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Women and Men are Different but Equal:  
Observations of Learning Behavior in Auctions

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## **Abstract**

We examined gender differences in bidding and learning behavior in Second Price Auctions (SPAs). Although bidding one's true value is a weakly dominant strategy in SPAs, overbidding has been common and persistent in laboratory SPAs, i.e., bidding above one's value. In our study, we found that inexperienced women overbid more than inexperienced men when they were provided with endowment money in the auctions. However, when participants were asked to bid using their own money, women became more cautious, bidding lower and closer to the optimal strategy (true value) even without experiences, while inexperienced men still overbid significantly deviating from the optimal strategy. As men gained more experiences, they learned from costly overbidding and eventually lowered their bids to the same level as those of women's bids. In conclusion, we found that although women and men initially behaved differently in SPAs, both genders would eventually bid according to the optimal strategy and obtain the same outcome given sufficient learning experiences.

## **I. Introduction**

Gender differences in cognitive ability and economic behavior have been studied extensively since the last century (e.g. Rappoport & Chammah, 1965; Eckel & Grossman, 1996, 2008; Croson & Gneezy, 2009). Evidence from social and behavioral sciences found substantial differences between women and men but the conclusions were often conflicting under different environments or laboratory settings. For example, some studies found women shying away from competitions while men embracing it (Gneezy et al., 2003; Niederle & Vesterlund, 2007; Eckel & Grossman, 2002), whereas some other

studies showed that women were more aggressive in the competitive environment (Ham & Kagel 2006; Bucher-Koenen et al. 2014). Some studies suggested men and women differed in cognitive abilities and men learned faster (Halpern, 2013). However, many studies have found that women learned faster instead (Casari et al. 2007; Ham & Kagel 2006; Goertz, J. 2007). For example, Casari et al. (2007) found that although inexperienced women started out bidding more aggressively than inexperienced men in common auctions, they learned at a faster rate such that the gap between men and women disappeared eventually as they gained more experiences.

As discussed above, while a significant number of studies have examined gender differences in economic behavior, there is lack of consistency in the findings. This is an important topic for researchers since it is necessary in understanding how women and men learn differently and how to design mechanisms that motivate effective learning for both genders. In this study, we examined gender differences in bidding and learning behavior in Second Price Auctions (SPAs). It is well known that bidding one's true value is a weakly dominant strategy in SPAs. However many laboratory experiments have reported significant and persistent overbidding in SPAs, i.e., bidding above one's value (e.g. Kagel et al. 1987, Kagel & Levin, 1993, Copper & Fang, 2008). One explanation for overbidding is bounded rationality, which causes the systematic errors in reasoning (Kagel et al., 1987). If overbidding represents a mistake in decision making, subjects should learn from the costly outcome and bid closer true value in the future (Cooper & Fang 2008). Furthermore, several studies suggested that subjects may learn effectively when they have to pay the cost of overbidding using their own money (Georganas et al.

2014; Rosenboim & Shavit, 2012). In this study, we investigated whether women and men bid differently and how they learned from the costly overbidding. We found that even though women and men initially bid differently, the final outcome was equivalent for both genders after subjects gained sufficient experiences.

## **II. Experimental Methodology**

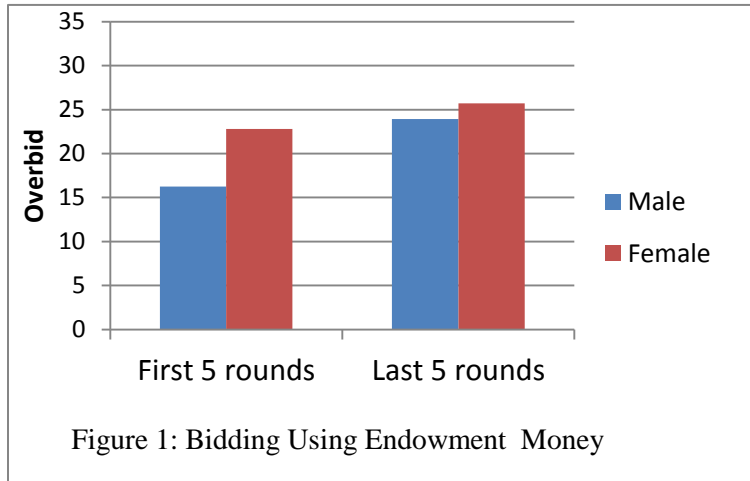
One hundred and twenty undergraduate students in a major public university were recruited and participated in twelve 10-bidder second price induced value auctions. Subjects were randomly assigned to two treatments: with endowment money and without endowment money. Each treatment was then conducted in six sessions each. Hence, in 6 out of the 12 auction sessions, subjects had to pay using their own money <sup>1</sup> on the experiment day when incurring a loss, while the participants in the other six sessions paid experimental losses out of endowment money provided to them. To avoid the selection bias, participants were assigned into different treatment groups randomly. Each auction was repeated 20 rounds. In each round of auction, every subject was first assigned a private value (i.e. the induced value) and then asked to submit a non-negative integer bid. The values were randomly drawn from a uniform distribution on the interval [1,100] and were different for each bidder in every round. Each subject had no information about other subjects' values. After each auction round, the subjects were informed about the profit they earned from that round and their total profit up to that round, which was the sum of profits from all the completed rounds. This information was made known only to each subject privately.

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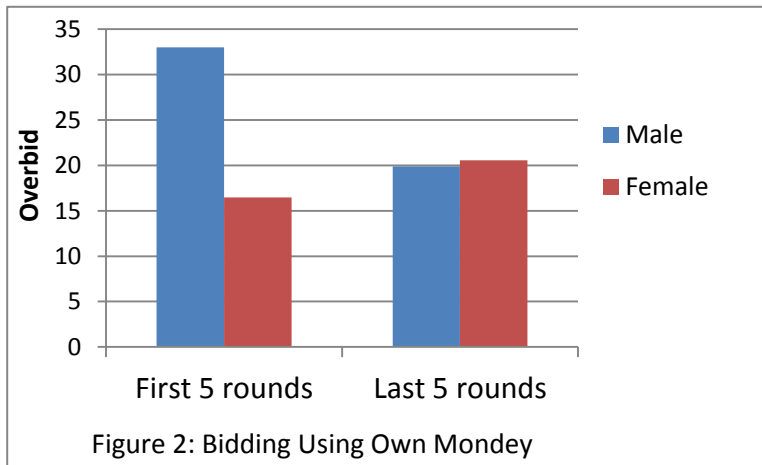
<sup>1</sup> Due to ethical reasons, subjects who had to use their own money on the experiment day still received the participation fee. To reduce the house money effect, the participation fee was delivered to them either two weeks before or two weeks after the experiment day.

### III. Results and Discussion

Consistent with previous studies (Kagel et al. 1987, Kagel & Levin, 1993, Copper & Fang, 2008), we found substantial overbidding in both treatments (i.e., with and without



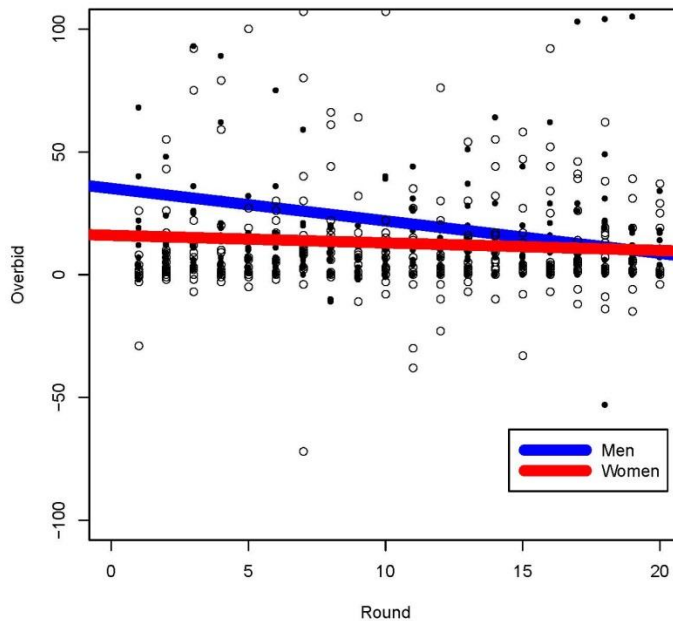
endowment money), with 80% of the bids exceeding the associated values. Figure 1 and 2 reported the results when subjects bid using endowment money and own money, respectively. Overbid was calculated as (bid – value). When subjects bid using the endowed money, women initially bid significantly higher than men ( $p$  value = 0.0051).



Both genders did not lower their bids but instead bid more aggressively after they played in more rounds. The bids in the final rounds were not significantly different between male and female subjects ( $p$  value = 0.6893). Interestingly, we found very different

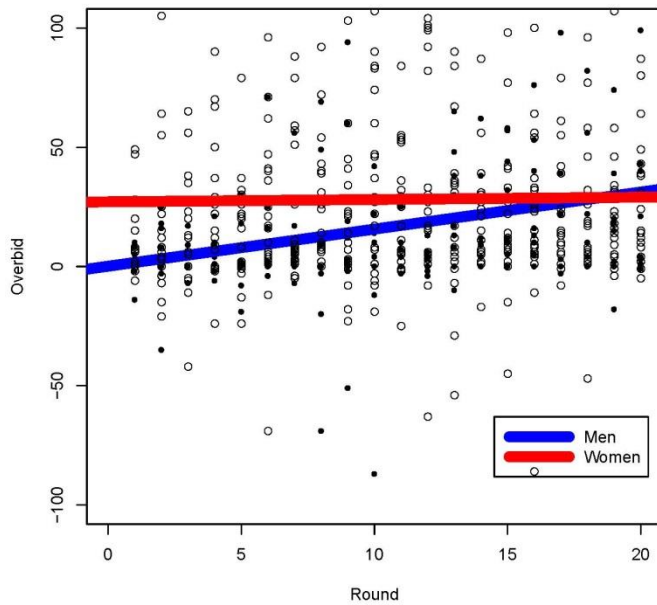
results when subjects had to use their own money to pay the experimental loss (Figure 2). In the first few rounds, women bid cautiously while men were more aggressive by bidding significantly higher than women ( $p$  value = 0.0102). However, men decreased their bids over more rounds and their bids in the last five rounds became eventually similar to women's bids ( $p$  value = 0.8738). We now used the regression analysis to test if this result is due to learning effect as men gained more experience.

We modeled individual bidder effects as random effects and examined whether bidders learned from previous loss. We used overbid as the dependent variable. The explanatory variables in the regressions included indicator of rounds, risk attitude, time discount rate, amount of money brought to the experiment, age, gender, monthly allowance, work



**Figure 3: Level of Overbidding when Using Own Money**

status, GPA, BMI, loss in the previous round, and interaction between loss in the previous round and current number of rounds. The regression results for each treatment (Table 1) suggest that when using their own money, men would learn from previous loss and reduce overbidding, since the interaction between loss in the previous round and current number of rounds had a significant negative effect ( $p$  value = 0.0184). This learning effect was not evident for women ( $p$  value = 0.8543). This result may seem



**Figure 4: Level of Overbidding when Using Endowment Money**

perplexing that women were not learning as significantly as men were. However, women might already know that they should bid closer to the true value even without much experience. As shown in Figure 3, when bidding using their own money, women indeed bid much lower than men at the beginning of the auction ( $p$  value = 0.0102). As men gained more experience and learned from previous loss, in the final rounds bids became statistically indifferent for both genders ( $p$  value = 0.8738).



Interestingly, we observed an opposite trend when subjects used the endowment money provided by the experimenters to bid. In this case, women initially bid higher than men ( $p$  value = 0.0051). Then men bid more and more aggressively as they participated in more auction rounds, and eventually bid as high as women ( $p$  value = 0.6893).

#### **IV Conclusion**

Our results showed that inexperienced women were more aggressive in bidding than inexperienced men when they were provided with endowment money in the auctions. However, when participants were asked to bid using their own money, women became more cautious, bidding lower and closer to the optimal strategy (true value) even without experiences, while inexperienced men still overbid significantly deviating from the optimal strategy. However, as men gained more experiences, they learned from costly overbidding and eventually their bids were as low as women's bids. In conclusion, we found that although women and men initially behaved differently in second price auctions, they eventually obtained the same outcome when provided sufficient learning experiences.

Table 1. The Effect of Previous Loss on Degree of Overbidding

	Overbids Using Endowment		Overbids Using Own Money	
	<b>Female</b>	<b>Male</b>	<b>Female</b>	<b>Male</b>
	Coef.	Coef.	Coef.	Coef
<b>Intercept</b>	-155.8857	-226.8281	41.9109	108.5383
<b>Round#</b>	-0.5074	1.3811	0.2552	0.7881
<b>Risk attitude</b>	-14.6434	77.5369	-0.2321	22.4987
<b>Time discount rate</b>	-24.6403	133.5385	0.0319	122.5066
<b>Pocket Money</b>	0.0026	-0.0103	-0.0083	-0.0031
<b>Age</b>	11.2962	11.5578	-1.1243	-6.5198
<b>Monthly allowance</b>	-10.7699	-12.5637	-17.3306	150.5288
<b>Work status</b>	-47.5003**	-8.4130	22.6925	17.2360
<b>GPA</b>	-8.5539	9.1115	4.1170	-9.4483
<b>BMI</b>	0.8442	-1.5615	-0.5288	0.5750
<b>Loss</b>	0.3325	-0.0353	0.8012	1.1533***
<b>I(Round# x Loss)</b>	-0.0064	-0.0281	0.0091	-0.0825***

Note: \*,\*\*,\*\*\*: Statistically significant at the levels of 0.10, 0.05 and 0.01 respectively.

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