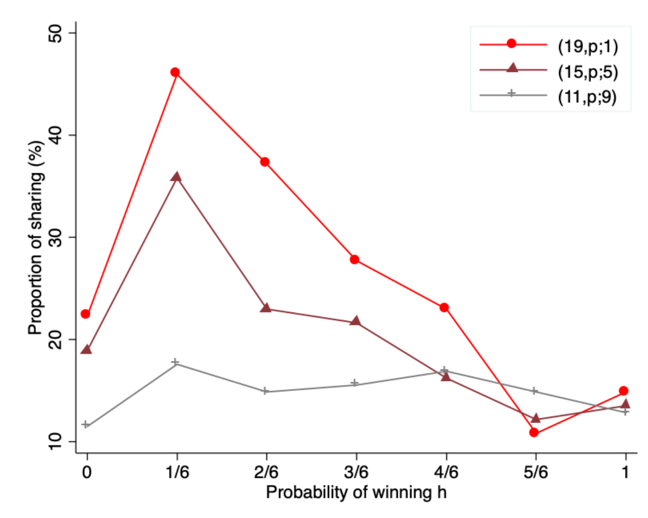


Dictator Game Experiment. Figure 3 reports the proportions of choosing the box to share payoffs with others in the Dictator Game experiment. First, similar to the Dice Game experiment, uncertainty motivates sharing behavior. The proportion of sharing is 22.2 percent in uncertainty conditions, which is higher than those in certainty conditions with high payoff (13.7 percent) and low payoff (17.6 percent).[12] Second, the observed difference between certainty and uncertainty is larger when the spread between high and low payoffs is larger. For example, the proportion of sharing is 45.9 percent for $(19, \frac{1}{6}; 1)$ and 14.9 percent and 22.3 percent for certain payoff 19 and certain payoff 1, respectively. By contrast, under the payoff pair $(11, p; 9)$, all seven conditions are statistically indifferent. Moreover, we observe a distinct pattern in this experiment: The difference between uncertainty and certainty decreases with the increase in the winning probability, but is invariant to the winning probability in the Dice Game and Ex Ante Resolution experiments. For instance, the proportion is 45.9 percent for the lottery $(19, \frac{1}{6}; 1)$ and 23.0 percent for the lottery $(19, \frac{4}{6}; 1)$.[13] We further verify these findings through OLS regression analyses (Table A.9).

[12]The observed proportions in certainty conditions are comparable to the literature, in which 16.7 percent of dictators choose the equal split in a meta-analysis of dictator game experiments (Engel, 2011).

[13]This distinct pattern can be due to the fact that the cost of sharing increases with the winning

Figure 3: Sharing Behavior in the Dictator Game Experiment



4 Discussion

In this section, we discuss our observations in terms of theoretical implications, the connection with notions of magical thinking and quasi-magical thinking, as well as some alternative explanations.

4.1 Theoretical Implications

Most models of decision-making under uncertainty employ a balancing scheme, whereby decision makers think through all possible outcomes and balance them according to their (weighted) probabilities. This pattern implies that decision makers should respect the principle of dominance. In other words, if an act is chosen in all deterministic situations, it should remain the favorable option when decision makers need to balance across these situations under uncertainty. However, our findings of

probability in the Dictator Game experiment. More specifically, the expected monetary cost of sharing, $p\frac{h}{2} + (1-p)\frac{l}{2}$, increases with p. By contrast, the cost of telling the truth is fixed at RMB4 in the Dice Game experiment and SGD2 in the Ex Ante Resolution experiment, in which we do not observe any difference of effect with respect to the winning probability. We explain this formally in Online Appendix C higher tendency to be honest and altruistic under uncertainty than certainty violate dominance.

More formally, in our setting there are two states—s_h yields the high monetary payoff h and s_l yields the low monetary payoff l—and two acts, moral act m and immoral act i. Decision makers evaluate each act under each state, which generates four possible consequences: $\{h_m, l_m, h_i, l_i\}$. For example, h_m denotes the consequence of the moral act when state s_h happens, and so on. Here the consequence can capture not only monetary payoffs but also moral considerations such as lying aversion, and other-regarding concern. In our main experiment, we show that a substantial proportion of subjects prefer the immoral act to the moral act in the two deterministic situations—$h_i \succ h_m$ and $l_i \succ l_m$—but choose the moral act in the uncertain situations, $(h_m, p; l_m) \succ (h_i, p; l_i)$. If individuals are expected utility maximizers,

$$\begin{aligned} U(\text{immoral}) &= pu(h_i) + (1-p)u(l_i) \\ U(\text{moral}) &= pu(h_m) + (1-p)u(l_m) \end{aligned}$$

Given that $u(h_i) > u(h_m)$ and $u(l_i) > u(l_m)$, we will have $pu(h_i) + (1-p)u(l_i) > pu(h_m) + (1-p)u(l_m)$. Similarly, if individuals are rank-dependent utility maximizers with probability weighting function $w(p)$,

$$\begin{aligned} U(\text{immoral}) &= w(p)u(h_i) + (1-w(p))u(l_i) \\ U(\text{moral}) &= w(p)u(h_m) + (1-w(p))u(l_m) \end{aligned}$$

We will also have $w(p)u(h_i) + (1-w(p))u(l_i) > w(p)u(h_m) + (1-w(p))u(l_m)$. In this regard, standard models have difficulty accommodating the documented uncertainty-motivated morality.[14]

[14] It is also important to consider models that permit dominance violation, including the disappointment theory (Bell, 1985; Loomes and Sugden, 1986); regret theory (Bell, 1982; Loomes and Sugden, 1982); reference-dependence theory (Kőszegi and Rabin, 2007); and models with preference for gambling (Fishburn, 1980; Diecidue, Schmidt, and Wakker, 2004). For example, under models with preference for gambling, when the utility of gambling is sufficiently high, util-

The implications above are general, because the consequences $\{h_m, l_m, h_i, l_i\}$ can capture both monetary payoffs and moral concerns. We would like to further investigate prior models of truth-telling behavior. Abeler, Nosenzo, and Raymond (2019) propose a model in which individuals make trade-offs among the monetary payoff, the fixed cost of lying, and the cost of being perceived as a liar by the audience. Gneezy, Kajackaite, and Sobel (2018) propose a model with three components: the monetary payoff, the direct cost of lying, and the value of being perceived as honest. It is worth noting that these studies model another form of uncertainty, the random process that generates the privately observed variable (e.g., the die-rolling process), which differs from the uncertainty studied in our paper.

Specifically, these models propose that features of this random process affect the propensity to lie. First, the probability of observing the high payoff variable affects reputational concerns (Abeler, Nosenzo, and Raymond, 2019; Gneezy, Kajackaite, and Sobel, 2018). Put differently, when the objective probability of the high payoff is low, reporting the high payoff looks more suspicious to the audience, and thus decision makers with image concerns may be less likely to report this maximum payoff. Second, the probability distribution of this random process shapes the reference points of decision makers, which can lead to a change in lying behavior. Garbarino, Slonim, and Villeval (2019) show that when the probability of the low payoff variable decreases, the reference point measured by the ex ante expected payoff increases. Consequently, decision makers would suffer a greater loss if reporting the low payoff variable, which leads to a stronger tendency to lie.

In comparison, the uncertainty of our interest lies in the given $(h, p; l)$, which is implicit in the prior models. Our experiment keeps the random process constant: The probability of the high payoff is fixed to be $\frac{1}{6}$ and the monetary gain from lying

ity for the lottery can be higher than that for the best realization of the lottery. Namely, it is possible that $(h_m, p; l_m) \succeq h_m$ and $(h_i, p; l_i) \succeq h_i$. However, given that $h_i \succ h_m$, in order for $(h_m, p; l_m) \succ (h_i, p; l_i)$ to account for our findings, we need to have a strong assumption that preference for gambling is substantially stronger under a moral act than under an immoral act.

is fixed to be RMB4 or SGD2. The effect of reputation concern or reference point concern is likely to be similar between $p = 1$ and $p = 0$ given the similar proportion of lying, and it seems implausible to differ for uncertainty ($p \in (0, 1)$). To formally integrate $(h, p; l)$ into these models, we can embed the preference for truth-telling, with reputation concern or reference point concern, in the consequences $\{h_m, l_m, h_i, l_i\}$. However, as noted above, this specification can not account for our observations due to dominance violation.

In Online Appendix C, we provide discussions of models of social preference and their predictions in our Dictator Game experiment (Brock, Lange, and Ozbay, 2013; Saito, 2013). In general, these models fall short in addressing the uncertainty-motivated sharing behavior under regular conditions (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Andreoni and Miller, 2002; Charness and Rabin, 2002). To obtain clearer theoretical implications, it is crucial to further investigate the underlying mechanism.

4.2 Magical Thinking and Quasi-Magical Thinking

Our preferred mechanism, by which individuals behave as if their moral act leads to a favorable outcome of uncertainty, can be further captured by two closely related notions: magical thinking and quasi-magical thinking. We discuss these two notions below and show that both can explain the observed behavior in our study.

Magical thinking refers to the belief that one can influence the outcome of uncertainty through some specific acts, even though the acts have no causal link to the uncertainty. For example, people may believe that throwing the dice harder results in higher numbers, tolerating cold for a longer time extends life expectancy, and voting induces others to vote. A possible way to model magical thinking is to directly assume that decision makers explicitly hold such a belief—that their acts can change the outcome of the uncertainty. More specifically, subjects believe that with probability α, the world is karmic and thus a moral act leads to high payoff h_m, and an immoral act leads to low payoff l_i. With probability $1-\alpha$, the world is objective, and thus high and low payoffs occur with probability p and $1-p$, respectively. Namely, if individuals are expected utility maximizers with karmic belief α, we have

$$U(\text{immoral}) = \alpha u(l_i) + (1-\alpha)(pu(h_i) + (1-p)u(l_i))$$
$$U(\text{moral}) = \alpha u(h_m) + (1-\alpha)(pu(h_m) + (1-p)u(l_m))$$

Therefore, uncertainty-motivated moral behavior no longer violates dominance, and it occurs if karmic belief α is strong and the gap between $u(h_m)$ and $u(l_i)$ is large.

An alternative approach is quasi-magical thinking, whereby people act as if they believe that their action influences the outcome of uncertainty, even though they do not really hold such a belief when asked (Shafir and Tversky, 1992; Risen, 2016). More specifically, as Shafir and Tversky (1992) observe, it is unlikely that subjects truly believe they can control the outcome of the die by throwing harder, live longer by tolerating cold for a longer time, or induce others to vote by voting. Nevertheless, they behave as if they hold such beliefs. This notion can be modelled as an act-dependent probability weighting function, based on the source method (Chew and Sagi, 2008; Abdellaoui et al., 2011). More specifically, moral acts and immoral acts yield distinct probability weighting functions $w_m(p)$ and $w_i(p)$, respectively. If individuals are rank-dependent utility maximizers with an act-dependent probability weighting function, we will have

$$U(\text{immoral}) = w_i(p)u(h_i) + (1-w_i(p))u(l_i)$$
$$U(\text{moral}) = w_m(p)u(h_m) + (1-w_m(p))u(l_m)$$

Similarly, uncertainty-motivated moral behavior no longer violates dominance with $w_m(p) > w_i(p)$, which can be viewed as a sense of optimism (pessimism) following one's moral behavior (immoral behavior), and is more likely to emerge when the gap in decision weights $w_m(p) - w_i(p)$ is larger.[15]

[15]Online Appendix C provides more details of these two approaches. A more general approach

Our findings are more consistent with the notion of quasi-magical thinking. First, our design makes it hard for subjects to consciously embrace magical thinking. To avoid confusion and suspicion, we strive to make sure that subjects understand the independence between their choices and the resolution of the uncertainty, with corresponding comprehension tests and detailed explanations. Second, we measure a form of karmic belief in a survey at the end of the experiment—the winning probability of the high payoff conditional on choosing the box with an additional RMB4 and choosing one of the other five boxes. We find that 72.9 percent of subjects reveal an objective belief and 23.4 percent report a lower winning probability for choosing the box with an additional RMB4. We find no significant difference in the uncertainty-motivated truth-telling behavior between these two subgroups of subjects (Table A.10). Third, in the Ex Ante Resolution experiment, uncertainty has been resolved prior to the decisions, but is unknown to subjects. Even though subjects are unlikely to believe that they can undo the resolved uncertainty by acting morally, we continue to observe uncertainty-motivated honesty.

There are various reasons for the lack of explicit acceptance of karmic belief in our survey. One possible explanation is that subjects may have reservations about disclosing their superstitious beliefs and consider these beliefs cognitively wrong. Moreover, subjects may avoid making claims that their moral behavior will bring them good fortune, which can be perceived to be tempting fate. Risen (2016) suggests that magical thinking, along with widespread beliefs in a similar spirit, is likely to serve as a heuristic in System 1 to guide our daily behavior, and sophisticated System 2 is aroused to deny such erroneous beliefs when we are asked. In this regard, it is difficult to measure those beliefs and to separate magical thinking and quasi-magical thinking. As Shafir and Tversky (1992) put it, "Whereas magical thinking involves indefensible beliefs, quasi-magical thinking yields inexplicable actions." Given the

is to reformulate the state space, which can be found in Chapter 11 of Gilboa (2009) on Newcomb's paradox. More discussion of Newcomb's paradox and related theoretical works can be found in Nozick (1969); Jeffrey (1965); Gilboa and Schmeidler (1995); Karni and Vierø (2013); Schipper (2016); Karni (2017); Gilboa, Minardi, and Samuelson (2020).

difficulty in directly eliciting these beliefs, we focus on observable actions in the current study and leave the joint investigations of actions and beliefs for future studies.

4.3 Alternative Explanations

When individuals find uncertain situations too complex and have difficulty thinking through contingencies, they may adopt heuristic rules to guide their behavior. Here quasi-magical thinking can be viewed as a heuristic rule that helps explain our observations. Nevertheless, it would be of interest to consider alternative explanations.

First, individuals may be more likely to choose salient options under uncertainty than under certainty. Arguably, one salient option can be the box that distinguishes itself from the remaining five boxes: an extra payoff in the Dice Game, Direct Choice, and Ex Ante Resolution experiments and a sharing ratio of 5:5 in the Dictator Game experiment. However, when comparing uncertainty situations with certainty situations, we observe that subjects are less likely to choose the salient box to lie and more likely to choose the salient box to share, which is inconsistent with this alternative mechanism.

Second, individuals may make inferences about outcomes in the six boxes and regard the extra payoff in the dice game as a signal of the low outcome. As a consequence, they tend to avoid the extra payoff under uncertainty. An implication of this form of misunderstanding is that, on the contrary, a box with an extra loss could be considered to signal the high outcome of the lottery and subjects are more likely to lie by choosing this box. To test this alternative mechanism, we conduct another experiment (see Online Appendix B for details), which is similar to our main experiment except that there is one box with an extra loss rather than an extra gain of RMB4. We find that subjects do not lie by overreporting that box. This suggests that the extra payoff is unlikely to be viewed as a signal of the low outcome of the lottery.

Apart from these two, there could be other mechanisms in response to the difference between uncertainty and certainty situations. Nevertheless, in the Direct Choice and Second Party experiments, we maintain the uncertainty in the six-box design and show that the difference between uncertainty and certainty either diminishes or disappears. These two experiments suggest that our results cannot be fully explained by general issues related to uncertainty, such as complexity or confusion, and point out that the morality of choice behavior and the target of uncertainty are central to our observations.

5 Concluding Remarks

We propose an uncertainty-motivated morality hypothesis whereby people act morally, as if their moral behavior can lead to a better resolution of the uncertainty. We test this hypothesis in a series of experiments. In the main experiment, we find that individuals are less likely to lie under uncertain situations than under certain situations with degenerate outcomes. We further conduct two experiments to strengthen our hypothesis and two experiments to examine the robustness and generalizability of our findings. We show that prior models have difficulty explaining our choice patterns, and suggest quasi-magical thinking as a possible explanation.

Our study has some implications in applied settings. For example, using a 4-year longitudinal dataset of 696,942 actual donations and a 6-month dictator game study with 1,003 subjects, a recent paper shows that individuals' generosity increases under the COVID-19 threat (Fridman, Gershon, and Gneezy, 2022). Consistent with our hypothesis, this observation can be viewed as uncertainty, in the form of the COVID-19 threat, motivating potential donors to give. Moreover, it has been widely documented that investors exhibit an aversion to sin stocks and a preference for socially responsible investment. This is in line with the explanation whereby investors may choose their stocks as if the morality of the chosen stocks affects the return to their portfolio. Also, some taxpayers may comply with tax laws because they worry that lying on their tax return may increase their chance of being caught and investigated. Our observed uncertainty-motivated morality may provide a new perspective on these settings.

Our study also sheds light on models of decision making under uncertainty. An implicit prerequisite of standard models in decision-making under uncertainty is that individuals "properly" perceive and "fully" attend to the choice situations—that is, the states, acts, and consequences. However, many departures from expected utility can be interpreted as manifestations of basic human perception. For example, probability weighting is often linked to the perception of likelihoods with a sense of optimism and pessimism (i.e., Diecidue and Wakker, 2001), and some anomalies in the literature can be due to the difficulty of thinking through contingencies (Esponda and Vespa, 2021). Here we propose that the perceived connection between moral behavior and outcomes from uncertainty, either conscious or unconscious, can be viewed as a manifestation of a failure of contingent thinking and can be modelled through a probability-weighting function that links moral behavior to optimism. This approach can help explain the uncertainty-motivated morality in our experiments, some phenomena in the aforementioned settings, and beyond.

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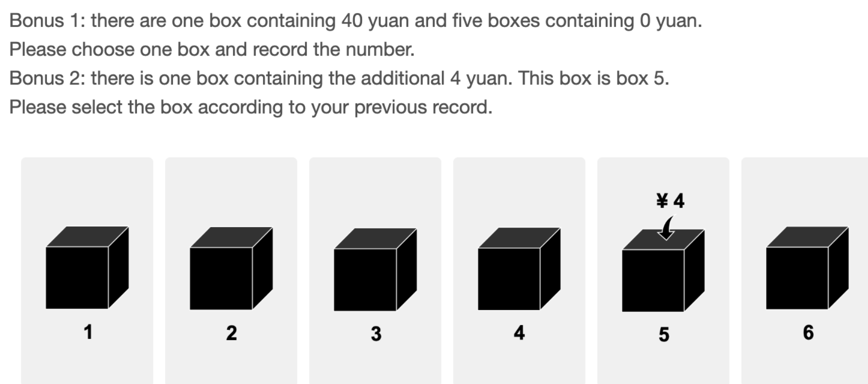
Online Appendix A: Additional Figures and Tables

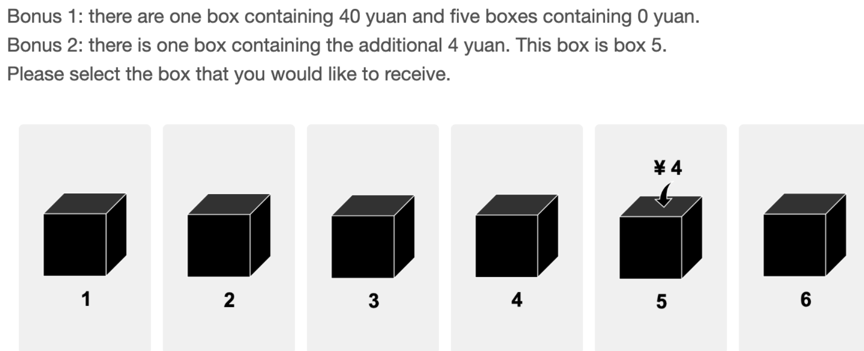
Figure A.1: The Interface of the Main Experiment



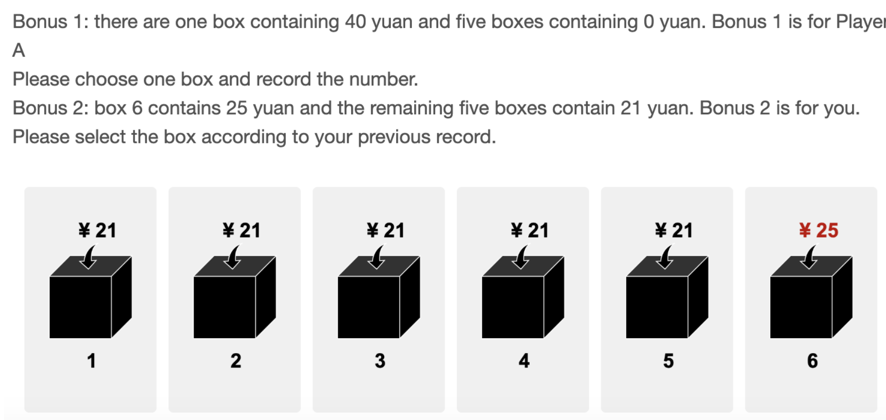
Notes: This is an example the interface of the Dice Game experiment. This example shows the interface of the condition $(40, \frac{1}{6}; 0)$. Interfaces of other conditions are similar. Specifically, when $p = 0$ ($p = 1$), the first line will be "*Bonus 1: there are six box containing l (h).*" In the experiment, we display each line of sentence sequentially.

Figure A.2: Interfaces of the Two Experiments on Mechanisms

Panel (a): The Interface of the Direct Choice experiment



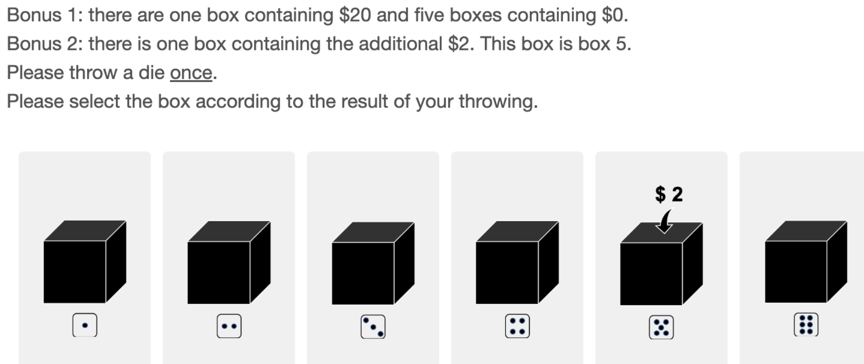
Panel (b): The Interface of the Second Party experiment



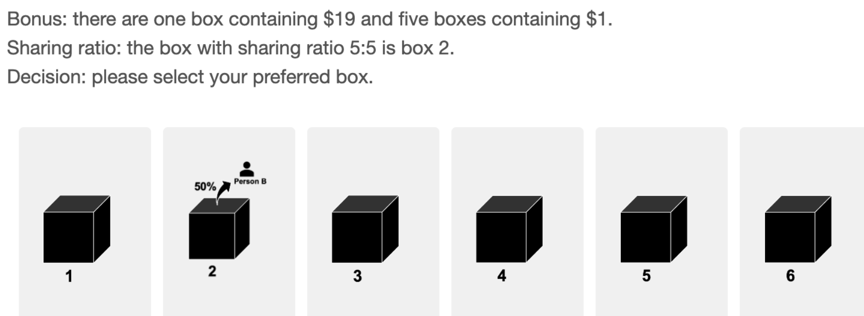
Notes: Panel (a) is an example the interface of the Direct Choice experiment. This example shows the interface of the condition $(40, \frac{1}{6}; 0)$. Interfaces of other conditions are similar. Specifically, when $p = 0$ ($p = 1$), the first line will be "*Bonus 1: there are six box containing l (h).*" Panel (b) is an example the interface of the Second Party experiment. This example shows the interface of the condition $(40, \frac{1}{6}; 0)$. Interfaces of other conditions are similar. Specifically, when $p = 0$ ($p = 1$), the first line will be "*Bonus 1: there are six box containing l (h). Bonus 1 is for Player A.*" In the experiment, we display each line of sentence sequentially.

Figure A.3: Interfaces of the Two Experiments on Robustness and Generalizability

Panel (a): The Interface of the Ex Ante Resolution experiment



Panel (b): The Interface of the Dictator Game experiment



Notes: Panel (a) is an example the interface of the Ex Ante Resolution experiment. This example shows the interface of the condition $(20, \frac{1}{6}; 0)$. Interfaces of other conditions are similar. Specifically, when $p = 0$ ($p = 1$), the first line will be "*Bonus 1: there are six box containing l (h).*" Panel (b) is an example the interface of the Dictator Game experiment. This example shows the interface of the condition $(19, \frac{1}{6}; 1)$. Interfaces of other conditions are similar. Specifically, when $p = 0$ ($p = 1$), the first line will be "*Bonus: there are six box containing l (h).*" In the experiment, we display each line of sentence sequentially.

Table A.1: Summary of Experiments

Experiment	# Subjects	Duration (mins)	Ave Payoffs	Outcome Var Var	Outcome Var Mean	Outcome Var SD
Dice Game	107	18.24	RMB44.06	1_{+4}	0.64	0.48
Direct Choice	102	15.21	RMB42.73	1_{+4}	0.94	0.24
Second Party	107	26.62	RMB36.91	1_{+4}	0.56	0.5
Ex Ante Resolution	191	14.23	SGD19.77	1_{+2}	0.35	0.48
Dictator Game	148	13.69	SGD20.37	1_{share}	0.2	0.4
Second Party Information	108	25.13	RMB36.10	1_{+4}	0.63	0.48
Dice Game with Loss	109	18.07	RMB42.82	1_{-4}	0.09	0.29

Notes: Duration reports the time spent on the experiment, including comprehension tests, main experiment, and questionnaires. For the Dictator Game experiment, apart from the dictators' results summarized in this table, 148 subjects are assigned to play the role of recipient. We give recipients a small incentive to predict dictators' choices. Recipients' average payoffs are SGD14.63.

Table A.2: Pairwise Comparisons in the Dice Game Experiment

Panel A: Payoff Pair (40, p; 0)							
p	0	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$	1
0							
$\frac{1}{6}$	-0.206***						
$\frac{2}{6}$	-0.299***	-0.093					
$\frac{3}{6}$	-0.168**	0.037	0.131**				
$\frac{4}{6}$	-0.243***	-0.037	0.056	-0.075			
$\frac{5}{6}$	-0.308***	-0.103	-0.009	-0.14**	-0.065		
1	-0.056	0.15**	0.243***	0.112*	0.187***	0.252***	
Panel B: Payoff Pair (30, p; 10)							
p	0	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$	1
0							
$\frac{1}{6}$	-0.178***						
$\frac{2}{6}$	-0.262***	-0.084					
$\frac{3}{6}$	-0.308***	-0.131**	-0.047				
$\frac{4}{6}$	-0.178***	0	0.084	0.131**			
$\frac{5}{6}$	-0.178***	0	0.084	0.131**	0		
1	0.028	0.206***	0.29***	0.336***	0.206***	0.206***	
Panel C: Payoff Pair (22, p; 18)							
p	0	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$	1
0							
$\frac{1}{6}$	-0.121**						
$\frac{2}{6}$	-0.131**	-0.009					
$\frac{3}{6}$	-0.037	0.084	0.093				
$\frac{4}{6}$	-0.121**	0	0.009	-0.084			
$\frac{5}{6}$	-0.131**	-0.009	0	-0.093	-0.009		
1	-0.075	0.047	0.056	-0.037	0.047	0.056	

Notes: This table presents the pairwise comparisons of 1_{+4} within each payoff pair. The value in each cell is the difference of the mean of 1_{+4} between the two specific conditions, with the value of the condition in rows being the minuend. *** p<0.01, ** p<0.05, * p<0.1.

Table A.3: Probit Regression Analyses of the Dice Game Experiment

	Probit: 1_{+4}				
	(1)	(2)	(3)	(4)	(5)
Panel A. Full sample and subsamples by payoff pairs					
	All	All	(40, p; 0)	(30, p; 10)	(22, p; 18)
1_h	0.163***	0.159***	0.191***	0.267***	0.030
	(0.031)	(0.032)	(0.049)	(0.049)	(0.038)
1_l	0.205***	0.201***	0.262***	0.225***	0.114***
	(0.029)	(0.030)	(0.049)	(0.046)	(0.042)
Controls	N	Y	Y	Y	Y
Observations	2,247	2,247	749	749	749
Panel B. Subsamples by winning probabilities					
	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$
1_h	0.122***	0.182***	0.126***	0.128***	0.161***
	(0.030)	(0.037)	(0.033)	(0.036)	(0.032)
1_l	0.160***	0.221***	0.165***	0.167***	0.200***
	(0.030)	(0.032)	(0.032)	(0.035)	(0.032)
Controls	Y	Y	Y	Y	Y
Observations	963	963	963	963	963

Notes: This table follows the structure of Table 2 to examine our main results using probit regressions. Coefficients in this table report the marginal effect of the corresponding independent variables. Control variables are the payoff pair fixed effect, the duration of the decision (in seconds), and the order of the decision (between 1 and 21). Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.4: Regression Analyses of the Dice Game Experiment with Alternative Controls

			OLS: 1_{+4}		
	(1)	(2)	(3)	(4)	(5)
Panel A. Full sample and subsamples by payoff pairs					
	All	All	(40, p; 0)	(30, p; 10)	(22, p; 18)
1_h	0.157***	0.152***	0.184***	0.245***	0.029
	(0.028)	(0.028)	(0.045)	(0.041)	(0.039)
1_l	0.191***	0.187***	0.240***	0.213***	0.106***
	(0.025)	(0.025)	(0.042)	(0.042)	(0.037)
Controls	N	Y	Y	Y	Y
Constant	0.591***	-0.430	-0.091	-0.267	-0.759
	(0.029)	(0.543)	(0.700)	(0.598)	(0.544)
Observations	2,247	2,247	749	749	749
R-squared	0.027	0.225	0.241	0.262	0.219
Panel B. Subsamples by winning probabilities					
	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$
1_h	0.127***	0.192***	0.132***	0.137***	0.169***
	(0.031)	(0.037)	(0.035)	(0.038)	(0.034)
1_l	0.162***	0.226***	0.167***	0.171***	0.204***
	(0.030)	(0.033)	(0.033)	(0.037)	(0.032)
Controls	Y	Y	Y	Y	Y
Constant	-0.492	-0.468	-0.245	0.157	-0.358
	(0.559)	(0.542)	(0.525)	(0.551)	(0.541)
Observations	963	963	963	963	963
R-squared	0.284	0.273	0.245	0.237	0.292

Notes: This table follows the structure of Table 2 to examine our main results with different control variables. Control variables are the payoff pair fixed effect, duration of the decision (in seconds), order of the decision (between 1 and 21), session fixed effect, and demographic information on gender, age, place of birth, major, and religion. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.5: Testing the Spillover Effect of the Dice Game Experiment

	OLS: 1_{+4}	
	(1)	(2)
1_h	0.156***	0.148***
	(0.030)	(0.054)
1_l	0.180***	0.211***
	(0.025)	(0.041)
$L.1_{+4}$	-0.102***	-0.097***
	(0.025)	(0.030)
$1_h \times L.1_{+4}$		0.014
		(0.056)
$1_l \times L.1_{+4}$		-0.048
		(0.047)
Controls	Y	Y
Constant	0.371***	0.366***
	(0.030)	(0.034)
Observations	2,140	2,140
R-squared	0.395	0.395

Notes: This table examines the effect of the decision lagged one round on the effect of uncertainty in the current round. $L.1_{+4}$ denotes the value of 1_{+4} lagged one round. Therefore, decisions in the first round are excluded from the analysis. The set of control variables are the payoff pair fixed effect, individual fixed effect, and order and duration of the decision. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.6: Testing Effect of the Size of Endowment in the Dice Game Experiment

	OLS: 1_{+4}			
	(1)	(2)	(3)	(4)
endowment	-0.001			
	(0.001)			
p		-0.012	-0.027	
		(0.045)	(0.025)	
$1_{uncertain}$			-0.172***	
			(0.023)	
Mean				-0.001
				(0.001)
Var				-0.001***
				(0.000)
Controls	Y	Y	Y	Y
Constant	0.364***	0.361***	0.484***	0.518***
	(0.045)	(0.035)	(0.029)	(0.039)
Observations	642	1,605	2,247	2,247
R-squared	0.526	0.389	0.383	0.371

Notes: Column 1 uses data on the 6 choices under certainty, with *endowment* being the amount of the corresponding certain payoff. Column 2 uses data on the 15 choices under uncertainty, with p being the winning probability. Column 3 regresses 1_{+4} on p and $1_{uncertain}$, the latter of which equals 1 for conditions under uncertainty and 0 otherwise. Column 4 regresses 1_{+4} on the mean and variance of the lottery in each choice. All columns control for the individual fixed effect, duration of the decision, and order of the decision. In addition, columns 2-4 control for the payoff pair fixed effect. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.7: Individual Types of the Dice Game Experiment

Classification	Type	# Subjects (%)	Mean		
			$+4^l$	$+4^u$	$+4^h$
(1)	(2)	(3)	(4)	(5)	(6)
$+4^u < +4^l$, $+4^u < +4^h$	Uncertainty-motivated	54 (50.47)	0.877	0.536	0.901
$+4^u > +4^l$, $+4^u > +4^h$	Certainty-motivated	5 (4.67)	0.133	0.320	0.133
$+4^l < +4^u < +4^h$	Increase	7 (6.54)	0.190	0.371	0.524
$+4^l > +4^u > +4^h$	Decrease	12 (11.21)	0.750	0.422	0.139
$+4^l = +4^u = +4^h$	Invariant	20 (18.69)	1	1	1
All other cases	Unclassified	9 (8.41)	0.593	0.556	0.593

Notes: For each subject, we compute three measures. $+4^l$ is the mean of 1_{+4} of the 3 choices under certain low payoffs 0, 10, and 18. $+4^u$ is the mean of 1_{+4} among the 15 choices under uncertain payoffs. $+4^h$ is the mean of 1_{+4} of the 3 choices under certain high payoffs 40, 30, and 22. Column 1 presents the classification criteria and column 2 assigns a descriptive name for each type. Column 3 shows the number and proportion of subjects of each type. Columns 4-6 give the mean values of $+4^l$, $+4^u$, and $+4^h$ among each type. Using the same criteria, we can identify a type for each subject at each payoff pair, which shows that individual types are internally consistent. For example, types are consistent across the payoff pairs $(40, p; 0)$ and $(30, p; 10)$ (Pearson chi2 test, Pr=0.000).

Table A.8: Regression Analyses of the Ex Ante Resolution Experiment

	OLS: 1_{+2}				
	(1)	(2)	(3)	(4)	(5)
Panel A. Full sample and subsamples by payoff pairs					
	All	All	(20, p; 0)	(15, p; 5)	(11, p; 9)
1_h	0.129***	0.130***	0.151***	0.200***	0.038
	(0.021)	(0.022)	(0.038)	(0.039)	(0.037)
1_l	0.117***	0.117***	0.140***	0.166***	0.045
	(0.023)	(0.024)	(0.039)	(0.037)	(0.035)
Controls	N	Y	Y	Y	Y
Constant	0.314***	0.406***	0.510***	0.373***	0.413***
	(0.017)	(0.021)	(0.033)	(0.031)	(0.037)
Observations	4,011	4,011	1,337	1,337	1,337
R-squared	0.014	0.266	0.310	0.349	0.369
Panel B. Subsamples by winning probabilities					
	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$
1_h	0.133***	0.130***	0.127***	0.146***	0.117***
	(0.027)	(0.029)	(0.029)	(0.028)	(0.028)
1_l	0.119***	0.116***	0.113***	0.133***	0.105***
	(0.029)	(0.030)	(0.029)	(0.030)	(0.029)
Controls	Y	Y	Y	Y	Y
Constant	0.576***	0.676***	0.547***	0.555***	0.451***
	(0.034)	(0.034)	(0.031)	(0.037)	(0.033)
Observations	1,719	1,719	1,719	1,719	1,719
R-squared	0.383	0.344	0.346	0.356	0.352

Notes: 1_{+2} equals 1 if subjects choose the box with the additional SGD2 and 0 otherwise. 1_h (1_l) equals 1 if the condition gives certain high (low) payoff and 0 otherwise. In Panel A, column 1 uses all data without controls. Column 2 further controls for the payoff pair fixed effect, individual fixed effect, duration of the decision (in seconds), and order of the decision (between 1 and 21). Columns 3-5 report results using data on the seven choices under the payoff pair $(20, p; 0)$, $(15, p; 5)$, and $(11, p; 9)$, respectively. In Panel B, each of columns 1-5 uses data on the nine choices, including six choices under certainty and three choices under uncertainty with the winning probability being $\frac{1}{6}$ to $\frac{5}{6}$, respectively. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.9: Regression Analyses of the Dictator Game Experiment

	OLS: 1_{share}				
	(1)	(2)	(3)	(4)	(5)
Panel A. Full sample and subsamples by payoff pairs					
	All	All	(19, p; 1)	(15, p; 5)	(11, p; 9)
1_h	-0.085***	-0.086***	-0.148***	-0.082***	-0.032
	(0.021)	(0.022)	(0.034)	(0.031)	(0.026)
1_l	-0.046**	-0.048**	-0.070*	-0.029	-0.046*
	(0.022)	(0.022)	(0.037)	(0.033)	(0.025)
Controls	N	Y	Y	Y	Y
Constant	0.222***	0.155***	0.159***	0.013	0.133***
	(0.021)	(0.019)	(0.025)	(0.022)	(0.023)
Observations	3,108	3,108	1,036	1,036	1,036
R-squared	0.006	0.368	0.401	0.425	0.522
Panel B. Subsamples by winning probabilities					
	$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$
1_h	-0.195***	-0.117***	-0.080***	-0.050**	0.010
	(0.030)	(0.029)	(0.028)	(0.025)	(0.023)
1_l	-0.157***	-0.079***	-0.042	-0.012	0.048*
	(0.028)	(0.029)	(0.028)	(0.025)	(0.025)
Controls	Y	Y	Y	Y	Y
Constant	0.187***	0.137***	0.081***	0.159***	0.106***
	(0.036)	(0.035)	(0.029)	(0.029)	(0.026)
Observations	1,332	1,332	1,332	1,332	1,332
R-squared	0.458	0.434	0.446	0.500	0.494

Notes: 1_{share} equals 1 if subjects choose to share and 0 otherwise. 1_h (1_l) equals 1 if the condition gives certain high (low) payoff and 0 otherwise. In Panel A, column 1 uses all data without controls. Column 2 further controls for the payoff pair fixed effect, individual fixed effect, duration of the decision (in seconds), and order of the decision (between 1 and 21). Columns 3-5 report results using data on the seven choices under the payoff pair $(19, p; 1)$, $(15, p; 5)$, and $(11, p; 9)$, respectively. In Panel B, each of columns 1-5 uses data on the nine choices, including six choices under certainty and three choices under uncertainty with the winning probability being $\frac{1}{6}$ to $\frac{5}{6}$, respectively. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A.10: Regression Analyses of Karmic Belief in the Dice Game Experiment

	OLS: 1_{+4}			
	Objective	Karmic	Other	All
	(1)	(2)	(3)	(4)
1_h	0.150***	0.193***	0.021	0.144***
	(0.034)	(0.061)	(0.023)	(0.033)
1_l	0.190***	0.246***	-0.150	0.174***
	(0.030)	(0.051)	(0.096)	(0.030)
1_{Karmic}				0.221***
				(0.015)
$1_h \times 1_{\text{Karmic}}$				0.045
				(0.066)
$1_l \times 1_{\text{Karmic}}$				0.068
				(0.058)
Controls	N	Y	Y	Y
Constant	0.306***	0.208***	1.085***	0.301***
	(0.033)	(0.068)	(0.140)	(0.029)
#Subjects	78	25	4	107
Observations	1,638	525	84	2,247
R-squared	0.395	0.349	0.358	0.384

Notes: In our main (Dice Game) experiment, we include five questions to measure unincentivized karmic belief at the end of the experiment. More specifically, we present the five uncertain conditions under the payoff pair $(40, p; 0)$. Under each condition, we ask subjects who is more likely to win the high payoff of 40—the subject who chooses the box with the additional RMB4 or the subject who chooses one of the remaining five boxes. We classify a subject as the Objective type if she reveals objective beliefs in all five questions—i.e., chooses "*equally likely.*" We classify a subject as the Karmic type if she reveals karmic beliefs in one of the five questions—i.e., chooses "*those who choose one of the remaining five boxes are more likely to win 40.*" All remaining subjects are classified as Other. Columns 1-3 report the main regression results use data on Objective, Karmic, and Other types, respectively. Column 4 uses all data, in which 1_{Karmic} equals 1 if subjects are the Karmic type and 0 otherwise. All columns involve a full set of controls. Standard errors are clustered at individual level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix B: Two Additional Experiments

This appendix presents the design and results of two additional experiments. This first experiment is related to the Second Party experiment on moral wiggle room referred in Subsection 3.2, and the second experiment is related to an alternative explanation referred in Subsection 4.3.

B.1 Second Party Information Experiment

The main text reports the Second Party experiment, which is designed to test whether uncertainty imposed on decision makers themselves is critical for our observation. In the Second Party experiment, Player A is endowed with a lottery $(h, p; l)$ and makes no decision, while Player B faces no uncertainty and makes decisions with honesty concern. Such a design allows us to examine individuals' moral decision-making when others face uncertainty, and is closely related to the literature on moral wiggle room.

Most studies on moral wiggle room focus on how decision makers respond to uncertainty about others. In their baseline experiment, Dana, Weber, and Kuang (2007) compare decisions under two situations: (1) subjects know the influence of their decisions on the payoff for an anonymously paired subject or (2) they have no such information but can reveal it without cost. In the first situation, subjects tend to avoid the option that maximizes their payoffs when they know that this option reduces the payoff for the paired subjects; In the second situation, they choose to avoid the information and directly choose the option with maximum payoffs. Exley (2016) shows that such behavior is related to the notion of excuse-driven selfishness. To shed further light on the difference between moral wiggle room and our uncertainty-motivated morality hypothesis, we modify the Second Party experiment to incorporate the paradigm of Dana, Weber, and Kuang.

B.1.1 Design

The *Second Party Information* experiment also involves two players. Player A receives a lottery $(h, \frac{1}{2}; l)$ that yields high outcome h with probability $\frac{1}{2}$ and low outcome l otherwise.[1] To facilitate implementation, we only include three payoff pairs $(20, \frac{1}{2}; 0)$, $(15, \frac{1}{2}; 5)$, and $(11, \frac{1}{2}; 9)$. Player B receives a fixed amount of RMB21 and may need to decide whether to lie to get an additional RMB4. Similar to other experiments in this paper, we use a six-box framework. Three boxes contain h and the remaining three boxes contain l, which will be received by Player A. Additionally, for Player B, one box contains RMB25 and five boxes contain RMB21. In other words, the box that contains RMB25 for Player B may contain h or l for Player A. Therefore, Player B's decisions on choosing a box also affect Player A's payoffs. Following Dana, Weber, and Kuang (2007), we predetermine the outcome of the lottery $(h, \frac{1}{2}; l)$ in the current experiment. The randomization device we use is the RANDBETWEEN function in Excel.

We generate three conditions. In the *Certain* condition, Player B receives information on the resolution of Player A's lottery $(h, \frac{1}{2}; l)$, which shows how her decision in choosing a box affects Player A's payoffs. In the *Uncertain* condition, Player B receives no information on the resolution of Player A's lottery $(h, \frac{1}{2}; l)$. In the *Choosing* Condition, Player B is asked to choose whether to receive the information on the resolution of $(h, \frac{1}{2}; l)$, which leads to either the Certain or Uncertain condition depending on Player B's decision on information acquisition. When the resolution information is revealed, the condition can be further separated into two conditions, *Aligned* whereby the box with RMB25 for Player B contains a high payoff for Player A, and *Unaligned* whereby the box with RMB25 for Player B contains a low payoff for Player A. Whether the condition is Aligned or Unaligned is, as stated above, pre-

[1] In the paradigm of Dana, Weber, and Kuang (2007), the effect of uncertainty is documented by comparing situations in which the uncertainty is unresolved and when it is resolved, which is different from our other experiments that compare $p \in (0, 1)$ with $p = 1$ and $p = 0$, respectively. To closely follow Dana, Weber, and Kuang and simplify the experiment, we fix the winning probability to be $\frac{1}{2}$ in this experiment and include the three conditions of Certain, Uncertain, and Choosing.

determined by chance. To collect enough data for comparisons between uncertainty and certainty, we repeat each payoff pair ($(20, \frac{1}{2}; 0)$, $(15, \frac{1}{2}; 5)$, or $(11, \frac{1}{2}; 9)$) and each condition (Certain, Uncertain, or Choosing) three times, which results in 27 rounds.

Each round has four steps. First, in the frame of six boxes, Player B chooses a box and writes the number on a piece of paper. Second, Player B learns that "*Box y contains RMB25 and the remaining five boxes contain RMB21.*" The third step includes information on the result of Player A's endowed lottery $(h, \frac{1}{2}; l)$. When Player B faces the Certain condition, she learns that "*Boxes abc contain h and boxes xyz contain l,*" in which "*abc*" and "*xyz*" are exact numbers. When Player B faces the Uncertain condition, she learns that "*Boxes ??? contain h and boxes ??? contain l,*" with hidden information. When Player B faces the Choosing situation, she receives the hidden information first but can click a button to review the information or decline to do so. In the last step, Player B is asked to select the box she has chosen in step 1.[2]

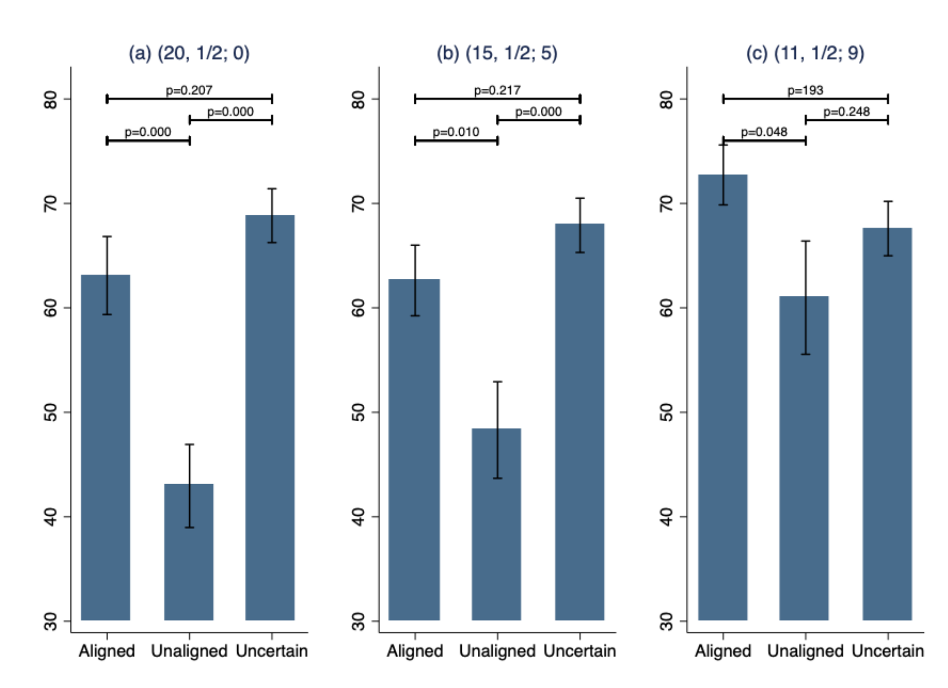
B.1.2 Results

We are interested in examining whether uncertainty in others motivates subjects' truth-telling behavior. To illustrate this point, we investigate subjects' tendency to lie under the Uncertain condition compared with the Aligned and Unaligned conditions, respectively, since they are the two degenerate certainty conditions for the Uncertain condition. Figure B.1 presents the proportions of reporting +4 under these three conditions for the payoff pairs $(20, \frac{1}{2}; 0)$, $(15, \frac{1}{2}; 5)$, and $(11, \frac{1}{2}; 9)$, respectively. Across the three payoff pairs, we find that the proportions of reporting +4 are significantly higher in the Aligned condition than in the Unaligned condition. That is, subjects are more likely to lie when lying also benefits Player A. More importantly, the proportions of reporting +4 are indistinguishable between the Aligned

[2] Role assignment here followed that in the Second Party experiment. We recorded the process of predetermining the lotteries. Moreover, even though we repeated each payoff pair and each condition three times in the experiment, the predetermination may still be "unbalanced" because of chance. Therefore, we separately predetermined the lotteries for three different subsamples of subjects.

and Uncertain conditions. This pattern suggests that when subjects do not know whether Aligned or Unaligned will occur, they behave as if Aligned will occur and are more likely to lie. For example, they may adjust the probability weight Aligned to lie their own interest, which is in line with Exley's (2016) findings that people use risk as an excuse for selfishness. As for the Choosing condition, the proportions of subjects choosing to avoid the resolution information are 33.7 percent on average. The observed information avoidance is also consistent with Dana, Weber, and Kuang (2007).

Figure B.1: Truth-telling Behavior in the Second Party Information Experiment



Notes: This figure compares truth-telling behavior between the Certain and the Uncertain conditions. The y-axis is the proportion of decisions that choose the box with the additional RMB4. We display the proportions when the payoff pair is $(20, \frac{1}{2}; 0)$, $(15, \frac{1}{2}; 5)$, and $(11, \frac{1}{2}; 9)$ in Panels (a), (b), and (c), respectively. Under each payoff pair, we further separate the Certain condition into two conditions: Aligned and Unaligned. Standard error bars correspond to +/- one standard error. Top horizontal bars indicate the p-values for two-sided tests of proportions between different conditions.

In summary, when uncertainty is imposed on others rather than on decision makers themselves, we find that it would not give rise to morality. Contrarily, it can lead to selfish behavior and information avoidance. This is consistent with our observation in the Second Party experiment, and in line with studies of moral wiggle room and excusing selfishness (Dana, Weber, and Kuang, 2007; Haisley and Weber, 2010; Exley, 2016; Gino, Norton, and Weber, 2016; Garcia, Massoni, and Villeval, 2020).

B.2 Dice Game with Loss Experiment

There is an alternative explanation that individuals may regard the extra payoff as a signal of a low outcome of the lottery. For example, subjects believe that nature or the experimenter go against their interest, and hence if a box contains the additional RMB4, it is more likely to contain low payoff compared with other boxes. One possible implication of this hypothesis is that if one of the six boxes contains an extra loss instead of an extra gain, subjects would view it as a signal of high payoff and tend to choose it under uncertainty. Put differently, this hypothesis predicts that subjects are more likely to overreport the state that carries the extra loss under uncertainty. We conduct a *Dice Game with Loss* experiment to test this hypothesis.

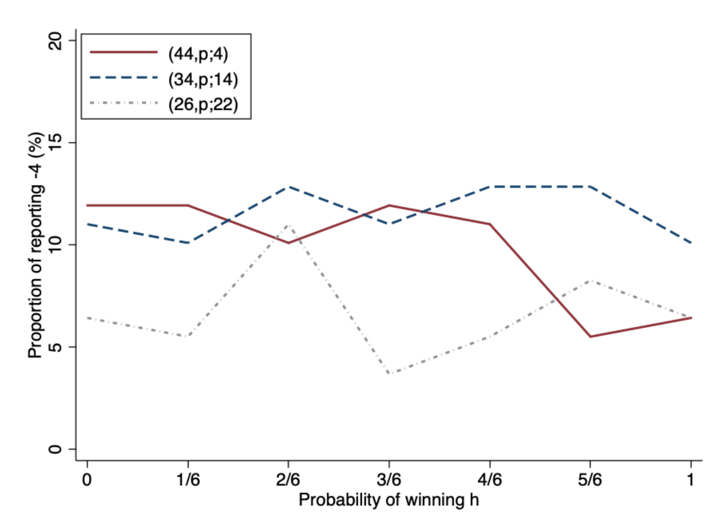
B.2.1 Design

The design closely follows the Dice Game experiment. Each round of decisions consists of four steps. First, subjects receive the lottery $(h, p; l)$ in the six-box frame and are told that "*There are x box(es) containing h and $6 - x$ box(es) containing l.*" Second, subjects choose a box randomly in their mind and write the number on a piece of paper. Third, subjects are informed that one exact box involves a payoff deduction of RMB4. Last, subjects are asked to select the box they chose in the second step. The lottery $(h, p; l)$ has three possible payoff pairs $(44, p; 4)$, $(34, p; 14)$, and $(26, p; 22)$ with winning probability $p \in \{0, \frac{1}{6}, \frac{2}{6}, \frac{3}{6}, \frac{4}{6}, \frac{5}{6}, 1\}$, which yields 21 rounds of decisions.

B.2.2 Results

Figure B2 presents the proportions across all 21 rounds. The proportion of reporting -4 is 9.60 percent under uncertainty, compared to 9.79 percent and 7.65 percent under certainty with low and high payoffs, respectively. First, the proportion of reporting -4 under uncertainty is significantly lower than the completely truth-telling rate of 0.1667 ($p < 0.0001$, two-sided proportion test). This suggests that subjects do not overreport the losing state under uncertainty, which does not support this alternative explanation. Second, we also find significant evidence for uncertainty-motivated truth-telling behavior. This may be because only $\frac{1}{6}$ of subjects need to lie to obtain higher payoffs in this experiment, compared with $\frac{5}{6}$ of subjects in the Dice Game experiment, which leaves little room to detect the difference between certainty and uncertainty.

Figure B.2: Truth-telling Behavior in the Dice Game with Loss Experiment



Online Appendix C: Theoretical Discussions

This appendix provides more details on theoretical discussions. First, we introduce existing models of social preference under uncertainty. We are interested in whether these models can account for the observed uncertainty-motivated sharing behavior. Second, we provide more details about two simple frameworks to model magical thinking and quasi-magical thinking, respectively. Last, we discuss the implications on state space.

C.1 Existing Models on Social Preference

In studies on social preference under uncertainty, an important literature examines the distinction between preference for ex ante and ex post fairness (Brock, Lange, and Ozbay, 2013; Saito, 2013). The framework described in the main text captures the ex post consideration. Namely, the dictator first evaluates the utility of each contingent allocation between herself and the recipient based on social preference, which results in the four consequences $\{h_m, l_m, h_i, l_i\}$. The dictator then aggregates across consequences in all states based on risk preference. As the discussion in the main text suggests, uncertainty-motivated sharing behavior violates dominance for models with ex post consideration.

Under ex ante consideration, the dictator first evaluates the lottery for herself and for the recipient separately based on risk preference, then aggregates across the two valuations based on social preference. We assume that the dictator uses the expected payoffs to evaluate the lotteries of both players (Brock, Lange, and Ozbay, 2013; Saito, 2013) and uses the social preference $f(x, y)$ to evaluate the allocation that gives herself x and the recipient y. If the dictator chooses to share evenly, the uncertain allocation $((\frac{h}{2}, \frac{h}{2}), p; (\frac{l}{2}, \frac{l}{2}))$ is evaluated as $f(p\frac{h}{2} + (1-p)\frac{l}{2}; p\frac{h}{2} + (1-p)\frac{l}{2})$; if the dictator chooses not to share, the uncertain allocation $((h, 0), p; (l, 0))$ is evaluated as $f(ph + (1-p)l, 0)$. Most existing social preference models predict that if the dictator decides not to share under certain stakes h and l, she would continue to do so under an intermediate stake $ph + (1-p)l$.[3] In addition, the observed sharing behavior in our experiment and in the literature is monotonically decreasing rather than hump-shaped in stake size.

In this regard, the ex post or ex ante approach alone is hard to explain the observed uncertainty-motivated sharing behavior. Saito (2013) proposes an expected inequality-averse (EIA) model that adopts a linear combination of ex post and ex ante consideration. EIA captures common properties of Brock, Lange, and Ozbay (2013). Applying the EIA model to evaluate the two options of the dictator, $((\frac{h}{2}, \frac{h}{2}), p; (\frac{l}{2}, \frac{l}{2}))$ and $((h, 0), p; (l, 0))$, we have the following utility:

$$U(share) = \delta(pf(\frac{h}{2}, \frac{h}{2}) + (1-p)f(\frac{l}{2}, \frac{l}{2})) + (1-\delta)f(p\frac{h}{2} + (1-p)\frac{l}{2}, p\frac{h}{2} + (1-p)\frac{l}{2})$$
$$U(not\ to\ share) = \delta(pf(h, 0) + (1-p)f(l, 0)) + (1-\delta)f(ph + (1-p)l, 0)$$

The first term captures the preference for ex post fairness, in which social preference function f is used to evaluate the allocations and the expectation is then used to aggregate across the social preference of each allocation. The second term captures the preference for ex ante fairness, in which the expected payoff is calculated for each individual and then social preference function f is used to evaluate the expected allocations of individuals. The weight δ measures the relative importance of ex post and ex ante fairness. For individuals who choose not to share under both certain stakes h and l, we know that $f(h, 0) > f(\frac{h}{2}, \frac{h}{2})$ and $f(l, 0) > f(\frac{l}{2}, \frac{l}{2})$. Consequently, social preference that is not hump-shaped predicts that $f(ph + (1-p)l, 0) > f(\frac{ph+(1-p)l}{2}, \frac{ph+(1-p)l}{2})$. Therefore, the EIA model predicts that these selfish individuals will choose not to share under uncertain stake $(h, p; l)$, and thus fails to account for the observed behavior.

We can also allow the social preference to define over the player's utility rather

[3]Existing models, including Fehr and Schmidt (1999); Bolton and Ockenfels (2000); Andreoni and Miller (2002); Charness and Rabin (2002) satisfy the property that social preference is not hump-shaped.

than over the payoffs, and use the non-expected utility model to capture risk attitudes. Specifically, suppose $u(\cdot)$ captures the utility of monetary payoffs with $u'(\cdot) > 0$. We consider that the dictator uses $f(u(x), u(y))$ to evaluate the allocation (x, y) that gives herself x and the recipient y, and uses $\Theta(x_1, p; x_2) = w(p)u(x_1) + (1 - w(p))u(x_2)$ to evaluate the binary prospect that yields x_1 with probability p and x_2 otherwise. Under the linear combination of ex post and ex ante consideration in EIA, we have the following utility:

$$\begin{aligned}
U(\mathit{share}) =& \delta(w(p)f(u(\frac{h}{2}), u(\frac{h}{2})) + (1 - w(p))f(u(\frac{l}{2}), u(\frac{l}{2}))) \\
&+ (1 - \delta)f(w(p)u(\frac{h}{2}) + (1 - w(p))u(\frac{l}{2}), w(p)u(\frac{h}{2}) + (1 - w(p))u(\frac{l}{2})) \\
U(\mathit{not\ to\ share}) =& \delta(w(p)f(u(h), 0) + (1 - w(p))f(u(l), 0)) \\
&+ (1 - \delta)f(w(p)u(h) + (1 - w(p))u(l), 0)
\end{aligned}$$

Similarly, for individuals who choose not to share under both certain stakes h and l, we know that $f(u(h), 0) > f(u(\frac{h}{2}), u(\frac{h}{2}))$ and $f(u(l), 0) > f(u(\frac{l}{2}), u(\frac{l}{2}))$. If the social preference model is homogeneous of degree 1, which is a common property in most existing models (i.e., Fehr and Schmidt, 1999; Andreoni and Miller, 2002; Charness and Rabin, 2002), then we have $u(h)f(1, 0) > u(\frac{h}{2})f(1, 1)$ and $u(l)f(1, 0) > u(\frac{l}{2})f(1, 1)$. Therefore, $(w(p)u(h)+(1-w(p))u(l))f(1, 0) > (w(p)u(\frac{h}{2})+(1-w(p))u(\frac{l}{2}))f(1, 1)$, and thus $f(w(p)u(h)+(1-w(p))u(l), 0) > f(w(p)u(\frac{h}{2})+(1-w(p))u(\frac{l}{2}), w(p)u(\frac{h}{2}) + (1 - w(p))u(\frac{l}{2}))$. That is, selfish individuals will continue to choose not to share under uncertainty. In this regard, the ex post approach, the ex ante approach, and their combination encounter difficulties in explaining the observed uncertainty-motivated sharing behavior.

C.2 Magical Thinking

This subsection provides more details of the framework on magical thinking in Subsection 4.2. In this framework, individuals believe that with α chance the world is karmic, whereby a moral act leads to high payoff and vice versa, and with $1 - \alpha$

chance the world is objective as described, whereby high and low payoffs occur with probabilities p and $1-p$, respectively. This simple framework involves two common perceptions, spiritual and materialistic; the former is in line with beliefs in the just world, moralistic gods, and karmic doctrine. As Karni (2017) observes, the assignment of subjective probabilities is a matter of the perception of the decision maker. We assume that individuals are expected utility maximizers and make decisions based on a comparison of the following:

$$U(immoral) = \alpha u(l_i) + (1-\alpha)(pu(h_i) + (1-p)u(l_i))$$
$$U(moral) = \alpha u(h_m) + (1-\alpha)(pu(h_m) + (1-p)u(l_m))$$

Here we assume that individuals are selfish and $u(\cdot)$ captures the utility of monetary payoffs with $u'(\cdot) > 0$. Selfish individuals prefer the moral act over the immoral act if

$$\alpha(u(h_m) - u(l_i)) > (1-\alpha)(p(u(h_i) - u(h_m)) + (1-p)(u(l_i) - u(l_m))).$$

The left-hand side $\alpha(u(h_m) - u(l_i))$ captures the benefit of the moral act conditional on the karmic world. The right-hand side $(1-\alpha)(p(u(h_i) - u(h_m)) + (1-p)(u(l_i) - u(l_m)))$ captures the expected cost of the moral act conditional on the objective world, which negatively affects the likelihood of choosing the moral act. This simple model has the following predictions: Individuals exhibit uncertainty-motivated moral behavior when (1) the belief in karma α is sufficiently large; (2) the difference between h_m and l_i is sufficiently large; and (3) the expected cost of moral act $p(u(h_i) - u(h_m)) + (1-p)(u(l_i) - u(l_m))$ is sufficiently small. These predictions are generally in line with our experimental observations—the uncertainty-motivated truth-telling behavior, the uncertainty-motivated sharing behavior, and the stronger effect for lotteries with a wider spread between the two outcomes.

In addition, this framework helps to reconcile the observed difference in the two behavioral domains: While uncertainty-motivated truth-telling behavior is not affected by the winning probability, uncertainty-motivated sharing behavior is present only when the winning probability is small. In our dice game experiments, lying delivers an additional a (RMB4 or SGD2) that is independent of the winning probability. According to this model, when the marginal benefits of getting a are similar under high and low payoffs, namely, $u(h+a) - u(h) \approx u(l+a) - u(l)$, the winning probability p plays no role in the lying behavior. In our dictator game experiment, suppose it is costlier to share evenly under high than low payoff, namely, $u(h) - u(\frac{h}{2}) > u(l) - u(\frac{l}{2})$;[4] larger winning probability p leads to a higher expected cost and hence to a lower proportion of sharing. Taking lotteries under (19, p; 1) as an example, when it is costlier to share evenly on stake 19 than on 1, the cost of sharing increases with p. To sum, in this model, the role of the winning probability p is determined by the cost of acting morally in the high state $u(h_i) - u(h_m)$ relative to that in the low state $u(l_i) - u(l_m)$, which explains the observed difference in the two types of experiment.

C.3 Quasi-Magical Thinking

This subsection provides more details of the framework on quasi-magical thinking in Subsection 4.2. In this framework, individuals view the morality of an act as a source of uncertainty. Chew and Sagi (2008) axiomatize the probabilistic sophistication within each source of uncertainty, and Abdellaoui et al. (2011) model source dependence through distinct probability weighting functions for different sources. In our setting, we can have two source-dependent probability weighting functions $w_m(p)$ and $w_i(p)$, for the moral and immoral acts correspondingly. Here, $w_m(0) = w_i(0) = 0$, $w_m(1) = w_i(1) = 1$, $w'_m(p) > 0$, and $w'_i(p) > 0$. Therefore, individuals make decisions based on the comparison among the following utility.

$$U(immoral) = w_i(p)u(h_i) + (1 - w_i(p))u(l_i)$$
$$U(moral) = w_m(p)u(h_m) + (1 - w_m(p))u(l_m)$$

[4]The condition is satisfied under common forms of a utility function, such as $u(x) = x^\gamma$.

We assume that individuals are more optimistic and assign a higher decision weight to the high outcome under the moral act than under the immoral act, namely, $w_m(p) > w_i(p)$. After the rearrangement of the inequality, individual acts morally if

$$(w_m(p) - w_i(p))(u(h_m) - u(l_m)) > w_i(p)(u(h_i) - u(h_m)) + (1 - w_i(p))(u(l_i) - u(l_m))$$

The left-hand side captures the benefit of the moral act based on the comparison of the two act-dependent weights. The right-hand side captures the expected cost of the moral act. This model has the following predictions: Individuals exhibit uncertainty-motivated moral behavior when (1) $w_m(p) - w_i(p)$ is sufficiently large; (2) the difference between h_m and l_m is sufficiently large; and (3) the expected cost of moral act $w_i(p)(u(h_i)-u(h_m))+(1-w_i(p))(u(l_i)-u(l_m))$ is sufficiently small. Thus, the predictions in this framework are analogous to those in the previous subsection with similar intuitions.

C.4 A More General Formulation

To capture the perceived link between moral behavior and uncertainty, a more general framework is to reformulate the state space, as described by Schmeidler and Wakker (1987) and Karni and Schmeidler (1991). Instead of using states and consequences as primitives, in the causal state space, acts and consequences are taken as primitives, and states are defined as all mappings from acts to consequences. This allows the perceived causality between acts and consequences (see Chapter 11 of Gilboa (2009) for a detailed discussion).[5]

[5]The causal state space is related the Newcomb's Paradox as follows. There are two boxes. The first contains \$1,000 and the second contains either \$1M or \$0. You are to choose between taking both boxes and taking only the second box. A being with superpower predicts your choice and puts \$0 (\$1M) in the second box if she predicts that you will take both boxes (the second box). After the being makes the prediction and prepares the second box, you make the choice. While some individuals would take both boxes with a dominance argument, others may take only the second box, since taking the second box would have been predicted and lead to the \$1M. The paradox attributed to Newcomb first appeared in Nozick (1969). One can extend the state space: \$1M regardless of the act, \$0 regardless of the act, \$0 if taking both boxes and \$1M if taking the second box (following the being with superpower), and \$M if taking both boxes and \$0 if taking the second

We assume that individuals are selfish, and thus consequences in the causal state space are the monetary payoffs of decision makers. Namely, h_m and l_m are the consequences of the moral act under high and low payoffs ($h_m \geq l_m$), and correspondingly, h_i and l_i are the consequences of the immoral act under high and low payoffs ($h_i \geq l_i$). As the moral act is costly, we have $h_m \leq h_i$ and $l_m \leq l_i$. Our setting has two acts, and each has two possible consequences; this gives rise to four states in the causal state space, as shown below.

	s_h	s_k	s_{rk}	s_l
moral	h_m	h_m	l_m	l_m
immoral	h_i	l_i	h_i	l_i

The two states s_h and s_l, as reflected in the standard space, capture the occurrence of high and low payoffs regardless of the acts. The two new states s_k and s_{rk} can be interpreted as the perceived correlation between acts and consequences. Namely, s_k captures the karmic doctrine whereby moral behavior leads to the high payoff and immoral behavior leads to the low payoff. In contrast, s_{rk} represents the reverse karmic situation. If a nonzero probability is assigned to s_k, uncertainty-motivated moral behavior does not violate dominance. Our theoretical framework of magical thinking directly assigns a subjective probability α to the state s_k, while in the quasi-magical thinking approach, the inflated probability weight to the high outcome under the moral act (i.e., $w_m(p) - p$) captures the belief in the state s_k. Therefore, causal state space provides a more general formulation to accommodate both magical thinking and quasi-magical thinking underlying uncertainty-motivated morality.

box. With the causal state space, taking only the second box does not violate dominance. See more related discussions in Jeffrey (1965); Gilboa and Schmeidler (1995); Karni and Vierø (2013); Schipper (2016); Karni (2017); Gilboa, Minardi, and Samuelson (2020).

Online Appendix D: Experimental Instructions, Interfaces, Tests and Surveys

Contents

1 Dice Game Experiment

1.1 Instructions

Welcome to our study on decision making. In this study, you will be given a participation fee 20 yuan and a potential bonus. The bonus you earn today depends partly on the decisions you make, and partly on chance. All information provided will be kept confidential and will be used for research purpose only. We will first introduce the experiment. Afterward, we will provide you with the link for the experiment, which you will complete on your computer. Before introducing our study, there are several things to remind you:

- Please Prepare a piece of paper and a pen
- Cell phones are not allowed
- Please do not use other apps or browse other websites
- Please do not communicate with others during the experiment
- If you have any questions, please contact our experimenters through the chat box in the online meeting room at any time

There are 21 rounds in this study. We label each round with a unique string of three random uppercase letters. In each round, there are six boxes, numbered from 1 to 6. There are two bonuses, Bonus 1 and Bonus 2, among these six boxes. The followings describe the bonus scheme and what you should do in each round.

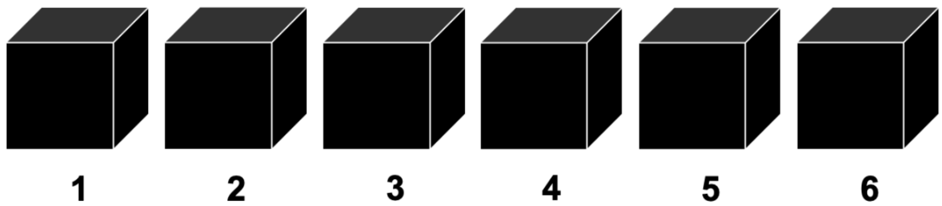
Bonus 1

There are some boxes containing H (high amount of Bonus 1) and the rest of boxes containing L (low amount of Bonus 1). You know the composition: how many boxes containing H and how many boxes containing L. You do NOT know the exact distribution: which boxes containing H and which boxes containing L.

Example:

Round: ABC

Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan.



In this example, you know that this round has three boxes containing 20 yuan and the rest of three boxes containing 0 yuan, but you do not know which boxes have 20 yuan.

Task 1

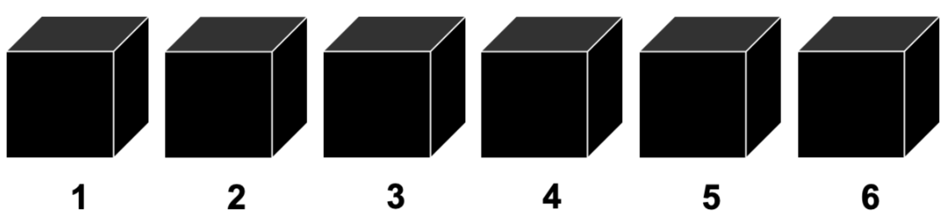
After you receive the information about Bonus 1, you need to choose one box out of the six boxes numbered from 1 to 6, and record the number on the paper you have prepared, in the format of "round number - box number."

Example:

Round: ABC

Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan.

Please choose one box and record the number.

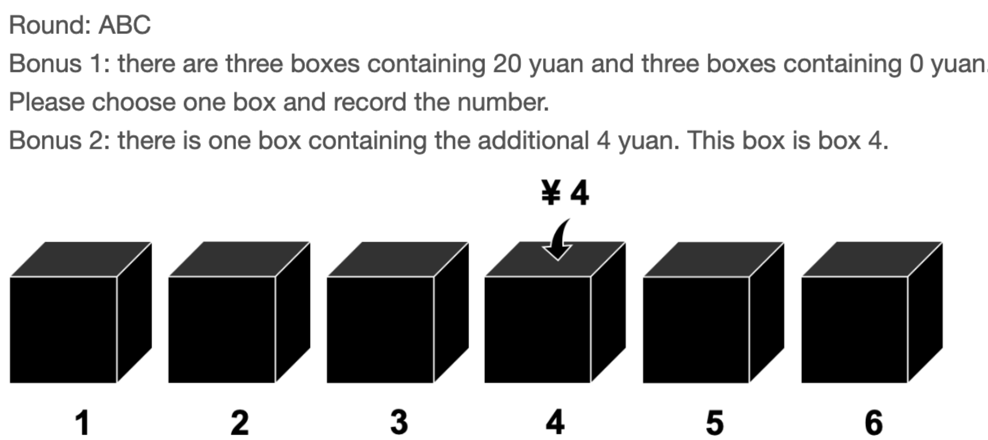


In this example, if you want to choose box 1, you should record "ABC - 1" on *your paper; if you want to choose box 2, you should record "ABC - 2"; so on and so forth.*

Bonus 2

There is an additional 4 yuan given to one of the six boxes. You know exactly which box contains the 4 yuan after you finish Task 1.

Example:



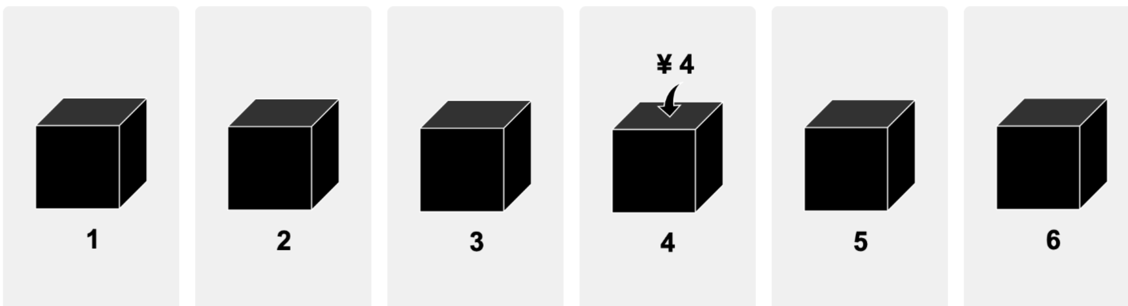
In this example, you know that, in this round, box 4 contains additional 4 yuan. That is, apart from Bonus 1, box 4 has 4 yuan on top.

Task 2

After you receive the information about Bonus 2, you need to report the box you selected in Task 1 by clicking. Please note that your choice in Task 1 is known only to you. Other people, including experimenters, cannot see the choice you recorded. At any time during or after the experiment, you do not need to upload or show the record of your choice in Task 1.

Example:

Round: ABC
Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 5.
Please select the box according to your previous record.



In this example, you need to click on the choice you recorded in Task 1. In Task 1, if you recorded "ABC - 1", you need to click on box 1; if you recorded "ABC - 2", you need to click on box 2; so on and so forth.

Summary

Each round has five screens as follows.

- First screen: the beginning of a round.
- Second screen: the composition of Bonus 1—how many boxes containing H and how many boxes containing L.
- Third screen: Task 1—choose a box and record your choice.
- Forth screen: the distribution of Bonus 2—which box contains the additional 4 yuan.
- Fifth screen: Task 2—click on the box you selected based on the record from Task 1.

Using the Random Device to determine Bonus 1 and Bonus 2

Bonus 1 and Bonus 2 are given randomly and independently. Whether a box has H or L is NOT correlated with its chance to be given the additional 4 yuan. The random device in this study is the RANDBETWEEN function provided by Excel.

Bonus 1: In each round, we specify the composition of Bonus 1, that is, how many boxes with H and how many boxes with L. After you finish all decisions, we will use the RANDBETWEEN function in Excel to determine which boxes have H and the remaining boxes have L.

Example: For the composition "three boxes containing 20 yuan and three boxes containing 0 yuan", we will use the RANDBETWEEN(1,6) function to generate three integers between 1 and 6 to determine which three boxes have 20 yuan. Suppose the numbers drawn are 1, 2, and 5, there will be 20 yuan in box 1, 2, and 5, and 0 yuan in the other three boxes. Suppose the numbers drawn are 2, 3, and 6, there will be 20 yuan in box 2, 3, and 6, and 0 yuan in the other three boxes. If the RANDBETWEEN function generates duplicate numbers, we will continue to draw until three distinct integers between 1 and 6 are produced.

Bonus 2: In each round, we specify the distribution of Bonus 2. Before we start the experiment, we used the RANDBETWEEN(1,6) function to generate one integer between 1 and 6 to determine which box has the additional 4 yuan. In each round, you will know which box has an additional 4 yuan.

Example: If the number drawn is 4, box 4 will have an additional 4 yuan. If the number drawn is 6, box 6 will have an additional 4 yuan. We have already completed this random selection before the experiment starts.

Payment Collection

After completing the entire experiment, you need to fill in the mobile phone number you used when registering your account on Weikeyan, so that we can match the data to transfer the payment. We will pay you the reward within 48 hours through the Weikeyan platform, which can be directly withdrawn to your WeChat wallet. Your experiment reward includes a participation fee of 20 yuan and a possible bonus.

We will randomly select one of the 21 rounds of your decisions to determine your bonus. In that round, the amount in the box you selected is your bonus for this experiment. Specifically, we will use the function RANDBETWEEN(1,21) to randomly select an integer between 1 and 21 to determine which round will determine your bonus. Then, as explained earlier for Bonus 1, we will use RANDBETWEEN(1,6) to determine how Bonus 1 will be distributed in that round. You will receive the amount in the box you selected, including Bonus 1 and 2 (if any).

Please note that the random selection part will be completed by the staff in real-time through screen sharing to ensure transparency. This experiment uses a random selection of one round to determine the reward. You should treat every round of decision-making as the one that will ultimately determine your reward and make decisions carefully.

The experiment instructions are now complete. If you have any questions, please ask questions in the chat box. Thank you!

1.2 Understanding Tests

Before the experiment begins, you need to answer eight questions to test your understanding of the experiment. Please answer the questions carefully.

Understanding Test 1

Suppose in one round, you know that "Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan." Which box has the highest probability of containing 30 yuan?

Box 1

Box 2

Box 3

Box 4

Box 5

Box 6

All boxes have the same probability to contain 30 yuan

Understanding Test 1 - Answer and Explanations

Question:
Suppose in one round, you know that "Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan." Which box has the highest probability of containing 30 yuan?

Your answer: All boxes have the same probability to contain 30 yuan

Your answer is **correct.** Suppose in one round, among the six boxes, two boxes contain 30 yuan and four boxes contain 0 yuan, all boxes have the same probability to contain 30 yuan.

Understanding Test 2

Suppose in one round, you know that "Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan." What is the probability for you to earn 30 yuan?

- 0
- 1/6
- 1/3
- 1/2
- 2/3
- 5/6
- 1

Understanding Test 2 - Answer and Explanations

Question:
Suppose in one round, you know that "Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan." What is the probability for you to earn 30 yuan?

Your answer: 1/3

Your answer is **correct**. Suppose in one round, among the six boxes, two boxes contain 30 yuan and four boxes contain 0 yuan, the probability for each box to contain 30 yuan is 2/6=1/3.

Understanding Test 3

Suppose in one round, you know that "Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan." Which box has the highest probability of containing Bonus 2 (the additional 4 yuan)?

- Box 1
- Box 2
- Box 3
- Box 4
- Box 5
- Box 6
- All boxes have the same probability to contain the additional 4 yuan

Understanding Test 3 - Answer and Explanations

Question:
Suppose in one round, you know that "Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan." Which box has the highest probability of containing Bonus 2 (the additional 4 yuan)?

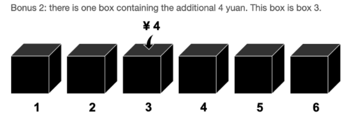
Your answer: All boxes have the same probability to contain the additional 4 yuan

Your answer is **correct**. In each round, all boxes have the same probability to contain Bonus 2 (the additional 4 yuan).

Understanding Test 4

Suppose in one round, you know that

Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.



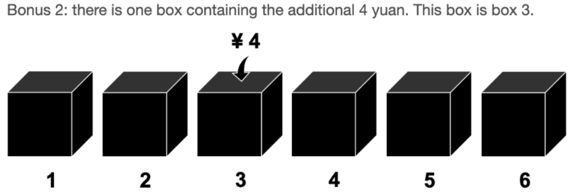
Which box has the highest probability of containing 30 yuan?

- Box 1
- Box 2
- Box 3
- Box 4
- Box 5
- Box 6
- All boxes have the same probability to contain 30 yuan

Understanding Test 4 - Answer and Explanations

Question: Suppose in one round, you know that

Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.



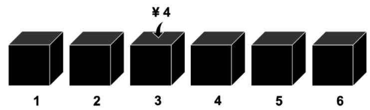
Which box has the highest probability of containing 30 yuan?
Your answer: All boxes have the same probability to contain 30 yuan

Your answer is **correct**. Suppose in one round, among the six boxes, two boxes contain 30 yuan and four boxes contain 0 yuan, and Box 3 contains Bonus 2. All boxes have the same probability to contain 30 yuan. Containing 30 yuan and containing Bonus 2 (the additional 4 yuan) are randomly and independently determined.

Understanding Test 5

Suppose in one round, you know that

Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.



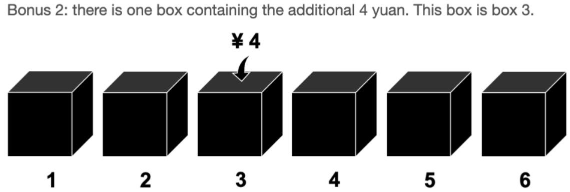
What are the possible amounts in Box 3 (considering both Bonus 1 and Bonus 2)?

- Box 3 contains either 30 yuan or 0 yuan
- Box 3 contains either 4 yuan or 0 yuan
- Box 3 contains either 34 yuan or 4 yuan
- Box 3 contains either 34 yuan or 0 yuan
- Box 3 contains either 30 yuan or 4 yuan

Understanding Test 5 - Answer and Explanations

Question:
Suppose in one round, you know that

Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.



What are the possible amounts in Box 3 (considering both Bonus 1 and Bonus 2)?

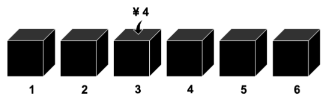
Your answer: Box 3 contains either 34 yuan or 4 yuan

Your answer is **correct**. As for Bonus 1, Box 3 contains either 30 yuan or 0 yuan. As for Bonus 2, Box 3 contains 4 yuan for sure. Therefore, if we consider both Bonus 1 and Bonus 2, box 3 contains 34 yuan or 4 yuan.

Understanding Test 6

Suppose in one round, you know that

Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.



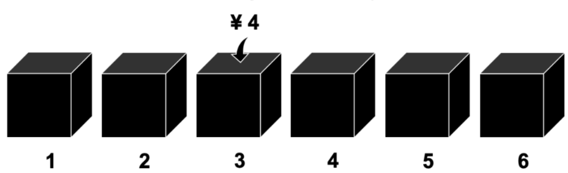
What are the possible amounts in Box 1 (considering both Bonus 1 and Bonus 2)?

- Box 1 contains either 30 yuan or 0 yuan
- Box 1 contains either 4 yuan or 0 yuan
- Box 1 contains either 34 yuan or 4 yuan
- Box 1 contains either 34 yuan or 0 yuan
- Box 1 contains either 30 yuan or 4 yuan

Understanding Test 6 - Answer and Explanations

Question:
Suppose in one round, you know that

Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.

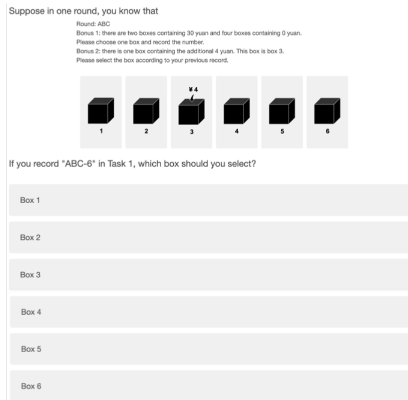


What are the possible amounts in Box 1 (considering both Bonus 1 and Bonus 2)?

Your answer: Box 1 contains either 30 yuan or 0 yuan

Your answer is **correct**. As for Bonus 1, Box 1 contains either 30 yuan or 0 yuan. As for Bonus 2, Box 1 contains 0 yuan for sure. Therefore, if we consider both Bonus 1 and Bonus 2, box 1 contains 30 yuan or 0 yuan.

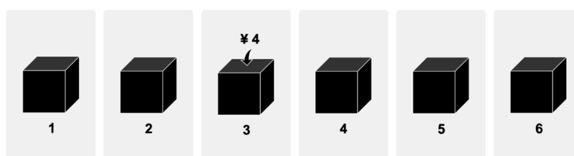
Understanding Test 7



Understanding Test 7 - Answer and Explanations

Question: Suppose in one round, you know that

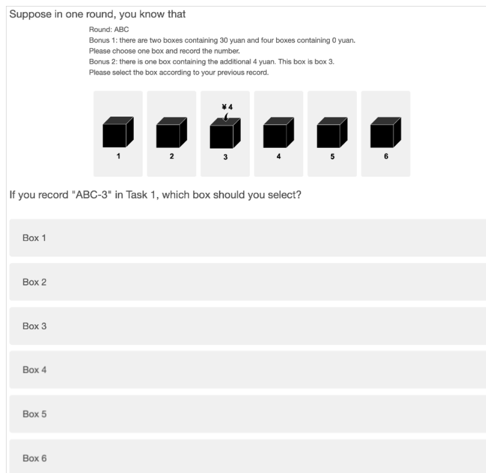
Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.
Please select the box according to your previous record.



If you record "ABC-6" in Task 1, which box should you select?
Your answer: Box 6

Your answer is **correct**. If you choose Box 6 in Task 1, you should record "ABC-6", and you should select Box 6 in Task 2 accordingly.

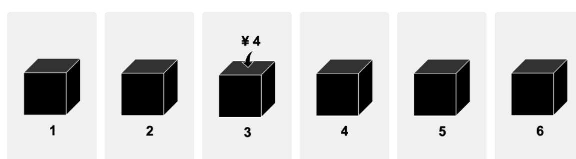
Understanding Test 8



Understanding Test 8 - Answer and Explanations

Question: Suppose in one round, you know that

Round: ABC
Bonus 1: there are two boxes containing 30 yuan and four boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 3.
Please select the box according to your previous record.



If you record "ABC-3" in Task 1, which box should you select?
Your answer: Box 3

Your answer is **correct**. If you choose Box 3 in Task 1, you should record "ABC-3", and you should select Box 3 in Task 2 accordingly.

1.3 Screens in One Round

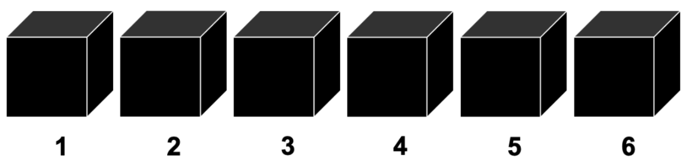
Screen 1

Round: JSZ

Screen 2

Round: JSZ

Bonus 1: there are six boxes containing 0 yuan.

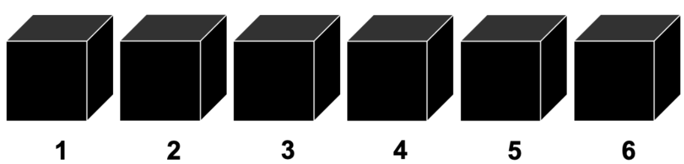


Screen 3

Round: JSZ

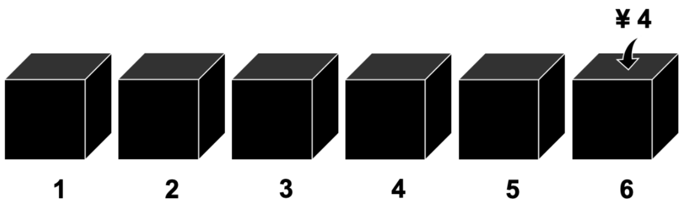
Bonus 1: there are six boxes containing 0 yuan.

Please choose one box and record the number.



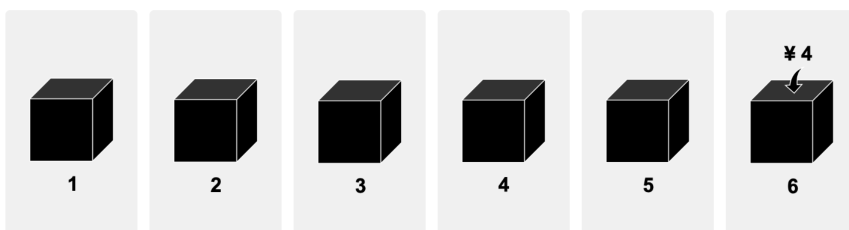
Screen 4

Round: JSZ
Bonus 1: there are six boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 6.



Screen 5

Round: JSZ
Bonus 1: there are six boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 6.
Please select the box according to your previous record.



Please click the arrow below to proceed to the next round.

Screen 6

Please wait for the next round.

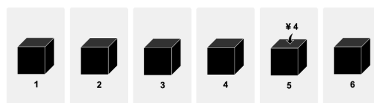
1.4 Belief Elicitation

In this experiment, different participants will receive different payoffs based on their choices and chance. In each of the following scenarios, please predict the payoffs that different participants will receive.

Question 1

Consider the following decision scenario for a round:

Bonus 1: there are one box containing 40 yuan and five boxes containing 0 yuan.
Please choose one box and record the number.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 5.
Please select the box according to your previous record.



- Some participants chose box 5 and received Bonus 2 (an additional 4 yuan);
- Some participants chose one of the other five boxes (box 1, 2, 3, 4, or 6) and did not receive Bonus 2.

Which group of participants is more likely to receive the 40 yuan as Bonus 1?

Participants who choose Box 5			equally likely			Participants who choose one of the remianing five boxes
○	○	○	○	○	○	○

2 Direct Choice Experiment

2.1 Instructions

Welcome to our study on decision making. In this study, you will be given a participation fee 20 yuan and a potential bonus. The bonus you earn today depends partly on the decisions you make, and partly on chance. All information provided will be kept confidential and will be used for research purpose only. We will first introduce the experiment. Afterward, we will provide you with the link for the experiment, which you will complete on your computer. Before introducing our study, there are several things to remind you:

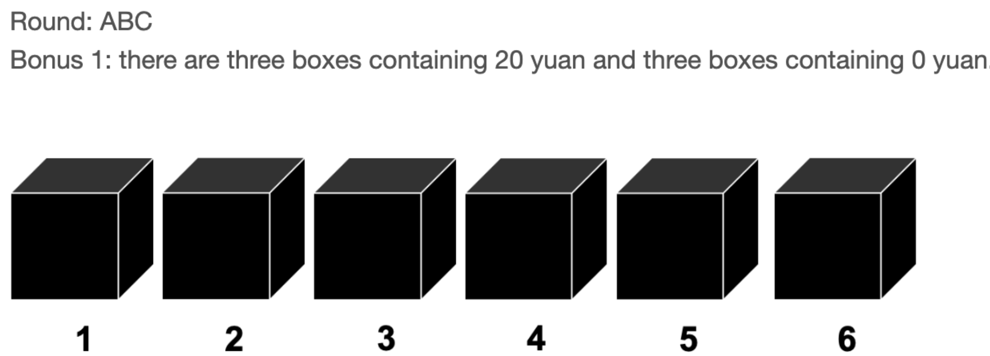
- Cell phones are not allowed
- Please do not use other apps or browse other websites
- Please do not communicate with others during the experiment
- If you have any questions, please contact our experimenters through the chat box in the online meeting room at any time

There are 21 rounds in this study. We label each round with a unique string of three random uppercase letters. In each round, there are six boxes, numbered from 1 to 6. There are two bonuses, Bonus 1 and Bonus 2, among these six boxes. The followings describe the bonus scheme and what you should do in each round.

Bonus 1

There are some boxes containing H (high amount of Bonus 1) and the rest of boxes containing L (low amount of Bonus 1). You know the composition: how many boxes containing H and how many boxes containing L. You do NOT know the exact distribution: which boxes containing H and which boxes containing L.

Example:

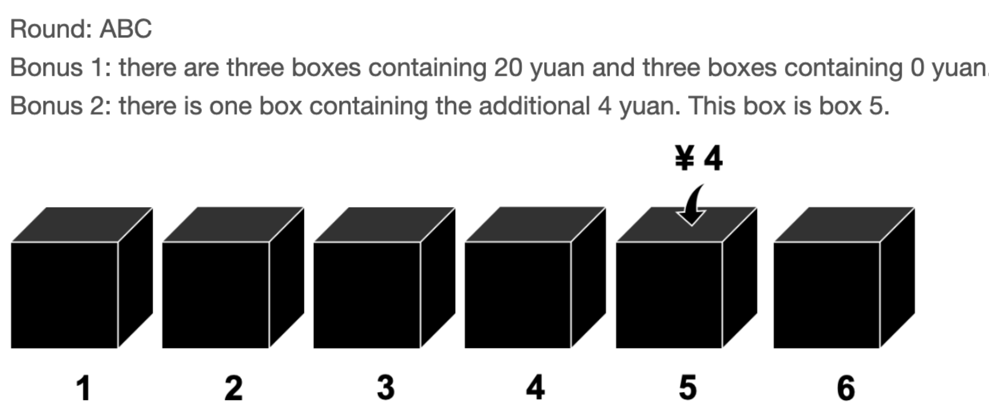


In this example, you know that this round has three boxes containing 20 yuan and the rest of three boxes containing 0 yuan, but you do not know which boxes have 20 yuan.

<u>Bonus 2</u>

There is an additional 4 yuan given to one of the six boxes. You know exactly which box contains the 4 yuan.

Example:



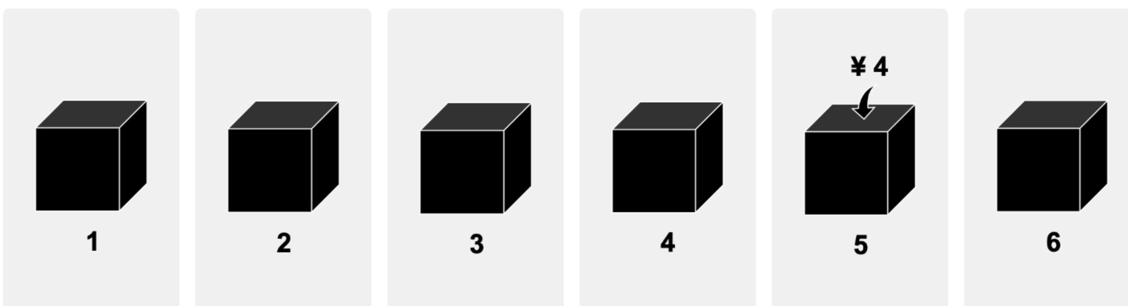
In this example, you know that, in this round, box 5 contains additional 4 yuan. That is, apart from Bonus 1, box 5 has 4 yuan on top.

Task

After you receive the information about Bonus 1 and Bonus 2, you need to report the box you want to receive by clicking.

Example:

Round: ABC
Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan.
Bonus 2: there is one box containing the additional 4 yuan. This box is box 5.
Please select the box that you would like to receive.



In this example, you need to click on the choice you want to select. If you want to receive box 1, you need to click on box 1; if you want to receive box 2, you need to click on box 2; so on and so forth.

Summary

Each round has four screens as follows.

- First screen: the beginning of a round.
- Second screen: the composition of Bonus 1—how many boxes containing H and how many boxes containing L.

- Third screen: the distribution of Bonus 2—which box contains the additional 4 yuan.
- Forth screen: Click on the box you want to receive.

Using the Random Device to determine Bonus 1 and Bonus 2

Bonus 1 and Bonus 2 are given randomly and independently. Whether a box has H or L is NOT correlated with its chance to be given the additional 4 yuan. The random device in this study is the RANDBETWEEN function provided by Excel.

Bonus 1: In each round, we specify the composition of Bonus 1, that is, how many boxes with H and how many boxes with L. After you finish all decisions, we will use the RANDBETWEEN function in Excel to determine which boxes have H and the remaining boxes have L.

Example: For the composition "three boxes containing 20 yuan and three boxes containing 0 yuan", we will use the RANDBETWEEN(1,6) function to generate three integers between 1 and 6 to determine which three boxes have 20 yuan. Suppose the numbers drawn are 1, 2, and 5, there will be 20 yuan in box 1, 2, and 5, and 0 yuan in the other three boxes. Suppose the numbers drawn are 2, 3, and 6, there will be 20 yuan in box 2, 3, and 6, and 0 yuan in the other three boxes. If the RANDBETWEEN function generates duplicate numbers, we will continue to draw until three distinct integers between 1 and 6 are produced.

Bonus 2: In each round, we specify the distribution of Bonus 2. Before we start the experiment, we used the RANDBETWEEN(1,6) function to generate one integer between 1 and 6 to determine which box has the additional 4 yuan. In each round, you will know which box has an additional 4 yuan.

Example: If the number drawn is 4, box 4 will have an additional 4 yuan. If the number drawn is 6, box 6 will have an additional 4 yuan. We have already completed *this random selection before the experiment starts.*

Payment Collection

After completing the entire experiment, you need to fill in the mobile phone number you used when registering your account on Weikeyan, so that we can match the data to transfer the payment. We will pay you the reward within 48 hours through the Weikeyan platform, which can be directly withdrawn to your WeChat wallet. Your experiment reward includes a participation fee of 20 yuan and a possible bonus.

We will randomly select one of the 21 rounds of your decisions to determine your bonus. In that round, the amount in the box you selected is your bonus for this experiment. Specifically, we will use the function RANDBETWEEN(1,21) to randomly select an integer between 1 and 21 to determine which round will determine your bonus. Then, as explained earlier for Bonus 1, we will use RANDBETWEEN(1,6) to determine how Bonus 1 will be distributed in that round. You will receive the amount in the box you selected, including Bonus 1 and 2 (if any).

Please note that the random selection part will be completed by the staff in real-time through screen sharing to ensure transparency. This experiment uses a random selection of one round to determine the reward. You should treat every round of decision-making as the one that will ultimately determine your reward and make decisions carefully.

The experiment instructions are now complete. If you have any questions, please ask questions in the chat box. Thank you!

3 Second Party Experiment

3.1 Instructions

Welcome to our study on decision making. In this study, you will be given a participation fee 20 yuan and a potential bonus. The bonus you earn today may depend on your decisions, others' decisions, and chance. All information provided will be kept confidential and will be used for research purpose only. We will first introduce the experiment. Afterward, we will provide you with the link for the experiment, which you will complete on your computer. Before introducing our study, there are several things to remind you:

- Please Prepare a piece of paper and a pen
- Cell phones are not allowed
- Please do not use other apps or browse other websites
- Please do not communicate with others during the experiment
- If you have any questions, please contact our experimenters through the chat box in the online meeting room at any time

In this experiment, there are two players, A and B. Player A does not need to make any choices, while Player B needs to make choices. Therefore, in the following content, we will explain what choice you need to make if you are Player B.

In this experiment, if you are Player B, the decision you make will affect both the bonus for Player A and the bonus for you. We will determine the specific amount of your bonuses based on the decisions you make and chance. Please note that the bonus for Player A will be paid entirely by the experimenters, not by you.

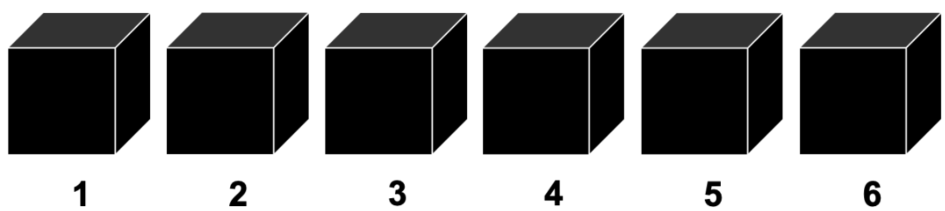
There are 42 rounds in this study. We label each round with a unique string of three random uppercase letters. In each round, there are six boxes, numbered from 1 to 6. There are two bonuses among these six boxes. Bonus 1 is for Player A and Bonus 2 is for you. The followings describe the bonus scheme and what you should do in each round.

Bonus 1

Bonus 1 is for Player A. There are some boxes containing H (high amount of Bonus 1) and the rest of boxes containing L (low amount of Bonus 1). As Player B, you know the composition: how many boxes containing H and how many boxes containing L. You do NOT know the exact distribution: which boxes containing H and which boxes containing L.

Example:

Round: ABC
Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan. Bonus 1 is for Player A.



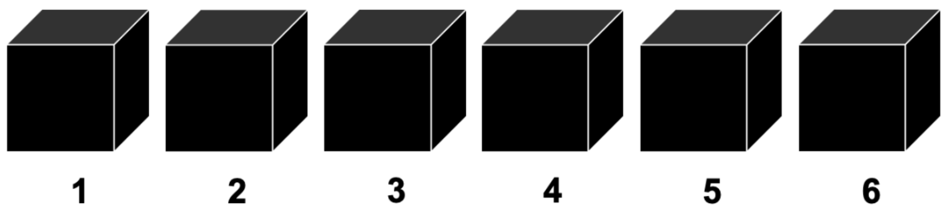
In this example, you know that this round has three boxes containing 20 yuan and the rest of three boxes containing 0 yuan, but you do not know which boxes have 20 yuan. Bonus 1 will be paid to Player A.

Task 1

After you receive the information about Bonus 1, you need to choose one box out of the six boxes numbered from 1 to 6, and record the number on the paper you have prepared, in the format of “round number - box number.”

Example:

Round: ABC
Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan. Bonus 1 is for Player A.
Please choose one box and record the number.



In this example, if you want to choose box 1, you should record "ABC - 1" on your paper; if you want to choose box 2, you should record "ABC - 2"; so on and so forth.

Bonus 2

Bonus 2 is for you. Among the six boxes, there are one box containing 25 yuan as Bonus 2 and five boxes containing 21 yuan as Bonus 2. You know exactly which box contains the 25 yuan after you finish Task 1.

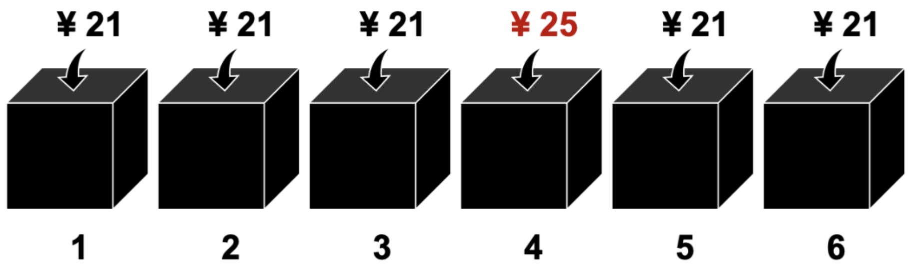
Example:

Round: ABC

Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan. Bonus 1 is for Player A.

Please choose one box and record the number.

Bonus 2: box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 2 is for you.



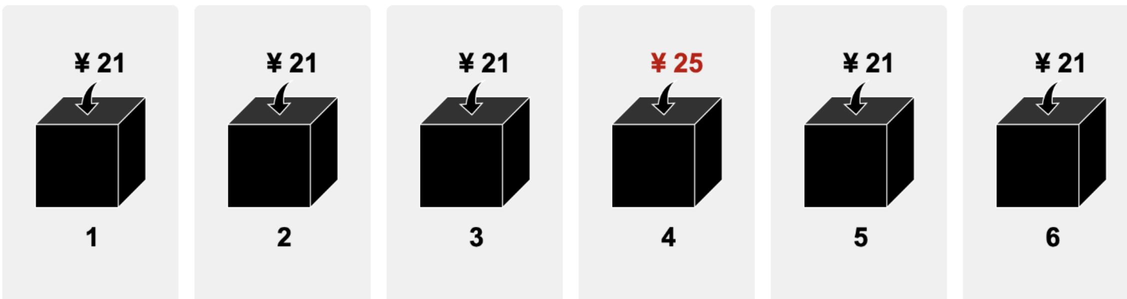
In this example, you know that, in this round, box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 1 will be paid to you.

<u>Task 2</u>

After you receive the information about Bonus 2, you need to report the box you selected in Task 1 by clicking. Please note that your choice in Task 1 is known only to you. Other people, including experimenters, cannot see the choice you recorded. At any time during or after the experiment, you do not need to upload or show the record of your choice in Task 1.

Example:

Round: ABC
Bonus 1: there are three boxes containing 20 yuan and three boxes containing 0 yuan. Bonus 1 is for Player A.
Please choose one box and record the number.
Bonus 2: box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 2 is for you.
Please select the box according to your previous record.



In this example, you need to click on the choice you recorded in Task 1. In Task 1, if you recorded "ABC - 1", you need to click on box 1; if you recorded "ABC - 2", you need to click on box 2; so on and so forth.

Summary

Each round has five screens as follows.

- First screen: the beginning of a round.
- Second screen: the composition of Bonus 1—how many boxes containing H and how many boxes containing L.
- Third screen: Task 1—choose a box and record your choice.
- Forth screen: the distribution of Bonus 2—which box contains 25 yuan and the remaining boxes contain 21 yuan.
- Fifth screen: Task 2—click on the box you selected based on the record from Task 1.

Using the Random Device to determine Bonus 1 and Bonus 2

Bonus 1 and Bonus 2 are given randomly and independently. Whether a box has H or L as Bonus 1 is NOT correlated with whether it has 25 or 21 yuan as Bonus 2. The random device in this study is the RANDBETWEEN function provided by Excel.

Bonus 1: In each round, we specify the composition of Bonus 1, that is, how many boxes with H and how many boxes with L. After you finish all decisions, we will use the RANDBETWEEN function in Excel to determine which boxes have H and the remaining boxes have L.

Example: For the composition "three boxes containing 20 yuan and three boxes containing 0 yuan", we will use the RANDBETWEEN(1,6) function to generate three integers between 1 and 6 to determine which three boxes have 20 yuan. Suppose the numbers drawn are 1, 2, and 5, there will be 20 yuan in box 1, 2, and 5, and 0 yuan in the other three boxes. Suppose the numbers drawn are 2, 3, and 6, there will be 20 yuan in box 2, 3, and 6, and 0 yuan in the other three boxes. If the RANDBETWEEN function generates duplicate numbers, we will continue to draw until three distinct integers between 1 and 6 are produced.

Bonus 2: In each round, we specify the distribution of Bonus 2. Before we start the experiment, we used the RANDBETWEEN(1,6) function to generate one integer between 1 and 6 to determine which box has 25 yuan as Bonus 2. In each round, you will know which box has 25 yuan.

Example: If the number drawn is 4, box 4 will have 25 yuan. If the number drawn is 6, box 6 will have 25 yuan. We have already completed this random selection before the experiment starts.

Payment Collection

After completing the entire experiment, you need to fill in the mobile phone number you used when registering your account on Weikeyan, so that we can match the data to transfer the payment. We will pay you the reward within 48 hours through the Weikeyan platform, which can be directly withdrawn to your WeChat wallet. Your experiment reward includes a participation fee of 20 yuan and a possible bonus.

We will determine your rewards through the following process:

- All participants will be randomly divided into two groups, A and B. If the numbers are not equal, we will randomly select participants to balance the groups.
- Each participant in group A will be matched with a participant in group B to form several pairs of A and B.
- You will receive a participation fee of 20 yuan in addition to your bonus.
  - If you are Player A, your bonus will be determined by the choices of the matched Player B and chance.
  - If you are Player B, your bonus will be determined by your choices and chance.
  - Specifically, we will use the function RANDBETWEEN(1,42) to randomly select an integer between 1 and 42 to determine which round will decide bonuses for the pair. Then, as described earlier, we will use RANDBETWEEN(1,6) to determine how Bonus 1 is distributed in that round. Player A will receive Bonus 1 from the box selected by the paired Player B, and Player B will receive Bonus 2 from the selected box.

Please note that the random selection part will be completed by the staff in real-time through screen sharing to ensure transparency. This experiment uses a random selection of one round to determine the reward. Player B should consider each round as a result of re-matching with Player A, and should take each round seriously as a round that will ultimately determine their own and Player A's reward.

The experiment instructions are now complete. If you have any questions, please ask questions in the chat box. Thank you!

4 Ex Ante Resolution Experiment

4.1 Instructions

Welcome to our study on decision making. In this study, you will be given a participation fee $10 and a potential bonus. The bonus you earn today depends partly on the decisions you make, and partly on chance. All information provided will be kept confidential and will be used for research purpose only. Before introducing our study, there are several things to remind you:

- Cell phones and other electronic devices are not allowed.
- Please do not communicate with others during the experiment.
- If you have any questions, please raise your hand to ask our experimenters at any time.

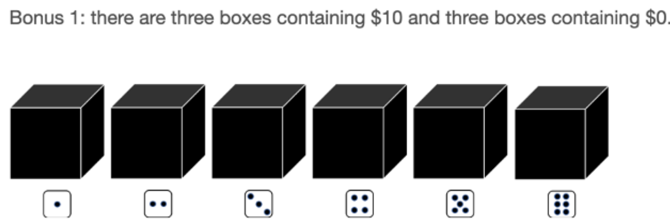
Part 1

There are 21 rounds in this study. We label each round with a unique string of three random uppercase letters. In each round, there are six boxes, numbered from 1 to 6 using symbols from a die. There are two bonuses, Bonus 1 and Bonus 2, among these six boxes. The amount of bonus in each box was randomly predetermined before the experiment started. The followings describe the bonus scheme and what you should do in each round.

Bonus 1

There are some boxes containing $H (high amount of Bonus 1) and the rest of boxes containing $L (low amount of Bonus 1). You know the composition: how many boxes containing $H and how many boxes containing $L. You do NOT know the exact distribution: which boxes containing $H and which boxes containing $L.

Example:

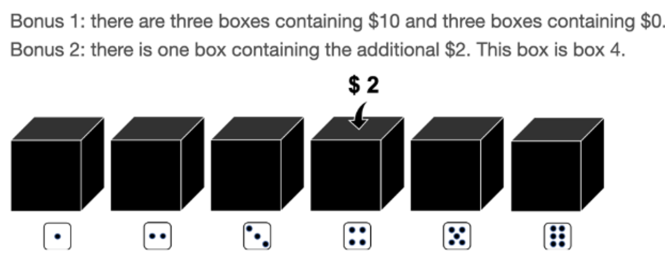


In this example, you know that this round has three boxes containing \$10 and the rest of three boxes containing \$0, but you do not know which boxes have \$10.

<u>Bonus 2</u>

There is an additional \$2 given to one of the six boxes. You know exactly which box containing the \$2.

Example:



In this example, you know that, in this round, box 4 containing additional \$2. That is, apart from the original bonus, box 4 has \$2 on top.

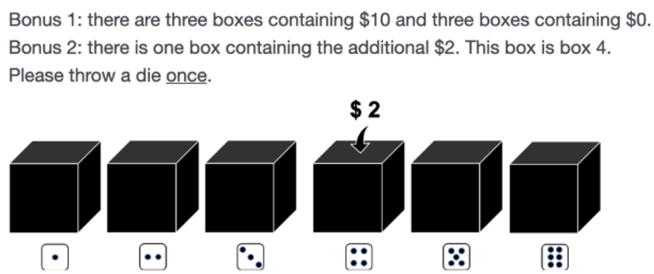
<u>Notice</u>

Bonus 1 and Bonus 2 are given randomly and independently. Whether a box has \$H or \$L is NOT correlated with its chance to be given the additional \$2. We will describe how we determine Bonus 1 and Bonus 2 detailedly in Part 2.

What you should do

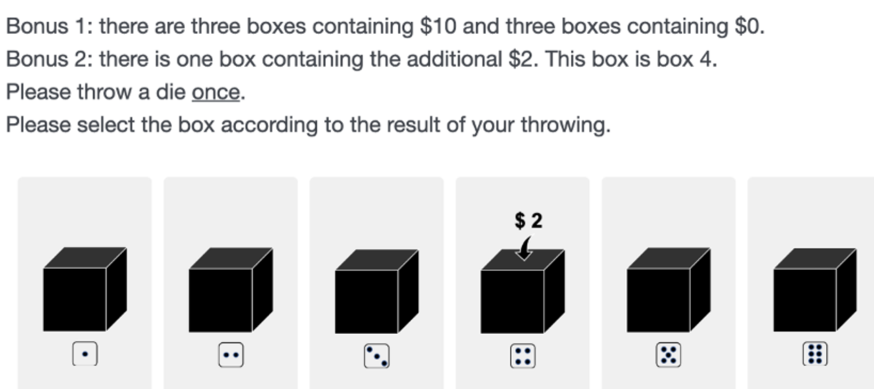
After you are given the information related to Bonus 1 and Bonus 2, you have two actions. First, you will throw a die once in private. The number that the die lands on indicates which box you receive. Note that no one else including experimenters can observe the number from your die throwing.

Example:



Second, you will report which box you receive by clicking on the box.

Example:



In this example, you are to throw a die and report which box you receive. If the die lands on number 1, you are to report that you receive box 1. If the die lands on *number 6, you are to report that you receive box 6.*

Summary of each round

Each round has four screens as follows.

- First screen: the beginning of a round.
- Second screen: the composition of Bonus 1 — how many boxes containing $H and how many boxes containing $L.
- Third screen: the box containing Bonus 2 — the addition $2.
- Forth screen: ask you to throw a die.
- Last screen: ask you to report the box you receive.

Payment collection

After you finish the whole experiment, you will receive a completion code. You should report this code to experimenters when you collect payment. The payment includes participation fee $10 and the potential bonus, the latter of which is decided as follows.

For each of the 21 rounds, you will receive one box according to the above rules. One out of these 21 boxes will be selected to pay you. To select such a box, the experimenters wrote one number randomly chosen from 1 to 21 in to be put into envelopes. These envelopes were distributed to all participants before the experiment. The number in your sealed envelope indicates the round, in which the box you receive will count. Please do not open the envelope before the end of the experiment. This protocol of determining payments suggests that you should treat each round as if it were the round to determine your payment.

Part 2

Part 2 explains how the Bonus 1 and Bonus 2 were predetermined using some random device before the experiment started.

<u>Random Device</u>

The random device in this study is an urn consisting of six balls numbered from 1 to 6.

<u>Using the Random Device to determine Bonus 1</u>

In each round, we specify the composition of Bonus 1, that is, how many boxes with \$H and how many boxes with \$L. For a given composition, the experimenters draw balls without replacement to determine which boxes have \$H.

Example: for the composition "three boxes containing \$10 and three boxes containing \$0", before the start of the experiment, the experimenter drew three balls from the urn without replacement. Suppose the balls drawn are ball 1, 2 and 5, there will be \$10 in box 1, 2 and 5, and \$0 in the other three boxes. Suppose the balls drawn are ball 2, 3 and 6, there will be \$10 in box 2, 3 and 6, and \$0 in the other three boxes. While these numbers can be verified, you do not know these numbers when making decisions.

<u>Using the Random Device to determine Bonus 2</u>

In each round, the experimenters draw one ball from the urn to determine which box has the \$2.

Example: suppose the ball drawn is ball 4, box 4 will have the additional \$2. Suppose the ball drawn is ball 6, box 6 will have the additional \$2.

<u>Records of the Bonus 1 and Bonus 2</u>

For Bonus 1, the experimenters recorded the distribution of Bonus 1 in a table.

Example: suppose for Round BEP, box 1, 2 and 5 have $10 according to the ball drawing. The distribution of Bonus 1 for this round would be recorded as follows:

Round	*Composition*	*Box*					
		1	*2*	*3*	*4*	*5*	*6*
...							
BEP	*3 boxes with $10; 3 boxes with $0*	*$10*	*$10*	*$0*	*$0*	*$10*	*$0*
...							

Before the start of this experiment, the experimenters recorded the distributions of Bonus 1 for all 21 rounds. After that, the experimenters printed out this table, put it in the same envelope containing a number from 1 to 21, and sealed the envelope. Envelopes have same records of Bonus 1 but different numbers. Again, please do not open the envelope during the experiment. You are supposed to seal off the envelop in front of experimenter when you collect payment.

For Bonus 2, the interface of each round has the information that which box has the $2.

Video

To make the procedure transparent and verifiable, the experimenters recorded the whole randomization process in a video. At the end of the experiment, you will be provided a link of the video, showing how the experimenters drew balls and recorded the distribution of Bonus 1 and Bonus 2 for each round.

Summary of the Procedure

Bonus 1 and Bonus 2 in each round were predetermined randomly and independently.

This is the end of Instructions. If you have any question, please raise your hand.

5 Dictator Game Experiment

5.1 Instructions

Welcome to our study on decision making. In this study, you will be given a participation fee $10 and a potential bonus. The bonus you earn today depends partly on the decisions you make and the decisions of the other participants, and partly on chance. All information provided will be kept confidential and will be used for research purpose only. Before introducing our study, there are several things to remind you:

- Cell phones and other electronic devices are not allowed.
- Please do not communicate with others during the experiment.
- If you have any questions, please raise your hand to ask our experimenters at any time.

Part 1

There are 21 rounds in this study. We label each round with a unique string of three random uppercase letters.

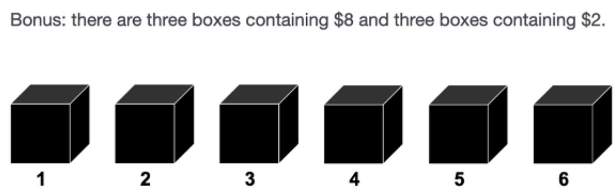
At the beginning of the experiment, all participants will be randomly assigned the role of either Person A or Person B. The numbers of Person As and Person Bs are equal. Each participant is coded with the role code and a number, e.g. A1. In each round, each Person A will be randomly matched with one Person B. Each participant has no information on the identity of the matched participant. The matching changes each round.

In each round, there are six boxes, numbered from 1 to 6. There is a Bonus among these six boxes. The amount of bonus in each box was randomly predetermined before the experiment started. The following describe the Bonus, the Sharing ratio, and what Person A and B should do in each round.

Bonus

There are some boxes containing \$H (high amount of Bonus) and the rest of boxes containing \$L (low amount of Bonus). You know the composition: how many boxes containing \$H and how many boxes containing \$L. You do NOT know the exact distribution: which boxes containing \$H and which boxes containing \$L.

Example:

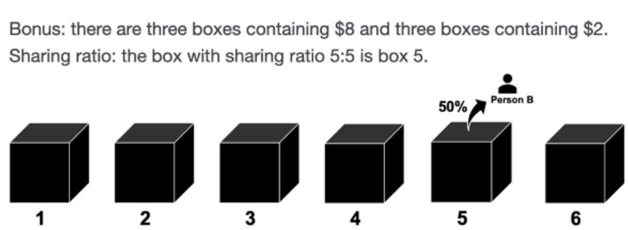


In this example, you know that this round has three boxes containing \$8 and the rest of three boxes containing \$2, but you do not know which boxes have \$8.

Sharing ratio

There are five boxes with sharing ratio 10:0, which means that Person A gets all the bonus in the box and Person B gets nothing. There is one box with sharing ratio 5:5, which means that Person A and Person B both get 50% of the bonus in the box. You know which box has the sharing ratio 5:5.

Example:



In this example, you know that, in this round, the box with sharing ratio 5:5 is box 5. The sharing ratios in box 1, 2, 3, 4 and 6 are all 10:0.

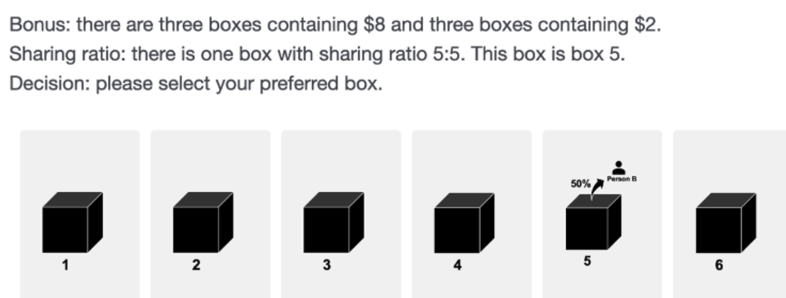
Notice

Bonus and Sharing ratio are given randomly and independently. Whether a box has \$H or \$L is NOT correlated with its chance to be attached with the sharing ratio 5:5. We will describe how we determine Bonus and Sharing ratio detailedly in Part 2.

What you should do—if you are Person A

After you are given the information related to Bonus and Sharing ratio, you need to choose a preferred box to receive in this round. That is, you will receive the bonus in this box, either \$H or \$L, and you will share the bonus with the Person B matched with you in this round, according to the sharing ratio attached to this box.

Example:



In this example, you are to select your preferred box. If you choose box 2, the sharing ratio will be 10:0. You will obtain all bonus in this box, which is either \$8 or \$2. If you choose box 5, the sharing ratio will be 5:5. If there is \$8 in box 5, both you and Person B obtain \$4. If there is \$2 in box 5, both you and Person B obtain \$1.

What you should do—if you are Person B

After you are given the information related to Bonus and Sharing ratio, you have no action need to do concerning the bonus in the box.

Summary of each round

Each round has screens as follows.

- First screen: beginning of a round.
- Second screen: composition of Bonus — how many boxes containing $H and how many boxes containing $L.
- Third screen: distribution of Sharing ratio — which box has the sharing ratio 5:5.
- Last screen: selection (for Person A).

Payment collection

After you finish the whole experiment, you will receive a completion code. You should report this code to experimenters when you collect payment. The payment includes participation fee $10 and the Bonus. Your Bonus is decided as follows.

One out of 21 rounds will be selected to implement. To select such a round and assign the pairs, the experimenters design a randomization program. The program reports implementation plan in the form of "Ax – By – Box Z", where "Ax" and "By" are codes for Person A and B, and "Z" is a number from 1 to 21. "Ax – By – Box Z" means that the choice of Person Ax in Round Z will be implemented to determine the Bonus of Ax and By. The experimenters recorded these pre-determined implementation plan in to be put into envelopes. These envelopes were distributed to all participants before the experiment. The randomization program suggests that Person A should treat each round as if it were the round to determine payment, and should also treat the Person B in each round as newly assigned.

Part 2

Part 2 explains how Bonus and Sharing ratio were predetermined using some random device before the experiment started.

Random Device

The random device in this study is an urn consisting of six balls numbered from 1 to 6.

Using the Random Device to determine Bonus

In each round, we specify the composition of Bonus, that is, how many boxes with $H and how many boxes with $L. For a given composition, the experimenters draw balls without replacement to determine which boxes have $H.

Example: for the composition "three boxes containing $8 and three boxes containing $2", before the start of the experiment, the experimenter drew three balls from the urn without replacement. Suppose the balls drawn are ball 1, 2 and 5, there will be $8 in box 1, 2 and 5, and $2 in the other three boxes. Suppose the balls drawn are ball 2, 3 and 6, there will be $8 in box 2, 3 and 6, and $2 in the other three boxes. While these numbers can be verified, you do not know these numbers when making decisions.

Using the Random Device to determine Sharing Ratio

In each round, the experimenters draw one ball from the urn to determine which box has the sharing ratio 5:5.

Example: suppose the ball drawn is ball 4, box 4 will have the sharing ratio 5:5.

Suppose the ball drawn is ball 6, box 6 will have the sharing ratio 5:5.

Records of the Bonus and Sharing Ratio

For Bonus, the experimenters recorded the distribution of Bonus in a table.

Example: suppose for Round BEP, box 1, 2 and 5 have $8 according to the ball drawing. The distribution of Bonus for this round would be recorded as follows:

Round	*Composition*	*Box*					
		1	*2*	*3*	*4*	*5*	*6*
...							
BEP	*3 boxes with $8; 3 boxes with $2*	*$8*	*$8*	*$2*	*$2*	*$8*	*$2*
...							

Before the start of this experiment, the experimenters recorded the distributions of Bonus for all 21 rounds. After that, the experimenters printed out this table, put it in the same envelope containing the implementation plan, and sealed the envelope. Envelopes have same records of Bonus but different implementation plans. Again, please do not open the envelope during the experiment. You are supposed to seal off the envelop in front of experimenter before you collect payment.

For Sharing ratio, the interface of each round has the information that which box has the sharing ratio 5:5.

Video

To make the procedure transparent and verifiable, the experimenters recorded the whole randomization process in a video. At the end of the experiment, you will be provided a link of the video, showing how the experimenters drew balls and recorded the distribution of Bonus and Sharing ratio for each round.

Summary of the Procedure

Bonus and Sharing ratio in each round were predetermined randomly and independently.

This is the end of Instructions. If you have any question, please raise your hand.

6 Second Party Information Experiment

6.1 Instructions

Welcome to our study on decision making. In this study, you will be given a participation fee 20 yuan and a potential bonus. The bonus you earn today may depend on your decisions, others' decisions, and chance. All information provided will be kept confidential and will be used for research purpose only. We will first introduce the experiment. Afterward, we will provide you with the link for the experiment, which you will complete on your computer. Before introducing our study, there are several things to remind you:

- Please Prepare a piece of paper and a pen
- Cell phones are not allowed
- Please do not use other apps or browse other websites
- Please do not communicate with others during the experiment
- If you have any questions, please contact our experimenters through the chat box in the online meeting room at any time

In this experiment, there are two players, A and B. Player A needs to make choices, while Player B does not need to make any choices. Therefore, in the following content, we will explain what choice you need to make if you are Player A.

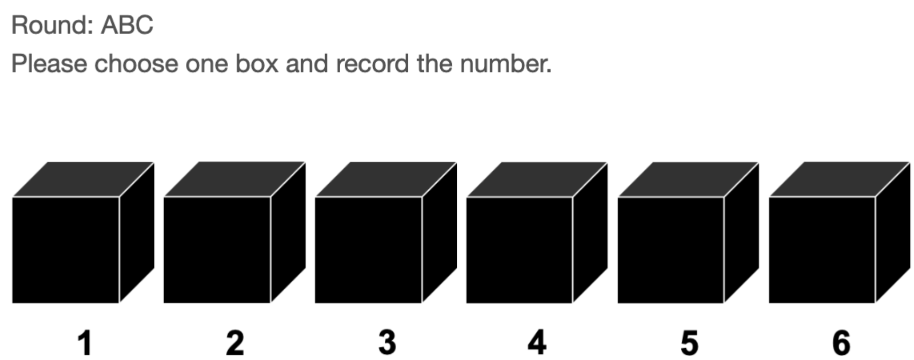
In this experiment, if you are Player A, the decision you make will affect both the bonus for you and the bonus for Player B. We will determine the specific amount of your bonuses based on the decisions you make and chance. Please note that the bonus for Player B will be paid entirely by the experimenters, not by you.

There are 27 rounds in this study. We label each round with a unique string of three random uppercase letters. In each round, there are six boxes, numbered from 1 to 6. There are two bonuses among these six boxes. Bonus 1 is for you and Bonus 2 is for Player B. The followings describe the bonus scheme and what you should do in each round.

Task 1

At the beginning of each round, you need to choose one box out of the six boxes numbered from 1 to 6, and record the number on the paper you have prepared, in the format of "round number - box number."

Example:



In this example, if you want to choose box 1, you should record "ABC - 1" on your paper; if you want to choose box 2, you should record "ABC - 2"; so on and so forth.

Bonus 1

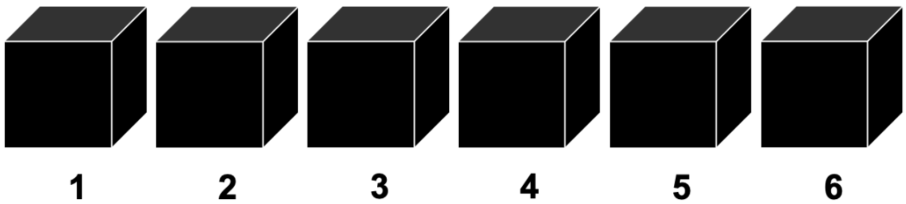
After you finish Task 1, you will know which box contains 25 yuan as Bonus 1 and the remaining five boxes contain 21 yuan as Bonus 1. Bonus 1 is for you.

Example:

Round: ABC

Please choose one box and record the number.

Bonus 1: box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 1 is for you.



In this example, you know that, in this round, box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 1 will be paid to you.

Bonus 2

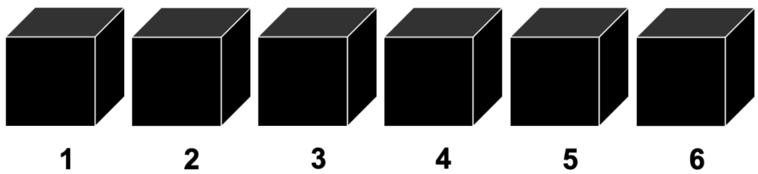
There are some boxes containing H (high amount of Bonus 1) and the rest of boxes containing L (low amount of Bonus 1). The specific amounts of H and L will vary with each round. In the experiment, you will see the specific amounts of H and L for each round. Bonus 2 is for Player B.

We will randomly decide whether the odd-numbered boxes (boxes 135) have H and the even-numbered boxes (boxes 246) has L, or whether the even-numbered boxes (boxes 246) have H and the odd-numbered boxes (boxes 135) has L. There are three possibilities regarding whether you know the distribution of Bonus 2:

1. You know the distribution of Bonus 2.

Example:

Round: ABC
Please choose one box and record the number.
Bonus 1: box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 1 is for you.
Bonus 2: boxes 135 contain 20 yuan and boxes 246 contain 0 yuan. Bonus 2 is for Player B.

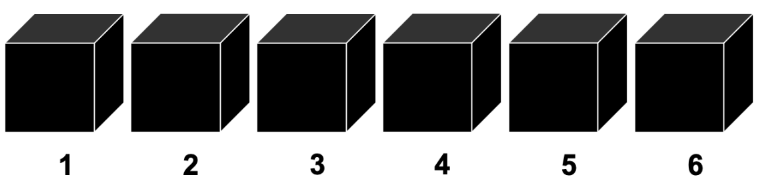


In this example, you know that in this round, the high amount is 20 yuan and the low amount is 0 yuan. And you know that there are 20 yuan in boxes 135 and 0 yuan in boxes 246.

2. You do not know the distribution of Bonus 2.

Example:

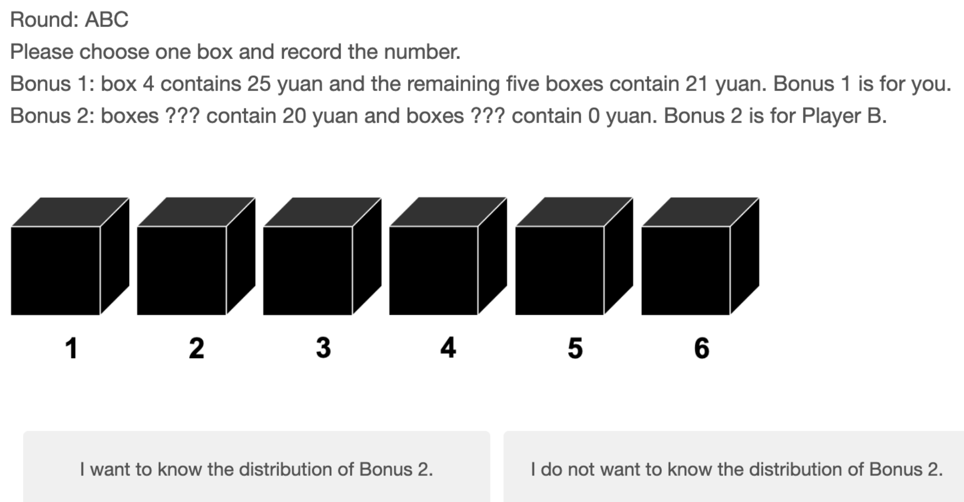
Round: ABC
Please choose one box and record the number.
Bonus 1: box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 1 is for you.
Bonus 2: boxes ??? contain 20 yuan and boxes ??? contain 0 yuan. Bonus 2 is for Player B.



In this example, you know that in this round, the high amount is 20 yuan and the low amount is 0 yuan. But you do not know whether the odd-numbered boxes or the even-numbered boxes have 20 yuan.

3. You can choose whether to know the distribution of Bonus 2.

Example:



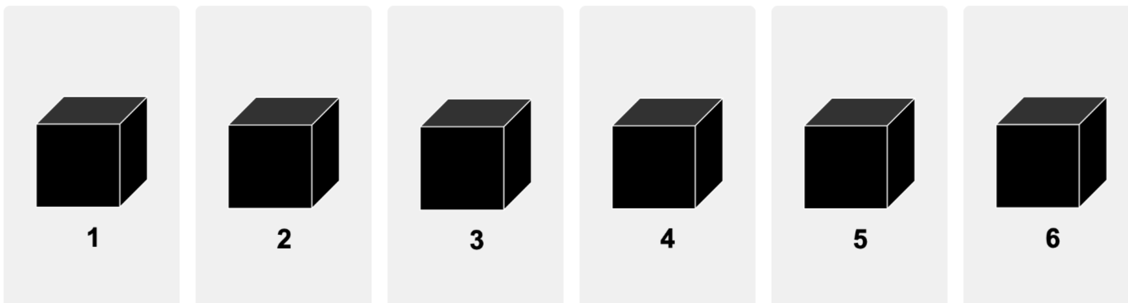
In this example, you know that in this round, the high amount is 20 yuan and the low amount is 0 yuan. You can choose whether to know the distribution of Bonus 2. If you choose "I want to know the distribution of Bonus 2", the exact information of the distribution will be displayed in the new page (? will be replaced by exact number). If you choose "I do not want to know the distribution of Bonus 2", the information will remain unchanged.

Task 2

After you receive the information about Bonus 1 and Bonus 2, you need to report the box you selected in Task 1 by clicking. You will receive Bonus 1 in the selected box and Player B will receive Bonus 2 in the selected box. Please note that your choice in Task 1 is known only to you. Other people, including experimenters, cannot see the choice you recorded. At any time during or after the experiment, you do not need to upload or show the record of your choice in Task 1.

Example:

Round: ABC
Please choose one box and record the number.
Bonus 1: box 4 contains 25 yuan and the remaining five boxes contain 21 yuan. Bonus 1 is for you.
Bonus 2: boxes 135 contain 20 yuan and boxes 246 contain 0 yuan. Bonus 2 is for Player B.
Please select the box according to your previous record.



In this example, you need to click on the choice you recorded in Task 1. In Task 1, if you recorded "ABC - 1", you need to click on box 1; if you recorded "ABC - 2", you need to click on box 2; so on and so forth.

Summary

Each round has five screens as follows.

- First screen: the beginning of a round.
- Second screen: Task 1—choose a box and record your choice.
- Third screen: the distribution of Bonus 1—which box contains 25 yuan and the remaining boxes contain 21 yuan.
- Forth screen: Bonus 2—the specific amounts of H and L; there are three possible situations about the distribution of Bonus 2: (1) you know; (2) you do not know; (3) you can choose whether to know.
- Fifth screen: Task 2—click on the box you selected based on the record from Task 1.

Using the Random Device to determine Bonus 1 and Bonus 2

Bonus 1 and Bonus 2 are given randomly and independently. Whether a box has 25 or 21 yuan as Bonus 1 is NOT correlated with whether it has H or L as Bonus 2. The random device in this study is the RANDBETWEEN function provided by Excel.

Bonus 1: In each round, we specify the distribution of Bonus 1. Before we start the experiment, we used the RANDBETWEEN(1,6) function to generate one integer between 1 and 6 to determine which box has 25 yuan as Bonus 1. In each round, you will know which box has 25 yuan.

Example: If the number drawn is 4, box 4 will have 25 yuan. If the number drawn is 6, box 6 will have 25 yuan.

Bonus 2: In each round, we specify the composition of Bonus 2. Before we start the experiment, we used the RANDBETWEEN(1,2) function to generate a random number to determine which boxes have H and the remaining boxes have L. Specifically, if the random number is 1, the odd-numbered boxes have H and the even-numbered boxes have L. If the random number is 2, the even-numbered boxes have H and the odd-numbered boxes have L. Regarding whether you have information about the distribution of Bonus 2, there are three possible situations.

Example: For the composition "three boxes containing 20 yuan and three boxes containing 0 yuan", if the random number is 1, boxes 135 have 20 yuan and boxes 246 have 0 yuan. If the random number is 2, boxes 246 have 20 yuan and boxes 135 have 0 yuan.

Payment Collection

After completing the entire experiment, you need to fill in the mobile phone number you used when registering your account on Weikeyan, so that we can match the data to transfer the payment. We will pay you the reward within 48 hours through the Weikeyan platform, which can be directly withdrawn to your WeChat wallet. Your experiment reward includes a participation fee of 20 yuan and a possible bonus.

We will determine your rewards through the following process:

- All participants will be randomly divided into two groups, A and B. If the numbers are not equal, we will randomly select participants to balance the groups.
- Each participant in group A will be matched with a participant in group B to form several pairs of A and B.
- You will receive a participation fee of 20 yuan in addition to your bonus.
  - If you are Player A, your bonus will be determined by your choices and chance.
  - If you are Player B, your bonus will be determined by the choices of the paired Player A and chance.
  - Specifically, we will use the function RANDBETWEEN(1,27) to randomly select an integer between 1 and 27 to determine which round will decide bonuses for the pair. Player A will receive Bonus 1 from the selected box, and Player B will receive Bonus 2 from the selected box.

Please note that before the experiment started, we randomly determined the distribution of Bonus 1 and 2 for each round, and recorded the video of the draw. Interested students can email us to obtain the video link. In addition, after the experiment is over, we will use screen sharing to determine the roles of each participant and the rounds for each pair to receive bonuses in real-time. This experiment uses a random selection of one round to determine the reward. Player A should consider each round as a result of re-matching with Player B, and should take each round seriously as a round that will ultimately determine their own and Player B's reward.

The experiment instructions are now complete. If you have any questions, please ask questions in the chat box. Thank you!

7 Dice Game with Loss Experiment

7.1 Instructions

Welcome to our study on decision making. In this study, you will be given a participation fee 20 yuan and a potential bonus. The bonus you earn today depends partly on the decisions you make, and partly on chance. All information provided will be kept confidential and will be used for research purpose only. We will first introduce the experiment. Afterward, we will provide you with the link for the experiment, which you will complete on your computer. Before introducing our study, there are several things to remind you:

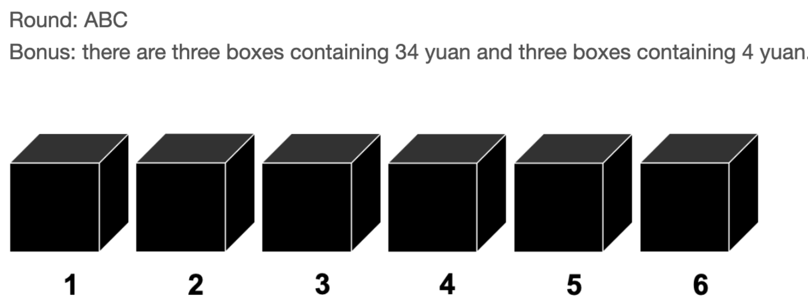
- Please Prepare a piece of paper and a pen
- Cell phones are not allowed
- Please do not use other apps or browse other websites
- Please do not communicate with others during the experiment
- If you have any questions, please contact our experimenters through the chat box in the online meeting room at any time

There are 21 rounds in this study. We label each round with a unique string of three random uppercase letters. In each round, there are six boxes, numbered from 1 to 6. There are one Bonus and one Bonus Deduction among these six boxes. The followings describe the bonus scheme and what you should do in each round.

Bonus

There are some boxes containing H (high amount of Bonus) and the rest of boxes containing L (low amount of Bonus). You know the composition: how many boxes containing H and how many boxes containing L. You do NOT know the exact distribution: which boxes containing H and which boxes containing L.

Example:

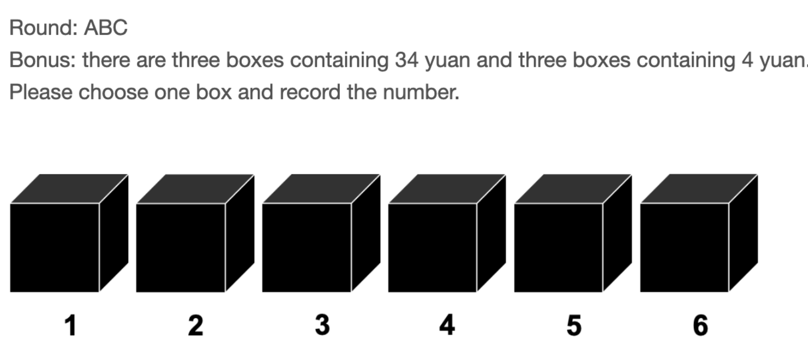


In this example, you know that this round has three boxes containing 34 yuan and the rest of three boxes containing 4 yuan, but you do not know which boxes have 20 yuan.

<u>Task 1</u>

After you receive the information about Bonus, you need to choose one box out of the six boxes numbered from 1 to 6, and record the number on the paper you have prepared, in the format of "round number - box number."

Example:



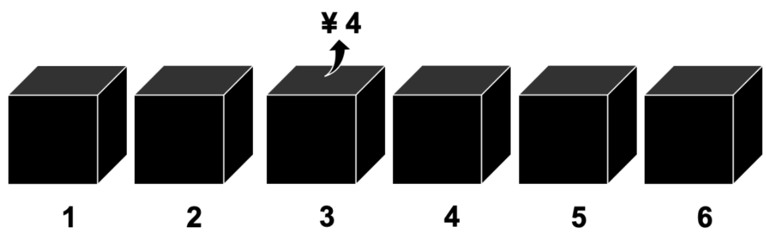
In this example, if you want to choose box 1, you should record "ABC - 1" on your paper; if you want to choose box 2, you should record "ABC - 2"; so on and so forth.

Bonus Deduction

There is a Bonus Deduction of 4 yuan given to one of the six boxes. You know exactly which box will be deducted by 4 yuan.

Example:

Round: ABC
Bonus: there are three boxes containing 34 yuan and three boxes containing 4 yuan.
Please choose one box and record the number.
Bonus Deduction: there is one box containing the bonus deduction of 4 yuan. This box is box 3.



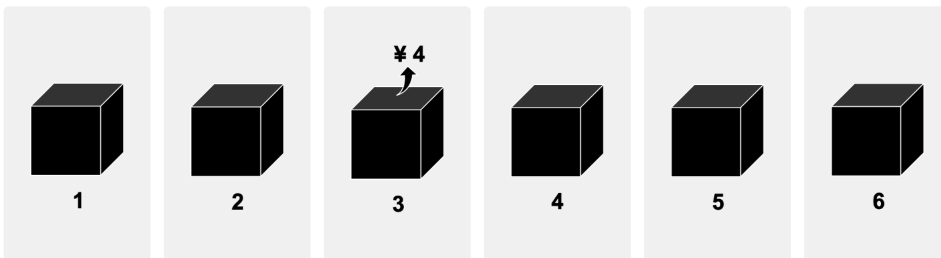
In this example, you know that, in this round, box 3 will be deducted by 4 yuan. Namely, regardless of whether box 3 contains H or L as Bonus, 4 yuan will be taken out of box 3.

Task 2

After you receive the information about Bonus and Bonus Deduction, you need to report the box you selected in Task 1 by clicking. Please note that your choice in Task 1 is known only to you. Other people, including experimenters, cannot see the choice you recorded. At any time during or after the experiment, you do not need to upload or show the record of your choice in Task 1.

Example:

Round: ABC
Bonus: there are three boxes containing 34 yuan and three boxes containing 4 yuan.
Please choose one box and record the number.
Bonus Deduction: there is one box containing the bonus deduction of 4 yuan. This box is box 3.
Please select the box according to your previous record.



In this example, you need to click on the choice you recorded in Task 1. In Task 1, if you recorded "ABC - 1", you need to click on box 1; if you recorded "ABC - 2", you need to click on box 2; so on and so forth.

Summary

Each round has five screens as follows.

- First screen: the beginning of a round.
- Second screen: the composition of Bonus—how many boxes containing H and how many boxes containing L.
- Third screen: Task 1—choose a box and record your choice.
- Forth screen: the distribution of Bonus Deduction—which box will be deducted by 4 yuan.
- Fifth screen: Task 2—click on the box you selected based on the record from Task 1.

Using the Random Device to determine Bonus and Bonus Deduction

Bonus and Bonus Deduction are given randomly and independently. Whether a box has H or L is NOT correlated with its chance to be given the Bonus Deduction.

The random device in this study is the RANDBETWEEN function provided by Excel.

Bonus: In each round, we specify the composition of Bonus, that is, how many boxes with H and how many boxes with L. After you finish all decisions, we will use the RANDBETWEEN function in Excel to determine which boxes have H and the remaining boxes have L.

Example: For the composition "three boxes containing 24 yuan and three boxes containing 4 yuan", we will use the RANDBETWEEN(1,6) function to generate three integers between 1 and 6 to determine which three boxes have 24 yuan. Suppose the numbers drawn are 1, 2, and 5, there will be 24 yuan in box 1, 2, and 5, and 4 yuan in the other three boxes. Suppose the numbers drawn are 2, 3, and 6, there will be 24 yuan in box 2, 3, and 6, and 4 yuan in the other three boxes. If the RANDBETWEEN function generates duplicate numbers, we will continue to draw until three distinct integers between 1 and 6 are produced.

Bonus Deduction: In each round, we specify the distribution of Bonus Deduction. Before we start the experiment, we used the RANDBETWEEN(1,6) function to generate one integer between 1 and 6 to determine which box will be deducted by 4 yuan. In each round, you will know which box has the Bonus Deduction of 4 yuan.

Example: If the number drawn is 4, box 4 will be deducted by 4 yuan. If the number drawn is 6, box 6 will be deducted by 4 yuan. We have already completed this random selection before the experiment starts.

Payment Collection

After completing the entire experiment, you need to fill in the mobile phone number you used when registering your account on Weikeyan, so that we can match the data to transfer the payment. We will pay you the reward within 48 hours through the Weikeyan platform, which can be directly withdrawn to your WeChat wallet. Your experiment reward includes a participation fee of 20 yuan and a possible bonus.

We will randomly select one of the 21 rounds of your decisions to determine your bonus. In that round, the amount in the box you selected is your bonus for this experiment. Specifically, we will use the function RANDBETWEEN(1,21) to randomly select an integer between 1 and 21 to determine which round will determine your bonus. Then, as explained earlier for Bonus, we will use RANDBETWEEN(1,6) to determine how Bonus will be distributed in that round. You will receive the amount in the box you selected, including Bonus and Bonus Deduction (if any).

Please note that the random selection part will be completed by the staff in real-time through screen sharing to ensure transparency. This experiment uses a random selection of one round to determine the reward. You should treat every round of decision-making as the one that will ultimately determine your reward and make decisions carefully.

The experiment instructions are now complete. If you have any questions, please ask questions in the chat box. Thank you!