

**Online Appendix of**  
**“Social and Strategic Ambiguity versus Betrayal Aversion”**

Chen Li, Uyanga Turmunkh, & Peter P. Wakker

March, 2020

## Appendix A. Instructions and structure of the experiment

The experiment of this paper was computer-based. This appendix presents the instructions and the structure of the experiment. A concise presentation can be found in Fig. 5 of the paper.

### Step 0. Distribution of sealed envelopes

The experiment was incentivized using a modification of the prior incentive system (Prince; Johnson et al. 2018). At the beginning of each session with  $n$  subjects, one volunteer was invited to randomly select  $n/2$  pairs of sealed envelopes.<sup>1</sup> The envelopes in the selected pile were unpaired by the experimenter by removing the clips holding each pair together. Each subject would then draw one envelope from the pile. Each subject's ID number was written on the outside of the sealed envelope drawn by the subject.

---

<sup>1</sup> The experiment involved three treatments, each corresponding to one of three ambiguity types that subjects faced: nature, social, and betrayal ambiguity. Subjects in the social and betrayal ambiguity treatments were assigned an anonymous partner (a fellow subject) at the start of the experiment. The partner assignment was implemented by pairing the envelopes. In the nature ambiguity treatment, subjects did not need to be assigned a partner. Thus, the  $n$  sealed envelopes selected by a volunteer at the start of the session involving nature ambiguity were not paired.

## Step 1. General instructions

Subjects began the experiment by entering their subject ID numbers and were presented with the general instructions informing them about the incentive mechanism (shown below).

### Welcome

You have just received a sealed envelope, not to be opened yet. It will be opened by the experimenters at the end of the experiment.

#### What is inside your envelope?

Inside your envelope there is a list of different (payment) options. One option from this list will be given to you for real. For example, one option in the list may be “Pay €15 to you” and a second option may be “Pay €15 to you with a 50% chance, pay €0 otherwise”. If the experimenters give you the first option, you will get €15. If they give you the second option, you will get €15 only with a 50% chance.

#### How to get your most preferred option from the list inside your envelope?

Out of the payment options inside your envelope you want the experimenters to give you your most preferred one. You can ensure this as follows:

- During the experiment you will view various possible lists of options that can be inside your envelope. From each list you will be asked to instruct the experimenters which option to give you in case that list is the one inside your envelope.
- At the end of the experiment, the experimenters will open your envelope and show you the list inside. They will then find your instruction that refers to the list inside your envelope. This instruction will determine which option you will get.

So you will get your most preferred option from the list inside your envelope, if from all the lists viewed during the experiment you instruct the experimenters to give you the option that you prefer most. If you give wrong instructions during the experiment, you may end up receiving your least preferred option. In short, if you say what you want during the experiment, then you get what you want at the end.

You will be paid as follows:

€5 (fixed amount) for participation  
+  
€X (variable amount) depending on  
(1) the list of options inside your envelope and  
(2) your instructions.

Proceed to Next Page.

*Please raise your hand if anything is unclear*





## Step 2. Presentation of ambiguity

Subjects in the nature ambiguity treatment were instructed to draw one card from a deck of four cards, which could be marked with the letter *A*, *B*, or *C*. It was ambiguous to the subject how many of the cards in the deck were marked with each of the three letters. Upon drawing and confirming, subjects were informed that the marking of their card had been saved to be revealed to them at the end of the experiment.

You will first draw one of the following 4 cards. Each card is marked either *A*, *B*, or *C*.

**You DO NOT know how many of the cards are marked *A*, *B*, or *C*.**

Please click on the button below the card you would like to draw

	
<input type="radio"/>	<input type="radio"/>
	
<input type="radio"/>	<input type="radio"/>

Subjects in the social-ambiguity treatment were informed about the partner matching and told that the partner would choose one of three snacks labeled *A*, *B*, and *C*.

**Throughout this experiment you are matched with one other participant.** This participant's ID number is specified inside your envelope. Similarly, your ID number is specified inside this participant's envelope. But you and your matched partner will never discover which person is behind each other's ID number.

Your partner will receive a snack from the experimenters. He/she can choose one of the following three snacks (note: the snacks have similar monetary values):



Proceed to Next Page.

*Please raise your hand if anything is unclear*

Subjects in the betrayal-ambiguity treatment were informed about the partner matching and presented with the description of the (trust) game and were told that the partner would choose one of the three allocations labeled *A*, *B*, and *C*.

**Throughout this experiment you are matched with one other participant.** This participant's ID number is specified inside your envelope. Similarly, your ID number is specified inside this participant's envelope. But you and your matched partner will never discover which person is behind each other's ID number.

On the next page you will see a list of two options that may be inside your envelope. You will be asked to instruct the experimenters which of the two options to give you in case that list is inside your envelope.

Proceed to Next Page.

*Please raise your hand if anything is unclear*

**The following may be inside your envelope.**

Recall that you are matched with one other participant. You can instruct the experimenters to give you one of the following two options:

**Option 1:** Follow your partner's instruction for payment

**Option 2:** Pay €10 to each of you

If you instruct the experimenters to give you Option 1,

your partner's instruction will determine the payments for the two of you. Your partner can instruct the experimenters to give you one of the following three options:

Option A: Pay €15 to each of you;

Option B: Pay you €10, pay him/her €18;

Option C: Pay you €8, pay him/her €22.

So if your partner has instructed to give Option A, you and your partner will get €15 each. If your partner has instructed to give Option B, you will get €10 and your partner €18. Finally, if your partner has instructed to give Option C, you will get €8 and your partner €22.

If you instruct the experimenters to give you Option 2,

In case the above list of two options is inside your envelope, what is your instruction?

**Option 1**

**Option 2**

Confirm

### **Step 3. Measurement of ambiguity attitude**

At the start of this section, subjects were presented with an explanation of the decision situations to be encountered. The explanations were identical across treatments, except for the referred ambiguous events. In the nature ambiguity treatment, the events referred to the hidden marking of the card (*A*, *B*, or *C*) drawn by the subject. In the social ambiguity treatment the events referred to the snack (*A*, *B*, or *C*) chosen by the subject's partner. In the betrayal ambiguity treatment, the events referred to the allocation (*A*, *B*, or *C*) chosen by the partner. Following the explanation, subjects were asked 3 comprehension questions in the nature and social ambiguity treatments, and 4 comprehension questions in the betrayal ambiguity treatment. Subjects needed to answer all questions correctly to be able to proceed.

The explanation and comprehension questions in the nature ambiguity treatment are shown below.

**The marker of the card you drew has been saved. It will be revealed to you at the end of the experiment.** The lists of options that you will see next are related to which marker (A, B, or C) you think your card may have.

**Here is an example of the lists that you will see next:**

**Option 1:** Pay you €15 if you drew a card marked **B or C**, pay €0 otherwise

**Option 2:** Pay you €15 with **57%** chance, pay €0 otherwise

### EXPLANATION

**Suppose that the list in this example is inside your envelope.**

**What happens if you instructed the experimenters to give you Option 1?** The experimenters will follow your instruction and give you Option 1. To determine whether to pay you €15 or €0, they will show you the marker of the card you drew. If your card is marked B or C, you will get €15; otherwise (if your card is marked A), you will get €0.

**What happens if you instructed the experimenters to give you Option 2?** The experimenters will let you throw two ten-sided dice (see the picture, where the number thrown is 38). If you throw any number smaller than 57, you will get €15; otherwise (if you throw a number equal to or larger than 57), you will get €0. Since each number between 0 and 99 has a 1% chance of being thrown, you will face exactly 57% chance of throwing a number smaller than 57. Other winning chances later in the experiment will be determined in a similar way.



**We will now test your understanding of the instructions.**



### Question 1

**Suppose that the list in this example is inside your envelope.** Suppose that your instruction for this list is to give you Option 1. If your card is marked C, what is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15

### Question 2

**Suppose that the list in this example is inside your envelope.** Suppose that your instruction for this list is to give you Option 2. If you throw the number 61, what is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15

### Question 3

**Suppose that the list inside your envelope is another list, different the list in this example.** What is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15
- Can't say. It will depend on my instruction relevant for that other list.

Check my answers

The explanation and comprehension questions in the social ambiguity treatment are shown below.

The lists of options that you will see next are related to which snack (A, B, or C) you think your partner may have chosen (if you cannot recall the snacks that your partner could choose from, you will be able to look it up in a reminder).

**Here is an example of the lists that you will see next:**

**Option 1:** Pay you €15 if your partner chose snack **B or C**, pay €0 otherwise

**Option 2:** Pay you €15 with **57%** chance, pay €0 otherwise

[Click to see the reminder of the snacks your partner could choose from .](#)

**EXPLANATION**

**Suppose that the list in this example is inside your envelope.**

**What happens if you instructed the experimenters to give you Option 1?** The experimenters will follow your instruction and give you Option 1. To determine whether to pay you €15 or €0, they will show you the snack that your partner chose. If your partner chose Snack B or C, you will get €15; otherwise (if your partner chose snack A), you will get €0.

**What happens if you instructed the experimenters to give you Option 2?** The experimenters will let you throw two ten-sided dice (see the picture, where the number thrown is 38). If you throw any number smaller than 57, you will get €15; otherwise (if you throw a number equal to or larger than 57), you will get €0. Since each number between 0 and 99 has a 1% chance of being thrown, you will face exactly 57% chance of throwing a number smaller than 57. Other winning chances later in the experiment will be determined in a similar way.



**We will now test your understanding of the instructions.**

### Question 1

**Suppose that the list in this example is inside your envelope.** Suppose that your instruction for this list is to give you Option 1. If your partner has chosen Snack C, what is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15

### Question 2

**Suppose that the list in this example is inside your envelope.** Suppose that your instruction for this list is to give you Option 2. If you throw the number 61, what is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15

### Question 3

**Suppose that the list inside your envelope is another list, different the list in this example.** What is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15
- Can't say. It will depend on my instruction relevant for that other list.

Check my answers

The explanation and comprehension questions in the betrayal ambiguity treatment are shown below.

The lists of options that you will see next are related to which option (A, B, or C) you think your partner may have chosen from his/her list on the previous page (if you cannot recall the list of options for your partner, you will be able to look it up in a reminder).

**Here is an example of the lists that you will see next:**

**Option 1:** Pay you €15 if your partner chose option B or C, pay €0 otherwise

**Option 2:** Pay you €15 with 57% chance, pay €0 otherwise

[Click to see the reminder of the options for your partner .](#)

**EXPLANATION**

**Suppose that the list in this example is inside your envelope.**

**What happens if you instructed the experimenters to give you Option 1?** The experimenters will follow your instruction and give you Option 1. To determine whether to pay you €15 or €0, they will show you the option that your partner chose from his/her list on the previous page. If your partner chose Option B or C, you will get €15; otherwise (if your partner chose option A), you will get €0.

**What happens if you instructed the experimenters to give you Option 2?** The experimenters will let you throw two ten-sided dice (see the picture, where the number thrown is 38). If you throw any number smaller than 57, you will get €15; otherwise (if you throw a number equal to or larger than 57), you will get €0. Since each number between 0 and 99 has a 1% chance of being thrown, you will face exactly 57% chance of throwing a number smaller than 57. Other winning chances later in the experiment will be determined in a similar way.



**We will now test your understanding of the instructions.**

### Question 1

**Suppose that the list in this example is inside your envelope.** Suppose that your instruction for this list is to give you Option 1. If your partner has chosen Option C, what is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15

### Question 2

**Suppose that the list in this example is inside your envelope.** Suppose that your instruction for this list is to give you Option 2. If you throw the number 61, what is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15

### Question 3

**Suppose that not the list in this example, but the list on the previous page is inside your envelope.** Suppose that your instruction for that list was to give you Option 1. If your partner has chosen Option C from the list on the previous page, what is your payment (not counting your participation fee of €5)?

[Click to see the reminder of the list on the previous page.](#)

- €10
- €8
- €0
- €15

### Question 4

**Suppose that the list inside your envelope is another list, different both from the list on the previous page and from this example.** What is your payment (not counting your participation fee of €5)?

- €10
- €8
- €0
- €15
- Can't say. It will depend on my instruction relevant for that other list.

[Check my answers](#)

Ambiguity attitudes were measured by eliciting subjects' matching probabilities. Subjects faced 24 decision situations designed to elicit their matching probabilities of the following six events:  $A$ ,  $B$ ,  $C$ , ( $A$  or  $B$ ), ( $A$  or  $C$ ), ( $B$  or  $C$ ).

All 24 matching-probability decision situations were identical in type: subjects chose between two options, with Option 1 being an ambiguous prospect paying €15 contingent on one of the six ambiguous events, and Option 2 being a risky prospect paying €15 with a specified chance.

A sample matching-probability decision situation in the nature ambiguity treatment is shown below.

**The following may be inside your envelope.**

You can instruct the experimenters to give you one of the following two options:

**Option 1:** Pay you €15 if you drew a card marked **C**, pay €0 otherwise

**Option 2:** Pay you €15 with **50%** chance, pay €0 otherwise

In case the above list of two options is inside your envelope, what is your instruction?

**Option 1**

**Option 2**

A sample matching-probability decision situation in the social ambiguity treatment is shown below.

**The following may be inside your envelope.**

You can instruct the experimenters to give you one of the following two options:

**Option 1:** Pay you €15 if your partner chose snack **A or B**, pay €0 otherwise

**Option 2:** Pay you €15 with **50%** chance, pay €0 otherwise

[Click to see the reminder of the snacks your partner could choose from .](#)

In case the above list of two options is inside your envelope, what is your instruction?

**Option 1**

**Option 2**

A sample matching-probability decision situation in the betrayal ambiguity treatment is shown below.

**The following may be inside your envelope.**

You can instruct the experimenters to give you one of the following two options:

**Option 1:** Pay you €15 if your partner chose option **A**, pay €0 otherwise

**Option 2:** Pay you €15 with **50%** chance, pay €0 otherwise

[Click to see the reminder of the options for your partner .](#)

In case the above list of two options is inside your envelope, what is your instruction?

**Option 1**

**Option 2**

For each event, subjects faced 4 decision situations, where the event-contingent Option 1 stayed fixed and the winning chance in Option 2 varied depending on the choices in the preceding situation (explained in detail in the paper). We refer to the four decision situations for each event as a block. The 24 decision situations for eliciting matching probabilities thus constituted of 6 blocks. The blocks appeared in a random order, and between two consecutive blocks, a demographic question was asked to refresh subjects' thinking mode. We asked 5 demographic questions about subjects' gender, drinking habits (weekly average number of alcoholic drinks consumed), subjective well-being, nationality (Dutch or non-Dutch), and number of siblings. The demographic questions also appeared in a random order (the demographic questions are shown below).

**Please indicate your gender:**

Female     Male











**On average, how many glasses of alcoholic drinks do you consume per week?**

**How many siblings (brothers and sisters) do you have?**

Please answer 0 if you don't have any.



**Do you feel happy in general? Please answer this question on the scale from 0 to 10.**

										
0	1	2	3	4	5	6	7	8	9	10
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

confirm

**Are you Dutch?**

Yes     No




confirm

#### Step 4. Ambiguity-generating choice as a partner to another subject

Following the matching-probability decision situations, subjects, who were assigned as partners to fellow subjects in the social ambiguity treatment, were asked to choose one of three snacks labeled *A*, *B*, and *C*.

**On top of your payment, you will also receive a snack.**

Please choose one of the following three snacks (note: the snacks have similar monetary value):

<p>● <b>Snack A:</b></p>  <p>Savoury Party Mixure</p>	<p>● <b>Snack B:</b></p>  <p>Dried Apple Rings</p>	<p>● <b>Snack C:</b></p>  <p>Milk Chocolate Bar</p>
--	---	--

Subjects, who were assigned as partners to fellow subjects in the betrayal ambiguity treatment, made a decision as the trustee in the (trust) game.

On the next page you will see a list of three options that may be inside your envelope. It is different from the lists that you have viewed until now. You will be asked to instruct the experimenters which of the three options to give you in case that list is inside your envelope.

**The following may be inside your envelope.**

Recall that you are matched with one other participant. You can instruct the experimenters to give one of the following three options:

**Option A:** Pay €15 to each of you

**Option B:** Pay you €18, pay your partner €10

**Option C:** Pay you €22, pay your partner €8

Your partner can instruct the experimenters to give you one of the following two numbered (1 and 2) options:

Option 1: Follow your instruction for payment

Option 2: Pay €10 to each of you

The experimenters will follow your instruction only if your partner instructed to give you Option 1. If your partner instructed Option 2, then you and your partner will get €10 each, and your instruction will play no role.

In case the above list of three options is inside your envelope, what is your instruction?

- Option A**
- Option B**
- Option C**

Confirm

## Step 7. Payment

At the end of the session, after all subjects finished the experiment, they were called to the payment desk one by one. Each subject opened her envelope. If the envelope contained a matching probability decision situation that she had encountered during the experiment, then the ambiguous (now resolved) event determined her final payment in case she had chosen the ambiguous option 1. Otherwise, the winning probability of option 2 decided her payment.<sup>2</sup> It could also happen that the subject had not encountered the matching probability decision situation that was in her envelope. We then inferred the subject's choice in the new situation from her choice in a similar situation by dominance. For instance, suppose the subject had chosen option 1 in the decision with a winning probability of 50%, but a decision situation with a winning probability of 26% was in her envelope. Because of the bisection procedure, she could not have encountered this situation during the experiment. We would then explain to the subject that, since she preferred the ambiguous option 1 to an even better option 2 (with 50% winning chance), we inferred that she would also prefer option 1 in the decision situation where option 2 gives 26% winning chance. We would then implement option 1.

In the betrayal ambiguity treatment, it could also happen that the envelope contained the (trust) game decision situation (in either role). In that case, the subject's and her partner's choices determined the subject's final payment.

Finally, subjects, who as partners to subjects in the social ambiguity treatment, had chosen a snack, received their chosen snacks in addition to their monetary payments.

---

<sup>2</sup> If, for instance, the winning probability of option 2 was 50%, then the subject threw two 10-sided dice, and any number below 50 (which had 50% chance of occurring) meant that the subject would be paid the prize.

## Appendix B. Analysis of data after excluding subjects with two or more violations of monotonicity

Table A1. Ambiguity attitudes by ambiguity treatment

I. Ambiguity aversion index ( $b$ )				
Ambiguity treatment	Mean	Median	Interquartile range	p-value Wilcoxon tests $b = 0$
Nature	0.07	0.00	[0.00, 0.20]	0.00
Social	0.01	0.00	[-0.04, 0.05]	0.23
Betrayal	-0.05	-0.02	[-0.10, 0.04]	0.19
II. A-insensitivity index ( $a$ )				
Ambiguity treatment	Mean	Median	Interquartile range	p-value Wilcoxon tests $a = 0$
Nature	0.19	0.10	[0.10, 0.31]	0.00
Social	0.16	0.13	[0.04, 0.28]	0.00
Betrayal	0.24	0.22	[0.10, 0.34]	0.00

Table A2. Comparisons of ambiguity attitude across treatments

I. Comparisons of Ambiguity aversion index ( $b$ )	
Compared treatments	p-value, Mann-Whitney test ( $b_i = b_j$ )
Nature vs. Social	0.01
Nature vs. Betrayal	< 0.001
Social vs. Betrayal	0.09
II. Comparisons of A-insensitivity index ( $a$ )	
Compared treatments	p-value, Mann-Whitney test ( $a_i = a_j$ )
Nature vs. Social	0.93
Nature vs. Betrayal	0.06
Social vs. Betrayal	0.04