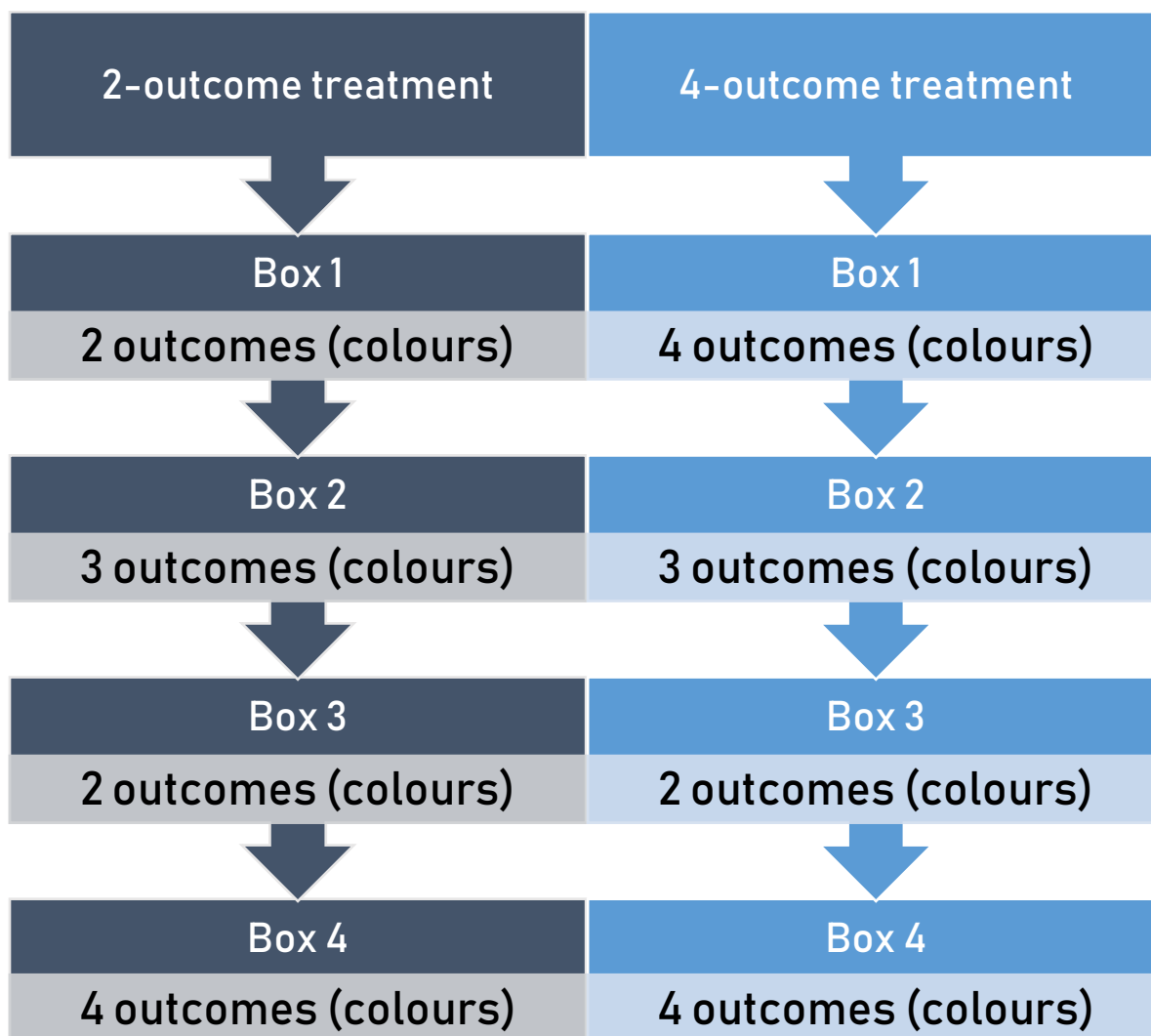


Sequence of boxes (urns) in the two treatments



	Box 1		Box 2	Box 3	Box 4
Likelihood (out of 100)	2 outcomes	4 outcomes			
O 1	55	40	53	75	48
O 2	45	28	35	25	28
O 3		20	12		12
O 4		12			12

Both treatments will end with short Raven test and some demographics questions (listed below).

Hypotheses to be tested:

1.
 - a. Participants expect fewer unforeseen events, the more they sample:
$$\lim_{\#samples \rightarrow \infty} \hat{p}_x \rightarrow 0 \text{ here: } \#samples \rightarrow 30 \Rightarrow \hat{p}_x \downarrow$$
 - b. Participants in 2-outcome treatment stop considering yet unobserved outcomes to be likely earlier than 4-outcome treatment participants after box 1.
 - c. Exploratory analysis on which sample number do participants stop expecting yet unobserved outcomes.
2. Decision makers are reverse-Bayesian, i.e. for previously observed events, following a new unobserved event:

$$\frac{\hat{p}_{E1}}{\hat{p}_{E2}} = \frac{\hat{p}'_{E1}}{\hat{p}'_{E2}}$$

3. Higher cognitive ability implies less deviations from reverse-Bayesian.
4. Higher cognitive ability participants consider unobserved outcomes to be possible at higher sample numbers compared to lower cognitive ability participants.

Instructions

General Instructions

Thank you for participating in today's experiment.

If you have any questions during the experiment, please raise your hand. An experimenter will approach your table to answer your question in private.

You may have heard about experiments in which participants were deceived. This experiment does not involve deception by the experimenters. That is, everything the experimenter tells you, and all on-screen instructions, are true and accurate.

The experiment consists of 4 parts. For participating in this experiment you will earn $\{\{ \text{Constants.show_up_fee} \mid c \} \}$ at the end of the experiment. In addition you can earn a bonus of $\{\{ \text{Constants.bonus} \mid c \} \}$ in each of the four parts, depending on your performance in the experiment and chance. After these four parts you will play a pattern game, in which you can earn additionally up to €2.

In the end follows a short demographic questionnaire.

Sampling Boxes

The experiment consists of 4 parts. In each part, you draw a random sample of (virtual) marbles from a (virtual) box containing exactly 100 colored marbles. Initially, you have no information about the contents of each box: you do not know which colors, or how many different colors, are in the box. The four parts and four boxes are independent of each other: different boxes are used for different parts.

In each part, you draw 30 marbles with replacement one after another from the box. You draw a marble by clicking the button "Draw" (or by pressing enter). Once clicked, the computer randomly draws a marble from the box. The result of a draw is shown on-screen with a marble of the color and the name of the color.

The sample draws are conducted with replacement. For example, if you drew a **magenta** marble (this color is not used in the actual experiment) from a box, this marble is placed back in the box for the next draw, such that the number of marbles of each color in the box stays the same as you sample. All marbles you have sampled (and their colors) are registered at the bottom of the screen.

Your payoff-relevant task

After each draw of a new marble, you will be asked to state your expectation about the contents of the box, that is, about the distribution of colors in the box. The more precise your prediction is, the higher will be your expected payoff from the experiment (details below). After each draw, you will be asked to separately indicate

- (i) your expected number of marbles in the box for each color that you have already observed for the box, and
- (ii) your expected number of marbles of “any other colors” that you have not yet observed for the box, and that may or may not be in the box.

Example

Suppose you drew a **magenta** marble in your first draw and a **teal** marble (this color is also not used in the actual experiment) in the second draw. After the first draw you would be asked to guess how many **magenta** marbles are in the box, and how many marbles of any other color, not yet observed, are in the box. After the second draw you would be asked how many **magenta** marbles are in the box, how many **teal** marbles are in the box, and how many marbles of any other color, not yet observed, are in the box.

As the box contains exactly 100 marbles, your estimates of the number of marbles of the already observed colors and of any other colors you may think are in the box (but not yet observed) must add up to 100. Moreover, if you expect the number of marbles of other colors to be zero, you need to explicitly submit an estimate of zero (that is, not just leaving the entry field open).

After the 30th marble is drawn, you will enter your last prediction for this box. A new button “Continue to the next box” will allow you to continue to the next part, with a new box to sample.

Entering estimates in the program

After each draw, you can enter your estimates by typing them into the entry fields. You can also use the “fill previous estimate” buttons to pre-fill your previous round’s estimates for each color. At any point before making the next draw, you can adjust the current estimates in the entry fields using “+” and “−” buttons next to the entry fields.

Getting paid for good predictions

You may earn a bonus of $\{\{ \text{Constants.bonus} \mid c \} \}$ for each part of the experiment. All of your answers provided for all four parts will affect your chances of receiving the bonus. If you want to maximize your expected earnings from this experiment, it is in your best interest to estimate the number of marbles for each box as accurately as possible, and report them truthfully after each draw. To determine whether you will win a bonus, you will draw a marble either from one of the boxes in the experiment (called *Estimate Box*), or from another, newly constructed one (called *New Box*). Importantly, your reported estimates will influence the construction of this new box.

If you report your estimates accurately and truthfully, this will be best for you in terms of your expected payment from the experiment. Below we will explain the payment procedure, and provide the intuition and an example why it is in your best interest to report your estimates as correctly as possible after each draw. You are invited to review these explanations. Please note that they are not necessary to understand the experiment and can be skipped without any harm if you are not interested. You can request a hard copy of these details at any point of the experiment in case of doubt.

Payment procedure (click to expand):

Payment procedure

After you finished sampling from all four boxes, for each of the four parts you may earn a bonus of $\{\{ \text{Constants.bonus} \mid c \} \}$ as follows:

Estimate box: The computer randomly selects one of the 30 draw rounds, and then randomly selects one color estimate you made for this round (this is the selected color for this task). This can be an estimate for some color you have observed, or alternatively an estimate for the number of not yet observed colors at some point, that is, “any other color”. Note than all of your estimates have the same chance to be randomly selected.

New box: Next, the computer constructs a new box of 100 marbles that contains only two colors, black or white. Every possible combination of black and white marbles (the number of white marbles = 100 – the number of black marbles) is equally likely.

Next, the computer compares the number of black marbles in the New Box with the estimate you made for the selected color in the experiment (or for “any other color”).

- If your estimate for the selected color is larger than the number of black marbles in the New Box, you will draw one marble from the Estimate Box. If this marble is of the selected color, you will receive $\{\{ \text{Constants.bonus} \mid c \} \}$. If the marble is not of the selected color, you will receive €0.
- If your estimate is smaller than the number of black marbles in the New Box, you will draw one marble from the New Box. If this marble is black, you will receive $\{\{ \text{Constants.bonus} \mid c \} \}$. If the marble is white, you will receive €0.

Intuition (click to expand):

Intuition

You will have the best chance to win the bonus of $\{\{ \text{Constants.bonus} \mid c \} \}$ for each part, by truthfully reporting your estimate. For example, if you think there are many magenta marbles in the Estimate Box, you will more likely make a draw from this box. This is because in your estimation the number of black marbles in the New Box will most likely be smaller than your estimate of magenta marbles for the Estimate Box.

If you think there are only few magenta marbles in the Estimate Box, you will more likely make a draw from the New Box. This is because the number of black marbles in the New Box will most likely be larger than your estimate of magenta marbles for the Estimate Box.

Thus, as long as you report your estimate for each color in each draw and each box accurately and truthfully, the mechanism makes sure that you get the box with the highest chance of winning the bonus.

Note that your winning chance in the case of making the payoff-relevant draw from the Estimate Box depends only on the true number of marbles of that color in the box. Similarly, in the case of making the payoff-relevant draw from New Box, the chance depends only on the number of black marbles in the box. Your estimate of colors for the boxes in the experiment is only relevant for determining the best boxes for you during the payment procedure. Thus, better estimates give you better chances to win.

Example (click to expand):

Part 1

For part 1, the computer selected the round 16 draw. In this round you provided estimates of the number of magenta marbles, teal marbles, and the number of marbles of “any other color”. The computer further selected magenta as the payoff-relevant color estimate. Suppose your estimate of the number of magenta marbles in box 1 in round 16 was 42 marbles.

Suppose the computer randomly generated a New Box that contained 35 black and 65 white marbles. Because 35 black winning marbles in New Box is less than your estimate of 42 magenta winning marbles in Estimate Box 1, your bonus would be determined by Estimate Box 1. Note that your true chance to win the bonus of $\{\{ \text{Constants.bonus} \mid c \} \}$ would depend on the true number of magenta marbles in box 1. Suppose you drew a teal marble from Estimate Box 1. Your bonus for part 1 would be €0.

Part 2

For part 2 box, the computer selected the round 2 draw. In this round you provided estimates of the number of magenta marbles, and the number of marbles of “any other color”. The computer further selected “any other color” as the payoff-relevant color estimate. Suppose your estimate for the number of “any other color” marbles in box 2 in round 2 was 50 marbles.

Suppose the computer randomly generated another New Box that contained 7 black and 93 white marbles. Because 7 black winning marbles in New Box is less than 50 winning marbles of “any other color” in Estimate Box 2, your bonus would be determined by a draw from Estimate Box 2. Note that your true chance to win the bonus of $\{\{ \text{Constants.bonus} \mid c \} \}$ would depend on the true number of - marbles in box 2 that are not magenta. Suppose you drew a teal marble from box 2. Your bonus for part 2 would be $\{\{ \text{Constants.bonus} \mid c \} \}$.

Part 3

For part 3 box, the computer selected the round 30 draw. In this round you provided estimates for the number of magenta marbles, the number of teal marbles, and the number of marbles of “any other color”. The computer further selected teal as the payoff-relevant color estimate. Suppose your estimate for the number of teal marbles in box 3 in round 30 was 20 marbles.

Suppose the computer randomly generated another New Box that contains 87 black and 13 white marbles. Because 87 black winning marbles in New Box is more than 20 twinning marbles of teal color in Estimate Box 3, your bonus would be determined by New Box 3. Suppose you drew a black marble from box 3. Your bonus for part 3 would be $\{\{ \text{Constants.bonus} \mid c \}\}$.

Part 4

For part 4 box, the computer selected the round 7 draw. In this round you provided estimates for the number of magenta marbles, the number of teal marbles, and the number of marbles of “any other color”. The computer further selected “any other color” as the payoff-relevant color estimate. Suppose your estimate for the number of “any other color” marbles in box 4 in round 7 was 33 marbles.

The computer randomly generated another New Box that contains 27 black and 73 white marbles. Because 27 black winning marbles in New Box 4 is less than 33 winning marbles of “any other color” in Estimate Box 4, your bonus would be determined by a random draw from Estimate Box 4. Note that your true chance to win the bonus of $\{\{ \text{Constants.bonus} \mid c \}\}$ would depend on the true number of marbles in box 4 that were neither magenta nor teal. Suppose you drew a teal marble from box 4. Your bonus for part 4 would be €0.

Next button

Next box

Click on "next" to proceed to box $\{\{ \text{player.currentTask} \}\}$

Next button

Pattern game

You will now play a pattern game, where you are asked to solve some puzzles

On the screen, you will see a set of abstract pictures with one of the pictures missing. You need to choose a picture from the choices below to complete the pattern.

You will have a total of 8 minutes to complete 12 such puzzles.

During these 8 minutes you will be able to move forwards and backwards and change your answers using the buttons and tabs on your screen.

At the end of the experiment, the computer will randomly draw two of the puzzles from the pattern game. Each puzzle has the same probability to be chosen. For each of the two puzzles that you solved correctly, you will earn an additional $\{\{ \text{Constants.raven_bonus} \mid c \}\}$.

Once the 8 minutes have passed, the pattern game will be automatically submitted and you will proceed to the results. You can submit all your answers and wait for the others to finish once you reach the last puzzle by clicking on the button that will appear and be labelled "Finish and go to results".

Click on "next" to proceed the pattern game.

Next button

Questionnaire

Thank you for participating!

Please answer the following three questions. We will use this information for scientific purposes only. They cannot be linked back to your person.

1. Age (16-100)
2. Gender (female, male, other, prefer not to tell)
3. Field of study
4. Please consider what you would do in the following situation: Imagine that you had won €100.000 in a lottery. Almost immediately after you collect the winnings, you receive the following financial offer, the conditions of which are as follows: The amount invested either gets doubled, or you lose half of it, with equal probability. You have the opportunity to invest the full amount, a part of it, or nothing and thus reject the offer. What share of your lottery winnings would you be prepared to invest in this financially risky, yet lucrative investment? [Choices = €100.000; €80.000; €60.000; €40.000; €20.000; Nothing, I would decline the offer.]
5. Before you started making draws how many different colours did you think there would be in each of the boxes?