Replication Report for "Regret and Feedback Information in First-Price Sealed-Bid Auctions"

By: Richard Engelbrecht-Wiggans and Elena Katok

Primary Team: Xiaoyang Long and Jordan Tong
University of Wisconsin-Madison

Secondary Team: Andrew M. Davis and Blair Flicker
Cornell University and University of South Carolina

Engelbrecht-Wiggans and Katok (2008) investigate the role of regret and feedback in bidding behavior in first-price sealed-bid auctions. They define two types of feedback. Under "Loser's Regret" subjects receive feedback on the winning price and how large their missed opportunity to win was (their resale value – winning bid, or zero if they won). Under "Winner's regret" subjects receive feedback on the second highest bid and how much money was left on the table (their bid – second highest bid, or zero if they did not win). They find that "Winner's Regret" feedback induces bidders to submit lower bids, but "Loser's Regret" feedback induces bidders to submit higher bids.

Hypothesis to replicate:

Corresponding to Hypothesis 1 (Effect of Winner's Regret), providing both "Loser's Regret" and "Winner's Regret" feedback leads to lower average bids than only providing "Loser's Regret" feedback.

Power Analysis

In the original study, Engelbrecht-Wiggans and Katok (2008) conduct a one-sided t-test comparing the average bid/value in the two treatments, with 20 subjects per treatment. To account for potential learning effects, they conduct the statistical analysis based on all decisions as well as on the last half of each set of decisions with the same value (i.e., the last 10 rounds for each value). The authors report a p-value of $p = 0.0103$ for all rounds and $p = 0.0105$ for the last 10 rounds (see Table 2 of Engelbrecht-Wiggans and Katok 2008). Based on their statistical analysis and the reported p-value of $p = 0.0103$ for all rounds, we estimated that to achieve 90% power, we would need 64 subjects, or 32 subjects per treatment.

Note that the original experiment is a 2-by-2 design with 4 treatments. In consultation with the authors, we decided to replicate 2 of the 4 original conditions: *Loser's Regret* and *Both* conditions. Comparing these two conditions tests the effect of "Winner's Regret" feedback, corresponding to Hypothesis 1 in the paper.

Sample

Participants for the original study were "Penn State students, mostly undergradu-

ates, from a variety of majors." The sample for the primary replication consists of University of Wisconsin-Madison students. The sample for the secondary replication consists of students from Cornell University. The target sample size for each replication is 64 subjects. Due to in-person laboratory interruptions from Covid-19, each replication was first conducted online. Subsequently, if the p-value associated with the primary hypothesis is greater than .05, that location would repeat the study in-person. In all cases, students are recruited from general laboratory populations.

Materials

The instructions were included in the appendices of the published paper. We use the same instructions, with minor modifications to reflect the online environment as well as a different payment method (see details below). The experiment is re-coded in SoPHIE, with the help of the original authors. Videos documenting the exact experiment process and stimuli we used are available online.[1]

Procedure

We follow the same protocols outlined in Section 2.3 with some minor modifications as noted later.

In the experiment, each subject plays the role of a bidder who bids against two computerized opponents. The computerized bidders' values are integers uniformly distributed from 1 to 100. The subject cycles through the values of $50, 60, 70, 80, 90$, and each value is repeated for 20 consecutive decisions before going to the next value, so that each session consists of 100 bidding decisions. Each bidding decision is used in 10 independent auctions, with the computerized rivals' values (and bids) changing in each of the 10 auctions, while the subject's value and bid remains the same. Thus, each session consists of 1,000 auctions.

Subjects are randomly assigned to one of two conditions: *Loser's Regret* and *Both*. In the *Loser's Regret* condition, after each bidding decision, and for each of the 10 auctions, subjects receive feedback on the winning price and how large their missed opportunity to win was (their resale value − winning bid, or zero if they won). In the *Both* condition, subjects also receive feedback on the second highest bid and how much money was left on the table (their bid − second highest bed, or zero if they did not win). The pre-registration report for the experiment is available at https://aspredicted.org/926k7.pdf.

Analysis

The analysis is identical to the original article: a one-sided t-test on whether the average bid/value in the *Both* treatment is lower than that in the *Loser's Regret* treatment. We conduct the analysis for data from all rounds. According to the original paper (see the Notes in Table 2): "The unit of observation is the average bid/value for an individual subject for all rounds (column 7) and for last 10 rounds with each value (column 8)." Thus, there is one observation per subject, and the target number of observations in each treatment is 32. As a secondary analysis, we also repeat the same test using data from only the last 10 rounds (of each value).

Differences from Original Study

The differences with respect to the original study are as follows. First, we use subject pools at the University of Wisconsin-Madison and Cornell University rather than Penn State. Second, we use SoPHIE software rather than the original JAVA-based software. Third, some of the replications are run online. Fourth, for the studies run online, we pay subjects by emailing

[1] See https://osf.io/cjuyz/?view_only=cfe3b0404b1f425390d7b9c9fcf3292e.

Amazon.com gift cards for University of Wisconsin-Madison subjects and executing online Venmo and PayPal payments for Cornell University subjects.

Replication Results

Table 1 summarizes the results by reporting the averages and standard deviations of bid/values by condition in each of the 4 replications as well as in the original study (across all rounds 1-20, and also only across rounds 11-20). We first discuss the results of the asynchronous online experiments, followed by the synchronous in-person experiments.

Online Experiments

At the primary site, following the preregistered recruitment protocol resulted in data from 36 participants in the *Loser's Regret* condition and 33 participants in the *Both* condition included in the analysis. At the secondary site, there were 33 participants from each of the *Loser's Regret* and the *Both* conditions included in the analysis.

Rows 2 and 3 of Table 1 show the averages of each participant's average bid/value by condition at each replication site (both averaging across all 20 rounds, and averaging across only rounds 11-20). For both the primary and secondary sites the difference between conditions is directionally consistent with the hypothesis, but not statistically significant at the $p < 0.05$ level ($p = 0.2161$ and $p = 0.1152$, respectively). These differences are also not statistically significant at the $p < 0.05$ level for the secondary analysis which uses only the bid/value from the last 10 rounds ($p = 0.3347$ and $p = 0.1223$, respectively). Thus, we proceeded to replicate the experiments in-person at both sites.

In-Person Experiments

At the primary site, following the preregistered recruitment protocol resulted in data from 32 participants in the *Loser's Regret* condition and 35 participants in the *Both* condition included in the analysis. At the secondary site, there were 33 participants from each of the *Loser's Regret* and the *Both* conditions included in the analysis.

Rows 4 and 5 of Table 1 show the averages of each participant's average bid/value by condition at each replication site (both averaging across all 20 rounds, and averaging across only rounds 11-20). At the primary site the difference between conditions is directionally consistent with the hypothesis, but not statistically significant at the $p < 0.05$ level ($p = 0.1196$). At the secondary site the difference between conditions supports the hypothesis at a statistically significant $p < 0.05$ level ($p = 0.0453$). These patterns of significance are the same for the secondary analysis which uses only the bid/value from the last 10 rounds ($p = 0.1016$ and $p = 0.0253$ at the primary and secondary sites, respectively).

Unplanned Protocol Deviations

After an initial online replication attempt (which resulted in data from 71 and 67 participants from the primary and secondary sites, respectively), the replication team noticed an error in the SoPHIE program that led to showing participants the incorrect value for the second-highest bid on the results screen. We therefore treated the data collected from this initial online replication as invalid. We corrected the programming error before starting the online replication attempt reported above.

Discussion

In summary, across all 4 replications, providing *Both* feedback led to lower average bids than providing *Loser's Regret* feedback only. The difference was statistically significant at the $p < 0.05$ level for the in-person replication at the secondary site, but not for the other 3 replications. The magnitudes

of the difference between *Both* and *Loser's Regret* are smaller in the replication studies than in the original study. The standard deviations are larger in the replication studies than those in the original study. These patterns are in line with the larger p-values in the replications relative to the original study.

Table 1 Average Bid/Value in Replications and Original Study

	Decisions 1-20			Decisions 11-20		
Experiment	Both	Loser's Regret	p-value	Both	Loser's Regret	p-value
E-W & K	.7263	.7660	.0103	.7231	.7664	.0105
	(.0529)	(.0479)		(.0583)	(.0536)	
Online (Wisconsin)	.7267	.7418	.2161	.7282	.7366	.3347
	(.0651)	(.0901)		(.0675)	(.0935)	
Online (Cornell)	.7251	.7482	.1152	.7251	.7476	.1222
	(.0733)	(.0811)		(.0719)	(.0833)	
In-Person (Wisconsin)	.7260	.7435	.1196	.7204	.7396	.1016
	(.0625)	(.0578)		(.0639)	(.0578)	
In-Person (Cornell)	.7124	.7458	.0453	.7049	.7435	.0253
	(.0751)	(.0829)		(.0694)	(.0871)	

Notes. Standard deviations reported in parentheses.

References

Engelbrecht-Wiggans, Richard, Elena Katok. 2008. Regret and feedback information in first-price sealed-bid auctions. *Management Science* **54**(4) 808–819.