Online Appendix for "Belief Uncertainty"

Marina Agranov* Wanying Huang†

September 12, 2026

This document contains additional materials for the paper titled "Belief Uncertainty". The pre-registration for the study is available here. This document is structured as follows:

- Section 1 presents the instructions and screenshots for the main treatment.
- Section 2 includes all scenarios used in the experiment and the simple comprehension questions for each scenario.
- Section 3 presents screenshots illustrating how the two robustness treatments differ from the main treatment.

1 Instructions and screenshots for the main treatment

Welcome to our study!

This study has **three** parts. Parts 1 and 2 are the main parts of the study and together consist of 9 rounds. They will take the most time. Part 3 consists of some short questions.

In addition to the participation payment, you are eligible for bonuses.

- For each participant, the computer will randomly select one round from either Part 1 or Part 2. One question from that round will be randomly chosen, and your answer to that question will determine whether you receive a bonus of up to \$10.
- In addition, 10% of participants will be randomly selected for an extra bonus of up to \$1 for their answers in some simple questions in either Part 1 or Part 2.
- In addition, 10% of participants will be randomly selected for an extra bonus for their answers in one task in Part 3.
- Finally, at the end of Part 3, there will also be some short puzzles in which all participants can earn a small bonus.

*Division of the Humanities and Social Sciences, Caltech and NBER. Email: magranov@caltech.edu
†Department of Economics, Monash University. Email: kate.huang@monash.edu

The **important thing to remember** is that ANY question you answer in this study may affect your bonus payment. So, pay close attention to the questions and answer them to the best of your ability to maximize the chance of earning the sizable bonus!

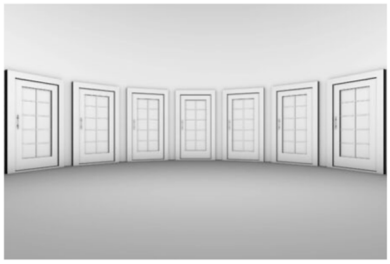
While answering the questions, we ask you **not to browse the internet** and **not to consult with others**. We are genuinely interested in your opinions and preferences.

To proceed to the study, please enter your Prolific ID below

NEXT

1.1 Part 1: Instructions

In each round, we will present a scenario and ask you a few questions about it.
Here is an example of a scenario:



There is a room with 10 identical doors: **3** of them hide a prize, and **7 do not**.

The computer repeats the following process **1 million times:**

- The computer randomly selects **ONE** door to open. Each door is equally likely to be selected.
- Then the computer checks whether the selected door contains a prize and records it.
- After that, the door is closed again, and the locations of the prizes are **re-randomized** among the 10 doors.

NEXT

First, we will ask you a few simple questions about the scenario. For instance, we might ask:

- How many doors contain the prize?
- How many times does the computer select a door and record whether it contains a prize?

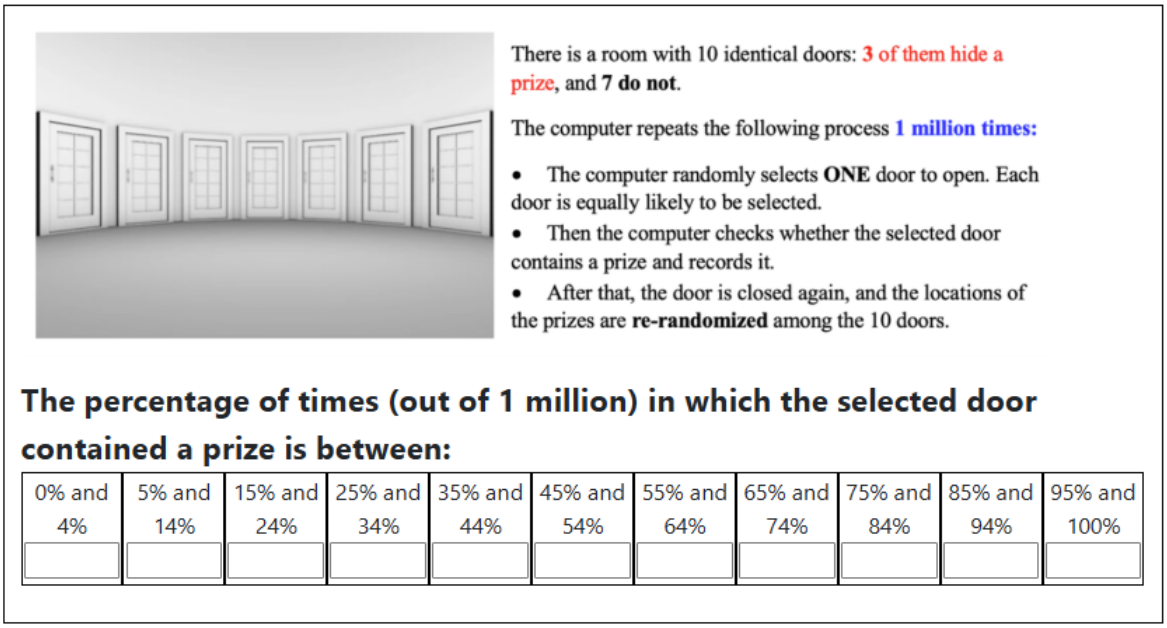
NEXT

Second, we will ask you to **report your belief** about **whether each statement in the table is correct**. You will do so by filling in a table that looks like this:

The percentage of times (out of 1 million) in which the selected door contained a prize is between:

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%

A Closer Look at the Table



The table consists of 11 columns.

Each column corresponds to a statement of the following form:

"The percentage of times (out of 1 million) in which the selected door contained a prize is between X% and Y%"

The ranges (X% and Y%) differ across columns and together cover the full spectrum from 0% to 100%.

In this round, the condition we care about is whether the selected door contains a prize.

NEXT

Here are some examples from this table:

- The statement in the 1st column (far left) is: The percentage of times (out of 1 million) the selected door contained a prize is between 0% and 4%.
- The statement in the 7th column (middle) is: The percentage of times (out of 1 million) the selected door contained a prize is between 55% and 64%.
- The statement in the last column (far right) is: The percentage of times (out of 1 million) the selected door contained a prize is between 95% and 100%.

NEXT

A Closer Look at the Table, continued

[*same figure as before*]

When you fill the table, **your task is to enter a number between 0 and 100 (inclusive) in each column**.

This number represents your belief that the statement in that column is correct:

- Entering 0 means you are certain that the statement is wrong, i.e., 0% correct
- Entering 100 means you are certain that the statement is correct, i.e., 100% correct
- Entering, say, 57, means you believe the statement is 57% likely to be correct

If you leave a column blank, it will be automatically treated as 0.

The sum of the numbers across all columns must add up to 100.

Below the table, you'll see the sum of the numbers entered so far (if the sum is not yet 100) to help track your progress.

NEXT

A Closer Look at the Table, continued

Let's see a few examples:

There is a room with 10 identical doors: **3** of them hide a prize, and **7 do not**.

The computer repeats the following process **1 million times:**

- The computer randomly selects **ONE** door to open. Each door is equally likely to be selected.
- Then the computer checks whether the selected door contains a prize and records it.
- After that, the door is closed again, and the locations of the prizes are **re-randomized** among the 10 doors.

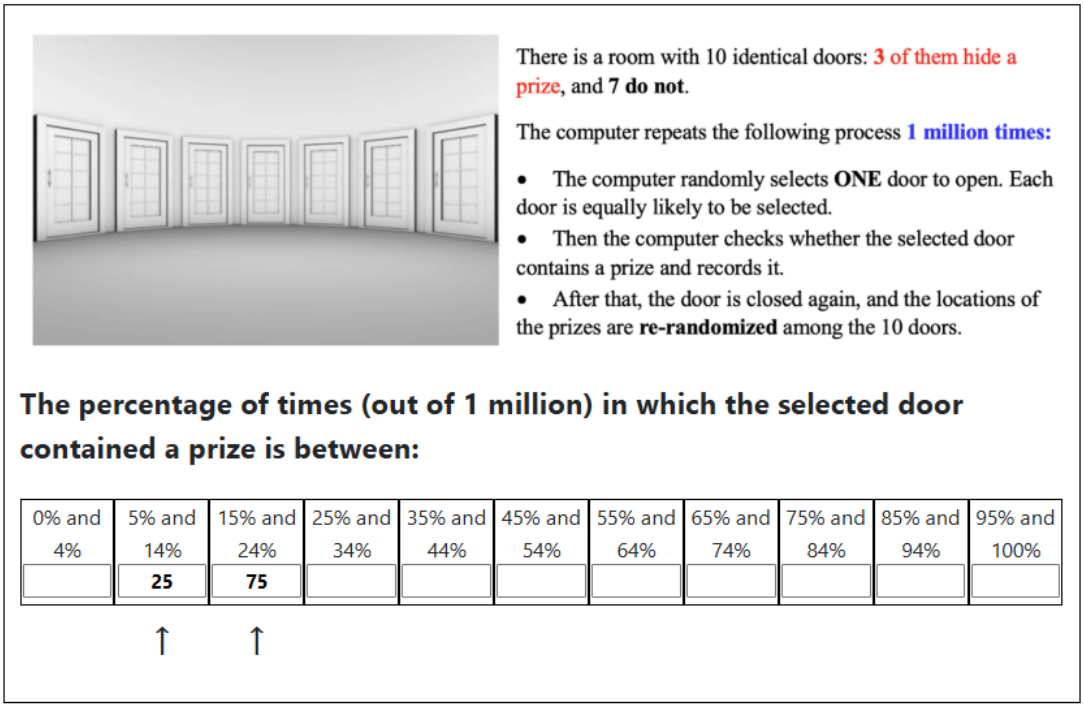
The percentage of times (out of 1 million) in which the selected door contained a prize is between:

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%
							100			

↑

- Suppose you enter 100 in the 8th column (from the left) and leave all others blank. This means you are certain (100%) that the true percentage is between 65% and 74%.

NEXT



- Suppose you enter 25 in the 2nd column and 75 in the 3rd column, leaving all others blank (or entering 0). This means you are not sure where the percentage falls, but you believe that one-quarter (25%) of the time the percentage is between 5% and 14%, and three-quarters (75%) of the time, it is between 15% and 24%.

NEXT

There is a room with 10 identical doors: **3** of them hide a prize, and **7 do not**.

The computer repeats the following process **1 million times:**

- The computer randomly selects **ONE** door to open. Each door is equally likely to be selected.
- Then the computer checks whether the selected door contains a prize and records it.
- After that, the door is closed again, and the locations of the prizes are **re-randomized** among the 10 doors.

The percentage of times (out of 1 million) in which the selected door contained a prize is between:

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%
5	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**10**	**5**

- Suppose you enter similar numbers across all columns. This means you have no idea where the true percentage lies and believe it is roughly equally likely to fall anywhere across the entire range.

NEXT

Part 1: How Your Bonus Is Determined

All questions that you answer during the study may affect your bonus payment. Therefore, we ask you to pay attention to all questions and answer them the best you can.

We will now describe how exactly the bonus is calculated.

Simple scenario questions (up to $1 bonus):

- 10% of participants are selected at random for a bonus based on their answers in simple scenario questions.
- For each selected participant, one of the simple scenario questions (the questions asked first in each round) will be randomly chosen.
- If the selected question comes from Part 1 and your answer to that question is correct, you will earn the $1 bonus.

Belief table questions (up to $10 bonus):

- All participants are eligible for a bonus of up to $10 based on their answers in one randomly selected round.

- If the selected round is from Part 1, the computer will randomly select one column from the table in that round.
- Your bonus will depend on the number you entered in the selected column and whether the statement in that column is actually correct.
- In short, **truthfully reporting your belief maximizes your chance of earning the $10 bonus.**

PRESS TO LEARN HOW BONUS IS DETERMINED CONTINUE

[*Participants can proceed by directly clicking the CONTINUE button; if "PRESS TO LEARN HOW BONUS IS DETERMINED" is clicked, it reveals the following.*]

Let's call A the number you entered in the selected column. So, A represents your belief that the statement in that column is correct. This is a number between 0 and 100.

The computer will randomly draw a number N between 0 and 100:

- If N is greater than or equal to A, you have an N% chance of earning $10.
- If N is less than A, you earn $10 if the statement in the selected column is actually correct.

In other words, you either have an N% chance of earning $10, or you earn $10 if your belief is correct. So, you should choose A as the highest number such that you'd rather rely on your belief being correct than leaving it up to chance.

If all of this sounds confusing, don't worry – it is actually simple!

Truthfully reporting your belief maximizes your chance of earning the $10 bonus.

NEXT

Part 1: Comprehension Quiz

To check your understanding of the instructions, please answer the following questions. Please read the questions carefully!

Consider the following scenario:

Computer flips a fair coin **1 million times**
and records the number of times that the HEADS come up.

For each column, indicate how likely you believe the statement in that column is CORRECT

The percentage of times the coin lands on HEADS is between:

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%
				10	**80**	**10**				

Your current sum is: 100

NEXT

[*Participants can allocate probability points across any intervals as long as the points sum to one hundred.*]

Part 1: Comprehension Quiz, continued

You reported that – the percentage of times the coin lands on HEADS is between:

[*Display participant's own answers from the previous page*]

Use the numbers reported in the table above when you answer the questions below. You will have **two attempts to answer ALL questions correctly**. If you fail both times, your participation in the study will be terminated and you will be paid 50 cents for your time.

Question 1 According to your answer above, how likely do you think it is that the percentage of times the coin lands on HEADS is between 85% and 94%? (Report a number between 0 and 100)

[*Correct answer based on the previous screenshot: 0*]

Question 2 According to your answer above, how likely do you think it is that the percentage of times the coin lands on HEADS is between 0% and 4%? (Report a number between 0 and 100)

[*Correct answer based on the previous screenshot: 0*]

Question 3 According to your answer above, *(radio choice)*:

- You are 100% sure that the percentage of times the coin lands on HEADS is between 15% and 24%
- You are not 100% sure that the percentage of times the coin lands on HEADS is between 15% and 24%

[*Correct answer based on the previous screenshot: the second choice*]

Question 4 If you leave the column blank, the computer will automatically fill in *(radio choice)*:

- 100
- a number that together with all other numbers completes the sum of 100
- 0

[*Correct answer: the third choice*]

Question 5 The sum of all numbers across 11 columns should be *(radio choice)*:

- 100
- depends on the scenario
- can be anything

[*Correct answer: the first choice*]

Question 6 What should you do to maximize your chances of winning the bonus if the table is selected for bonus? *(radio choice)*:

- Distribute 100 among all the columns in the table in roughly equal amounts.
- Always report 100 in only one column.
- Truthfully report your beliefs about each statement in the table.

[*Correct answer: the third choice*]

NEXT

A Quick Summary Before We Start

- The scenarios will be different in each round, so please pay close attention to the descriptions.
- There is absolutely no connection between rounds.
- Always report your true beliefs for each column of the table based on the information provided in each question. This is in your best interest!
- Any question may be selected for the bonus, so please answer each one carefully!

NEXT

Catcher

[*Shown only to participants who failed the comprehension quiz twice:*]

Unfortunately we have determined that you are ineligible for this study. You may close your browser window.

1.2 Part 1: Round [N]

Consider the following scenario:

There is a bag of 100 poker chips: **10** are **RED** and **90** are **BLACK**.

The computer repeats the following process **1 million times**:

- The bag is well-mixed.
- ONE chip is randomly selected from the bag; each chip is equally likely to be selected.
- The computer records the color of the selected chip and returns it to the bag.

NEXT

How many **RED** chips are in the bag?

[*numeric entry*]

How many **BLACK** chips are in the bag?

[*numeric entry*]

NEXT

For each column, indicate how likely you believe the statement in that column is CORRECT.

The percentage of times (out of 1 million) in which the selected chip was **RED** is between:

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%

Your current sum is: 0

NEXT

[*There are three rounds of the above interface, where the corresponding simple questions also vary with the scenario being presented. We include all scenarios used in the experiment and their corresponding simple questions in Section 2 of this document.*]

[*After all three rounds, subjects answer the following question as a brain break.*]

Can you spot the animal camouflaged in the image below?

Please click on the photo where you think the animal is located.

This task does not affect your payment and is just for fun.

[Participant clicks on an image; the camouflaged animal is then highlighted, with the status message "Great try! The highlighted answer is shown above. You can now continue.")

NEXT

1.3 Part 2: General Instructions

In each round, just like in Part 1, we will first present a scenario and ask you questions about it.

Each round may include two types of questions.

First, as in Part 1, some rounds begin with a few simple questions about the details of the scenario.

Second, each round includes *three main questions* about your beliefs regarding the scenario.

We will now explain these questions in detail using the same prize-behind-door scenario from Part 1.

You may earn an additional bonus payment in this part. We will explain how payment is determined later in these instructions.

NEXT

Part 2: Instructions for Question 1

Consider the following scenario:

[*same door diagram as Part 1*]

In **Question 1**, just like in Part 1, we will ask you to **report your belief** about **whether each statement in the table is correct**.

You will do so by filling in a table that looks the same as the one you filled in during Part 1. Here is a reminder of how this table looks like:

The percentage of times (out of 1 million) in which the selected door contained a prize is between:

[*Same 11-bin table as before*]

NEXT

Part 2: Instructions for Question 2

In **Question 2**, you will again evaluate statements about the percentage of items that satisfy the condition of interest (in our example, the doors that have a prize), based on the scenario in that round. This time, to help with your assessment, **the computer will run a diagnostic test on each selected item**.

The diagnostic test is **informative but not perfectly accurate**. It provides a signal about whether the item satisfies the condition.

For example, let's talk about our example with the prize-behind-door scenario. The condition of interest is whether there is a prize behind a selected door.

The test result will be either:

- **LIKELY CONTAIN A PRIZE** – This suggests the selected door is likely to contain a prize. However, since the test is not perfectly accurate, this result does not guarantee that the door contains a prize; it only makes it more likely.

- **LIKELY NOT CONTAIN A PRIZE** – This suggests the selected door is unlikely to contain a prize. Again, this does not prove that the door does not contain a prize; it only makes it less likely.

You will be told how accurate the test is. For instance, how often it correctly gives a "LIKELY CONTAIN A PRIZE" result when the door actually contains a prize, and how often it incorrectly gives a "LIKELY CONTAIN A PRIZE" result when the door does not contain a prize.

When you're ready, click the button to run the tests. The computer will test each randomly selected door and record the corresponding test results.

NEXT

Part 2: Instructions for Question 2, continued

After the tests have been completed and the results recorded, we will **focus on a specific group of doors:** those that received either a "LIKELY CONTAIN A PRIZE" or a "LIKELY NOT CONTAIN A PRIZE" test result.

We will tell you which one to focus on.

You will then fill out the table again.

This time, we are asking what you believe about the percentage of doors in that group that actually satisfy the condition of interest.

For example, **among the doors that received a LIKELY CONTAIN A PRIZE result, what percentage do you believe actually contain a prize?**

Just like before:

- You can enter numbers between 0 and 100 (inclusive) in each column
- All the numbers in the table must add up to 100

NEXT

Part 2: Instructions for Question 2 (Test Accuracy)

In today's study you will encounter two types of tests with different levels of accuracy: **60%** and **90%**.

Test accuracy tells you how often a test gives the correct result:

- A test with 60% accuracy is correct 6 out of every 10 times (a little more than half of the time).
- A test with 90% accuracy is correct 9 out of every 10 times (almost every time).

NEXT

Part 2: Instructions for Question 2 (Test Accuracy), continued

Let's go back to the scenario with prizes-behind-doors:

[*same door diagram*]

Suppose the diagnostic test has **90% accuracy**. It gives either a "LIKELY CONTAIN A PRIZE" or "LIKELY NOT CONTAIN A PRIZE" test result.

This means that for each selected door, the computer runs the test and:

- If there is a prize behind the selected door, the test gives a LIKELY CONTAIN A PRIZE result **90%** of the time, and a LIKELY NOT CONTAIN A PRIZE result **10%** of the time.
- If there is not a prize behind the selected door, the test gives LIKELY NOT CONTAIN A PRIZE **90%** of the time, and a LIKELY CONTAIN A PRIZE result **10%** of the time.

In other words, a "LIKELY CONTAIN A PRIZE" result is more likely when the selected door actually contains a prize, and a "LIKELY NOT CONTAIN A PRIZE" result is more likely when it does not contain a prize.

NEXT

Part 2: Comprehension Quiz

To check your understanding of the instructions, please answer the following questions. Please read the questions carefully! You will have **two attempts to answer ALL questions correctly**. If you fail both times, your participation in the study will be terminated and you will be paid 50 cents for your time.

Question 1 Say you are given a test with 90% accuracy in the prize-behind-door scenario. Then it means that *(radio choice)*:

- If the selected door contains a prize, there is a 10% chance the test result will be "LIKELY CONTAIN A PRIZE"
- If the selected door does not contain a prize, there is a 90% chance the test result will be "LIKELY CONTAIN A PRIZE"
- If the selected door contains a prize, there is a 90% chance the test result will be "LIKELY CONTAIN A PRIZE"
- If the selected door does not contain a prize, there is a 10% chance the test result will be "LIKELY NOT CONTAIN A PRIZE"

[*Correct answer: the third choice*]

Question 2 Select which of the statements is correct: *(radio choice)*:

- A "LIKELY CONTAIN A PRIZE" result is more likely when the selected door does not actually contain a prize, and a "LIKELY NOT CONTAIN A PRIZE" result is more likely when it does contain a prize.
- Both a "LIKELY CONTAIN A PRIZE" result and a "LIKELY NOT CONTAIN A PRIZE" result are equally likely regardless of the test accuracy and the scenario specifics.
- A "LIKELY CONTAIN A PRIZE" result is more likely when the selected door contains a prize, and a "LIKELY NOT CONTAIN A PRIZE" result is more likely when it does not contain a prize.

[*Correct answer: the third choice*]

Question 3 What should you do to maximize your chances of winning the bonus if Question 2 is selected for bonus? *(radio choice)*:

- Distribute 100 among all the columns in the table in roughly equal amounts.
- Always report 100 in only one column.
- Truthfully report your beliefs about each statement in the table.

[*Correct answer: the third choice*]

NEXT

Part 2: Instructions for Question 3

After entering your beliefs for Question 2, we will ask you one more question. For this question, **please continue focusing on the same group of doors.**

Continuing with the prize-behind-door scenario: suppose that in Question 2, you were asked to focus on the group of doors that received a "LIKELY CONTAIN A PRIZE" test result. **The computer will now randomly select ONE DOOR from that group.** That is, one door among those that tested "LIKELY CONTAIN A PRIZE".

In **Question 3**, you will choose **one of three bets**. Each bet offers a different payment depending on whether this randomly selected door from that group actually satisfies the condition of interest (e.g., contains the prize). Here is what the bets will look like:

- Bet A pays $2 for sure
- Bet B pays $5 if this selected door contains the prize and $0 otherwise
- Bet C pays $5 if this selected door does not contain the prize and $0 otherwise

NEXT

Part 2: How Your Bonus Is Determined

If the selected round is from Part 2, one of the 3 main questions in that round is randomly selected for bonus payment.

- If Question 1 or Question 2 is selected, your payment follows the same payment rule explained earlier. **Remember: truthfully reporting your belief maximizes your chance of earning the $10 bonus.**
- If Question 3 is selected, your payment is based on the outcome of the bet you chose.

In addition, 10% of participants are randomly selected for a $1 bonus based on one randomly selected simple scenario question. If the selected simple question is from Part 2 and your answer to that question is correct, you receive the $1 bonus.

Please answer each question carefully, since any question may be chosen for payment.

NEXT

Again, A Quick Summary Before We Start

- The scenarios will be different in each round, so please pay close attention to the descriptions.
- There is absolutely no connection between rounds.
- Always report your true beliefs for each column of the table based on the information provided in each question. This is in your best interest!
- Any question may be selected for the bonus, so please answer each one carefully!

NEXT

[*If subjects fail to pass the comprehension quizzes in Part 2, they would also be terminated from the study.*]

1.4 Part 2: Round [N]

Consider the following scenario:

There is a roulette wheel with 100 slots: **50** are **RED** and **50** are **BLACK**.

The computer repeats the following process **1 million times**:

- The roulette wheel is spun thoroughly
- ONE slot is randomly selected when the ball is released; each slot is equally likely to be selected.
- The computer records the color of the selected slot.

NEXT

Question 1

For each column, indicate how likely you believe the statement in that column is CORRECT.

The percentage of times (out of 1 million) in which the selected slot was **RED** is between:

The percentage of times (out of 1 million) in which the selected slot was **RED** is between:

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%

Your current sum is: 0

NEXT

[*same scenario image as above with subjects' answers to Question 1 displayed*]

Question 2

We will ask you to report your guess about the percentage of slots that are **RED**, but before doing so, you will run some tests to help with your assessment.

For each selected slot, the computer runs a diagnostic test that is **60% accurate**.

- If the slot is **RED**, the test returns a **LIKELY RED** result **60%** of the time and a **LIKELY BLACK** result **40%** of the time.
- If the slot is **BLACK**, the test returns a **LIKELY BLACK** result **60%** of the time and a **LIKELY RED** result **40%** of the time.

In other words, although the test is not perfectly accurate, it is still informative: It is more likely to return **LIKELY RED** when the slot is **RED**, and **LIKELY BLACK** when the slot is **BLACK**.

When you click the button below, the computer will test 1 million selected slots and record the diagnostic result for each.

RUN ONE MILLION TESTS

Now, focus on the slots whose test result was **LIKELY RED**.

Among those slots, what percentage do you believe were actually **RED**?

Please indicate **how likely you think it is that this percentage falls within each range** by entering a number between 0 and 100 (inclusive) in the table below.

The sum of numbers across all columns should be exactly 100.

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%

Your current sum is: 0

NEXT

[*same scenario image as above with subjects' answers to Question 2 displayed*]

Question 3

Now, among the slots where the test result was **LIKELY RED**, the computer will **randomly draw one.**

Based on this drawn slot, please choose ONE of the following options: *(radio choice)*

- Option A: pays $2
- Option B: pays $5 if the drawn slot is **RED** and $0 otherwise
- Option C: pays $5 if the drawn slot is **BLACK** and $0 otherwise

NEXT

[*There are six rounds of the above interface, where we randomly select two rounds for which two simple questions were also asked. We include all scenarios used in the experiment and their corresponding simple questions in Section 2 of this document.*]

[*Another brain break is included after every three rounds of Part 2 questions.*]

1.5 Part 3: General Instructions

This is the last part of the study. In this part, you will answer some short questions in 8 different tasks that are unrelated and different from all previous questions.

This part should take you about 10-20 minutes to complete.

There are **no right or wrong answers**. We are interested in studying **your preferences**.

In addition to the potential bonus from Part 1 and 2, you may earn an **extra bonus** in this part. We will explain later how this is determined.

NEXT

Part 3: Instruction for Tasks 1-3

The next 3 tasks are Tasks 1–3. Some of these tasks include only one question, while others include multiple questions.

For these tasks, 10% of participants will be randomly selected to be eligible for an extra bonus.

For each selected participant, the computer will randomly select one of these tasks, and the answers you provide in that task will determine whether you get the additional bonus.

When we talk about the tasks, we will describe how the bonus is determined based on your answers.

Please answer all questions carefully, as any one of these tasks may be selected for payment.

NEXT

Part 3: Instructions for Task 1

In the next six questions, you will be asked to make choices regarding urns containing either 20 or 30 balls. You will be told whether you are dealing with the urn containing 20 or 30 balls.

Each ball in the urn is either **RED** or BLACK.

- In some questions, you will be told the exact number of **RED** and BLACK balls in the urn.
- In some questions, you will NOT be told the exact number of **RED** and BLACK balls in the urn. It could contain all **RED** balls, all BLACK balls, or any other combination of **RED** and BLACK balls.
- In some questions, the composition of the urn, i.e., the number of **RED** and BLACK balls in the urn, is randomly determined. We will provide more details on it later.

In each such task, we will ask you to **assess the value of a gamble**. We will draw **ONE** ball from the urn. If it is the color you choose, you will receive $20; if it is the other color you will receive nothing.

NEXT

Part 3: Instructions for Task 1 (Continued)

How the screen will look like: We will provide you with details about the composition of the urn and with a list of rewards from $0 to $20 in increments of $1. For each one, we ask that you think whether you prefer that amount, or taking the urn gamble. If you specify an amount **$x** you prefer to drawing a ball from the urn, we will assume you prefer any number greater than **$x** to the gamble as well (and prefer the gamble to any lower amount).

Payment: If this task is selected for your bonus payment, then one of all questions you answered will be randomly chosen. From that question, **one row** from the list of choices you made – between **the bet on the ball** and **a fixed amount** for payment – will be randomly selected.

You will receive the option you have chosen in that row

- If you choose a **bet on the color of the ball** drawn from the urn, we will pay you $20 if you guessed correctly the color of the drawn ball from that urn.

- If you choose a **fixed amount** of money, you will receive that amount.

Please think about each choice carefully, as it may be chosen for your extra bonus payment.

NEXT

Question 1a

The urn contains **30 balls**: Each ball is either **RED** or **BLACK**.

The composition of the urn is **unknown**: it could contain all **RED** balls, all **BLACK** balls, or any other composition.

One ball is drawn from this urn at random.

Please choose a color of ball to bet on:

- (●) **RED**
- ( ) **BLACK**

Next

Question 1b

For each row below, which option would you prefer?
(make sure a radio button in each row is selected)

$20 if the ball drawn is **RED** (●)	( ) $0 for sure
$20 if the ball drawn is **RED** (●)	( ) $1 for sure
$20 if the ball drawn is **RED** (●)	( ) $2 for sure
$20 if the ball drawn is **RED** (●)	( ) $3 for sure
$20 if the ball drawn is **RED** (●)	( ) $4 for sure
$20 if the ball drawn is **RED** (●)	( ) $5 for sure
$20 if the ball drawn is **RED** (●)	( ) $6 for sure
$20 if the ball drawn is **RED** (●)	( ) $7 for sure
$20 if the ball drawn is **RED** (●)	( ) $8 for sure
$20 if the ball drawn is **RED** (●)	( ) $9 for sure
$20 if the ball drawn is **RED** (●)	( ) $10 for sure
$20 if the ball drawn is **RED** (●)	( ) $11 for sure
$20 if the ball drawn is **RED** (●)	( ) $12 for sure
$20 if the ball drawn is **RED** (●)	( ) $13 for sure
$20 if the ball drawn is **RED** ( )	(●) $14 for sure
$20 if the ball drawn is **RED** ( )	(●) $15 for sure
$20 if the ball drawn is **RED** ( )	(●) $16 for sure
$20 if the ball drawn is **RED** ( )	(●) $17 for sure
$20 if the ball drawn is **RED** ( )	(●) $18 for sure
$20 if the ball drawn is **RED** ( )	(●) $19 for sure
$20 if the ball drawn is **RED** ( )	(●) $20 for sure

NEXT

Depending on `task_number` (1–6, presented to each participant in a randomized order), the fixed urn-description paragraph is one of the following six (verbatim):

1. The urn contains 20 balls: 10 are **RED** and 10 are BLACK. One ball is drawn from this urn at random. Please choose a color of ball to bet on:

2. The urn contains 30 balls: 15 are **RED** and 15 are BLACK. One ball is drawn from this urn at random. Please choose a color of ball to bet on:

3. The urn contains 20 balls: Each ball is either **RED** or BLACK. The composition of the urn is randomly determined. Specifically, we will first draw a number at random between 0 and 20 (with each number equally likely). That number will determine how many **RED** balls are in the urn. The remaining balls will be BLACK. Once the composition is set, one ball will be drawn at random from the urn. Please choose a color of ball to bet on:

4. The urn contains 30 balls: Each ball is either **RED** or BLACK. The composition of the urn is randomly determined. Specifically, we will first draw a number at random between 0 and 30 (with each number equally likely). That number will determine how many **RED** balls are in the urn. The remaining balls will be BLACK. Once the composition is set, one ball will be drawn at random from the urn. Please choose a color of ball to bet on:

5. The urn contains 20 balls: Each ball is either **RED** or BLACK. The composition of the urn is unknown: it could contain all **RED** balls, all BLACK balls, or any other composition. One ball is drawn from this urn at random. Please choose a color of ball to bet on:

6. The urn contains 30 balls: Each ball is either **RED** or BLACK. The composition of the urn is unknown: it could contain all **RED** balls, all BLACK balls, or any other composition. One ball is drawn from this urn at random. Please choose a color of ball to bet on:

Part 3: Instructions for Task 2

The following task has 3 short questions similar to those in Part 1.

This time, instead of filling out a full table, we ask you simply to report your best guess as **a single number**.

Payment: If this task is selected for your bonus payment, one of the three short questions you answered will be randomly chosen. From that question, your reported best guess will be compared with the actual empirical frequency. If your guess matches the empirical frequency, you will earn an additional **$10** bonus.

NEXT

Part 3: Task 2 - Question 1

There is a pencil case containing 100 bullet pens: **10** are **RED** and **90** are **BLACK**.

The computer repeats the following process **1 million times**:

- The pens are thoroughly mixed inside the pencil case.
- ONE pen is randomly selected; each pen is equally likely to be selected.
- The computer records the color of the selected pen and returns it to the pencil case.

What is your best guess for the percentage of times (out of 1 million) in which the selected pen was RED?
(Input a number between 0 and 100)

[*numeric entry*]

[*The three rounds follow the same randomized task order established for the participant in Part 1.*]

Part 3: Instructions for Task 3

In this task, you will answer **one** question similar to those in Part 1. The only difference is that instead of repeating the process 1 million times, the computer will repeat it only **100 times**.

Payment: If this task is selected for your bonus payment, we will use the same procedure as in Part 1 to determine whether you will earn a **$10** bonus.

NEXT

Part 3: Task 3

Consider the following scenario:

There is a jar with 100 marbles: **80** are **BLUE** and **20** are **GREEN**.

The computer repeats the following process **a hundred times**:

- The marbles are well-mixed.
- ONE marble is randomly selected from the jar; each marble is equally likely to be selected.
- The computer records the color of the selected marble and returns it to the jar.

Question 1 **For each column, indicate how likely you believe the statement in that column is CORRECT.**

The percentage of times (out of 100) in which the selected marble was **BLUE** is between:

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%

Your current sum is: 0

NEXT

Part 3: Instructions for Task 4-8

For the remaining 5 tasks in this part, all participants will be eligible for an additional bonus payment.

The computer will randomly select one of these tasks for bonus payment, your answers in that task will determine whether you earn the additional bonus.

Again, we will describe how the bonus is determined based on your answers when we introduce each task.

Please answer all questions carefully, as any one of these tasks may be selected for payment.

NEXT

Part 3: Task 4

In this task, you will answer a short question about what others would choose.

Payment: If this task is selected for your additional bonus payment, then you will receive an additional $1 if your answer to the question is correct and $0 otherwise.

NEXT

Part 3: Task 4, continued

Recall one of the scenarios you encountered in Part 2 and one of the questions we asked you to answer.

[*a scenario image from that round*]

You were told the accuracy of a diagnostic test, and the computer ran this test on the 1 million selected chips.

We then asked you: now, focus on the [item]s whose test result was **LIKELY RED**. You reported your belief in the table shown below.

Among those chips, what percentage do you believe were actually **RED**?

[*the participant's own Part 2 posterior table for that question is redisplayed.*]

We have asked the **same question** to a group of 10 mathematicians and statisticians from Caltech (a world-renowned university that specializes in rigorous science and engineering). Please choose which of the following statements you believe is correct:

- All participants gave the same answer; they put numbers below 100 in several columns in the table above.
- All people gave the same answer; they put 100 in one of the columns in the table above.
- Different people gave different answers.

Part 3: Instructions for Task 5

There are 3 rounds in this task.

In each round, your task is to guess the color of the ball selected by the computer.

The ball can be either **RED** or **BLACK**. There are three balls: two of them are **RED** and one is **BLACK**. In each round, the computer randomly selects one of the balls (each ball is equally likely to be selected). That is, there is a two-thirds chance that the selected ball is **RED** and one-third chance that the selected ball is **BLACK**. This selection is done independently in each round.

Payment: If this task is selected for your additional bonus payment, then you will earn 25 cents for each round in which your guess is correct.

NEXT

Part 3: Task 5 - Round 1

Recall that:

- There are three balls: two of them are **RED** and one is **BLACK**.
- In each round, the computer randomly selects one of the balls (each ball is equally likely to be selected). That is, there is a two-thirds chance that the selected ball is **RED** and one-third chance that the selected ball is **BLACK**. This selection is done independently in each round.
- Your task in each round is to guess the color of the selected ball.

This is **Round 1**. Please make your guess for **Round 1**. *(radio choice)*

- **RED**
- **BLACK**

Part 3: Task 6

In this task, you will answer two questions based on the following description.

Suppose the computer first flips a coin that lands on either Heads or Tails with equal probability. Second, the computer flips the coin again. These two coin flips are independent.

If the outcomes of these two-coin flips are:

- Heads, Heads: you will get $1.
- Heads, Tails: you will get $0.
- Tails, Heads: you will get $1.
- Tails, Tails: you will get $0.

Question 1 What is your chance of getting a dollar?
[*numeric entry, %*]

Question 2 What is the average payoff in this lottery?
[*numeric entry, $*]

Payment: If this task is selected for your additional bonus payment, you will earn 25 cents for each correct answer.

Part 3: Task 7

We just have a few last questions for you before you finish.

Payment: If this task is selected for your additional bonus payment, you will earn 20 cents for each question you answer correctly.

1. A bat and ball cost $1.10 in total. The bat costs a dollar more than the ball. How much does the ball cost (in cents)?
2. A bear lost 20% of its weight during winter hibernation. When it wakes up in the spring, it weighs only 1,000 pounds. How much weight did it lose (in pounds)?
3. A man buys a pig for $60, sells it for $70, buys it back for $80, and sells it finally for $90. How much money has he made?
4. If John can drink one barrel of water in 6 days, and Sarah can drink one barrel of water in 12 days, how many days would it take them to drink one barrel of water together?
5. Jerry received both the 15th highest and the 15th lowest mark in the class. How many students are in the class?

NEXT

Part 3: Task 8

We just have two more questions for you before you finish.

Payment: If this task is selected for your additional bonus payment, you will earn 20 cents for each question you answer correctly.

Click here to see your previous answers
[*read-only display of the participant's five Task 7 answers.*]

Question 1 How many of the five previous puzzles do you think you answered correctly?
[*numeric entry*]

[*A correct answer is one that coincides with the actual number of puzzles the participant solved.*]

Question 2 We ran a similar experiment on Prolific and have data on 500 Prolific participants.

How many other Prolific participants out of these 500 correctly solved more puzzles than you? Please enter a number between 0 and 100:

[*numeric entry*]

[*A correct answer is one that is within 5 units of the actual number*].

NEXT

Final Question

Did you input a number other than 100 in any of the table-filling questions in Part 1 or Part 2? Please answer yes or no in the comment box below. If you answer yes, please share your reasoning. If you have any feedback or found anything unclear or confusing during the study, feel free to share it here as well.

[*Free-text box*]

NEXT

Thank you for participating.

Please click the button below to return to Prolific and complete your submission.

Return to Prolific

You will be redirected automatically in 10 seconds.

2 Screenshots of all scenarios and a list of simple comprehension questions

2.1 Screenshots of all scenarios

There is a bag of 100 poker chips: **10** are **RED** and **90** are **BLACK**.

The computer repeats the following process **1 million times**:

- The bag is well-mixed.
- ONE chip is randomly selected from the bag; each chip is equally likely to be selected.
- The computer records the color of the selected chip and returns it to the bag.

Figure 1: prior composition $x = 10$

There is a deck with 100 cards: **20** are **RED** and **80** are **BLACK**.

The computer repeats the following process **1 million times**:

- The deck is well-shuffled.
- ONE card is randomly selected from the deck; each card is equally likely to be selected.
- The computer records the color of the selected card and returns it to the deck.

Figure 2: prior composition $x = 20$

There is a box containing 100 tokens: **30** are **YELLOW** and **70** are **PURPLE**.

The computer repeats the following process **1 million times**:

- The box is well-mixed.
- ONE token is randomly selected from the box; each token is equally likely to be selected.
- The computer records the color of the selected token and returns it to the box.

Figure 3: prior composition $x = 30$

There is a roulette wheel with 100 slots: **50** are **RED** and **50** are **BLACK**.

The computer repeats the following process **1 million times**:

- The roulette wheel is spun thoroughly
- ONE slot is randomly selected when the ball is released; each slot is equally likely to be selected.
- The computer records the color of the selected slot.

Figure 4: prior composition $x = 50$

There is an urn containing 100 balls: **70** are **BLUE** and **30** are **GREEN**.

The computer repeats the following process **1 million times**:

- The urn is well-mixed.
- ONE ball is randomly selected from the urn; each ball is equally likely to be selected.
- The computer records the color of the selected ball and returns it to the urn.

Figure 5: prior composition $x = 70$

There is a jar with 100 marbles: **80** are **BLUE** and **20** are **GREEN**.

The computer repeats the following process **1 million times**:

- The marbles are well-mixed.
- ONE marble is randomly selected from the jar; each marble is equally likely to be selected.
- The computer records the color of the selected marble and returns it to the jar.

Figure 6: prior composition $x = 80$

There is a cup containing 100 beads: **90** are **YELLOW** and **10** are **PURPLE**.

The computer repeats the following process **1 million times**:

- The cup is well-mixed
- ONE bead is randomly selected from the cup; each bead is equally likely to be selected.
- The computer records the color of the selected bead and returns it back to the cup.

Figure 7: prior composition $x = 90$

2.2 List of all types of simple comprehension questions

For each scenario, two simple comprehension questions are asked if that scenario is selected. The items below illustrate the possible wordings, adjusted to match each scenario's items, container, and colors, using the $x = 10$ scenario as an example:

- How many **RED** chips are in the bag?
- How many times does the computer select a chip from the bag and record its color?
- After drawing a chip, did the computer put it back in the bag?
- How many **BLACK** chips are in the bag?

3 Additional screenshots for the two robustness treatments (T1 and T2)

3.1 The first robustness treatment (T1)

Recall from the main document that T1 differs from the main treatment only in Part 2, where we omit the initial belief elicitation, so subjects answer only Questions 2 and 3 in each round. As Parts 1 and 3 are unchanged, only the differing Part 2 interface is shown below.

Part 2: Round [N]

Consider the following scenario:

There is a roulette wheel with 100 slots: **50** are **RED** and **50** are **BLACK**.

The computer repeats the following process **1 million times**:

- The roulette wheel is spun thoroughly
- ONE slot is randomly selected when the ball is released; each slot is equally likely to be selected.
- The computer records the color of the selected slot.

NEXT

Question 1

We will ask you to report your guess about the percentage of slots that are **RED**, but before doing so, you will run some tests to help with your assessment.

For each selected slot, the computer runs a diagnostic test that is **60% accurate**.

- If the slot is **RED**, the test returns a **LIKELY RED** result **60%** of the time and a **LIKELY BLACK** result **40%** of the time.
- If the slot is **BLACK**, the test returns a **LIKELY BLACK** result **60%** of the time and a **LIKELY RED** result **40%** of the time.

In other words, although the test is not perfectly accurate, it is still informative: It is more likely to return **LIKELY RED** when the slot is **RED**, and **LIKELY BLACK** when the slot is **BLACK**.

When you click the button below, the computer will test 1 million selected slots and record the diagnostic result for each.

RUN ONE MILLION TESTS

Now, focus on the slots whose test result was **LIKELY RED**.

Among those slots, what percentage do you believe were actually **RED**?

Please indicate **how likely you think it is that this percentage falls within each range** by entering a number between 0 and 100 (inclusive) in the table below.

The sum of numbers across all columns should be exactly 100.

0% and 4%	5% and 14%	15% and 24%	25% and 34%	35% and 44%	45% and 54%	55% and 64%	65% and 74%	75% and 84%	85% and 94%	95% and 100%

Your current sum is: 0

NEXT

[*same scenario image as above with subjects' answers to Question 1 displayed*]

Question 2

Now, among the slots where the test result was **LIKELY RED**, the computer will **randomly draw one.**

Based on this drawn slot, please choose ONE of the following options: *(radio choice)*

- Option A: pays $2
- Option B: pays $5 if the drawn slot is **RED** and $0 otherwise
- Option C: pays $5 if the drawn slot is **BLACK** and $0 otherwise

NEXT

3.2 The second robustness treatment (T2)

Recall that T2 differs from the main treatment only in the number of bins used to partition the unit interval: T2 uses 20 bins instead of 11. To illustrate this difference, we include the Part 1 table with 20 bins for one question below.

3.3 Part 1: Round [N]

Consider the following scenario:

There is an urn containing 100 balls: **70** are **BLUE** and **30** are **GREEN**.

The computer repeats the following process **1 million times**:

- The urn is well-mixed.
- ONE ball is randomly selected from the urn; each ball is equally likely to be selected.
- The computer records the color of the selected ball and returns it to the urn.

NEXT

For each column, indicate how likely you believe the statement in that column is CORRECT.

The percentage of times (out of 1 million) in which the selected ball was **BLUE** is between:

0% and 4%	5% and 9%	10% and 14%	15% and 19%	20% and 24%	25% and 29%	30% and 34%	35% and 39%	40% and 44%	45% and 49%	50% and 54%	55% and 59%	60% and 64%	65% and 69%	70% and 74%	75% and 79%	80% and 84%	85% and 89%	90% and 94%	95% and 100%

Your current sum is: 0

NEXT