Correlation Neglect in Belief Formation

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Appendix H: Instructions and Control Questions

Contents

1 Individual Decision Making Treatments

1.1 Instructions (Paper-Based) - *Correlated*

Translated into English

You will now take part in an economic experiment. You will receive a show-up fee of 4 euros,[1] which will be paid out to you at the end of the experiment. You can earn additional money which will also be paid out at the end of the experiment. How much you earn depends on your decisions. In this experiment, we will talk about points. 100 points correspond to 10 euros. The points you earn during the course of the experiment will be exchanged into euros and paid out at the end of the experiment. During the experiment, communication with other participants is not allowed. The curtain of your cabin must be closed at all times. If you have questions, you can raise your arm out of your cabin and the experimenter will try to answer your questions.

Your task: In this experiment, you will have to solve ten estimation tasks. In these tasks, you will have to estimate how many items a specific imaginary container contains. For example, these items could be peas in a vase or stones in a glass. All estimation tasks are different and entirely independent from each other. Your earnings will depend on how precisely you estimate, i.e., how close your estimate is to the actual number of items in the container. At the end of the experiment, one of the ten tasks will be randomly selected and you will be paid according to the precision of your estimate in this task. This will be explained in more detail in the next section.

Your earnings: In addition to your show-up fee you will be paid according to the precision of your estimates. You receive more money the closer your estimate is to the true number of items in the container. One of the ten estimation tasks will be randomly selected for payment and you will be paid according to the precision of your estimate in that task. This means that every estimate is potentially relevant for your payment, so that you should think about each task carefully. You can earn at most 100 points. You get these 100 points if you get the number of items exactly right. The further away your estimate lies from the true value, the lower will be your earnings. This will be

[1] *Subjects received an additional 2 euros for filling out the sociodemographic questionnaire after the main part of the experiment.*

determined according to the following formula:[2]

$$\text{Payment} = 100 - 0.16 \times (\text{Percentage deviation between estimate and true value})^2$$

This means that the percentage deviation (in percent) between your estimate and the true value will be squared and multiplied by 0.16. This number will then be deducted from the maximum earnings of 100 points. While this formula may look complicated, the underlying principle is very simple: the smaller the difference between your estimate and the true value, the higher your earnings. However, your earnings can never be smaller then zero, i.e., you cannot make losses. Consider the following example: Suppose that the container in question contains 650 items. You would then earn the following amount of points depending on your estimate:

Estimate 0	→ Deviation 100 %	→ Earnings 0 points
Estimate 520	→ Deviation 20 %	→ Earnings 36 points
Estimate 585	→ Deviation 10 %	→ Earnings 84 points
Estimate 650	→ Deviation 0 %	→ Earnings 100 points
Estimate 715	→ Deviation 10 %	→ Earnings 84 points
Estimate 780	→ Deviation 20 %	→ Earnings 36 points
Estimate 1300	→ Deviation 100 %	→ Earnings 0 points

You can see that your earnings only depend on the percentage deviation. For example, it does not matter whether you over- or underestimate the true container content by 10 items.

Information regarding the estimation tasks: You will not see any of the estimation tasks, i.e., you will not see any of these imaginary containers. Instead, for every estimation task, you will receive different computer-generated pieces of information about the correct estimation result. For every task, you will see this information and then enter your own estimate. The information you receive will be explained in detail below.

On computers, we simulate devices which solve exactly the same estimation tasks as you. There are two different types of devices. First, there are devices which themselves

[2] *We provide the formula for the baseline treatments. The formula for the high-stakes treatments (see section 3) is given by*

$$\textit{Payment} = 300 - 0.48 \times (\textit{Percentage deviation between estimate and true value})^2$$

provide an estimate of the container content (these devices will be called estimation devices and are denoted by letters). Second, there are devices which observe the estimates of the estimation devices and compute their own estimate from these reports (these devices are referred to as communication devices and denoted by numbers). For every estimation task, 10,000 computers (estimation devices) determined their own estimates; the estimates of these devices are completely independent from each other. The devices all have the same quality, i.e., they are equally good in determining estimates. Note that these estimation devices are good at solving these estimation tasks. If these estimation devices would determine a lot of estimates, then the average of these estimates would be correct. Thus, while almost every single estimate will contain an error, the average of these 10,000 estimates will be correct (or very precise). Moreover, many estimates are relatively close to the true value. You will see an illustrative example below.

Summary: (1) The devices make mistakes, but it is much more likely that the estimate is close to the true value, than that it is very far away. (2) The average of these 10,000 estimates is correct. This means that the estimation devices are on average correct (or very precise).

In the following, we provide you with an example. Again suppose that the container contains 650 items. The following figure then illustrates how often the 10,000 estimation devices give which estimate. You can see that the frequency increases as one approaches the center of the bell curve (the true value 650). Thus, it is much more likely that an estimate is very close to the true value than that it is very far away. You can also infer that the average of all estimates equals 650 and is hence correct.

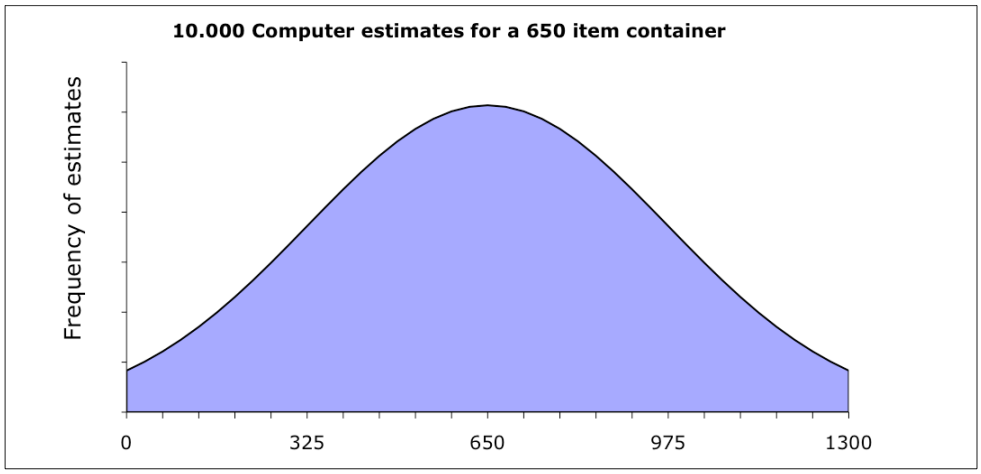

Figure 1: Example: computer estimates for a 650 item container

For every estimation task, out of these 10,000 estimates, a computer randomly

chooses the estimates of exactly four estimation devices (A, B, C, D). These four estimates are completely independent from each other.
Apart from the estimation devices, there are also three communication devices (1, 2, 3). These communication devices do not determine an own estimate. Rather, they always observe two estimation devices and compute an estimate from these observed estimates. To be more precise, they do this by taking the average of these two estimates.

You will receive the following information as described in Figure 2.

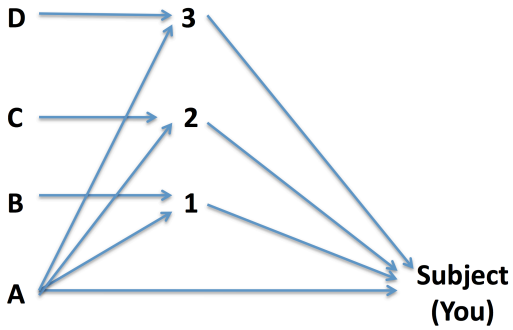

Figure 2: The four estimation devices determine their own estimates. The three communication devices receive the estimate of estimation device A and of one other estimation device, as described by the arrows. They compute their own estimate by taking the average of the two estimates. You will see the estimate of estimation device A as well as of the three communication devices.

This means that you will receive the following information: You receive the estimate of estimation device A as well as the estimates of all communication devices. As is evident from figure 2, every communication device sees the estimates of estimation device A and of one other estimation device. As you can see, communication device 1 receives the estimates of estimation devices A and B. Communication device 2 sees the estimates of estimation devices A and C. Communication device 3 sees the estimates of estimation devices A and D. As explained above, the communication devices take the average of these two estimates and report this average as their estimate.
Summary: You receive the estimate of estimation device A as well as the estimates of the communication devices 1, 2, and 3.
The following simple example illustrates this. Above, we showed you the 10,000 estimates regarding the container which contained 650 items. Now imagine that out of these estimates a computer randomly chooses the following estimates of the estimation devices:
Estimation device A: 810
Estimation device B: 126
Estimation device C: 1078
Estimation device D: 937

The communication devices take the averages of two of these estimates as described above. They then report the following estimates:
Communication device 1: 468
Communication device 2: 944
Communication device 3: 873.5
Thus, for this estimation task, you would see the following information on your computer screen (see figure 3):

Figure 3: Exemplary screenshot

Please read these instructions again carefully. The experimenter will read out a summary of the instructions shortly. Afterwards, you will answer a set of control questions at the computer in order to check your understanding of the instructions.

1.2 Summary (read out aloud by experimenter) - *Correlated*

- In this experiment you will face 10 different estimations tasks.
- At the end of the experiment one of the 10 rounds will be randomly picked to determine your earnings. Your earnings depend on how precise your answer in the estimation task was, i.e., how close it was to the correct value. Since all of the 10 estimation tasks are potentially payoff-relevant you should answer carefully in all rounds.
- You will not actually see the estimation tasks. Instead, you will be provided with computer-generated information regarding the solution of the estimation tasks.
- The structure of the information will be as follows: In each round, four estimation devices that try to solve your estimation task will be randomly picked. These devices are always equally good at solving the task. Every device provides an own estimate.
- In addition, there are three communication devices which process the estimates they observe from the estimation devices and then report an estimate derived from these estimates.
- Please take a look at figure 2 in your instructions again. There you can see which estimates the respective communication devices observe, how they are processed and how they map into the estimate the respective communication device reports.
- For each estimation task, you receive the following information: You will see the estimate from estimation device A as well as the estimates from communication devices 1, 2, and 3.
- After observing this information, you will then be given 5 minutes to think about an own estimate and to enter it into your computer.

1.3 Control Questions (Computerized) - *Correlated*

Note: Across all treatments, the control questions were presented on a computer screen such that a given decision screen contained at least three separate control questions. Subjects could only proceed to the next screen once they had correctly answered all questions. If at least one answer was incorrect, the subject was notified of this, but the program didn't tell subjects which question they got wrong. Also note that the BonnEconLab has a control room in which the decision screens of all 24 subjects can be monitored. Whenever a subject appeared to have problems in solving the control questions, one of the experimenters

approached that subject, clarified open questions. Subjects which showed a clear lack of understanding of the experiment were excluded from the analysis, but were allowed to take part in the experiment so as to avoid noise due to subjects' leaving the room and getting paid while others were completing their tasks.

- In this experiment, you have to solve ten estimation tasks. Which of these tasks will be relevant for your final profit?

    1. At the end of the experiment, one estimation task will be randomly selected. Profits will be paid out according to performance in this task.
    2. None of the estimation tasks will be paid out.
    3. At the end of the experiment, three estimation tasks will be randomly selected. Profits will be paid out according to performance in these tasks.
    4. All estimation tasks will be paid out.

- Your profit in this experiment will depend on the precision of your estimates. Suppose your estimate differs from the true value by 100 %. How many points will you receive if this task is relevant for your profit?

    1. 100 points
    2. 50 points
    3. 0 points

- The estimation devices provide estimates for every estimation task. What can you say about the quality (regarding the probability of making errors) of the different estimation devices?

    1. The quality of the estimation devices is identical, i.e., the estimation devices do not differ in this respect.
    2. The quality of the estimation devices differs. Estimation device C is the best one.
    3. The quality of the estimation devices differs. Estimation device A is the best one.

- Which of the following statements is correct?

    1. If estimation device B reports an estimate of 3160, then all other estimation devices will also report an estimate of 3160.
    2. The estimates of the estimation devices are independent of each other, so that they potentially report different estimates.

- Suppose estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will communication device 1 report?

    1. 6
    2. 9
    3. 11
    4. 12

- Suppose estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will communication device 2 report?

    1. 6
    2. 9
    3. 11
    4. 12

- Which information will be provided to you for every estimation task?

    1. You will see the estimation task, i.e., you will see the respective container.
    2. You will see the estimates of all estimation devices.
    3. You will see the estimate of estimation device A as well as the estimates of the communication devices 1, 2, and 3.

  Subjects then saw the following screen: “You will now start working on the first estimation task. As described in the instructions, you will receive the estimates of estimation device A as well as the estimates of the communication devices 1,2, and 3. You have five minutes for your decision.”

1.4 Instructions (Paper-Based) - *Uncorrelated*

Translated into English

You will now take part in an economic experiment. You will receive a show-up fee of 4 euros,[3] which will be paid out to you at the end of the experiment. You can earn additional money which will also be paid out at the end of the experiment. How much you earn depends on your decisions. In this experiment, we will talk about points. 100 points correspond to 10 euros. The points you earn during the course of the experiment will be exchanged into euros and paid out at the end of the experiment. During the experiment, communication with other participants is not allowed. The curtain of your cabin must be closed at all times. If you have questions, you can raise your arm out of your cabin and the experimenter will try to answer your questions.

Your task: In this experiment, you will have to solve ten estimation tasks. In these tasks, you will have to estimate how many items a specific imaginary container contains. For example, these items could be peas in a vase or stones in a glass. All estimation tasks are different and entirely independent from each other. Your earnings will depend on how precisely you estimate, i.e., how close your estimate is to the actual number of items in the container. At the end of the experiment, one of the ten tasks will be randomly selected and you will be paid according to the precision of your estimate in this task. This will be explained in more detail in the next section.

Your earnings: In addition to your show-up fee you will be paid according to the precision of your estimates. You receive more money the closer your estimate is to the true number of items in the container. One of the ten estimation tasks will be randomly selected for payment and you will be paid according to the precision of your estimate in that task. This means that every estimate is potentially relevant for your payment, so that you should think about each task carefully. You can earn at most 100 points. You get these 100 points if you get the number of items exactly right. The further away your estimate lies from the true value, the lower will be your earnings. This will be determined according to the following formula:[4]

$$\text{Payment } = 100 - 0.16 \times (\text{Percentage deviation between estimate and true value})^2$$

[3] *Subjects received an additional 2 euros for filling out the sociodemographic questionnaire after the main part of the experiment.*

[4] *We provide the formula for the baseline treatments. The formula for the high-stakes treatments (see section 3) is given by*

$$\textit{Payment } = 300 - 0.48 \times (\textit{Percentage deviation between estimate and true value})^2$$

This means that the percentage deviation (in percent) between your estimate and the true value will be squared and multiplied by 0.16. This number will then be deducted from the maximum earnings of 100 points. While this formula may look complicated, the underlying principle is very simple: the smaller the difference between your estimate and the true value, the higher your earnings. However, your earnings can never be smaller then zero, i.e., you cannot make losses. Consider the following example: Suppose that the container in question contains 650 items. You would then earn the following amount of points depending on your estimate:

Estimate 0	→ Deviation 100 %	→ Earnings 0 points
Estimate 520	→ Deviation 20 %	→ Earnings 36 points
Estimate 585	→ Deviation 10 %	→ Earnings 84 points
Estimate 650	→ Deviation 0 %	→ Earnings 100 points
Estimate 715	→ Deviation 10 %	→ Earnings 84 points
Estimate 780	→ Deviation 20 %	→ Earnings 36 points
Estimate 1300	→ Deviation 100 %	→ Earnings 0 points

You can see that your earnings only depend on the percentage deviation. For example, it does not matter whether you over- or underestimate the true container content by 10 items.

Information regarding the estimation tasks: You will not see any of the estimation tasks, i.e., you will not see any of these imaginary containers. Instead, for every estimation task, you will receive different computer-generated pieces of information about the correct estimation result. For every task, you will see this information and then enter your own estimate. The information you receive will be explained in detail below.

On computers, we simulate devices which solve exactly the same estimation tasks as you. There are two different types of devices. First, there are devices which themselves provide an estimate of the container content (these devices will be called estimation devices and are denoted by letters). Second, there are devices which observe the estimates of the estimation devices and compute their own estimate from these reports (these devices are referred to as communication devices and denoted by numbers). For every estimation task, 10,000 computers (estimation devices) determined their own estimates; the estimates of these devices are completely independent from each other. The devices all have the same quality, i.e., they are equally good in determining estimates. Note that these estimation devices are good at solving these estimation tasks. If

these estimation devices would determine a lot of estimates, then the average of these estimates would be correct. Thus, while almost every single estimate will contain an error, the average of these 10,000 estimates will be correct (or very precise). Moreover, many estimates are relatively close to the true value. You will see an illustrative example below.
Summary: (1) The devices make mistakes, but it is much more likely that the estimate is close to the true value, than that it is very far away. (2) The average of these 10,000 estimates is correct. This means that the estimation devices are on average correct (or very precise).
In the following, we provide you with an example. Again suppose that the container contains 650 items. The following figure then illustrates how often the 10,000 estimation devices give which estimate. You can see that the frequency increases as one approaches the center of the bell curve (the true value 650). Thus, it is much more likely that an estimate is very close to the true value than that it is very far away. You can also infer that the average of all estimates equals 650 and is hence correct.

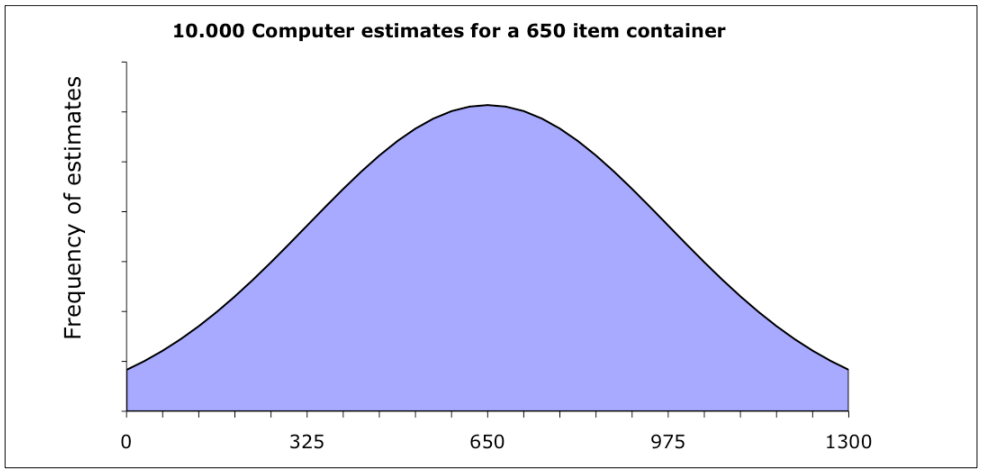

Figure 4: Example: computer estimates for a 650 item container

For every estimation task, out of these 10,000 estimates, a computer randomly chooses the estimates of exactly four estimation devices (A, B, C, D). These four estimates are completely independent from each other.
Apart from the estimation devices, there are also three communication devices (1, 2, 3). These communication devices do not determine an own estimate. Rather, they always observe one estimation device and report the estimate of this estimation device.
You will receive the following information as described in Figure 2.

This means that you will receive the following information: You receive the estimate of estimation device A as well as the estimates of all communication devices. As is ev-

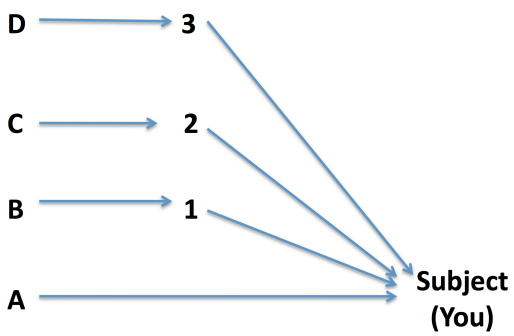

Figure 5: The four estimation devices determine their own estimates. The three communication devices receive the estimate of one estimation device as described by the arrows. They compute their own estimate by adopting the estimate of the estimation device. You will see the estimate of estimation device A as well as of the three communication devices.

ident from figure 2, every communication device sees the estimate of one estimation device. As you can see, communication device 1 receives the estimate of estimation device B. Communication device 2 sees the estimate of estimation device C. Communication device 3 sees the estimate of estimation device D. As explained above, the communication device then reports the estimate of the respective estimation device.
Summary: You receive the estimate of estimation device A as well as the estimates of the communication devices 1, 2, and 3.
The following simple example should illustrate this. Above, we showed you the 10,000 estimates regarding the container which contained 650 items. Imagine now, that out of these the computer randomly chooses the following estimates of the estimation devices:
Estimation device A: 810
Estimation device B: 126
Estimation device C: 1078
Estimation device D: 937
The communication devices each report the estimate of one estimation device as described above. They thus report the following estimates:
Communication device 1: 126
Communication device 2: 1078
Communication device 3: 937
Thus, for this estimation task, you would see the following information on your computer screen:
(SCREENSHOT IDENTICAL TO CORRELATED TREATMENT WITH RESPECTIVE CHANGES IN REPORTS FROM COMMUNICATION DEVICES)
Please read these instructions again carefully. The experimenter will read out a short summary of the instructions. Afterwards, you will answer a set of control questions at

the computer in order to check your understanding of the instructions.

1.5 Summary (read out aloud by experimenter) - *Uncorrelated*

The summary was identical to the Correlated treatment.

1.6 Control Questions (Computerized) - *Uncorrelated*

- In this experiment, you have to solve ten estimation tasks. Which of these tasks will be relevant for your final profit?

    1. At the end of the experiment, one estimation task will be randomly selected. Profits will be paid out according to performance in this task.
    2. None of the estimation tasks will be paid out.
    3. At the end of the experiment, three estimation tasks will be randomly selected. Profits will be paid out according to performance in these tasks.
    4. All estimation tasks will be paid out.

- Your profit in this experiment will depend on the precision of your estimates. Suppose your estimate differs from the true value by 100 %. How many points will you receive if this task is relevant for your profit?

    1. 100 points
    2. 50 points
    3. 0 points

- The estimation devices provide estimates for every estimation task. What can you say about the quality (regarding the probability of making errors) of the different estimation devices?

    1. The quality of the estimation devices is identical, i.e., the estimation devices do not differ in this respect.
    2. The quality of the estimation devices differs. Estimation device C is the best one.
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- Which of the following statements is correct?

1. If estimation device B reports an estimate of 3160, then all other estimation devices will also report an estimate of 3160.
2. The estimates of the estimation devices are independent of each other, so that they potentially report different estimates.

- Suppose estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will communication device 1 report?

  1. 6
  2. 9
  3. 12
  4. 16

- Suppose estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will the communication device 2 report?

  1. 6
  2. 9
  3. 12
  4. 16

- Which information will be provided to you for every estimation task?

  1. You will see the estimation task, i.e., you will see the respective container.
  2. You will see the estimates of all estimation devices.
  3. You will see the estimate of estimation device A as well as the estimates of the communication devices 1, 2, and 3.

  Subjects then saw the following screen: “You will now start working on the first estimation task. As described in the instructions, you will receive the estimates of estimation device A as well as the estimates of the communication devices 1,2, and 3. You have five minutes for your decision.”

2 Individual Robustness Treatments

2.1 Instructions (Paper-Based)

Translated into English - we provide instructions for the correlated treatment only. For the differences between the correlated and uncorrelated treatments, see the baseline instructions above.

You will now take part in an economic experiment. You will receive a show-up fee of 4 euros,[5] which will be paid out to you at the end of the experiment. You can earn additional money which will also be paid out at the end of the experiment. How much you earn depends on your decisions. In this experiment, we will talk about points. 100 points correspond to 10 euros. The points you earn during the course of the experiment will be exchanged into euros and paid out at the end of the experiment. During the experiment, communication with other participants is not allowed. The curtain of your cabin must be closed at all times. If you have questions, you can raise your arm out of your cabin and the experimenter will try to answer your questions.

Your task: In this experiment, you will have to solve ten estimation tasks. In these tasks, you will have to estimate an unknown number X. In each round, the computer randomly determines the number X, which will however be unknown to you. As will be explained in more detail below, you will receive some information about this number. Then you will be asked to provide an estimate about X. In total, there are 10 rounds; in each round, you will face a new estimation task, i.e., in each round the computer will determine a new number X and that number will be entirely independent from the numbers in the other rounds.

Your earnings will depend on how precisely you estimate, i.e., how close your estimate is to the actual number X. At the end of the experiment, one of the ten tasks will be randomly selected and you will be paid according to the precision of your estimate in this task. This will be explained in more detail in the next section.

Your earnings: In addition to your show-up fee, you will be paid according to the precision of your estimates. One of the ten estimation tasks will be randomly selected for payment and you will be paid according to the precision of your estimate in that task. This means that every estimate is potentially relevant for your payment, so that you should think about each task carefully. You can earn either 100 points or 0 points. In the following, you will learn how you earn the 100 points. After you have provided your estimate, the computer randomly determines a number k. This number will lie

[5] *Subjects received an additional 2 euros for filling out the sociodemographic questionnaire after the main part of the experiment.*

somewhere between 0 and 100000. (More specifically, this number will be randomly drawn from a uniform distribution on the interval between 0 and 100000.) You will receive 100 points if the quadratic distance between your estimate and the actual number X is less or equal than k. If the distance is larger than k, you will receive 0 points. This will be determined according to the following formula:

$$\text{Payment } = 100, \text{if}(X - \text{estimate})^2 \leq \text{k}$$

$$\text{Payment } = 0, \text{if}(X - \text{estimate})^2 > \text{k}$$

This implies the following: If the quadratic distance between your estimate and the true number X is larger than the value k, you will receive 0 points. If the quadratic distance between your estimate and the true number X is less or equal than the value k, you will receive 100 points. You can hence see that you should try to minimize the distance between your estimate and the number X. While this formula might look complicated, the underlying principle is very simple: the better your estimate, i.e., the smaller the distance between your estimate and the true value, the higher is the likelihood that you will receive the 100 points. Consider the following example: Suppose that the computer randomly draws the number $X = 150$. In addition we would have that $k = 500$. You would then earn the following amount of points depending on your estimate:

Estimate 50	$\rightarrow$ quadratic distance $= 10000 >$ k	$\rightarrow$ Earnings 0 points
Estimate 100	$\rightarrow$ quadratic distance $= 2500 >$ k	$\rightarrow$ Earnings 0 points
Estimate 130	$\rightarrow$ quadratic distance $= 400 <$ k	$\rightarrow$ Earnings 100 points
Estimate 150	$\rightarrow$ quadratic distance $= 0 <$ k	$\rightarrow$ Earnings 100 points
Estimate 170	$\rightarrow$ quadratic distance $= 400 <$ k	$\rightarrow$ Earnings 100 points
Estimate 200	$\rightarrow$ quadratic distance $= 2500 >$ k	$\rightarrow$ Earnings 0 points
Estimate 250	$\rightarrow$ quadratic distance $= 10000 >$ k	$\rightarrow$ Earnings 0 points

You can see that your chances of receiving 100 points only depend on the absolute distance. For example, it does not matter whether you over- or underestimate the true number by 10 points.

The estimation task: In each round you will have to provide an estimate about an unknown number X. As already mentioned, for each round the computer will randomly determine a new number X. You will not know this number. The computer draws this number for each round from a probability distribution, that is displayed below.

The distribution you see in Figure 1 is a so-called normal distribution. The distribu-

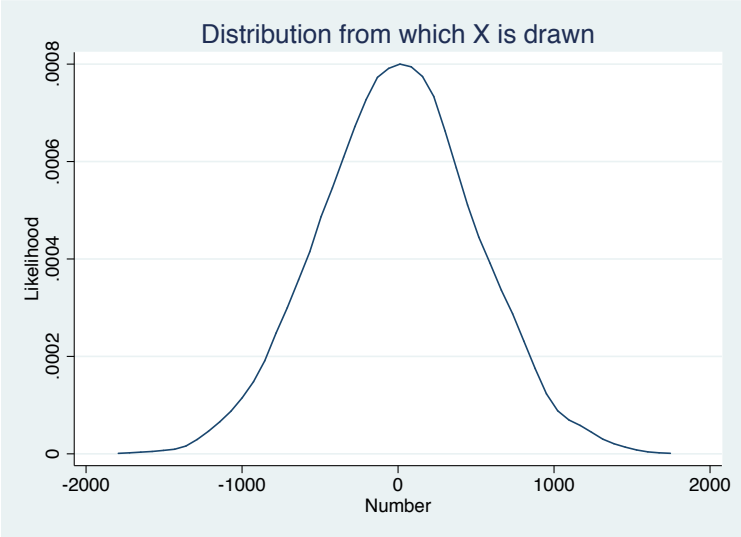

Figure 6: Distribution from which the computer draws X.

tion has a mean of 0 and a standard deviation of 500.[6] Although you will not know the number X, the graph tells you something about the range from which X is drawn.
After the computer has drawn X, you will need to provide an estimate about X. For that purpose, for every estimation task, you will receive different computer-generated pieces of information about the correct estimation result. For every task, you will see this information and then enter your own estimate. The information you receive will be explained in detail below.

Information regarding the estimation tasks: Your task in this experiment is to provide an estimate about a randomly drawn number X (unknown to you), based on some information. For every estimation task, you will receive different computer-generated pieces of information about the number X. For every task, you will see this information and then enter your own estimate. The information you receive will be explained in detail in the following.
On computers, we simulate devices which solve exactly the same estimation tasks as you. There are two different types of devices. First, there are devices which themselves provide an estimate of X (these devices will be called estimation devices and are denoted by letters). Second, there are devices which observe the estimates of the estimation devices and compute their own estimate from these reports (these devices are referred to as communication devices and denoted by numbers).
The estimation devices provide an estimate about the number X, and the estimates of these devices are completely independent from each other. The estimation devices all

[6]The exact distribution of a normal distribution with mean 0 and a standard deviation of 500 is given by the following formula: $f(x) = \frac{1}{500\sqrt{2\pi}} exp(-\frac{x^2}{500000})$. Throughout the experiment, we round all drawn numbers to integers.

have the same quality, i.e., they are equally good in determining estimates. Note that these estimation devices are good at solving these estimation tasks:
The estimation devices determine an estimate by randomly drawing a number from a normal distribution. Importantly, this distribution takes as mean the number *X*, and a standard deviation of 500. The figure below shows you an example of such a distribution. You can see that the highest point of the bell curve is at the number *X*, i.e., the correct value. The further you move away from *X*, the less likely it is that the corresponding numbers are drawn from the estimation devices.

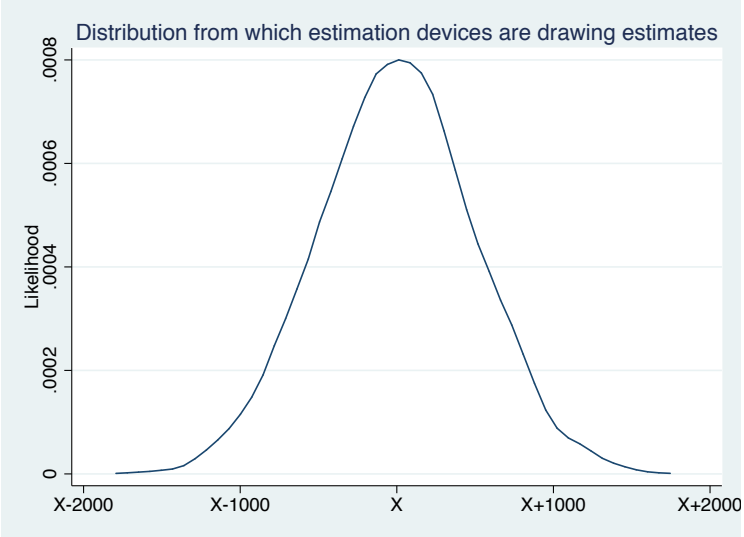

Figure 7: Distribution from which the estimation devices draw their estimates.

This means that the estimation devices are good at solving the estimation task. If the estimation devices would provide a large number of estimates, then the average of these estimates would be correct. While almost every individual estimate will be incorrect, the average taken over many estimates will be very precise. In addition, many estimates will be rather close to the correct value.
Summary: (1) The devices draw from a normal distribution with mean *X*. This means that the estimation devices are good at solving the estimation task. If the estimation devices would provide a large number of estimates, i.e., if they would draw many times from the normal distribution, then the average of these estimates would be correct (or very precise). (2) The devices make mistakes, but it is much more likely that the estimate is close to the true value, than that it is very far away.
For every estimation task, there are a total of four estimation devices (A, B, C, D). These four devices, which are completely independent from each other, each randomly draw an estimate from the normal distribution (with mean *X* and a standard deviation of 500).

Apart from the estimation devices, there are also four communication devices (1, 2, 3, 4). These communication devices do not determine an own estimate. Rather, they observe the estimation devices and compute an estimate from these observed estimates. Intermediary 1 only observes estimation device A, and simply transmits the estimate of estimation device A. Intermediaries 2, 3, 4 each observe the estimates from two of the estimation devices, and compute an estimate from these two estimates by computing the respective average.
You will receive the following information as described in the following Figure.

SUBJECTS SAW THE APPLICABLE FIGURE AS SHOWN IN THE INSTRUCTIONS OF THE BASELINE TREATMENTS, WITH THE OBVIOUS MINOR CHANGE THAT THERE ARE NOW FOUR INTERMEDIARIES.

This means that you will receive the following information: As is evident from the figure, communication device 1 receives the estimate from estimation device A and reports this estimate to you. The other communication devices all see the estimate of estimation device A and of one other estimation device. As you can see in the figure, communication device 2 receives the estimates of estimation devices A and B. Communication device 3 sees the estimates of estimation devices A and C. Communication device 4 sees the estimates of estimation devices A and D. The communication devices 2, 3, 4 take the average of these two estimates and report this average as their estimate.
Summary: You receive the estimates of the communication devices 1, 2, 3 and 4.
The following simple example illustrates this. We again assume that the correct number X is 150. Let's assume for this example that the estimates of the four estimation devices would be as follows:
Estimation device A: 81.0
Estimation device B: 127.0
Estimation device C: 209.0
Estimation device D: 176.0
Communication device 1 would then report the estimate of estimation device A. The communication devices 2, 3, 4 would take the average of the two estimates they see, as described above. The communication devices would thus report the following estimates:
Communication device 1: 81.0
Communication device 2: 104.0
Communication device 3: 145.0
Communication device 4: 128.5

Thus, for this estimation task, you would see the following information on your computer screen:

SUBJECTS SAW A SCREENSHOT ANALOGOUS TO THE ONE SHOWN IN THE BASELINE INSTRUCTIONS ABOVE.

Please read these instructions again carefully. The experimenter will read out a summary of the instructions shortly. Afterwards, you will answer a set of control questions at the computer in order to check your understanding of the instructions.

2.2 Summary (read out aloud by experimenter)

- In this experiment, you will face 10 different estimations tasks.
- At the end of the experiment, one of the 10 rounds will be randomly picked to determine your earnings. Your earnings depend on how precise your answer in the estimation task was, i.e., how close it was to the correct value. Since all of the 10 estimation tasks are potentially payoff-relevant, you should answer carefully in all rounds.
- For each estimation task, you will be provided with computer-generated information regarding the solution of the task.
- The structure of the information will be as follows: In each round, four estimation devices randomly draw from a normal distribution with mean X. These devices are always equally good at solving the task.
- In addition, there are four communication devices which process the estimates they observe from the estimation devices and then report an estimate derived from these estimates.
- Please take a look at figure 4 in your instructions again. There you can see which estimates the respective communication devices observe, how they are processed and how they map into the estimate which the respective communication device reports.
- For each estimation task, you receive the following information: You will see the estimates from communication devices 1, 2, 3 and 4.
- After observing this information, you will then be given 5 minutes to think about an own estimate and to enter it into your computer.

2.3 Control Questions (Computerized)

Questions 1 and 3 as in the individual baseline conditions

- Your profit in this experiment will depend on the precision of your estimates. Suppose your estimate differs from the true value by 1000. How many points will you receive if this task is relevant for your profit?

    1. 100 points
    2. 50 points
    3. 0 points

- What is the mean of the distribution from which the number X is drawn?

    1. I cannot know this.
    2. 0.
    3. 100.

- What is the relation between the standard deviation of the distribution from which X is drawn and the standard deviation of the distribution from which the estimation devices draw their estimates?

    1. The standard deviation of both distributions is 500, i.e., identical.
    2. The standard deviation of the distribution from which X is drawn is larger.
    3. The standard deviation of the distribution from which X is drawn is smaller.

- Which of the following statements about you payment is correct?

    1. The closer my estimate is to the true value X, the smaller the likelihood that I will receive 100 points.
    2. The closer my estimate is to the true value X, the higher the likelihood that I will receive 100 points.

- Which of the following statements is correct?

    1. If estimation device B reports an estimate of 3160, then all other estimation devices will also report an estimate of 3160.
    2. The estimates of the estimation devices are independent of each other, so that they potentially report different estimates.

- Suppose estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will communication device 2 report?

1. 6
2. 9
3. 11
4. 12
5. 16

- Suppose estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will the communication device 3 report?

  1. 6
  2. 9
  3. 11
  4. 12
  5. 16

- Which information will be provided to you for every estimation task?

  1. You will see the number X.
  2. You will see the estimates of all estimation devices.
  3. You will see the estimates of the communication devices 1, 2, 3 and 4.

3 Low Complexity Treatments and High-Stakes Treatments

The instructions, control questions, and the decision screen were identical to the baseline treatments expect for the obvious minor changes regarding the number of estimation devices which generated the signals (low complexity treatments) and regarding the payment scheme (high-stakes treatments).

4 Treatment *Many Stimuli*

The instructions for this treatment closely followed those of the baseline correlated treatment, with obvious minor changes regarding the number of estimation devices and how the intermediaries transformed the estimates of the computers into their own reports.

5 Treatment *Alternating*

5.1 Instructions (Paper-Based)

Translated into English.

You will now take part in an economic experiment. You will receive a show-up fee of 4 euros,[7] which will be paid out to you at the end of the experiment. You can earn additional money which will also be paid out at the end of the experiment. How much you earn depends on your decisions. In this experiment, we will talk about points. 100 points correspond to 10 euros. The points you earn during the course of the experiment will be exchanged into euros and paid out at the end of the experiment. During the experiment, communication with other participants is not allowed. The curtain of your cabin must be closed at all times. If you have questions, you can raise your arm out of your cabin and the experimenter will try to answer your questions.

Your task: In this experiment, you will have to solve ten estimation tasks. In these tasks, you will have to estimate how many items a specific imaginary container contains. For example, these items could be peas in a vase or stones in a glass. All estimation tasks are different and entirely independent from each other. Your earnings will depend on how precisely you estimate, i.e., how close your estimate is to the actual number of items in the container. At the end of the experiment, one of the ten tasks will be randomly selected and you will be paid according to the precision of your estimate in this task. This will be explained in more detail in the next section.

Your earnings: In addition to your show-up fee you will be paid according to the precision of your estimates. You receive more money the closer your estimate is to the true number of items in the container. One of the ten estimation tasks will be randomly selected for payment and you will be paid according to the precision of your estimate in that task. This means that every estimate is potentially relevant for your payment, so that you should think about each task carefully. You can earn at most 100 points. You get these 100 points if you get the number of items exactly right. The further away your estimate lies from the true value, the lower will be your earnings. This will be determined according to the following formula:

$$\text{Payment } = 100 - 0.16 \times (\text{Percentage deviation between estimate and true value})^2$$

This means that the deviation (in percent) between your estimate and the true value

[7] *Subjects received an additional 2 euros for filling out the sociodemographic questionnaire after the main part of the experiment.*

will be squared and multiplied by 0.16. This number will then be deducted from the maximum earnings of 100 points. While this formula may look complicated, the underlying principle is very simple: the smaller the difference between your estimate and the true value, the higher your earnings. However, your earnings can never be smaller then zero, i.e., you cannot make losses. Consider the following example: Suppose that the container in question contains 650 items. You would then earn the following amount of points depending on your estimate:

Estimate 0	→ Deviation 100 %	→ Earnings 0 points
Estimate 520	→ Deviation 20 %	→ Earnings 36 points
Estimate 585	→ Deviation 10 %	→ Earnings 84 points
Estimate 650	→ Deviation 0 %	→ Earnings 100 points
Estimate 715	→ Deviation 10 %	→ Earnings 84 points
Estimate 780	→ Deviation 20 %	→ Earnings 36 points
Estimate 1300	→ Deviation 100 %	→ Earnings 0 points

You can see that your earnings only depend on the percentage deviation. For example, it does not matter whether you over- or underestimate the true container content by 10 items.

Information regarding the estimation tasks: You will not see any of the estimation tasks, i.e., you will not see any of these imaginary containers. Instead, for every estimation task, you will receive different computer-generated pieces of information about the correct estimation result. For every task, you will see this information and then enter your own estimate. The information you receive will be explained in detail below.

On computers, we simulate devices which solve exactly the same estimation tasks as you. There are two different types of devices. First, there are devices which themselves provide an estimate of the container content (these devices will be called estimation devices and are denoted by letters). Second, there are devices which observe the estimates of the estimation devices and compute their own estimate from these reports (these devices are referred to as communication devices and denoted by numbers). The role of the communication devices depends on the scenario of the respective estimation task. In total there are two scenarios (scenario I and scenario II) which will be explained to you in more detail below. In some estimation tasks you will find yourself in scenario I, in some estimation tasks you will find yourself in scenario II. Before each estimation task, you will be informed about the prevailing scenario in the current task. It will be

important that you always remember the currently prevailing scenario.

For every estimation task, 10,000 computers (estimation devices) determined their own estimates; the estimates of these devices are completely independent from each other. The devices all have the same quality, i.e., they are equally good in determining estimates. Note that these estimation devices are good at solving these estimation tasks. If these estimation devices would determine a lot of estimates, then the average of these estimates would be correct. Thus, while almost every single estimate will contain an error, the average of these 10,000 estimates will be correct (or very precise). Moreover, many estimates are relatively close to the true value. You will see an illustrative example below.
Summary: (1) The devices make mistakes, but it is much more likely that the estimate is close to the true value, than that it is very far away. (2) The average of these 10,000 estimates is correct. This means that the estimation devices are on average correct.
In the following, we provide you with an example. Again suppose that the container contains 650 items. The following figure then illustrates how often the 10,000 estimation devices give which estimate. You can see that the frequency increases as one approaches the center of the bell curve (the true value 650). Thus, it is much more likely that an estimate is very close to the true value than that it is very far away. You can also infer that the average of all estimates equals 650 and is hence correct.

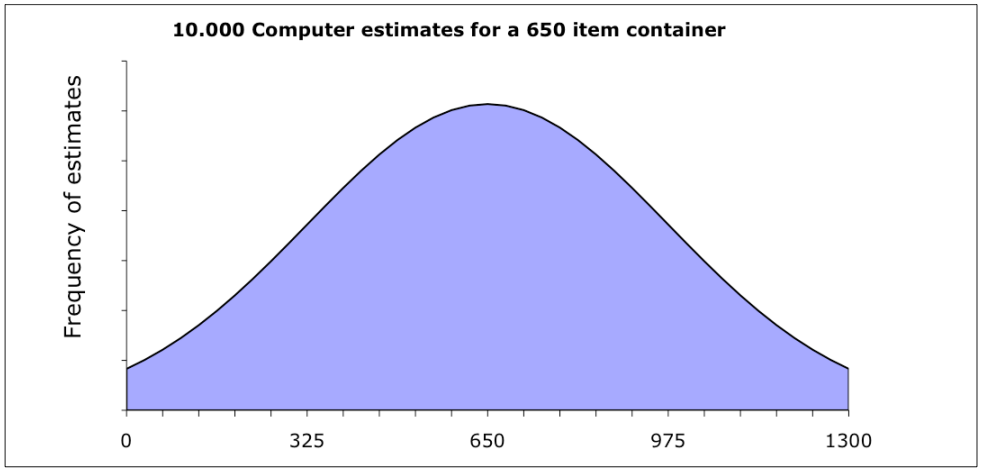

Figure 8: Example: computer estimates for a 650 item container

For every estimation task, out of these 10,000 estimates, a computer randomly chooses the estimates of exactly four estimation devices (A, B, C, D). These four estimates are completely independent from each other.

Apart from the estimation devices, there are also three communication devices (1, 2, 3). The role of these communication devices depends on the respective scenario of the specific estimation task. The scenario differs from task to task. In some tasks you will be in scenario I, in some tasks you will be in scenario II. Before each estimation task you will learn in which scenario you currently are.

In the following you will first be instructed in detail about scenario I. Afterwards you will receive detailed information about scenario II.

Scenario I

In estimation tasks in which you are in scenario I, you will receive the following information about the estimation task as depicted in the following figure.

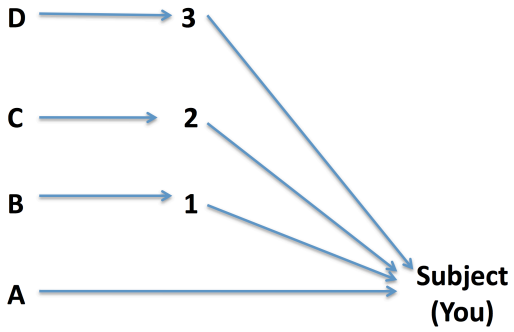

Figure 9: The four estimation devices determine their own estimates. The three communication devices receive the estimate of one estimation device as described by the arrows. They compute their own estimate by adopting the estimate of the estimation device. You will see the estimate of estimation device A as well as of the three communication devices.

This means that in scenario I you will receive the following information: You receive the estimate of estimation device A as well as the estimates of all communication devices. As is evident from the figure, every communication device sees the estimate of one estimation device. As you can see, communication device 1 receives the estimate of estimation device B. Communication device 2 sees the estimate of estimation device C. Communication device 3 sees the estimate of estimation device D. As explained above, the communication device then reports the estimate of the respective estimation device. Summary: You receive the estimate of estimation device A as well as the estimates of the communication devices 1, 2, and 3. In Szenario I, every communication device will obtain the estimate of one estimation device, and the communication device reports this estimate as its own estimate.

The following simple example should illustrate this. Above, we showed you the 10,000 estimates regarding the container which contained 650 items. Imagine now, that out of these the computer randomly chooses the following estimates of the estimation de-

vices:
Estimation device A: 810
Estimation device B: 126
Estimation device C: 1078
Estimation device D: 937
The communication devices each report the estimate of one estimation device as described above. They thus report the following estimates:
Communication device 1: 126
Communication device 2: 1078
Communication device 3: 937
Thus, for this estimation task, in scenario I you would see the following information on your computer screen:
(SCREENSHOT IDENTICAL TO BASELINE CONTROL TREATMENT, BUT IN ADDITION THE RESPECTIVE SCENARIO WAS AGAIN MENTIONED ON THE SCREEN)

Scenario II

In estimation tasks in which you are in scenario II, you will receive the following information about the estimation task as depicted in the following figure.

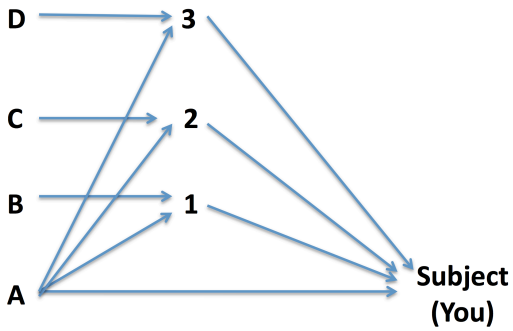

Figure 10: The four estimation devices determine their own estimates. The three communication devices receive the estimate of estimation device A and of one other estimation device, as described by the arrows. They compute their own estimate by taking the average of the two estimates. You will see the estimate of estimation device A as well as of the three communication devices.

This means that in scenario II you will receive the following information: You receive the estimate of estimation device A as well as the estimates of all communication devices. As is evident from the figure, every communication device sees the estimates of estimation device A and of one other estimation device. As you can see, communication device 1 receives the estimates of estimation devices A and B. Communication device 2 sees the estimates of estimation devices A and C. Communication device 3 sees the estimates of estimation devices A and D. As explained above, the communication devices

take the average of these two estimates and report this average as their estimate.
Summary: You receive the estimate of estimation device A as well as the estimates of the communication devices 1, 2, and 3. In scenario II, every communication device learns the estimate of estimation device A and of one other estimation device. The communication device then reports the average of these two estimates and reports this average as an own estimate.

The following simple example should illustrate this. Above, we showed you the 10,000 estimates regarding the container which contained 650 items. Imagine now, that out of these the computer randomly chooses the following estimates of the estimation devices:
Estimation device A: 810
Estimation device B: 126
Estimation device C: 1078
Estimation device D: 937
The communication devices take the averages of two of these estimates as described above. They then report the following estimates:
Communication device 1: 468
Communication device 2: 944
Communication device 3: 873.5
Thus, for this estimation task, in scenario II you would see the following information on your computer screen:
(SCREENSHOT IDENTICAL TO BASELINE CORRELATED TREATMENT, BUT IN ADDITION THE RESPECTIVE SCENARIO WAS AGAIN MENTIONED ON THE SCREEN)

You can se that the key difference between scenario I and scenario II concerns the way the communication devices compute their estimates. In scenario I, each communication device reports the estimate of one other estimation device. In scenario II, the communication devices compute the average of the estimate of estimation device A and the estimate of one other estimation device and report this average. Before each estimation task, you will be informed about the scenario prevailing in the respective task.

Please read these instructions again carefully. At the end of these instructions you will find a separate sheet again summarizing the two scenarios. The experimenter will read out a short summary of the instructions. Afterwards, you will answer a set of control questions at the computer in order to check your understanding of the instructions.

5.2 Summary (Read out aloud by experimenter)

- In this experiment you will face 10 different estimations tasks.
- At the end of the experiment one of the 10 rounds will be randomly picked to determine your earnings. Your earnings depend on how precise your answer in the estimation task was, i.e., how close it was to the correct value. Since all of the 10 estimation tasks are potentially payoff-relevant you should answer carefully in all rounds.
- You will not actually see the estimation tasks. Instead, you will be provided with computer-generated information regarding the solution of the estimation tasks.
- The structure of the information will be as follows: In each round, four estimation devices that try to solve your estimation task will be randomly picked. These devices are always equally good at solving the task. Every device provides an own estimate.
- In addition, there are three communication devices which process the estimates they observe from the estimation devices and then report an estimate derived from these estimates.
- The specific way the communication devices observe estimates from estimation devices and transform them into own estimates depends on the scenario of the respective estimation round.
- There are two scenarios, scenario I and scenario II. Before each estimation task you will learn about the currently prevailing scenario.
- Please take a look at figure 2 and figure 3 in your instructions again. There you can see for scenario 1 and scenario 2 respectively which estimates the respective communication devices observe, how they are processed and how they map into the estimate the respective communication device reports.
- For each estimation task, you receive the following information: You will see the estimate from estimation device A as well as the estimates from communication devices 1, 2, and 3.
- After observing this information, you will then be given 5 minutes to think about an own estimate and to enter it into your computer.

5.3 Control Questions (Computerized)

Questions 1-4 as in the individual baseline conditions

- When will you be informed of the prevailing scenario?

    1. I will never actually know the current scenario, but will have to guess it.
    2. I will be informed of the currently prevailing scenario right before each new estimation task.

- Suppose you are in scenario II. Estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will communication device 1 report?

    1. 6
    2. 9
    3. 11
    4. 12

- Suppose you are in scenario II. Estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will communication device 2 report?

    1. 6
    2. 9
    3. 11
    4. 12

- Suppose you are in scneario I. Estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will communication device 1 report?

    1. 6
    2. 9
    3. 12
    4. 16

- Suppose you are in scenario I. Estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16. Which estimate will the communication device 2 report?

1. 6
2. 9
3. 12
4. 16

- Suppose estimation device A estimates 20 and estimation device B estimates 30. Which estimates will communication device 2 report, depending on the prevailing scenario?

    1. The communication device will report 25 in both scenarios.
    2. The communication device will report 25 in scenario I and 30 in scenario II.
    3. The communication device will report 30 in scenario I and 25 in scenario II.

Final question as question 9 as in the individual baseline condition

6 Treatment *Math*

The instruction and control questions for this treatment largely followed the baseline condition, except that we included very salient hints at multiple places which told subjects that the best problem-solving strategy consists of computing the average of the estimates of the four estimation devices. For instance, at the very end of the instructions, we included the following hint:

Important hint:
Reminder: The best estimate you can provide based on your information consists of computing the average of the estimates of the four estimation devices A, B, C, and D. Thus, in each round, you should try to determine this average.

Likewise, the oral instructions emphasized this aspect. We also included an additional control question:

Which problem-solving strategy should you pursue?

1. I should try to compute the average of the estimates of the communication devices.
2. I should try to compute the average of the estimates of the four estimation devices.
3. I should combine the communication and estimation devices.

7 Treatment *Face Value*

7.1 Instructions (Paper-Based)

Translated into English

You will now take part in an economic experiment. You will receive a show-up fee of 4 euros,[8] which will be paid out to you at the end of the experiment. You can earn additional money which will also be paid out at the end of the experiment. How much you earn depends on your decisions. In this experiment, we will talk about points. 100 points correspond to 10 euros. The points you earn during the course of the experiment will be exchanged into euros and paid out at the end of the experiment. During the experiment, communication with other participants is not allowed. The curtain of your cabin must be closed at all times. If you have questions, you can raise your arm out of your cabin and the experimenter will try to answer your questions.

Your task: In this experiment, you will have to solve ten estimation tasks. In these tasks, you will have to estimate how many items a specific imaginary container contains. For example, these items could be peas in a vase or stones in a glass. All estimation tasks are different and entirely independent from each other. Your earnings will depend on how precisely you estimate, i.e., how close your estimate is to the actual number of items in the container. At the end of the experiment, one of the ten tasks will be randomly selected and you will be paid according to the precision of your estimate in this task. This will be explained in more detail in the next section.

Your earnings: In addition to your show-up fee you will be paid according to the precision of your estimates. You receive more money the closer your estimate is to the true number of items in the container. One of the ten estimation tasks will be randomly selected for payment and you will be paid according to the precision of your estimate in that task. This means that every estimate is potentially relevant for your payment, so that you should think about each task carefully. You can earn at most 100 points. You get these 100 points if you get the number of items exactly right. The further away your estimate lies from the true value, the lower will be your earnings. This will be determined according to the following formula:

$$\text{Payment} = 100 - 0.16 \times (\text{Percentage deviation between estimate and true value})^2$$

This means that the percentage deviation (in percent) between your estimate and the true value will be squared and multiplied by 0.16. This number will then be deducted

[8] *Subjects received an additional 2 euros for filling out the sociodemographic questionnaire after the main part of the experiment.*

from the maximum earnings of 100 points. While this formula may look complicated, the underlying principle is very simple: the smaller the difference between your estimate and the true value, the higher your earnings. However, your earnings can never be smaller then zero, i.e., you cannot make losses. Consider the following example: Suppose that the container in question contains 650 items. You would then earn the following amount of points depending on your estimate:

Estimate 0	→ Deviation 100 %	→ Earnings 0 points
Estimate 520	→ Deviation 20 %	→ Earnings 36 points
Estimate 585	→ Deviation 10 %	→ Earnings 84 points
Estimate 650	→ Deviation 0 %	→ Earnings 100 points
Estimate 715	→ Deviation 10 %	→ Earnings 84 points
Estimate 780	→ Deviation 20 %	→ Earnings 36 points
Estimate 1300	→ Deviation 100 %	→ Earnings 0 points

You can see that your earnings only depend on the percentage deviation. For example, it does not matter whether you over- or underestimate the true container content by 10 items.

Information regarding the estimation tasks: You will not see any of the estimation tasks, i.e., you will not see any of these imaginary containers. Instead, for every estimation task, you will receive different computer-generated pieces of information about the correct estimation result. For every task, you will see this information and then enter your own estimate. The information you receive will be explained in detail below.

On computers, we simulate devices which solve exactly the same estimation tasks as you. There are three different types of devices. First, there are devices which themselves provide an estimate of the container content (these devices will be called estimation devices and are denoted by letters). Second, there are devices which observe the estimates of the estimation devices and compute their own estimate from these reports (these devices are referred to as communication devices and denoted by numbers). Finally, there are machines, that are denoted by letter-number-combinations. These machines each take an estimate from a communication device, add a number X, and then report the resulting value. The number X, however, is not related to the correct solution of the task.

For every estimation task, 10,000 computers (estimation devices) determined their own estimates; the estimates of these devices are completely independent from each other.

The devices all have the same quality, i.e., they are equally good in determining estimates. Note that these estimation devices are good at solving these estimation tasks. If these estimation devices would determine a lot of estimates, then the average of these estimates would be correct. Thus, while almost every single estimate will contain an error, the average of these 10,000 estimates will be correct (or very precise). Moreover, many estimates are relatively close to the true value. You will see an illustrative example below.
Summary: (1) The devices make mistakes, but it is much more likely that the estimate is close to the true value, than that it is very far away. (2) The average of these 10,000 estimates is correct. This means that the estimation devices are on average correct (or very precise).
In the following, we provide you with an example. Again suppose that the container contains 650 items. The following figure then illustrates how often the 10,000 estimation devices give which estimate. You can see that the frequency increases as one approaches the center of the bell curve (the true value 650). Thus, it is much more likely that an estimate is very close to the true value than that it is very far away. You can also infer that the average of all estimates equals 650 and is hence correct.

SUBJECTS WERE SHOWN THE SAME FIGURE AS IN THE BASELINE INSTRUCTIONS

For every estimation task, out of these 10,000 estimates, a computer randomly chooses the estimates of exactly four estimation devices (A, B, C, D). These four estimates are completely independent from each other.
Apart from the estimation devices, there are also three communication devices (1, 2, 3) and three machines (M1, M2, M3).
The communication devices always observe two estimation devices and compute an estimate from these observed estimates. To be more precise, they do this by taking the average of the respective two estimates. They then report this average to the machines, as we explain in the following.
The machines each see the estimate of one of the intermediaries, and add a number X. The machines then report this sum, i.e., the sum of the estimate of the intermediary and the number X. Please note that this number X is unrelated to the solution of the task. You will know the number X.

You will receive the following information as described below.

SUBJECTS SAW A FIGURE SIMILAR TO THE BASELINE CORRELATED INSTRUC-

TIONS, WITH THE DIFFERENCE THAT THIS FIGURE ALSO INCLUDED THE MACHINES (SEE ALSO FIGURE 6 IN THE MAIN TEXT).

This means that you will receive the following information: You receive the estimate of estimation device A as well as the values of all machines. As is evident from the figure, every communication device sees the estimates of estimation device A and of one other estimation device. As you can see, communication device 1 receives the estimates of estimation devices A and B. Communication device 2 sees the estimates of estimation devices A and C. Communication device 3 sees the estimates of estimation devices A and D. As explained above, the communication devices take the average of these two estimates and report this average as their estimate.
As you can see from the figure, every machine sees the estimate of one of the communication devices. Machine M1 observes the estimate of communication device 1, machine M2 sees the estimate of communication device 2 and machine M3 observes the estimate of communication device 3. The machines then add the number X to the estimate they observe from the respective communication device. This number X is unrelated to the solution of the task and can also take negative values.

Summary: You receive the estimate of estimation device A as well as the estimates of the machines M1, M2, and M3. In addition the number X will be known to you.
While, in each round, you will see the estimate of estimation device A as well as the estimates of the machines M1, M2, and M3 on you computer screen, the following table already informs you about the value that the number X will take in each round.

Round	Number X
Round 1	3126
Round 2	-34
Round 3	35427
Round 4	4269
Round 5	54
Round 6	14895
Round 7	-90
Round 8	-6
Round 9	-1794
Round 10	192

The following simple example illustrates this. Above, we showed you the 10,000 estimates regarding the container which contained 650 items. Now imagine that out of these estimates a computer randomly chooses the following estimates of the estimation devices:

Estimation device A: 810
Estimation device B: 126
Estimation device C: 1078
Estimation device D: 937
The communication devices take the averages of two of these estimates as described above. They then report the following estimates:
Communication device 1: 468
Communication device 2: 944
Communication device 3: 873.5
The machines then each see the estimate of one of the communication devices as described above. They then add the number X to this estimate. Let's assume we are in round 1, such that the number X would be 3126. The machines would then report the following values:
Machine M1: 3594
Machine M2: 4070
Machine M3: 3999.5

Thus, for this estimation task, you would see the following information on your computer screen:

SUBJECTS SAW A SCREENSHOT SIMILAR TO THE ONE DISPLAYED IN THE BASELINE INSTRUCTIONS

Please read these instructions again carefully. The experimenter will read out a summary of the instructions shortly. Afterwards, you will answer a set of control questions at the computer in order to check your understanding of the instructions.

7.2 Summary (read out aloud by experimenter)

- In this experiment you will face 10 different estimations tasks.
- At the end of the experiment one of the 10 rounds will be randomly picked to determine your earnings. Your earnings depend on how precise your answer in the estimation task was, i.e., how close it was to the correct value. Since all of the 10 estimation tasks are potentially payoff-relevant you should answer carefully in all rounds.
- You will not actually see the estimation tasks. Instead, you will be provided with computer-generated information regarding the solution of the estimation tasks.

- The structure of the information will be as follows: In each round, four estimation devices that try to solve your estimation task will be randomly picked. These devices are always equally good at solving the task. Every device provides an own estimate.
- In addition, there are three communication devices which process the estimates they observe from the estimation devices and then report an estimate derived from these estimates.
- These estimates are then reported to the machines.
- Please take a look at figure 2 in your instructions again.
- The machines then add a number X to the estimate they observe from the communication devices.
- You can see the value of the number X for each estimation task in the table on page 6.
- For each estimation task, you receive the following information: You will see the estimate from estimation device A as well as the estimates from the machines M1, M2, and M3.
- After observing this information, you will then be given 5 minutes to think about an own estimate and to enter it into your computer.

7.3 Control Questions (Computerized)

Questions 1-3 as in the individual baseline conditions

- Which of the following statements about the estimation devices is correct?
    1. The estimates of the estimation devices are unrelated to the solution of the task.
    2. The estimation devices are good at solving the task.
- Which of the following statements about the number X is correct?
    1. The number X is unrelated to the solution of the task.
    2. The number X is on average correct.
- What happens with the number X?

1. Machines 1, 2, 3 add the number X to the estimate they observe from the respective communication device.
2. Nothing happens with the number X.

- Which of the following statements is correct?

1. If estimation device B reports an estimate of 3160, then all other estimation devices will also report an estimate of 3160.
2. The estimates of the estimation devices are independent of each other, so that they potentially report different estimates.

- Suppose, estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16 and the number X is 8. Which estimate will communication device 1 report to machine M1?

1. 6
2. 9
3. 10
4. 11

- Suppose, estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16 and the number X is 8. Which estimate will communication device 2 report to machine M2?

1. 6
2. 9
3. 10
4. 11

- Suppose, estimation device A estimates 6. Estimation device B estimates 12 and estimation device C 16 and the number X is 8. Which estimate will machine M1 report?

1. 6
2. 8
3. 10
4. 12
5. 17

- Which information will be provided to you for every estimation task?

    1. You will see the estimation task, i.e., you will see the respective container.
    2. You will see the estimates of all estimation devices.
    3. You will see the estimate of estimation device A as well as the estimates of the machines M1, M2, and M3. You will also know the actual value of the number X.

8 Treatment *Multiply*

The instructions for this treatment closely followed those of the uncorrelated treatment, with obvious minor changes regarding how the intermediaries transformed the estimates of the computers into their own reports. These instructions are available upon request.

9 Market Treatments

9.1 Instructions (Paper-Based)

Translated into English - We present here the version from the correlated market treatment. All parts where instructions differed between the correlated and the uncorrelated treatment are already outlined in the instructions of the individual decision making treatments (see above). Instructions in the market treatments partly differed depending on the role (buyer or seller). Whenever that was the case, we first provide the version for the sellers, followed by the respective part for the buyers.

You will now take part in an economic experiment. You will receive a show-up fee of 4 euros[9] which will be paid out to you at the end of the experiment. You can earn additional money which will also be paid out at the end of the experiment. How much you earn depends on your decisions. In this experiment, we will talk about points. At the end of the experiment, the points you earned will be exchanged into euros at a certain exchange-rate. This is explained in more detail below. During the experiment, communication with other participants is not allowed. The curtain of your cabin must be closed at all times. If you have questions, you can raise your arm out of your cabin, and the experimenter will try to answer your questions.

[9] *Subjects received an additional 2 euros for filling out the sociodemographic questionnaire after the main part of the experiment.*

The Experiment: In this experiment, you, together with 7 other randomly selected participants, will form a market. In this market, 4 buyers and 4 sellers trade certain goods in a total of 10 trading rounds. At the beginning of each trading round, each seller owns 4 goods which he can sell to the buyers. Every buyer has a budget in each round from which he can buy goods from the sellers. In this experiment you are a (SELLER/BUYER). In the following, all the details of the experiment will be explained.

The Trading Goods: The goods that are traded are imaginary containers which contain a certain number of items. The value of the containers differs from round to round. For all participants (buyers and sellers) the value per container in a particular round depends on the number of items a container contains in that round. More precisely, the value of a container in points in a particular round exactly equals the number of items the container contains.

Please note: You will not know the exact value of the containers, i.e., the number of items a container contains. Instead, before each trading round, you will receive some information regarding the number of items the containers contain in that round. On the basis of this information, you will then have time to form an opinion about the value of the containers (in points) in that round. This will be one of the most important tasks for you during this experiment, as will be explained in more detail below.

Trade: (SELLERS) As already mentioned, you are in the role of a seller. At the beginning of each trading period you own 4 containers, which you can sell to buyers if you want to. There are two ways to sell containers.

1. You can post selling prices. To do so, you need to enter a selling price, at which you are willing to sell a container. If a buyer accepts your selling price, you sell him the container at that price. In total, you have 4 containers which you can sell. You can post new selling prices any time you want to (as long as you still have containers to sell). Note, however, that every new selling price you post must be below all other selling prices that are currently posted in the market.

2. You can accept buying offers from the buyers. In case you accept a buying price offered from a buyer, you sell him a container at that price. You can of course only accept buying offers as long as you have containers left to sell.

(BUYER) As already mentioned, you are in the role of a buyer. At the beginning of each trading period, you have a budget, from which you can buy containers from sellers if you want to. There are two ways to buy containers.

1. You can post buying prices. To do so, you need to enter a buying price, at which you are willing to buy a container. If a seller accepts your buying price, you buy

a container from him at that price. You have a budget, from which you can buy containers if you want to. You can post new buying prices any time you want to (as long as you still have enough budget to do so). Note, however, that every new buying price you post must be above all other buying prices that are currently posted in the market.

2. You can accept selling offers from the sellers. In case you accept a selling price offered from a seller, you buy a container from him at that price. You can of course only accept selling offers as long as you have a sufficient budget.

Earnings per round: (SELLER) Your earnings in points for each trading round are determined as follows:

Proceeds of containers sold + Value of the containers you own

Assume for example that in a particular round each container contained 1500 items, so that the true value of each container was 1500 points. Assume that in this round you sold one container for 1550 points. Your earnings would then equal:

1550 (*proceeds from selling*) + 3× 1500 (*value of containers you owned at end of round*)

Assume instead that you had sold one container for 1600, one for 1450 and one for 1530 points. Your earnings from that round would then be:

1600 + 1450 + 1530 (*proceeds from selling*) + 1500 (*value of containers you owned at end of round*)

As you can see, your earnings as a seller increase if you sell a container at a price which is above the true value of the container. Your earnings as a seller decrease if you sell a container at a price below the true value of the container. Note again that you will not know the true value of the containers. Instead, you will receive some helpful information about the true value at the beginning of each round. On the basis of this information, you can then think about and form an estimate about the true value of the containers in that round. Your assessment of the true value of the assets is very important. You should sell containers when the price is above your estimate of the value of the containers. On the other hand, you should not sell when the price is below your estimate of the actual value.

(BUYER) Your earnings in points for each trading round are determined as follows:

Budget - Costs of containers bought + Value of containers bought

Assume for example that in a particular round each container contained 1500 items, so that the true value of each container was 1500 points. Your budget was 10000 points. Assume that in this round you bought one container for 1450 points. Your earnings would then equal:

10000 - 1450 (*costs of buying*) + 1500 (*value of containers bought*)

Assume instead that you had bought one container for 1600, one for 1450 and one for 1330 points. Your earnings from that round would then be:

10000 - (1600 + 1450 + 1330) (*costs of buying*) + 3× 1500 (*value of containers bought*)

As you can see, your earnings as a buyer increase if you buy a container at a price which is below the true value of the container. Your earnings as a buyer decrease if you buy a container at a price above the true value of the container. Note again that you will not know the true value of the containers. Instead, you will receive some helpful information about the true value at the beginning of each round. On the basis of this information, you can then think about and form an estimate about the true value of the containers in that round. Your assessment of the true value of the assets is very important. You should buy containers when the price is below your assessment of the value of the containers. On the other hand, you should not buy when the price is above your estimate of the true value.

At the end of the experiment, one of the 10 trading rounds will be randomly selected for payment. Thus, you should take your decisions in all trading rounds carefully, since all trading rounds could potentially be relevant for your earnings.

(BUYERS) Please note that at the end of each trading period we will deduct 10 % of your initial budget from your profits. This is merely intended to scale profits and is of no intrinsic importance to you.

(BOTH) Please also note the following: The number of items in the containers, i.e.,

the true value of the containers, varies from period to period (as was already mentioned). In order to keep the potential earnings in each round similar, the exchange-rate between points and euros differs between rounds. In addition, the budget of the buyers changes from round to round. At the end of these instructions you find a table, in which the exchange-rate points/euros is given for every trading round. While this table might look complicated, it is actually not of great importance for you. (SELLER) Your goal in every period should be to maximize earnings, by selling containers at prices above your assessment of the value of the containers. (BUYER) Your goal in every period should be to maximize earnings, by buying containers at prices below your assessment of the value of the containers.

Procedure of a trading round: In the following, we explain in detail how each trading round proceeds. Every trading round consists of 2 phases:

1. In phase 1, you will receive information about the number of items in the containers of the respective round, i.e., about the true value of the containers in points. Then you will have 5 minutes to think about and assess the value of the containers in that round. This phase is important, as it allows you to assess the true value of the trading goods of the respective round.

2. In phase 2 you can trade the containers, together with 7 other randomly selected participants. Trading will end after four minutes.

Phase 1 - Information about the value of the containers: In every round you will receive some information about the actual number of items in the containers of that round, i.e., about the true value of the containers in that round in points. In every round you will receive this information and you will then be asked to state an estimate of the true value of the containers. This estimate can later be helpful for your trading activities. In the following, you will be explained in more detail what kind of information you will receive.

On computers, we simulate devices that give estimates about the actual number of items in a container...

SUBJECTS NOW RECEIVED EXACTLY THE SAME INFORMATION AS IN THE INDIVIDUAL TREATMENTS (SEE ABOVE).

Thus, in every trading round, you will receive information about the actual number of items in the containers (value of the containers in points). You will have 5 minutes to form an estimate about the value of the containers which you should then enter into the computer. In addition, we will distribute a (paper-based) table in which you can (if you want to) enter your estimate for each round in order to support your trading activities.

In the following, we show you an example of how the computer screen in phase 1 will look like:

COMPUTER SCREEN IDENTICAL TO DECISION SCREEN IN INDIVIDUAL TREATMENTS

As already mentioned, phase 1 is supposed to facilitate subsequent trading activities, as it allows you to think about the value of the containers. We thus recommend that you write down your estimate before trading starts.

Phase 2 - Trading: (SELLER) After you have received the information about the value of the containers in the respective period, trading begins. You are in the role of a seller. As such, you own 4 containers, which you can sell if you want to. Trading lasts for 4 minutes. As already explained, there are two ways to sell containers: (1) You can post selling prices which can then be accepted by buyers; (2) You can accept buying offers from the buyers.

The following provides an example of the decision screen that you will see while trading:

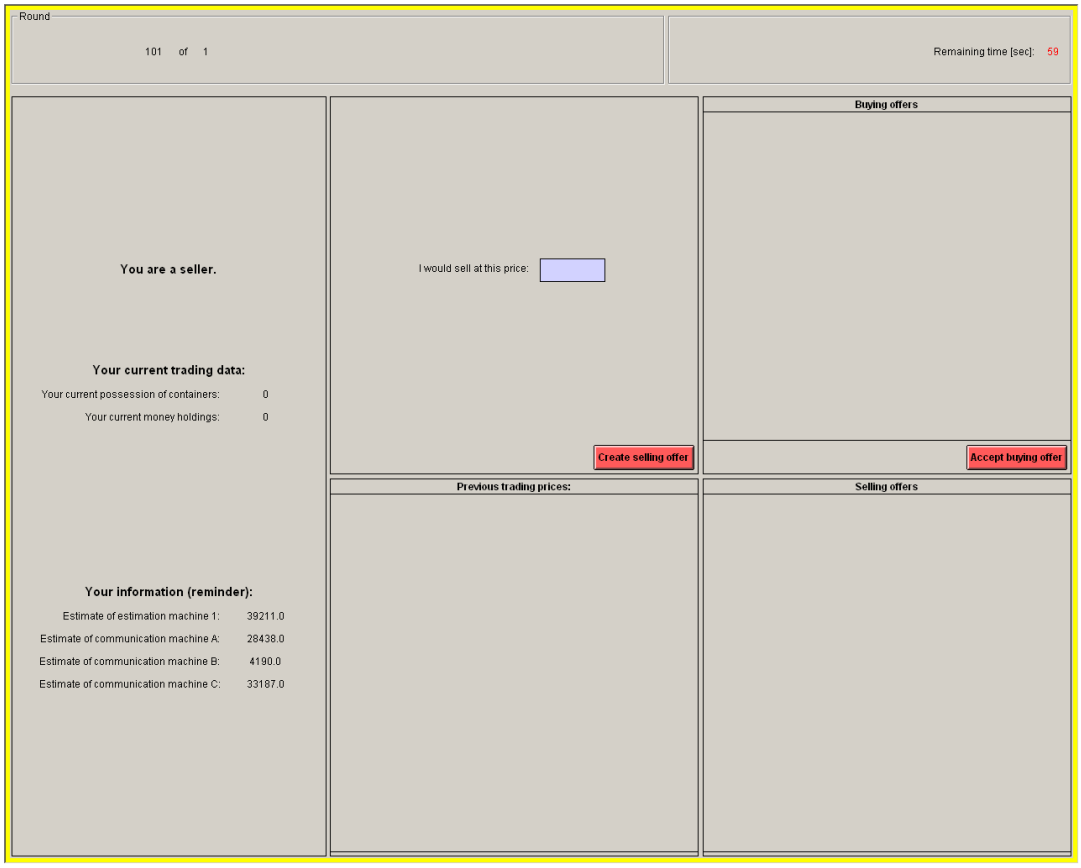

Figure 11: Trading decision screen for sellers

In the left column of the screen you see your current stock of containers as well as your money holdings. At the beginning of each trading period you have four containers in your stock and your money holdings are 0. Now assume for example that you would sell a container for 25000 points. Then your money holdings would increase to 25000 and your stock of containers would be reduced to 3.

In the upper panel of the middle column, you can enter selling prices. Here, the following points are important to note:

- In order to post a selling price, you simply need to enter a price in points at which your are willing to sell a container in the respective window (decimals must be separated by a point). As soon as you click “Create selling offer", your offer will be posted to the other market participants. Therefore, you should verify your offer before you click the “Create selling offer" button.

- Note that every new selling offer must be below the lowest selling offer that is currently posted in the market. Thus, your offers must always lie below the current offers of the other sellers in the market.

- The selling price you post appears on the screens of the buyers. In addition, it appears in the lower panel of the right column of your screen. There, you can see all current selling offers in the market.

- If a buyer accepts your selling offer, you sell him the container at the price you posted, and your selling offer disappears.

- Note that when a buyer accepts one of your offers, then all your other selling offers in the market disappear as well.

- You can post as many selling offers as you wish, as long as you have containers in your stock.

In the upper panel of the right column of the screen you see the buying offers of the buyers in the market. You can accept a buying offer by first clicking on the respective offer and then clicking the “Accept buying offer" button. Here, the following points are important to note:

- In case you accept a buying offer, you sell a container to the buyer at the price offered by the buyer.

- You can only accept buying offers as long as you have containers in your stock.

- Note that once you accept a buying offer, all your current selling offers disappear.

In the lower panel of the middle column you see a list of prices at which trades have been conducted so far in the current period. In total, each trading period lasts for 4 minutes.

(BUYER) After you have received the information about the value of the containers in the respective period, trading begins. You are in the role of a buyer. As such, you have a budget, from which you can buy containers if you want to. Trading lasts for 4 minutes. As already explained, there are two ways to buy containers: (1) You can post buying prices which then can be accepted by sellers; (2) You can accept selling offers from the sellers.

The following provides an example of the decision screen that you will see while trading:

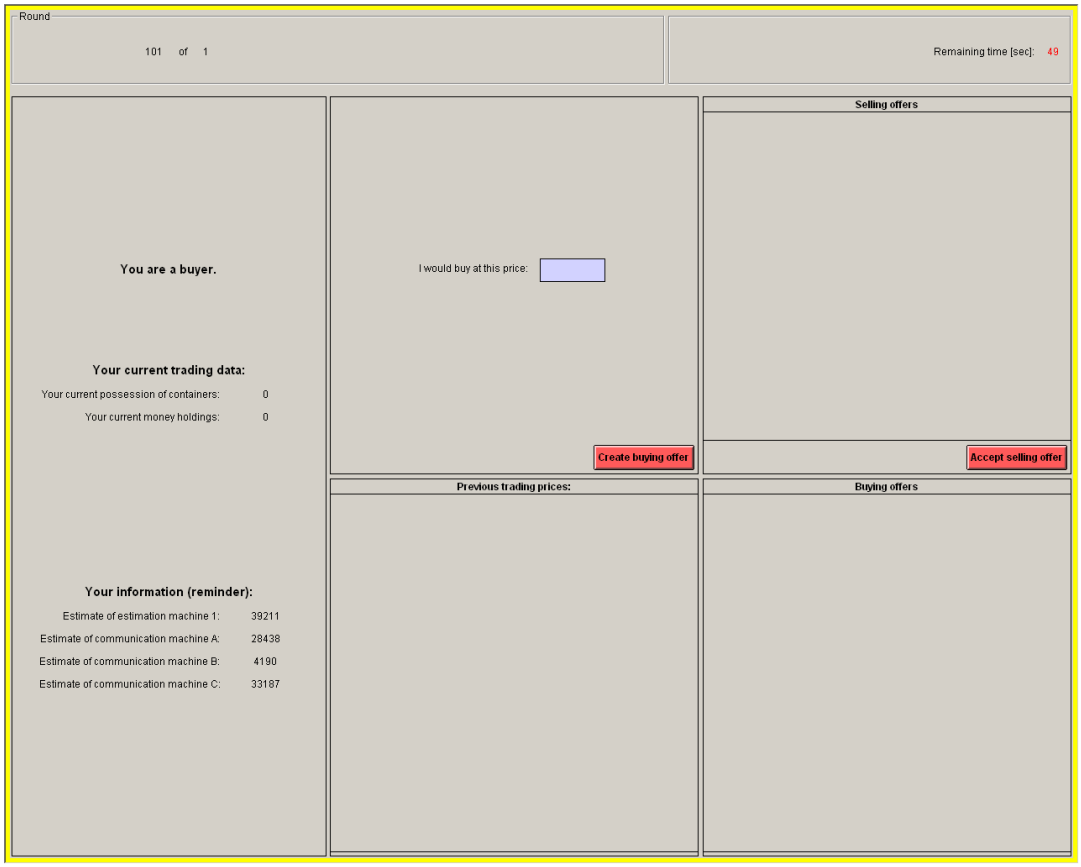

Figure 12: Trading decision screen for buyers

In the left column of the screen you see your current budget and the containers you own. At the beginning of each trading period, you own a certain budget and you own 0 containers. Now assume for example that you would buy a container for 25000 points.

Then your budget would decrease by 25000 points and your stock of containers would be increased to 1.

In the upper panel of the middle column you can enter buying prices. Here, the following points are important to note:

- In order to post a buying price, you simply need to enter a price in points at which your are willing to buy a container in the respective window (decimals must be separated by a point). As soon as you click “Create buying offer", your offer will be posted to the other market participants. Therefore, you should verify your offer before you click the “Create buying offer" button.

- Note that every new buying offer must be above the highest buying offer that is currently posted in the market. Thus, your offers must always lie above the current offers of the other buyers in the market.

- The buying price you post appears on the screens of the sellers. In addition, it appears in the lower panel of the right column of your screen. There you can see all current buying offers in the market.

- If a seller accepts your buying offer, you buy from him a container at the price you posted and your buying offer disappears.

- Note that when a seller accepts one of your offers, then all your other buying offers in the market disappear as well.

- You can post as many buying offers as you wish, as long as you have a sufficient budget.

In the upper panel of the right column of the screen, you see the selling offers of the sellers in the market. You can accept a selling offer by first clicking on the respective offer and then clicking the “Accept selling offer" button. Here, the following points are important to note:

- In case you accept a selling offer, you buy a container from the seller at the price offered by the seller.

- You can only accept selling offers as long as you have a sufficient budget.

- Note that once you accept a selling offer, all your current buying offers disappear.

In the lower panel of the middle column you see a list of prices, at which trades have been conducted so far in the current period. In total, in each period, trading lasts

for 4 minutes.

Final screen: (SELLER) After each trading round, you will see a screen that provides your earnings from the respective round, as well as the actual number of items in the containers of that round.

Your earnings - as already mentioned - are determined as follows:

Earnings (in points) = Earnings from containers sold + Value of containers not sold

Earnings (in euros) = (Earnings (in points))/(Exchange rate of respective round (see table below))

(BUYER) After each trading round, you will see a screen that provides your earnings from the respective round, as well as the actual number of items in the containers of that round.

Your earnings - as already mentioned - are determined as follows:

Earnings (in points) = Budget left + Value of containers bought

Earnings (in euros) = (Earnings (in points))/(Exchange rate of respective round (see table below))

Next, the experimenter will read aloud a summary of the instructions. Then, you will have to answer a series of control questions to verify your understanding of the instructions. Afterwards, there will be a test round that should allow you to familiarize yourself with the experiment. Then the experiment begins.

Table with exchange rates by trading round:

1. 1 euro = 3333.34 points
2. 1 euro = 30 points
3. 1 euro = 13333.34 points
4. 1 euro = 1666.67 points
5. 1 euro = 100 points
6. 1 euro = 6000 points

7. 1 euro = 333.34 points
8. 1 euro = 2.67 points
9. 1 euro = 3333.34 points
10. 1 euro = 200 points

9.2 Summary (read out aloud by experimenter)

- In this experiment, you together with 7 other randomly determined participants, will form a market. In this market, 4 buyers and 4 sellers can trade certain goods.
- In total, there will be 10 trading rounds, out of which one will be randomly selected at the end of the experiment and will be payoff-relevant.
- You will trade containers whose value depends on the number of items the containers contain. The value of the containers differs from round to round.
- You will not know the value of the goods, i.e., the actual number of items the containers contain. Instead, you will receive computer-generated information concerning the value of the goods.
- The structure of the information will be as follows: In each round, four estimation devices that try to estimate the actual number of items in the containers will be randomly picked. These devices are always equally good at solving the task. Every device provides an own estimate.
- In addition, there are three communication devices which process the estimates they observe from the estimation devices and then report an estimate determined from these.
- Please take a look at figure 2 in your instructions again. There you can see which estimates the respective communication devices observe, how they are processed and how they map into the estimate the respective communication device reports.
- For each estimation task, you receive the following information: You see the estimate from estimation device A as well as the estimates from communication devices 1, 2, and 3.
- In every round, after observing this information, you will then be given 5 minutes to think about an own estimate and to enter it into your computer. Then trading begins, which always lasts for 4 minutes.

9.3 Control Questions (Computerized)

- In this experiment, you will take part in ten trading rounds. Which of these rounds will be relevant for your profit?

    1. At the end of the experiment, one trading round will be randomly selected. Profits will be paid out according to performance in this round.
    2. None of the trading rounds will be paid out.
    3. At the end of the experiment, three trading rounds will be randomly selected. Profits will be paid out according to performance in these rounds.
    4. All trading rounds will be paid out.

- Your profit in this experiment depends on how many containers and how much money you own at the end of a trading period. What can you say about your profit?

    1. My profit from a trading round will be adjusted by the respective round's exchange rate.
    2. The content of a container equals my profit in euros.

Questions 3-9 as in the individual treatments.

- (SELLER) Which of the following statements is correct?

    1. In the beginning of a trading round, I own four containers of which I must sell at least one.
    2. In the beginning of a trading round, I own four containers, all of which I can keep if I choose to do so.
    3. In the end, I will only get money if I sell a container.

- (BUYER) Which of the following statements is correct?

    1. In the beginning of a trading round, I own no containers and I must buy at least one.
    2. It the beginning of a trading round, I own no containers and I do not have to buy any if I choose to do so.
    3. In the end, I will only get money if I own a container.

- (SELLER) Which of the following statements is correct?

1. I increase my profits if I sell a container at a price which is higher than the number of items in the container.
2. If I hold money at the end of a period, this does not contribute to my profits.
3. I should definitely sell all my containers because I will not get any money for them at the end of the experiment.

- (BUYER) Which of the following statements is correct?

  1. I increase my profits if I buy a container at a price which is lower than the number of items in the container.
  2. If I hold money at the end of a period, this does not contribute to my profits.
  3. I should definitely buy as many containers as possible because I will not get any money for my money holdings at the end of the experiment.

- (SELLER) Which actions can you take in the course of a trading period?

  1. I can only accept buying offers by the buyers.
  2. I can only set my selling offers.
  3. I can accept buying offers as well as post selling offers.

- (BUYER) Which actions can you take in the course of a trading period?

  1. I can only accept selling offers by the sellers.
  2. I can only set my buying offers.
  3. I can accept selling offers as well as post buying offers.

- (SELLER) What do you need to keep in mind when posting selling offers?

  1. My selling offer must be higher than the highest previous selling offer.
  2. My selling offer must be lower than the lowest previous selling offer.

- (BUYER) What do you need to keep in mind when posting buying offers?

  1. My buying offer must be higher than the highest previous buying offer.
  2. My buying offer must be lower than the lowest previous buying offer.

Before each trading round, subjects then saw a screen describing the computer estimates (see the individual treatments). Afterwards, all subjects were presented a screen which contained information on how many containers each seller owned (always four) and which budget each buyer was endowed with.