# Too Good to be True - Individual and Group Decision-Making with Correlated Signals*

– Pre-Analysis Plan –

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## 1 Experimental Design

We conduct an online experiment. In every round, decision-makers have to make a decision (*red* or *blue*), either individually or collectively (in groups of three), depending on the treatment. If the correct decision is taken, i.e. if the decision equals the state of the world (*red* or *blue*), each player enjoys a positive payoff. *A priori* each state is equally likely and signals (*red* or *blue*) are randomly drawn from an urn representing the state of the world. Our treatments vary the bias of the decision makers, the correlation structure of the signals and whether the decisions are made individually or collectively. The experiment will be conducted online using LIONESS (Giamattei et al. (2020)). Subjects will be recruited via the platform Prolific. We exclude non-native English speakers.

Each session consists of instructions, control questions, six rounds of the game without feedback in between, post experimental tasks and a final feedback stage. These tasks consist of filling out a socio-economic questionnaire, answering an open question about the strategies applied in the experimental task, a test of subject's cognitive reflection capabilities, a question on the risk taking preferences, and questions relating to the flexible thinking scale.

| **Individual** | No Bias | Bias |
|---|---|---|
| With correlation | *Ind-NoBias-Corr* | *Ind-Bias-Corr* |
| Without correlation | *Ind-NoBias-NoCorr* | *Ind-Bias-NoCorr* |

| **Group** | No Bias | Bias |
|---|---|---|
| With Correlation | *Gr-NoBias-Corr (2)* | *Gr-Bias-Corr* |
| Without Correlation | *Gr-NoBias-NoCorr* | *Gr-Bias-NoCorr* |

Table 1: Treatments Overview

*The hash code of this plan was created and submitted to the blockchain using http://originstamp.org on August 23, 2020. Data collection started on August 24. We obtained IRB Approval (https://gfew.de/ethik/6aJqoedH) for this study on August 23.

We follow a 2x2x2 between-subjects design. Table 1 provides an overview. For the cell Group-No Bias-Correlation, we run the additional treatment *Gr-NoBias-Corr-Message* with a message option: Together with the predefined recommendation, subjects can enter a message in free-form communication that is visible to the other group members prior to the voting decision. Hence, 9 treatments will be conducted in total.[1]

**Treatments with Correlation** In the treatments without correlation, three signals are randomly drawn (with replacement) from the urn representing the correct state of the world. Each urn contains three correct and two wrong signals. In the treatments with correlation, the signals in one state of the world are drawn randomly with 50% probability and all have the (same) color which is not equal to the state with 50% probability. The state of the world where this correlation of signals can occur is varied between subjects or groups, respectively.

**Treatments with Bias** The bias dimension of the treatments refers to the payoff of the individuals after a correct decision. An individual without bias receives £0.2 if the correct decision is taken. A biased individual receives £0.25 in case the decision is correct in her favorite state, and £0.15 in case the decision is correct in the other state. In the group treatments without bias, all group members are unbiased. In the treatments with bias, there is always one unbiased member and two members who are biased: they receive the higher payoff in case the decision is correct in the state where no correlation of signals can occur. The payoff structure of each individual is public information.

**Individual vs. Group treatments** In the individual choice treatments each subject observes three signals and subsequently comes to a decision. In the group treatments, groups of three subjects are formed and each subject privately observes one signal. After the signal observation stage, there is a straw poll stage: Each group member can publicly send one of the predefined messages: *'I drew a blue ball.'*, *'I drew a red ball.'*,*'I prefer not to reveal.'* A voting stage follows, where each individual has to vote for one of the two decisions, and the decision is implemented via simple majority rule.

## 2 Predictions, Hypothesis Tests, Power and Further Analyses

Following the theoretical findings in Le Quement and Yokeeswaran (2015) and calculating the Nash equilibria of the game reveals the following equilibrium strategies: In the group treatments without bias, the preferences of the group members are aligned, and honestly revealing the observed signal is an equilibrium. In the treatments with bias and without correlation, however, honestly revealing the privately observed signal is not an equilibrium strategy for the unbiased individual. The equilibrium strategies in this treatment consist of the biased individuals ignoring the message of the unbiased individual, and the unbiased individual to either mix between the messages irrespective of the signal received, or to *not reveal* the signal. In the treatments with bias and correlation, on the other hand, truth-telling can be sustained in equilibrium. The reason is the second pivot event.

For simplicity assume for the remainder of this section that correlation can only occur in the red state in our setup.[2] The following hypotheses follow from the equilibrium predictions without assuming correlation neglect.

**H1** (*Individual Treatments*) The share of subjects deciding for blue after observing three blue signals will be higher in the *NoCorrelation* treatments than in the *Correlation* treatments.

[1] We ran two small pilot sessions, one for an Individual treatment and one for a Group treatment to test whether or not everything runs smoothly.

[2] In the experiment, we vary the state in which correlation can occur between subjects/groups.

**H2** (*Individual Treatments*) The share of unbiased subjects deciding for blue after observing one blue signal will be higher in the *Correlation* treatments than in the *NoCorrelation* treatments.

**H3** (*Individual Treatments*) In the *NoCorrelation* treatments the share of unbiased subjects deciding for blue after observing one blue signal will be lower than the share of biased subjects deciding for blue after observing one blue signal.

**H4** (*Group Treatments*) In the *NoCorrelation* treatments the share of unbiased subjects who honestly report the signal they observed will be higher in the *NoBias* treatments than in the *Bias* treatments.

**H5** (*Group Treatments*) In the *Bias* treatments the share of unbiased subjects who honestly report the signal they observed will be higher in the *Correlation* treatments than in the *NoCorrelation* treatments.

Previous literature documented that many individuals suffer from correlation neglect (see e.g. Enke and Zimmermann (2019)). A rational Bayesian updater would realize that three blue signals would now make it more likely that the true state is red and vote accordingly. Individuals who suffer from correlation neglect, however, would not see this and the number of wrong decisions would increase. If an unbiased subject in the correlation treatments (Individual and Group) suffers from correlation neglect, he is predicted to vote in favor of blue when two or three blue signals occur. If he did not suffer from correlation neglect, he would vote for blue in case one or two blue signals occurred. A biased individual who does not suffer from correlation neglect in the correlation treatments is predicted to vote for blue if one or two signals occurred. If he suffers from correlation neglect, he is predicted to vote for blue if one, two or three blue signals occurred.

**H6** (*Individual no Bias Treatment with Correlation*) The share of wrong decisions will be higher after either one or three blue signals than with zero or two blue signals when correlation can only occur in the red state.

**H7** (*Individual Bias Treatment with Correlation*) The share of wrong decisions will be higher after three blue signals than with fewer blue signals when correlation can only occur in the red state.

**H8** (*Correlation Neglect – Individual Treatments*) The share of wrong decisions is higher in Individual with Correlation than in the Individual Treatments without Correlation in the situations with three red signals.

Finally, we want to test whether free-form communication can decrease the share of wrong decisions:

**H9** (*Free form communication*) The share of correct decisions is higher in the *Gr-NoBias-Corr-Message* treatment than in the *Gr-NoBias-Corr* treatment in the situations with two or three red signals.

Tables 2 and 3 give an overview of the predicted success rates across the different situations. In addition to testing our hypotheses, we plan to do exploratory analyses to understand the observed patterns in the data. For this purpose, we will also make use of the data from the questionnaire.

| Signals | No Bias, No Corr | Bias, No Corr | No Bias, Corr | | Bias, Corr | |
|---|---|---|---|---|---|---|
| | | | Rational | Corr. Neg. | Rational | Corr. Neg. |
| bbb | 0.7714 | 0.7714 | 0.7112 | 0.2888 | 0.7112 | 0.2888 |
| bbr | 0.6 | 0.6 | 0.75 | 0.75 | 0.75 | 0.75 |
| brr | 0.6 | 0.4 | 0.5714 | 0.4286 | 0.5714 | 0.5714 |
| rrr | 0.7714 | 0.7714 | 0.6279 | 0.6279 | 0.6279 | 0.6279 |

Table 2: Success Probabilities of Individual Decisions: The order of signals do not play a role in theory.

| Signals | No Bias, No Corr | Bias, No Corr | No Bias, Corr | Bias, Corr |
|---|---|---|---|---|
| bbb | 0.7714 | 0.7714 | 0.7112 | 0.7712 |
| bbr | 0.6 | 0.6 | 0.75 | 0.75 |
| brb | 0.6 | 0.6 | 0.75 | 0.75 |
| brr | 0.6 | 0.6 | 0.5714 | 0.5714 |
| rbb | 0.6 | 0.6 | 0.75 | 0.75 |
| rbr | 0.6 | 0.4 | 0.5714 | 0.5714 |
| rrb | 0.6 | 0.4 | 0.5714 | 0.5714 |
| rrr | 0.7714 | 0.7714 | 0.6279 | 0.6279 |

Table 3: Success Probabilities of Group Decisions: The first letter in the first column denotes the signal of the unbiased player, the second and third signal denote the signals of the two biased players.

## 2.1 Sample size and power

In the individual treatments, the decisions of one subject are statistically independent of the decision of another subject. In the group treatments, we treat each group as one independent observation. Therefore, we recruit more subjects in the group treatment than in the individual treatments: For each of the four Individual treatments, we recruit 100 subjects. For each of the five group treatments, we recruit 300 subjects. These sample sizes will allow us to detect a difference of 20 percentage points between two treatments at the 5% level with slightly more than 80% power.

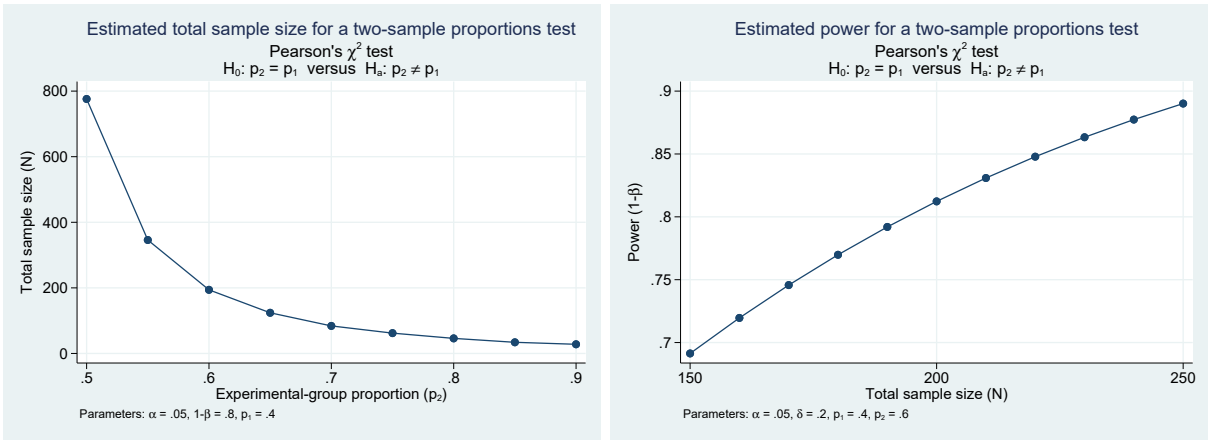



Figure 1: Illustration of Power Calculations.

## References


Enke, B. and F. Zimmermann (2019). Correlation Neglect in Belief Formation. *Review of Economic Studies 86*(1), 313–332.

Giamattei, M., K. S. Yahosseini, S. Gächter, and L. Molleman (2020). LIONESS Lab: a free web-based platform for conducting interactive experiments online. *Journal of the Economic Science Association*.

Le Quement, M. T. and V. Yokeeswaran (2015). Subgroup deliberation and voting. *Social Choice and Welfare 45*(1), 155–186.


# A Decision-Screens (also including the instructions)

In the following we show some examples of the decision-screens.

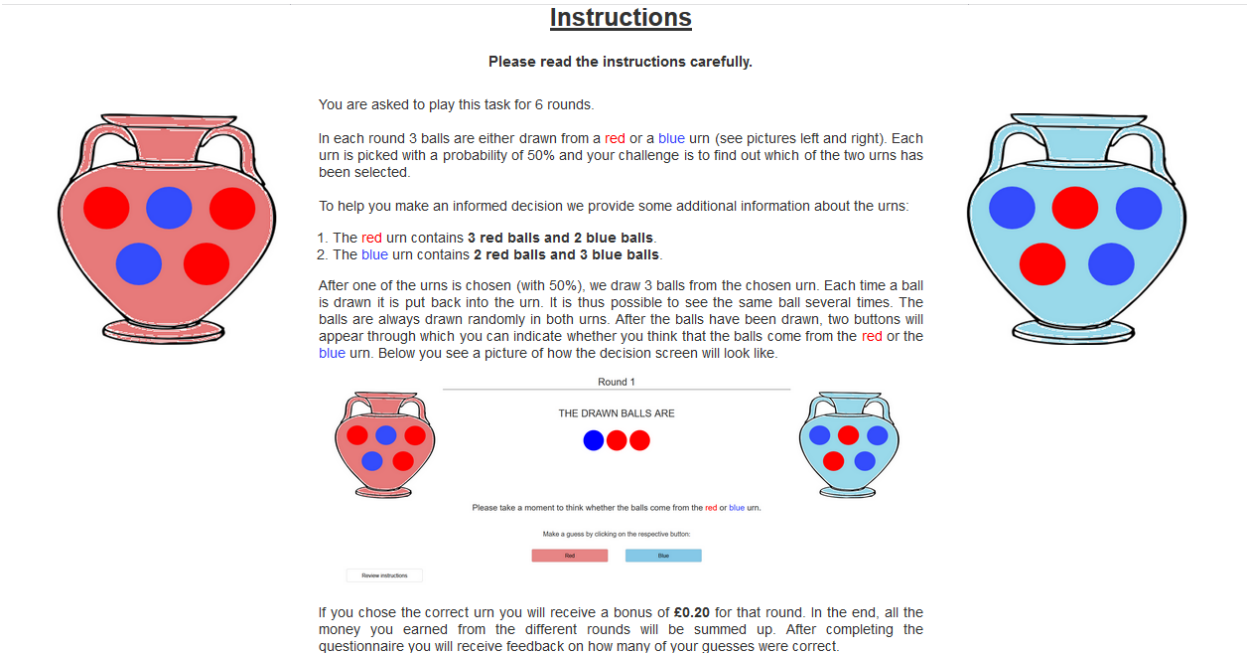



Figure 2: Instructions for the *Ind-NoBias-NoCorr* treatment.

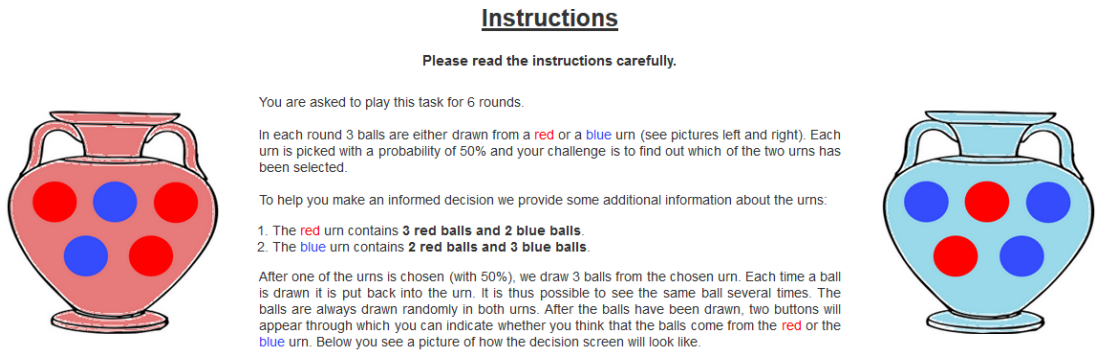



Figure 3: Instructions for the *Ind-Bias-NoCorr* treatment - Part 1.


**Bonus structure**

If you chose the correct urn you will receive a bonus for that round. However, both urns do not pay the same:

1. Correct decision for red: **£0.25**.
2. Correct decision for blue: **£0.15**.

In the end, all the money you earned from the different rounds will be summed up. After completing the questionnaire you will receive feedback on how many of your guesses were correct.

Figure 4: Instructions for the *Ind-Bias-NoCorr* treatment - Part 2.

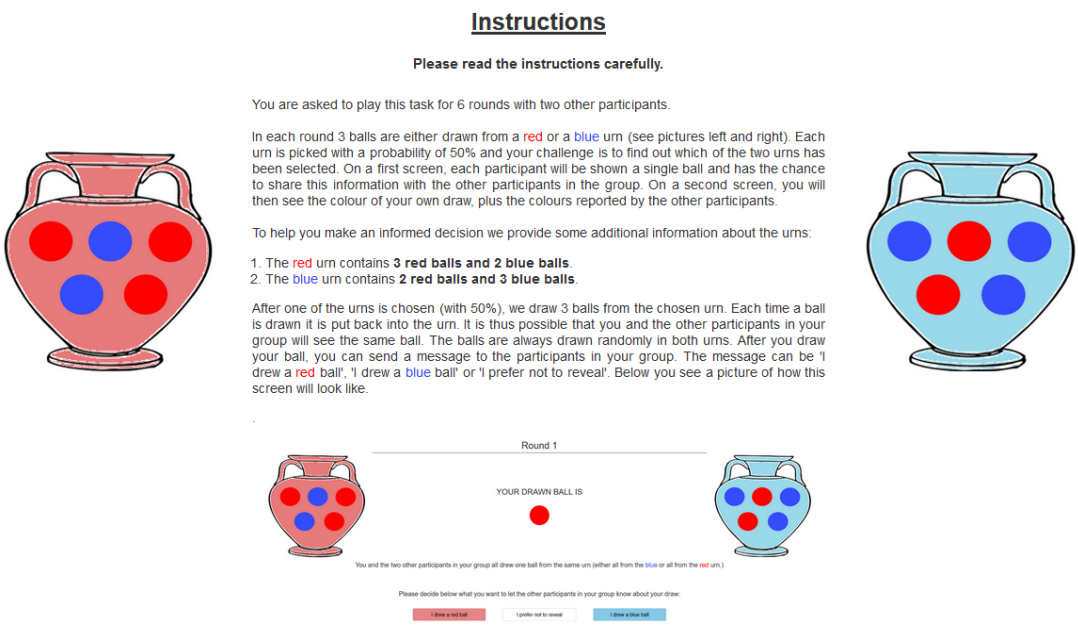



Figure 5: Instructions for the *Gr-NoBias-NoCorr* treatment - Part 1.

On the next screen you will see both the colour of your ball and the balls reported by the participants in your group. A white ball thereby means that a participant chose not to reveal their colour. Your task is then to make a guess whether the balls come from the red or blue urn. You can see a picture of the decision screen below.


The decision for an urn will be determined by **majority vote**. This means that if at least two people decide for an urn, this is taken as the group's decision. If the group decision is correct, everyone in the group will receive a bonus of **£0.20** for that round. In the end, all the money you earned from the different rounds will be summed up. After completing the questionnaire you will receive feedback on how many of your guesses were correct.

Figure 6: Instructions for the *Gr-NoBias-NoCorr* treatment - Part 2.

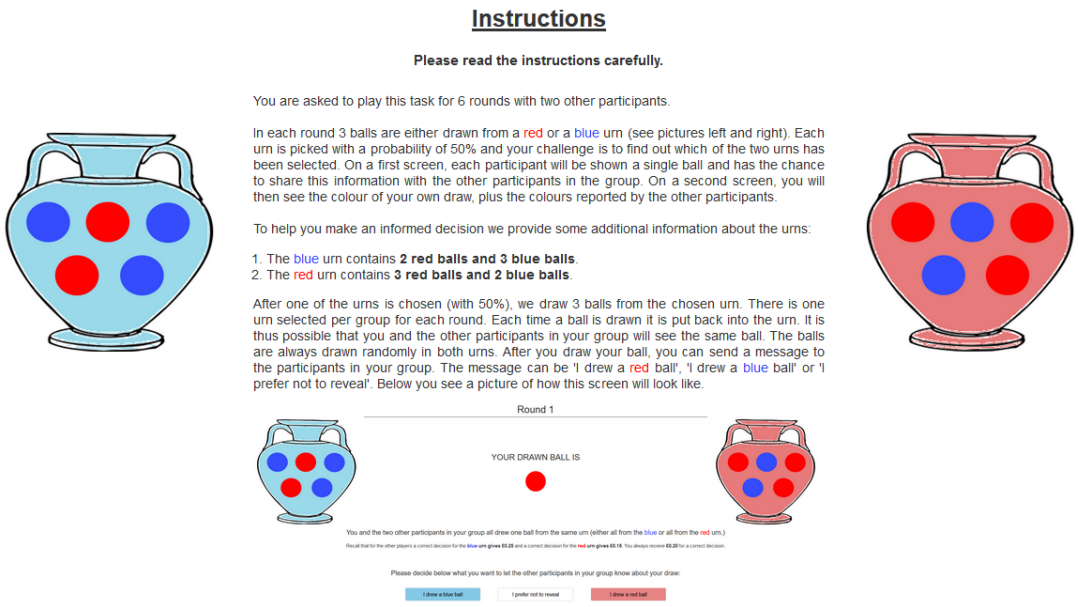



Figure 7: Instructions for the *Gr-Bias-NoCorr* treatment - Part 1.

On the next screen you will see both the colour of your ball and the balls reported by the participants in your group. A white ball thereby means that a participant chose not to reveal their colour. Your task is then to make a guess whether the balls come from the red or blue urn. You can see a picture of the decision screen below.


**Bonus structure**

The decision for an urn will be determined by **majority vote**. This means that if at least two people decide for an urn, this is taken as the group's decision. If your group chose the correct urn everyone will receive a bonus for that round. However, both urns do not pay the same for all participants. One participant will receive **£0.20** for a correct group decision independent of the urn colour, while for the other two:

1. Correct decision for blue: **£0.25**.
2. Correct decision for red: **£0.15**.

You will learn which of the payoffs is relevant for you after you have been matched with two other participants. In the end, all the money you earned from the different rounds will be summed up. After completing the questionnaire you will receive feedback on how many of your guesses were correct.

Figure 8: Instructions for the *Gr-Bias-NoCorr* treatment - Part 2.

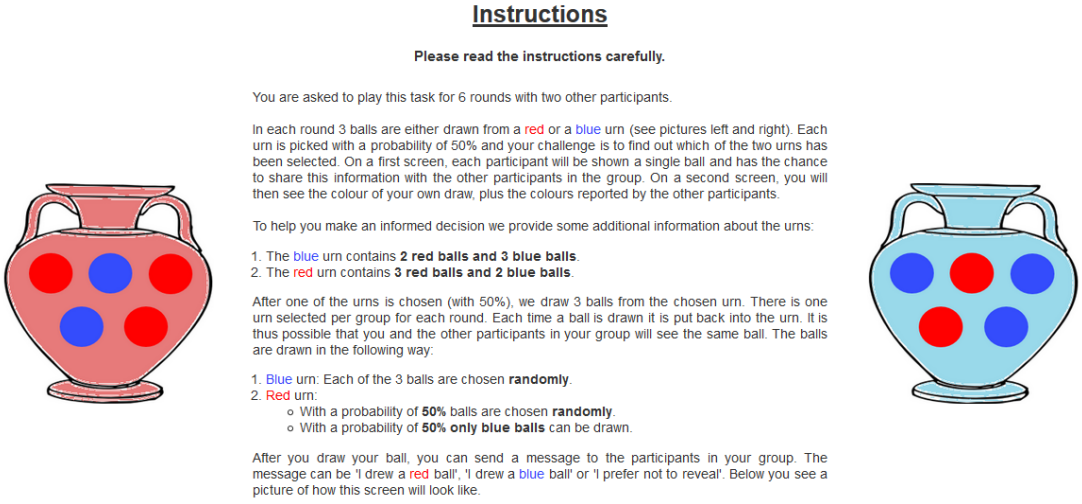
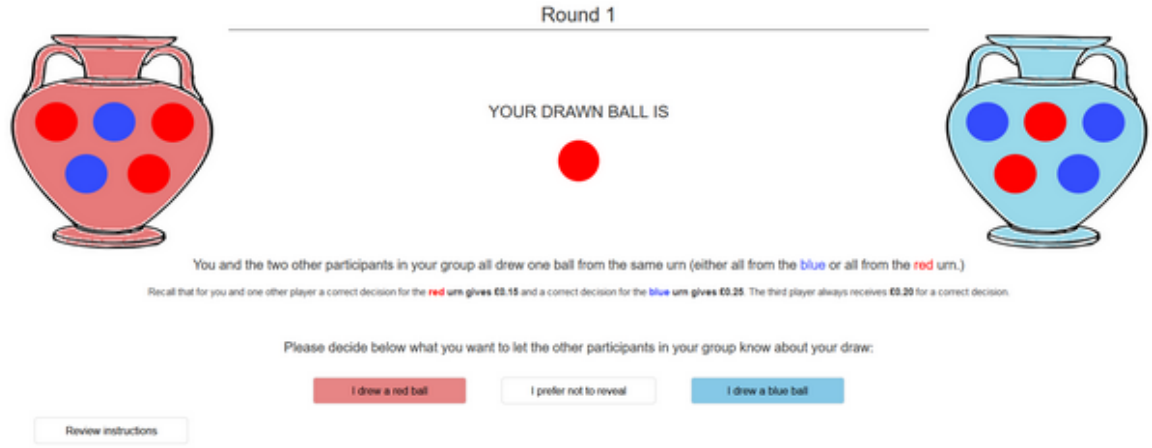



Figure 9: Instructions for the *Gr-Bias-Corr* treatment - Part 1.




On the next screen you will see both the colour of your ball and the balls reported by the participants in your group. A white ball thereby means that a participant chose not to reveal their colour. Your task is then to make a guess whether the balls come from the red or blue urn. You can see a picture of the decision screen below.


Figure 10: Instructions for the *Gr-Bias-Corr* treatment - Part 2.

**Bonus structure**

The decision for an urn will be determined by **majority vote**. This means that if at least two people decide for an urn, this is taken as the group's decision. If your group chose the correct urn everyone will receive a bonus for that round. However, both urns do not pay the same for all participants. One participant will receive **£0.20** for a correct group decision independent of the urn colour, while for the other two:

1. Correct decision for blue: **£0.25**.
2. Correct decision for red: **£0.15**.

You will learn which of the payoffs is relevant for you after you have been matched with two other participants. In the end, all the money you earned from the different rounds will be summed up. After completing the questionnaire you will receive feedback on how many of your guesses were correct.

Figure 11: Instructions for the *Gr-Bias-Corr* treatment - Part 3.


Figure 12: Decision Making Screen in the *Gr-Bias-Corr* treatment (biased player).

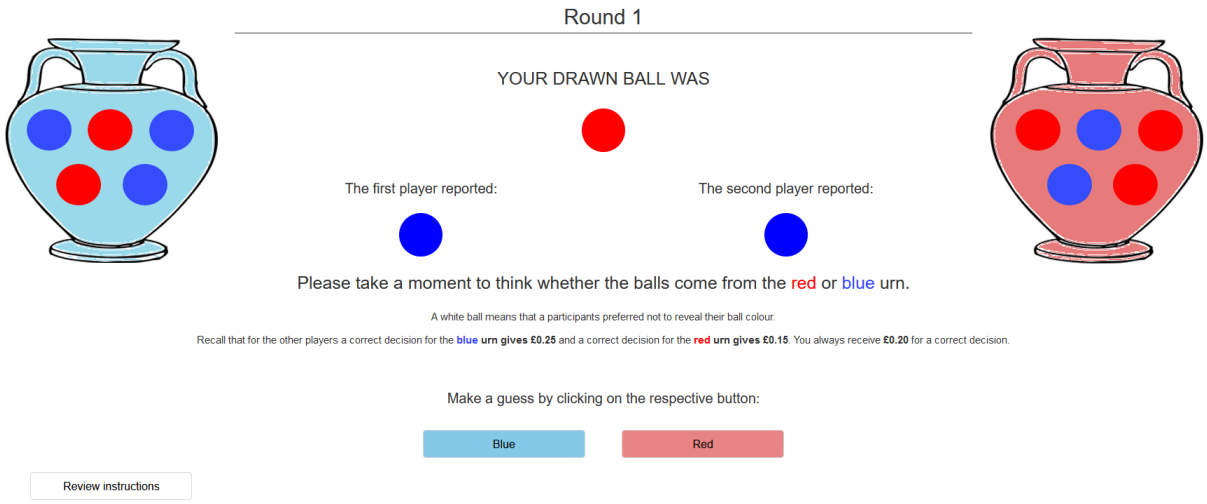



Figure 13: Decision Making Screen in the *Gr-Bias-Corr* treatment (unbiased player).

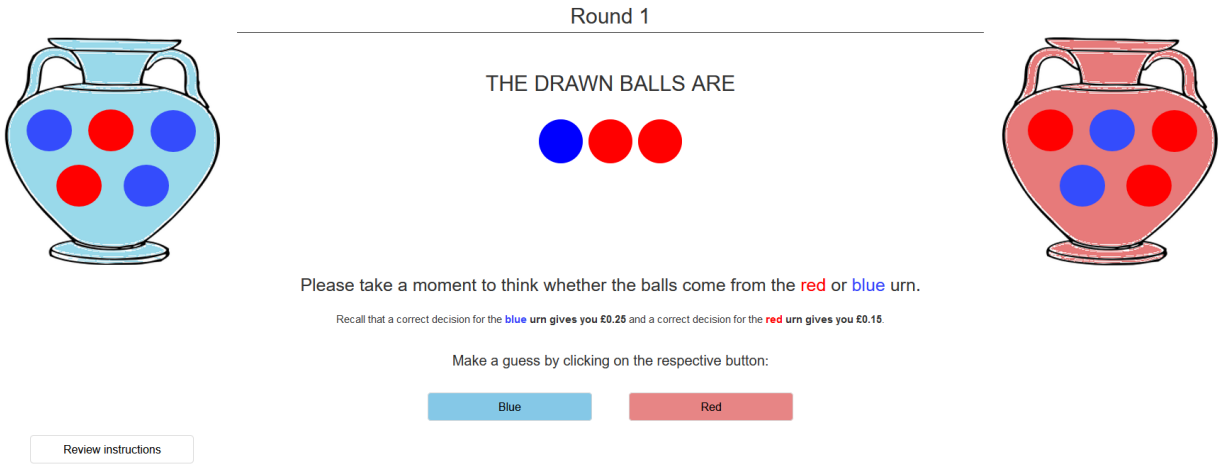



Figure 14: Decision Making Screen in the *Ind-Bias-Corr* treatment.

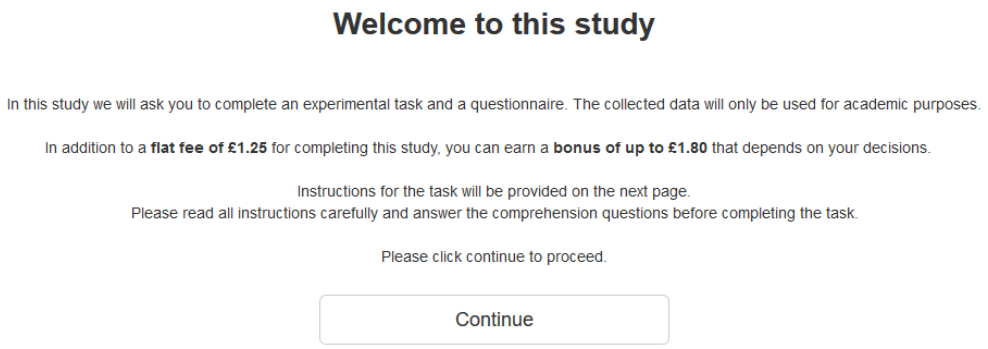



Figure 15: Welcome Screen for participants

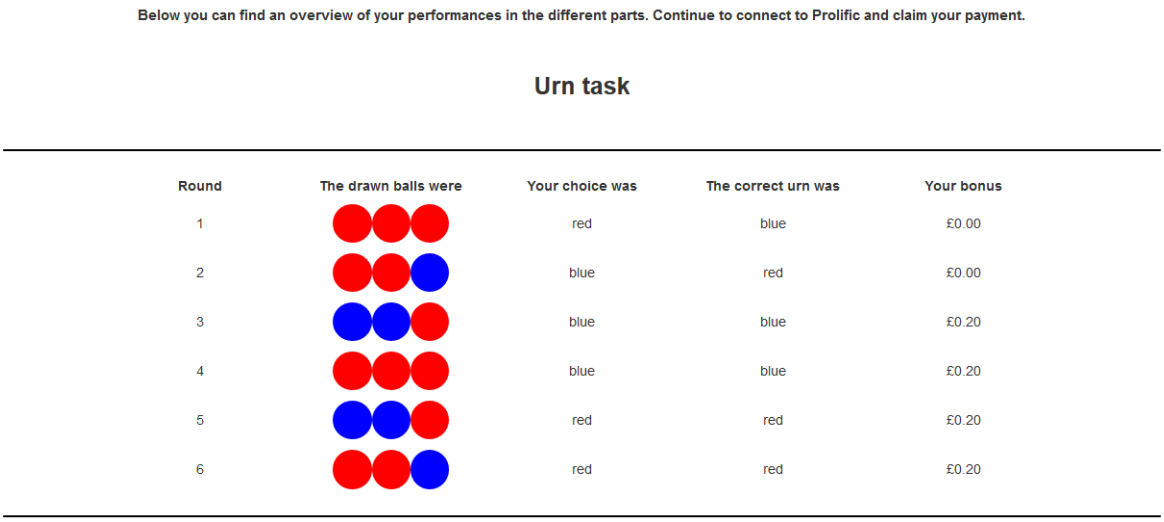



Figure 16: Feedback Screen after the last round.