Appendix A. Valuations

Table 1 provides an overview of the valuations of the bots, and the subjects that were drawn for the experiment.

Table 1. Valuations during the experiment.

Round	**Bot 1**	**Bot 2**	**Bot 3**	**Player**
1	73	83	92	81
2	54	34	76	74
3	87	51	89	89
4	54	55	4	99
5	56	43	45	43
6	39	18	18	12
7	32	69	23	91
8	21	24	3	80
9	19	18	68	25
10	30	79	34	87
11	96	15	26	71
12	95	78	81	60
13	0	40	2	69
14	87	77	55	56
15	23	2	33	53
16	77	14	80	11
17	29	63	60	77
18	81	32	27	27
19	9	23	56	90
20	9	49	90	84

Appendix B. Formal treatment of fact 3

Taking into consideration winner's regret, bidder i's utility function in the second-price auction can be expressed using the following formulation:

$$u_i(v_i, b^{(1)}) := \begin{cases} v_i - b^{(1)} & \text{if } v_i \geq b^{(1)} \text{ and } i \text{ wins,} \\ v_i - b^{(1)} - r(b^{(1)} - v_i) & \text{if } v_i < b^{(1)} \text{ and } i \text{ wins,} \\ 0 & \text{if } i \text{ loses,} \end{cases} \tag{1}$$

where $b^{(1)}$ is the highest bid of the competitors and $r(\cdot) : \mathbb{R} \to \mathbb{R}_+$is the regret function, which is assumed to be non-negative and non-decreasing. For the informed bidders, it is a weakly dominant strategy to bid their valuation. Hence, those bidders never experience regret. If the uninformed bidder remains uninformed, his best reply b^* to the bidding strategies of the informed bidders is the solution to[1]

$$\max_b \int_0^b \int_0^1 (v_1 - v^{(1)}) - \chi_{\{v_1 \leq v^{(1)}\}}(v_1) r(v^{(1)} - v_1) dF(v_1) dF^{N-1}(v^{(1)}). \tag{2}$$

The first-order condition for this problem amounts to

$$\left(\int_0^{b^*} (v_1 - b^*) - r(b^* - v_1) dF(v_1) + \int_{b^*}^1 (v_1 - b^*) dF(v_1) \right) (N-1) f(b^*) F^{N-2}(b^*) = 0. \tag{3}$$

If r is strictly positive on a subset of $[0, 50]$ with Lebesgue measure larger than 0, it directly follows that $b^* < E[v_1]$ and that

$$\int_0^{b^*} \int_0^1 (v_1 - v^{(1)}) - \chi_{\{v_1 \leq v^{(1)}\}} r(v^{(1)} - v_1) dF(v_1) dF^{N-1}(v^{(1)}) \leq E\left[\max\left\{ E[v_1], v^{(1)} \right\} - v^{(1)} \right]. \tag{4}$$

If bidder 1 acquires information, he bids his valuation and his bid is ex-post optimal, which means he does not experience regret. Hence, he acquires information before the auction starts if the expected utility of acquiring information is higher than the expected utility of remaining uninformed:

$$E\left[\max\{v_1, v^{(1)}\} - v^{(1)} \right] - c \geq \int_0^{b^*} \int_0^1 (v_1 - v^{(1)}) - \chi_{\{v_1 \leq v^{(1)}\}} r(v^{(1)} - v_1) dF(v_1) dF^{N-1}(v^{(1)}). \tag{5}$$

Comparing inequation (5) and (1) using inequality (4) yields the result.

Appendix C. Formal treatment of fact 4

Taking into consideration winner's regret, bidder i's utility function in the English auction can be expressed using the following formulation:

[1] $\chi_M(\cdot)$ denotes the indicator function with $\chi_M(x) = 1$ if $x \in M$ and $\chi_M(x) = 0$ otherwise.

$$u_i(v_i, b^{(1)}) := \begin{cases} v_i - p & \text{if } v_i \geq b^{(1)} \text{ and } i \text{ wins,} \\ v_i - p - r(p - v_i) & \text{if } v_i < b^{(1)} \text{ and } i \text{ wins,} \\ 0 & \text{if } i \text{ loses,} \end{cases} \tag{6}$$

where p is the price at which the last competitor left the auction and $r(\cdot) : \mathbb{R} \to \mathbb{R}_+$is the regret function as defined above. As before, for bidders who are informed about their valuation v_i, it is a weakly dominant strategy to drop out whenever $p = v_i$. Hence, those bidders never experience regret.

With the same argument as in Section 2, it remains weakly dominant for the uninformed bidder to consider information acquisition if and only if one competitor is left in the auction. If bidder 1 remains uniformed, his optimal drop out point $b^* < E[v_1]$ is the solution to problem (2) and is given by equation (3). We proceed in the same manner as in Section 2. To formalize the trade-off between the cost of information acquisition, the probability of winning, and the risk of buying at an unfavorable price, we define the following:

$$H_r(p, c) := E[\max\{v_1, v_2\} - v_2 | v_2 \geq p] - c,$$
$$K_r(p) := \int_0^{b^*} \int_0^1 (v_1 - v_2) - \chi_{\{v_1 \leq v_2\}} r(v_2 - v_1) dF(v_1) dF(v_2 | v_2 \geq p),$$

$$p_r^{**}(c) := \sup\{p \in [0,1] | H_r(p, c) \geq K_r(p)\}, \text{ and} \tag{7}$$

$$p_r^{*}(c) := \inf\{p \in [0,1] | E[\max(p, v_1) - v_1 + r(\max(p, v_1) - v_1)] - c \geq 0\}. \tag{8}$$

Therein v_2 denotes the valuation of the last remaining competitor. Comparing equations (7) and (8) to equation (2) and (3) using inequality (4) yields the result.

Appendix D. Formal treatment of risk aversion

Suppose bidder 1 is risk averse with a concave utility function $u(x)$. We start by showing that if bidder 1 decides not to buy information, his bid in a second-price auction b^* will be lower than $E[v_1]$. To see this, consider the maximization problem of bidder 1 once he decided not to buy information:

$$\max_b \int_0^b \int_0^{100} u(v_1 - v^{(1)}) dv_1 dv^{(1)}.$$

The first-order condition for this problem is:

$$\int_0^{100} u(v_1 - b^*)dv_1 = Eu(v_1 - b^*) = 0.$$

Within the parameters of the experiment, it holds that $E(v_1 - 50) = 0$. By the definition of risk aversion, all risk-averse individuals dislike zero-mean risks. Hence, $Eu(v_1 - 50) \leq 0$ and therefore $b^* < 50$.

Given the equilibrium behavior of the informed bidders and the choice of b^*, the decision as to whether to buy information or not is the choice between two random variables $\tilde{x} - c$ and $\tilde{y}$. If bidder 1 decides to buy information, his pay off is:

$$\tilde{x} - c = \max(v_1 - v^{(1)}, 0) - c.$$

If bidder 1 decides not to acquire information, the pay-off is:[2]

$$\tilde{y} = \chi_{\left\{v^{(1)} \leq b^*\right\}}(v_1 - v^{(1)}).$$

The highest c^* for which a risk-neutral bidder would acquire information is defined by $c^* = E[\tilde{x}] - E[\tilde{y}]$. To demonstrate that risk-averse bidders may refrain from information acquisition in situations where a risk-neutral bidder would have acquired information, we show that $E[u(\tilde{x} - c^*)] - E[u(\tilde{y})] \leq 0$.

Define $\tilde{x}_0 := \tilde{x} - E[\tilde{x}]$, $\tilde{y}_0 := \tilde{y} - E[\tilde{y}]$ and denote by $\pi(\omega, u, \tilde{x}_0)$ the risk premium of $\tilde{x}_0$ at a wealth level of ω. It follows:

$$\begin{aligned}
& E[u(\tilde{x} - c^*)] - E[u(\tilde{y})] \leq 0 \\
\Leftrightarrow & E[u(\tilde{x} - E[\tilde{x}] + E[\tilde{y}])] - E[u(\tilde{y})] \leq 0 \\
\Leftrightarrow & E[u(\tilde{x_0} + E[\tilde{y}])] - E[u(\tilde{y})] \leq 0 \\
\Leftrightarrow & E[u(E[\tilde{y}] - \pi(E[\tilde{y}], u, \tilde{x}_0))] - E[u(E[\tilde{y}] - \pi(E[\tilde{y}], u, \tilde{y}_0))] \leq 0 \\
\Leftrightarrow & \pi(E[\tilde{y}], u, \tilde{x}_0)) \geq \pi(E[\tilde{y}], u, \tilde{y}_0). \qquad (9)
\end{aligned}$$

For small risks, we can use the Arrow-Pratt approximation. Hence, inequality (9) holds true whenever $\text{Var}[\tilde{y}_0] \leq \text{Var}[\tilde{x}_0]$. For the parametrization of the experiment, we get $\text{Var}[\tilde{y}_0] \leq 1.354$ and $\text{Var}[\tilde{x}_0] = 1.6$ whenever $b^* < 50$. We can conclude that risk-averse bidders have a smaller willingness to pay for information than risk-neutral bidders in a second-price auction.

[2] χ denotes the indicator function.

Appendix E. Instructions

Welcome and thank you for participating in today's experiment. Please read the following instructions thoroughly. These are the same for all participants. Please do not hesitate to ask if you have any questions. However, we ask you to raise your hand and wait for us to come and assist you. We also ask that you refrain from communicating with the other participants from now on until the end of the experiment. Please ensure that your mobile phone is switched off. Violating these rules can result in your expulsion from this experiment. You will be able to earn money during this experiment. The amount of your payout depends on your decisions. Each participant will receive his payout individually in cash at the end of the experiment. You will receive 2.50 EUR for participating as well as payouts from each round. Potential losses at the end of the experiment will be deducted from the participation fee (if you accumulated losses on top of that, you will be required to pay these in cash at the end of the experiment). During the experiment payouts will be stated in the currency "ECU" (Experimental Currency Unit). 10 ECU are equivalent to 1 Euro (10 ECU = 1 EUR). The experiment consists of 20 payout relevant rounds.

Course of a Round (Treatment: 2nd Price Auction). During this experiment you will take part in an auction of a fictional product. You will be bidding in a group of four with three other participants. These three participants are pre-programmed bid robots. Their exact functioning will be described in more detail in the following.

Information prior to the Auction: The fictional product has a different value for each bidder. Therefore prior to each round a valuation is determined for each participant. This valuation is between 0 and 100 ECU and each number has the same probability. However, during this auction you will not have any initial information about your valuation. Nevertheless, at the cost of 2 ECU/ 8ECU, you can acquire knowledge as to your exact valuation at any time. In contrast, the bid robots know their exact valuation of the fictional product. Their valuation, just as your own valuation, is between 0 and 100 ECU and each number has the same probability. The three bid robots will always have different valuations.

Profits and Losses during the Auction: All bidders simultaneously make an offer for the fictional product. The bidder with the highest offer wins the auction. The price for the fictional product is set at the amount of the second highest bid. The winner of the auction has to pay this price for the product. If multiple bidders make the same offer during the round, then the winner is randomly determined. (Please note: You will not be able to revoke an offer or buy any information, once an offer has been submitted.) The payout for the winner of an auction is calculated from his previous, randomly determined product valuation minus the price at the end of the auction. (Please note: You will incur a loss if your offer is higher than your valuation of the product. Losses at the end of the experiment will be deducted from the participation fee. However, if you accumulate losses on top of that, you will be required to pay these in cash at the end of the experiment.) Additionally, if you have bought information at the cost of 2 ECU/ 8 ECU, then this amount will be deducted from your profit, or entered as a loss.

Feedback after an Auction Round: At the end of an auction round you will be informed, as to whether you won the fictional product with your bid. Additionally, you will be informed as to the second highest bid, and therefore the price of the fictional product as well as your individual profit for this round.

Course of a Round (Treatment: English Auction). During this experiment, you will take part in an auction of a fictional product. You will be bidding in a group of four, with three other participants. These three participants are pre-programmed bid robots. Their exact functioning is described in more detail in the following.

Information Prior to the Auction: The fictional product has a different value for each bidder. Therefore, prior to each round, the valuation is determined for each participant. This valuation is between 0 and 100 ECU, and each number has the same probability. However, during this auction you do not initially have any information about your valuation. Nevertheless, at the cost of 2 ECU/ 8ECU you can acquire knowledge of your exact valuation at any time. In contrast, the bid robots know their exact valuation of the fictional product. Their valuation, just as your own valuation, is between 0 and 100 ECU and each number has the same probability. The three bid robots will always have different valuations.

Profits and Losses during the Auction: The auction begins at 0 ECU for the fictional product. The bid will increase every 2 seconds by 1 ECU. A price clock indicates the current bid in ECU during the auction. You will also be able to see at any time how many bidders are still active and you will be able to buy information on your exact valuation. You can pause the price clock as you wish by clicking the button "Pause/ Continue". All participants automatically continue bidding until they leave the auction round by clicking the button "Quit" on their screen. The auction ends automatically once only one bidder is left active. The last active bidder wins the auction and has to pay the last price on the price-clock, i.e. the price when the second to last bidder dropped out. If multiple bidders quit simultaneously, then the winner of the round is randomly determined. The payout for the winner of an auction is calculated from his previous, randomly determined valuation of the good minus the price at the end of the auction. (Please note: You will incur a loss if your offer is higher than your valuation of the product. Losses at the end of the experiment will be deducted from the participation fee. However, if you accumulate losses on top of that, you will be required to pay these in cash at the end of the experiment.) Additionally, if you have bought information at the cost of 2 ECU/ 8 ECU, then this amount will be deducted from your profit, or entered as a loss.

Feedback after each Auction Round: At the end of an auction round you will be informed, as to whether you won the fictional product with your bid. Additionally, you will be informed as to the second highest bid, and therefore the price of the fictional product as well as your individual profit for this round.

End of Experiment. All auction rounds in this experiment are payout relevant. After completion of all 20 auction rounds, your payouts for each round as well as your overall result will be presented to you in a summary on your screen. After that we will ask you fill out a short questionnaire concerning the experiment. Please raise your hand if you have any further questions.

University of Cologne, Albertus Magnus Platz, 50923 Cologne, Germany
E-mail address: gretschko@wiso.uni-koeln.de