

Supplementary material for “Less fighting than expected — experiments with wars of attrition and all-pay auctions” by Hannah Schildberg-Hörisch and Oliver Kirchkamp.

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1 List of experiments

	Date	\underline{c}	\bar{c}	repetitions in a group	static	first-price	periods	subjects
1	20040116-10:39	2.2	4.4	6	0	0	18	10
2	20040116-14:09	2.2	4.4	6	0	0	18	10
3	20040120-10:31	2.2	4.4	6	0	0	24	14
4	20040120-12:25	2.2	4.4	6	0	0	24	12
5	20040120-13:57	2.6	5.2	6	0	0	24	12
6	20040122-14:01	2.6	5.2	6	0	0	24	12
7	20040122-15:53	2.6	5.2	6	0	0	24	12
8	20040123-10:31	1.8	3.6	6	0	0	24	12
9	20040123-12:19	1.8	3.6	6	0	0	24	12
10	20040123-16:07	1.8	3.6	6	0	0	24	12
11	20040219-10:31	2.2	4.4	1	0	0	24	12
12	20040219-13:35	2.2	4.4	1	0	0	24	12
13	20040219-15:49	2.2	4.4	1	0	0	24	12
14	20040220-10:23	.38	3	6	0	0	24	8
15	20040220-12:25	.38	3	6	0	0	24	12
16	20040220-16:17	.38	3	6	0	0	24	14
17	20040524-15:17	2.2	4.4	6	1	0	24	16
18	20040525-14:01	2.2	4.4	6	1	0	24	16
19	20040525-16:07	2.2	4.4	6	1	0	24	18
20	20041021-15:59	2.2	4.4	6	1	1	24	16
21	20041022-10:33	2.2	4.4	6	1	1	24	14
22	20041027-15:49	2.2	4.4	6	1	1	24	14

The experiment was carried out in the experimental laboratory of the SFB 504 at the University of Mannheim. All sessions were conducted in German. Section 2 contains a translation of the instructions.

2 Conducting the experiment and instructions

Participants were recruited by email and could register for the experiment on the internet. At the beginning of the experiment participants were randomly

allocated to seats and obtained printed instructions in German. A translation can be found below.

After reading the instructions participants start with control questions on the screen, then go through the actual treatment, conclude with a short questionnaire on the screen and are payed in cash immediately after the experiment. The experimental software is based on z-Tree (Fischbacher, U., 2007. z-Tree: Zurich Toolbox for Ready-made Economic Experiments. *Experimental Economics* 10(2), 171–178).

Translation of the instructions:

Welcome to a strategy experiment

This strategy experiment is financed by the University of Mannheim and the Deutsche Forschungsgemeinschaft (DFG). The instructions are easy to understand when you read them carefully. If you decide considerately and take into account the position of the other players you have the opportunity to gain a considerable amount of money. You receive the money at the end of the game. The profit is related to your performance during the game.

During the experiment you participate in an auction about prizes which are valued in “Experimental Currency Units” (ECU). During the auction your bids are also in ECU. At the end of the auction you will be paid in Euro. Thereby, 200 ECU equal 1 Euro. We have already held experiments similar to this one. Due to our experience we expect an average profit of 12 Euro, dependent on your strategy. We have no interest in paying you less money than you are entitled to. The amount of money not used will be returned to the Deutsche Forschungsgemeinschaft (DFG).

During the experiment talking and communicating between the bidders is strongly prohibited. You are not allowed to take any notes, books, and cell phones into the experimental laboratory. Moreover, you are not allowed to start other programs on the computers. If you don’t follow the rules we have to exclude you from the experiment and you won’t get any payment.

Instructions You play an auction which is held between two bidders. Bidders are randomly and anonymously assigned to each other. Each pair of bidders play 6 rounds together. Four times during the experiment you get a new partner, randomly selected.¹ In total you will play 24 rounds, thereof each 6 sequenced rounds with the same partner. Each single round corresponds to one auction in which one prize is sold. The value of the auction prize is in all 24 rounds and for all participants 100 ECU. Once an auction has started you and

¹ *In the treatment where players are randomly rematched after each round the instructions were: “The bidders are randomly and anonymously assigned to each other in each round of the experiment. In total you will play 24 rounds. Each single round corresponds to one auction in which one prize is sold.”*

Figure 1 The bidding interface in the dynamic treatment

round: 2 of 24	remaining time [sec]: 3596
<p>The value of the prize is 100</p> <p>The cost of the other bidder is between 2.2 and 4.4 per second</p> <p>Your cost is 3.59 per second</p> <p>You are now bidding the following number of seconds for the prize: 4.00</p> <p>You have, hence, bid the following amount this auction: 14.34</p> <p>To leave the auction, press the bottom right button</p> <p style="text-align: right;"><input type="button" value="I stop bidding"/></p>	

Figure 2 The bidding interface in the static and first-price treatment

round: 2 of 24	remaining time [sec]: 45						
<p>The value of the winner's prize is 100</p> <p>The cost of the other bidder is between 2.2 and 4.4 per second</p> <p>Your cost in this round is 3.59 per second</p> <p>Please enter the amount of seconds or total cost which you are ready to bid</p> <p>Maximal cost to bid maximal number of seconds</p> <table style="width: 100%; border: none;"><tr><td style="text-align: center;"><input type="text" value="14.36"/></td><td style="text-align: center;"><input type="button" value="to seconds →"/></td><td style="text-align: center;"><input type="text" value="4.00"/></td></tr><tr><td></td><td style="text-align: center;"><input type="button" value="← to cost"/></td><td></td></tr></table> <p style="text-align: right;"><input type="button" value="Continue"/></p>		<input type="text" value="14.36"/>	<input type="button" value="to seconds →"/>	<input type="text" value="4.00"/>		<input type="button" value="← to cost"/>	
<input type="text" value="14.36"/>	<input type="button" value="to seconds →"/>	<input type="text" value="4.00"/>					
	<input type="button" value="← to cost"/>						

the other bidder pay in every second a certain amount until either you or the other bidder are not willing to increase the bid.

In the beginning of each auction you will be informed of your bidding cost per second which corresponds to the amount of ECU you bid every second. During each auction the bidding cost per second are constant. At the beginning of every round each bidder randomly receives new bidding cost per second to participate in the auction of the prize. The bidding cost per second for both bidders are uniformly distributed between 2.20 and 4.40 ECU² but you have no information about the exact bidding cost per second of your partner.

[[In the dynamic treatment the instruction would here show figure 1. In the static treatment and in the first-price treatment the instructions would show figure 2]]

Each period, the screen shows the value of the prize which is constantly 100 ECU. Furthermore, the screen displays your bidding cost per second and re-

² The cost varies from treatment to treatment.

minds you that the bidding cost per second is an amount between 2.20 and 4.40.

The next part of the instructions differs between the dynamic war of attrition treatment and the static war of attrition and all-pay auction treatment. The instructions in the dynamic treatment were as follows:

In addition, you will be informed about how many seconds you have already bid and what your total cost of the current auction are. After 10 seconds a "Stop"-button with the title "I stop bidding" appears down right. You should use the countdown (10 seconds) to plan your optimal bidding strategy. Press the "Stop"-button if you don't want to proceed bidding and leave the auction. As soon as you leave the auction your partner wins the prize. Likewise, you win the prize if your partner leaves the auction earlier as you. **As long as you don't press the "Stop"-button, you are still bidding for the prize. The auction ends for both bidders as soon as the first bidder presses the "Stop"-button.**

For every second you bid, you have to pay the bidding cost per second. These cost occur independently of who (you or your partner) wins the auction.

The instructions in the static and first-price treatment were as follows

You can enter how many seconds or up to which amount of total cost you are ready to continue bidding. You can click on either the "to seconds" button to translate cost into seconds or the "to cost" button to translate seconds into cost. You can repeat this as often as you like until you are ready to commit to your bidding strategy, i.e. the amount of seconds up to which you want to bid or the cost up to which you want to bid.

Please note that some participants have the input field for cost on the left side of the screen and for seconds on the right side of the screen while others have the opposite layout.

In the lower right corner of the screen you find a button "Continue". You have to push this button once you have determined your bid. If the other bidder has chosen a higher number of seconds, he wins the prize. If the other bidder has chosen a smaller number of seconds, you win the prize. If both bidders have chosen the same number of seconds then the winner is determined randomly.

With your bid in seconds you determine how many seconds you continue to bid at most. The bidder with the smaller amount of seconds determines the end of the auction. The number of seconds he chose will be used to determine the cost for both bidders. Up to this time both bidders pay for each second their cost. The bidder whose bid in seconds is larger obtains the prize of 100 ECU.³

Note that for each second that you are bidding for the prize you have to pay your bidding cost per second — independently whether you or the other bidder wins the prize at the end of the auction.

³*In the first-price treatment this text would read as follows: "With your bid in seconds you determine how many seconds you continue to bid. The number of seconds each bidder chooses will be used to determine his cost. The bidder whose bid in seconds is larger obtains the prize of 100 ECU."*

From here on the instructions were again the same in both treatments:

In the beginning of the experiment your account balance is 2500 ECU. Your cost will be subtracted from the account balance. If you win the auction, the prize with the value of 100 ECU will be credited to your account. Your account balance at the end of each auction is calculated as follows:

$$\begin{array}{r}
 \text{Account balance before the start of the auction} \\
 - \quad (\text{Number of bidding seconds}) \times (\text{Bidding cost per second}) \\
 + \quad \text{Value of the prize, if you win the auction} \\
 \hline
 = \quad \text{Account balance after the auction}
 \end{array}$$

The account balance at the end of the auction is your account balance at the beginning of the following auction. The account balance at the end of the 24th auction is your payoff for the participation of the experiment. Thereby, you receive 1 Euro for 200 ECU.

At the end of each auction both bidders will be informed about their bid in seconds, total bidding cost, current account balance and who has won the prize. Furthermore, each bidder gets the information about his partner's bidding cost per second and total bidding cost in the previous auction.

During the experiment please fill in the table below at the end of each auction. Then you always know the bidding cost per second and the total cost of you and your partner and you have an overview of your gains and the development of your personal account.

If you have any questions, please don't hesitate to rise your hand. We will be glad to come to your seat and answer your questions.

Thank you very much for your participation!

Participants would find a table like one of the following at their desk. The were asked to fill in the result of each round into the table. This information was also shown on the screen as a feedback for each round (see figure 3).

dynamic treatment:

Auction	your cost per second	other bidder's cost per second	length of the auction in seconds	your cost (total)	other bidder's cost (total)	winner in the auction	your profit in this auction	new balance of your account
1								
2								
⋮								

Static treatment:

Auction	your cost per second	other bidder's cost per second	you bid at most ... seconds	you bid at most ... a cost of ...	length of the auction in seconds	your cost (total)	other bidder's cost (total)	winner in the auction	your profit in this auction	new balance of your account
1										
2										
⋮										

First-price treatment:

Auction	your cost per second	you bid ... seconds	you bid ... a cost of ...	other bidder's cost per second	the other bids ... seconds	the other bids a cost of ...	winner in the auction	your profit in this auction	new balance of your account
1									
2									
⋮									

Figure 3 Feedback given on the screen at the end of a round

round: 2 of 24				remaining time [sec]: 17			
The other bidder has won the auction							
auction	your cost per second	other bidder's cost per second	length of the auction in seconds	your cost (total)	other bidder's cost (total)	your profit in this auction	new balance of your account
2	3.59	2.91	4	14.36	11.64	-14.36	1876.54