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Technical Appendix to

OUT-OF-EQUILIBRIUM BIDS IN FIRST-PRICE AUCTIONS: WRONG EXPECTATIONS OR WRONG BIDS

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Appendix A. Derivation of Level-*k* Reasoning

We begin by defining the two-step uniform distribution that proves useful for characterising optimal bidding in the level-*k* model. Then, we state a Lemma that proves useful when deriving the best reply functions of level-*k*. The two-step uniform distribution's definition nests the standard uniform distribution as a special case so that the Lemma applies to uniformly distributed bids directly. To ease the application of the Lemma to uniformly distributed bids, a corollary summarises the relevant results.

A.1. *Auxiliaries*

Definition 1(Two-step uniform distribution). *Let $g(b)$ denote a probability density function with support $[\underline{b}, \bar{b}] \subset \mathbb{R}$. Let $A \equiv [\underline{b}, \hat{b}]$ and $B \equiv (\hat{b}, \bar{b}]$ where $\underline{b} < \hat{b} < \bar{b}$ and assume that density $g(b)$ is constant on either set, specifically, $g(b) = \delta_A > 0$ if $b \in A$ and $g(b) = \delta_B > 0$ if $b \in B$ such that $\delta_A \geq \delta_B$. The corresponding distribution function is*

$$G(b) = \begin{cases} 0 & \text{if } b < \underline{b}, \\ \delta_{\mathrm{A}}(b - \underline{b}) & \text{if } b \in [\underline{b}, \hat{b}], \\ \delta_{\mathrm{A}}(\hat{b} - \underline{b}) + \delta_{\mathrm{B}}(b - \hat{b}), & \text{if } b \in (\hat{b}, \bar{b}], \\ 1 & \text{otherwise}, \end{cases}$$

where normalisation implies $\delta_{\mathrm{A}}(\hat{b} - \underline{b}) + \delta_{\mathrm{B}}(\bar{b} - \hat{b}) \equiv 1$.

Remark. If the probability of a (two-step uniformly distributed) bid falling into interval A is $\lambda \geq 0$ so that the probability of the bid falling into interval B is $1-\lambda$, then the constant densities are given by $\delta_{\mathrm{A}} = (1-\lambda)/(\hat{b} - \underline{b}) + (\lambda)/(\bar{b} - \underline{b})$ and $\delta_{\mathrm{B}} = \lambda/(\bar{b} - \underline{b})$.

Lemma 1(Best replies to two-step uniform bids). *Let $G(b)$ be a two-step uniform distribution function and assume that bidder j submit bids in a first-price auction with two bidders according to $G(b)$. Then, the (risk neutral) best reply $b^*(x)$ of bidder i with value $x \geq \underline{b}$ facing the bid distribution of bidder j is the solution of the maximisation problem* $\max_b G(b)(x - b)$ *and given by*:

$$
b^*(x) = \begin{cases} 0.5\ \underline{b} + 0.5x & \text{if } x \in [\underline{b}, \underline{x}_{\hat{b}}], \\ \hat{b} & \text{if } x \in [\underline{x}_{\hat{b}}, \bar{x}_{\hat{b}}], \\ 0.5\underline{b} + 0.5x - \dfrac{\delta_{\mathrm{A}} - \delta_{\mathrm{B}}}{\delta_{\mathrm{B}}}\dfrac{\hat{b} - \underline{b}}{2} & \text{if } x \in [\bar{x}_{\hat{b}}, \bar{x}_{\bar{b}}], \\ \bar{b} & \text{if } x > \bar{x}_{\bar{b}} \end{cases}
$$

where $\underline{x}_{\hat{b}} = 2\hat{b} - \underline{b}$, $\bar{x}_{\hat{b}} = \hat{b} + (\delta_{\mathrm{A}}/\delta_{\mathrm{B}})(\hat{b} - \underline{b})$ and $\bar{x}_{\bar{b}} = 2\bar{b} + (\delta_{\mathrm{A}}/\delta_{\mathrm{B}})(\hat{b} - \underline{b}) - \hat{b}$.

Proof. Omitted.

COROLLARY 1. *Let the competitor's bids be uniformly distributed on support* $[\underline{b}, \bar{b}]$ *and let the probability density be given by* $\delta = 1/(\bar{b} - \underline{b})$. *This bid distribution is a special case of two-step uniform distributions with* $\delta_A = \delta_B = \delta$. *The application of Lemma 1 implies the best reply function for uniformly distributed bids that is given by*:

$$
b^*(x) = \begin{cases} 0.5\underline{b} + 0.5x & \text{if } x \in [\underline{b}, 2\bar{b} - \underline{b}], \\ \bar{b} & \text{if } x > 2\bar{b} - \underline{b}. \end{cases}
$$

A.2. *Derivation When Level k Plays Level-(k−1) Only*

A.2.1. *The symmetric auction*

In the symmetric auction, the value distribution is U[50, 100] for any bidder. Let us start from the anchor level *L*0 that bids truthfully, that is, $b_{L0}(x) = x$, implying uniformly distributed *L*0-bids on [50, 100]. *L*1 expects this bidding behaviour, $b_{L1}^{\exp}(x) = b_{L0}(x)$, and by Corollary 1 the best reply is $b_{L1}(x) = 25 + 0.5x$ which coincides with RNBNE bidding. Accordingly, *L*2 expects equilibrium bids, $b_{L1}^{\exp}(x) = b_{L1}(x)$, that are uniformly distributed on [50, 75]. By corollary 1 the best reply is $b_{L2}(x) = 25 + 0.5x$. Analogously *L*3 and any higher level form the same expectation as *L*2 and bid in the same way.

A.2.2. *The asymmetric auction*

In the asymmetric auction, the weak bidder's value distribution is U[50, 90], whereas the strong bidder's one is U[50, 110]. In the asymmetric setting, there are two versions of any level, a weak one and a strong one, as a bidder knows whether she is weak or strong. Here, the truthfully bidding anchor levels bid according to $b_{wL0}(x) = b_{sL0}(x) = x$ so that *wL*0-bids are uniformly distributed on [50, 90], whereas *sL*0-bids are uniformly distributed on [50, 110].

Weak *L*1 expects his competitor to be *sL*0 and by Corollary 1 his best reply is $b_{wL1}(x) = 25 + 0.5x$ where bids are uniformly distributed on [50, 70]. Similarly $b_{sL1}(x) = 25 + 0.5x$ so that bids are uniformly distributed on [50, 80].

Weak *L*2 expects his competitor to be *sL*1 and by Corollary 1 his best reply is $b_{wL2}(x) = 25 + 0.5x$ where bids are uniformly distributed on [50, 70] again.

For strong *L*2, however, the best reply is more involved since *sL*2 expects *wL*1 submitting uniformly distributed bids on [50, 70] and never submits a bid exceeding the largest bid of *wL*1, that is, 70, so that Corollary 1 implies

$$
b_{sL2}(x) = \begin{cases} 25 + 0.5x & \text{if } x \in [50,\ 90], \\ 70 & \text{if } x \in [90,\ 110]. \end{cases}
$$

Weak *L*3 expects that *sL*2's bid is 70 with probability 1/3 and that the remaining probability is uniformly spread over [50, 70], hence, the cumulative bid distribution function is

$B^{\exp}_{wL3}(b) = (b-50)/30$ for $b \in [50,\ 70)$, $B^{\exp}_{wL3}(b=70) = 5/6$ because of fair tie-breaking and $B^{\exp}_{wL3}(b>70) = 1$. Except for both jumps in probability at $b = 70$, the maximisation problem is the same as that of, for example, $wL2$. Here, however, we have to verify if the expected payoff of that solution is a global maximum or if it is dominated by a bid of $70 + \epsilon$. Indeed, for all $x > 110 - \sqrt{1200} \approx 75.359$, $wL3$ prefers to win the auction for sure with a bid of $70 + \epsilon$ ($\epsilon \to 0$).[1] Since there always exists a smaller $\epsilon > 0$ that allows to increase the expected payoff, the payoff-maximising bid is undefined for any $x \in (110 - \sqrt{1200}, 90]$. It follows that the best replies of strong $L4$, weak $L5$, etc. are not defined.

Strong $L3$ faces the same problem as strong $L2$, hence, $b_{sL3}(x) = b_{sL2}(x)$ with probability mass concentrating at a bid of 70 so that the best reply of weak $L4$ and beyond are undefined, too.

A.3. *Derivation When Level-k Plays a Distribution of Lower Levels*

When assuming that a player of level Lk plays against a distribution of lower levels, the best replies of levels $L0$ and $L1$ coincide with their counterparts playing against $L(k-1)$ only. The lowest level that plays against a non-degenerated distribution of lower levels is $L2$ expecting to face a competitor of either level $L0$ or $L1$.

For specifying the distribution of lower levels, we impose the consistency condition of the cognitive hierarchy model implying that the probability of facing any lower level $L(k-s)$, $s \in 1, \ldots, k$, as expected by Lk, coincides with the relative population share of this level as prevailing in the population of players conditional on facing lower levels only.[2] In particular, we denote the population share of level Lk by $\lambda_{Lk} \geq 0$ ($\sum_{k=0}^{\infty} \lambda_{Lk} = 1$) and the probability that a player of level Lk believes to face any lower level Ls ($s \in \{0, \ldots, k-1\}$) by $\lambda^{Ls}_{Lk} = \lambda_{Ls} / \sum_{j=0}^{k-1} \lambda_{Lj}$.

A.3.1. *Levels L2 and higher in the symmetric auction*

The probability that $L2$ expects to face an $L0$-player is $\lambda^{L0}_{L2} > 0$, bidding uniformly on [50, 100] and the probability of facing an $L1$-player is $1 - \lambda^{L0}_{L2}$, bidding uniformly on [50, 75]. For simplicity, we suppress the index of λ in the following derivations and reintroduce it where it matters. The bid distribution that $L2$ expects is two-step uniform with $\hat{b} = 75$, $\delta_A = (2-\lambda)/50$, $\delta_B = \lambda/50$ and follows from definition 1 as:

$$B^{\exp}_{L2\mathrm{mix}}(b) = \begin{cases} \dfrac{2-\lambda}{50}(b-50) & \text{if } b \in [50,\ 75], \\ 1 - 2\lambda + \dfrac{\lambda}{50} b & \text{if } b \in (75, 100]. \end{cases}$$

By Lemma 1, the best reply of $L2$ to the distribution of $L0$ and $L1$-bidders is

$$b_{L2\mathrm{mix}}(x) = 25 + 0.5x \quad (x \in [50, 100]),$$

where $L2$ submits uniformly distributed bids on [50, 75] as does $L1$.

By the consistency condition of beliefs, the probability that any level higher than $L2$ expects to face $L0$ does not exceed the probability of $L2$ believing to face $L0$, that is, $\lambda^{L0}_{L2} \geq \lambda^{L0}_{Lk}$ ($k \in \{3, \ldots, \infty\}$). Therefore, any level higher than $L2$ also finds it optimal to bid according to

[1] If it is optimal to submit a bid smaller than 70, then the best reply is $b^o = 25 + 0.5x$ implying an expected payoff of $(b^o - 50)/30(x - b^o) = (0.5x - 25)^2/30$. This falls short of the certain payoff of $x - (70 + \epsilon)$ with $\epsilon \to 0$ for $x > 110 - \sqrt{1200}$.

[2] See Camerer *et al.* (2004, p. 864f).

the best reply function of $L2$ (which is that of $L1$). Levels $L1$ and higher differ only in the probability of believing to face $L0$ bids that, with increasing level, converges from one (believed by $L1$) to the true population share λ_{L0} (believed latest by $L\infty$) monotonically.

A.3.2. *Levels L2 and higher in the asymmetric auction*

Let the probability that weak $L2$ expects to face a strong $L0$-player be $\lambda_{wL2}^{sL0} > 0$, bidding uniformly on [50, 110], hence, the probability of facing a strong $L1$-player is $1 - \lambda_{wL2}^{sL0}$, bidding uniformly on [50, 80]. With suppressing the index, the distribution of bids that $wL2$ expects is two-step uniform with $\hat{b} = 80$, $\delta_{\mathrm{A}} = (2-\lambda)/60$, $\delta_{\mathrm{B}} = \lambda/60$ and follows from definition 1 as:

$$B_{wL2\mathrm{mix}}^{\exp}(b) = \begin{cases} \dfrac{2-\lambda}{60}(b-50) & \text{if } b \in [50, 80], \\ 1 - \dfrac{11}{6}\lambda + \dfrac{\lambda}{60} b & \text{if } b \in (80, 110]. \end{cases}$$

By Lemma 1, the best reply of $wL2$ to the distribution of $sL0$ and $sL1$-bidders is

$$b_{wL2\mathrm{mix}}(x) = 25 + 0.5x \quad (x \in [50, 90]),$$

where $wL2$ submits uniformly distributed bids on [50, 70] as does $wL1$.

Strong $L2$ expects $wL0$ (bidding uniformly on [50, 90]) with probability λ_{sL2}^{wL0} and $wL1$ (bidding uniformly on [50, 70]) with probability $1 - \lambda_{sL2}^{wL0}$. Thus, the bid distribution expected by $sL2$ is two-step uniform with $\hat{b} = 70$, $\delta_{\mathrm{A}} = (2-\lambda)/40$, $\delta_{\mathrm{B}} = \lambda/40$ and follows from Definition 1 as

$$B_{sL2\mathrm{mix}}^{\exp}(b) = \begin{cases} \dfrac{2-\lambda}{40}(b-50) & \text{if} b \in [50, 70], \\ 1 - \dfrac{9}{4}\lambda + \dfrac{\lambda}{40} b & \text{if} b \in (70, 90]. \end{cases}$$

By Lemma 1, the best reply of $sL2$ to the distribution of $wL0$ and $wL1$-bidders is

$$b_{sL2\mathrm{mix}}(x) = \begin{cases} 25 + 0.5x & \text{if } x \in [50, 90], \\ 70 & \text{if } x \in [90, \ , x_\lambda], \\ 45 - \dfrac{20}{\lambda} + 0.5x & \text{if } x \in [x_\lambda, 110], \end{cases}$$

where $x_\lambda = 70 + [(2-\lambda)/\lambda]\, 20 > 90$ for $\lambda < 1$.

It follows that $sL2$'s best reply is flat on an interval such that $sL2$ bids 70 with strictly positive probability unless believing that the population consists of $L0$ players only ($\lambda = 1$). Hence, $wL3$ believes that a bid of 70 is submitted with strictly positive probability. It follows that the best reply of $wL3$ to $sL2$ is not defined for some values analogously to the situation of $wL3$ playing against $sL2$ with certainty. Hence, there are no best replies for $wL3$, $sL4$,. . . The best reply of $sL3$, however, exists and coincides with that of $sL2$ but, for the same reasons as stated for wL, there are no best replies for $wL4$, $sL5$, . . ., too.

Appendix B. List of Independent Observations

Table B1

List of All Sessions

Date	Treatment	Place	Participants
20091102-1559-0	asymmetric	Jena	10
20091102-1559-1	asymmetric	Jena	8
20091110-1347-0	asymmetric	Jena	10
20091110-1347-1	asymmetric	Jena	8
20091112-1349-0	asymmetric	Jena	8
20091112-1349-1	asymmetric	Jena	8
20091112-1600-0	asymmetric	Jena	10
20091112-1600-1	asymmetric	Jena	8
20091110-1555	computer opponents	Jena	17
20050511-10:51-0	expectations	Magdeburg	10
20050511-10:51-1	expectations	Magdeburg	10
20050511-14:55-0	expectations	Magdeburg	10
20050511-14:55-1	expectations	Magdeburg	10
20050512-09:01-0	expectations	Magdeburg	10
20050512-09:01-1	expectations	Magdeburg	8
20050512-12:59-0	expectations	Magdeburg	8
20050512-12:59-1	expectations	Magdeburg	8
20050207-10:53-0	expectations with info	Mannheim	8
20050209-14:09-0	expectations with info	Mannheim	12
20050209-16:11-0	expectations with info	Mannheim	6
20050414-10:37-0	expectations with info	Magdeburg	10
20050414-10:37-1	expectations with info	Magdeburg	10
20050414-16:35-0	expectations with info	Magdeburg	10
20050414-16:35-1	expectations with info	Magdeburg	10
20050415-08:59-0	expectations with info	Magdeburg	8
20050415-08:59-1	expectations with info	Magdeburg	8
20050415-11:11-0	expectations with info	Magdeburg	10
20050415-11:11-1	expectations with info	Magdeburg	10
20031211-18:23-0	no expectations	Mannheim	14
20031212-10:45-0	no expectations	Mannheim	14
20040517-12:21-0	no expectations	Mannheim	8
20040517-12:21-1	no expectations	Mannheim	6
20040517-17:17-0	no expectations	Mannheim	8
20040517-17:17-1	no expectations	Mannheim	8
20040519-15:53-0	no expectations	Mannheim	8
20040519-15:53-1	no expectations	Mannheim	10
20050414-08:55-0	no expectations	Magdeburg	10
20050414-08:55-1	no expectations	Magdeburg	10
20050414-13:17-0	no expectations	Magdeburg	10
20050414-13:17-1	no expectations	Magdeburg	10

Appendix C. Detailed Estimation Results for Equations (7)

	All	asymmetric	expectations with info
(Intercept)	0.315**	0.206	0.414**
	[0.118; 0.512]	[−0.147; 0.558]	[0.128; 0.699]
β^{other}	0.047***	0.034***	0.079***
	[0.040; 0.054]	[0.024; 0.044]	[0.069; 0.090]
Deviance	63,239.878	25,817.629	36,712.601
Independent observations	19	8	11
Participants	172	70	102
N	9,950	3,830	6,120

Significance levels denoted by: *** 0.001, ** 0.01, * 0.05, 95% confidence intervals are shown in brackets below coefficients. Confidence intervals and p-values are based on a parametric bootstrap with 1,000 replications.

Appendix D. Detailed Estimation Results for Equation (8)

	All	asymmetric	expectations with info
(Intercept)	0.281***	0.304 *	0.236*
	[0.152; 0.410]	[0.071; 0.537]	[0.051; 0.420]
β^{other}	0.055***	0.055***	0.056***
	[0.046; 0.064]	[0.039; 0.071]	[0.046; 0.065]
β^{own}	0.282***	0.105***	0.478***
	[0.264; 0.300]	[0.076; 0.134]	[0.457; 0.499]
Deviance	58725.368	22618.006	35003.196
Independent observations	19	8	11
Participants	172	70	102
N	9,620	3,500	6,120

Significance levels denoted by: *** 0.001, ** 0.01, * 0.05. 95% confidence intervals are shown in brackets below coefficients. Confidence intervals and p-values are based on a parametric bootstrap with 1,000 replications.

Appendix E. Conducting the Experiment

Participants were recruited by email and could register for the experiment on the internet.

- At the beginning of the experiment, participants drew balls from an urn to determine their allocation to seats in the laboratory.
- Then participants took a simple language test (participants had to find the correct word or form to complete a sentence). Those who failed the language test on at least two items out of 10 could not participate (this did not happen very often since participants knew about the language test when they booked the experiment).
- The remaining participants obtained written instructions in German (see Section E.1). These instructions vary slightly depending on the treatment. We give a translation of the instructions below.
- After answering control questions on the screen (see Section E.2), subjects entered the treatment. After completing the treatment, they answered a short questionnaire on the screen and were paid in cash. The experiment was carried out with z-Tree Version 3α (the final version is documented in Fischbacher, 2007).

E.1. *Instructions*

E.1.1. *General information*

You are participating in a scientific experiment that is sponsored by the Deutsche Forschungsgemeinschaft (German Research Foundation). If you read the following instructions carefully then you can – depending on your decision – obtain a considerable amount of money. It is, hence, very important that you read the instructions carefully.

The instructions that you have received are only for your private information. During the experiment no communication is permitted. Whenever you have questions, please raise your hand. We will then answer your question at your seat. Not following this rule leads to exclusion from the experiment and all payments.

During the experiment we are not talking about euro, but about Experimental Currency Unit(ECU). Your entire income will first be determined in ECU. The total amount of ECU that you have obtained during the experiment will be converted into euro at the end and paid to you in cash. The conversion rate will be shown on your screen at the beginning of the experiment.

E.1.2. *Information regarding the experiment*

Today, you are participating in an experiment on auctions. The experiment is divided into separate rounds. We will conduct 12 rounds. We now explain what happens in each round.

In each round you bid for an object that is being auctioned. Together with you, another participant is also bidding for the same object. Hence, in each round, there are two bidders. In each round you will be allocated randomly to another participant for the auction. Your co-bidder in the auction changes in every round. The bidder with the highest bid obtains the object. If bids are the same, the object will be allocated randomly.

You have a valuation in ECU for the auctioned object. This valuation lies between 50 and 100 ECU and is determined randomly in each round. In each round you will obtain new and random valuations for the object from this range. The other bidder in the auction also has a valuation for the object. The valuation that the other bidder attributes to the object is determined by the same rules as your valuation and changes in each round, too. All possible valuations of the other bidder are also in the interval from 50 to 100 from which also your valuations are drawn. All valuations between 50 and 100 are equally probable. Your valuations and those of the other player are determined independently. You will be told your valuation in each round. You will not know the valuation of the other bidder.

E.1.3. *Experimental procedure*

The experimental procedure is the same in each round and can be described as follows. Each round in the experiment has two stages.

First stage. In the first stage of the experiment, you see the following screen [*here the instructions show a screen similar to Figure 3 or Figure 4. Other than the Figure the screenshots in the instructions did not provide an example bidding function.*]

At that stage you do not know your own valuation for the object in this round. On the left side[3] of the screen you are asked to enter a bid for six hypothetical valuations that you might have for the object. These six hypothetical valuations are 50, 60, 70, 80, 90 and 100 ECU. Your input into this table will be shown in the graph on the left side of the screen when you click on ‘draw bids’. In the graph, the hypothetical valuations are shown on the horizontal axis, the bids are shown on the

[3] In the no expectation treatment, this was the right side.

vertical axis. Your input in the table is shown as six points in the diagram. Neighbouring points are connected with a line automatically. These lines determine your bids for all valuations between the six valuations for which you have entered a bid.

[*the following paragraph is only shown in the treatments with expectations:* On the right side you are asked to enter your expectations regarding the bids of the other bidder. Please enter six hypothetical valuations your expectation of the bid of the other bidder. If your expectation regarding the bids of the other bidder deviates from the actual bids of the other bidder then an amount which depends on the size of the deviation will be subtracted from your account.]

The screen of the other bidder looks identical. He also enters bids for six hypothetical valuations [*the following only in treatments with expectations:* and expectations regarding your bids]. You and the other bidder cannot see your mutual bids and expectations.

Second stage. The actual auction takes place in the second stage of each round. In each round, we will play not only a single auction but five auctions. This is done as follows: Five random valuations that you have for the object are determined. Similarly, five random valuations are determined for the other bidder. You see the following screen:

[*here the instructions show a screen similar to Figure 5. Other than these Figures the screenshots in the instructions do not provide example bidding functions, bids, valuations or payoffs.*]

For each of your five valuations, the computer determines your bid according to the graph from stage 1. If a valuation is precisely 50, 60, 70, 80, 90 or 100 then the computer takes the bid that you gave for this valuation. If a valuation is between these points then your bid is determined according to the connecting line. In the same way, the bids of the other bidder are determined for his five valuations. Your bid is compared with that of the other bidder. The bidder with the higher bid has obtained the object.

Your income from the auction:
For each of the five auctions the following holds:

- The bidder with the higher bid gets the valuation he had for the object in this auction added to his account minus his bid for the object.
- The bidder with the smaller bid gets **no income** from this auction.

[*the next two paragraphs and the screenshot are only shown in the treatments with expectations:*
The possible reduction if expectations are not correct The following screen again shows the expectations you entered in the first stage:
[*here the instructions show a screen similar to Figure 5 or 6. Other than these Figures the screenshots in the instructions do not provide examples for expected bidding functions, no examples for income and no examples for a loss.*]
The average difference between your expectations and the actual bids of the other bidder for the six hypothetical valuations 50, 60, 70, 80 and 100, multiplied with the conversion factor that is shown on the screen, is subtracted from your account.]
You total income in a round is the sum of the ECU income from those auctions in this round *[the following part is only shown in the treatments with expectations:* minus the reduction for your incorrect expectations regarding the other bidder.]
This ends one round of the experiment and, in the next round, you see the input screen from stage 1 again.
At the end of the experiment your total ECU income from all rounds will be converted into euro and paid to you in cash together with your Show-Up Fee of 3.00 Euro.
Please raise your hand if you have questions.

E.2. *Control Questions*

After participants had read the instructions, they were asked to answer control questions. These questions were implemented with z-Tree. Questions were presented and answered sequentially. When a question was answered correctly, participants saw the text 'This answer is correct' (in German). Otherwise participants saw the text 'This answer is not correct'. In this case, they got a brief explanation how to derive the correct answer for this question.

The structure of this treatment was (translated into English) as follows:

- The following control questions are supposed to improve your understanding of the experiment. We use some arbitrarily chosen examples to make you familiar with the calculation of profits and other rules in the auction.
  Please answer the following questions. You can check yourselves whether your answers are correct. The actual experiment will start after the last question.
- Please note: When you enter numbers with a decimal part you have to use the decimal point as a separator, not the decimal comma.
- If you need a calculator, please click on the symbol on your screen.

(*1*) Assume your valuation is 63.25 ECU and your bid that is derived from the bid function in the graph is 40 ECU. What is your income in this auction if
(*a*) the other bidder bids less than your bid?
(*b*) the other bidder bids more than your bid?

(*2*) Assume your valuation is 50 ECU and your bid that is derived from the bid function in the graph is 60 ECU. What is your income in this auction if
(*a*) the other bidder bids less than your bid?
(*b*) the other bidder bids more than your bid?

(*3*) Assume your valuation in this auction is 76.20 ECU. What is your valuation in the next auction?
- 76.20 ECU/one cannot say/0 ECU

(*4*) Assume your valuation in this auction is 51.67 ECU. What is the valuation of the other bidder in this auction?
- one cannot say/51.67 ECU/100 ECU

(*5*) The following table shows an example for your expectations regarding the bids of the other bidder as well as the actual bids of the other bidder. What amount will be subtracted from your account due to wrong expectations if the conversion factor is 1?

(*6*) Assume that in one round you have won one auction with a valuation of 80 ECU and a bid of 62 ECU. Furthermore, you lost 7 ECU due to wrong expectations. What is your total income from this round?

Value	Expected bid	Actual bid
50	40	40
60	40	40
70	40	30
80	40	40
90	40	50
100	40	50

E.3. *End of the Experiment*

At the end of the experiment, participants completed a questionnaire, again with z-Tree. From their answers, we know that about 20% of all participants were female, their median age was 23, about 68% were students of economics and business administration, 73% had participated already in another experiment and 33% already in another experiment with auctions. (Participants could attend only one of the treatments we describe in this article). They did not find the experiment very complicated (on a scale from 1 (not complicated) to 5 (very complicated) the average rating was 1.56).

After participants had completed the questionnaire, each of them obtained a sealed envelope with their profit from the experiment and left the laboratory.