The Dollar Auction Game: A laboratory comparison between Individuals and Groups

Morone, Andrea and Nuzzo, Simone and Caferra, Rocco

18 July 2016

The Dollar Auction Game: A laboratory comparison between Individuals and Groups

Andrea Morone[a,b], *Simone Nuzzo*[a*] *and Rocco Caferra*[a]

[a] Dipartimento di Economia, Management e Diritto dell'Impresa, Università degli Studi di Bari, Aldo Moro, Italy

[b] Departamento de Economía, Universidad Jaume I, Castellón, Spain

Abstract: By means of a laboratory experiment, this paper aims at studying how individuals and groups behave in a simple game such as the dollar auction. This game is extremely interesting since it induces subjects to fall prey into the paradigm of escalation, which is driven by agents' commitment to higher and higher bids. Indeed, whenever each participant commits himself to a bid, the lower bidder, moved by the wish to win as well as to defend his prior investment, finds it in his best interest to place a higher bid to overcome his opponent. The latter mechanism may lead subjects to overbid, implying that the winner pays more than the auctioned value. The aim of the paper is to analyze bidder's behavior, comparing individuals vs. groups' decisions within the dollar auction framework. We find that groups are closer than individuals to the Nash equilibrium, and that experience reduces the escalation phenomenon, but it has a different impact on winners and losers.

Key Words: escalation; winner's curse.

JEL code: C91

[*] Corresponding author: snuzzo1@gmail.com

1. Introduction

It is a matter of fact that many decisions are made by groups. Economic, legal and political decisions are recurrent examples. In this sense, whether or not decisions performed by groups are different or superior relative to decisions undertaken by individuals in isolation is still an open question[1]. This paper contributes to the debate studying whether groups' decisions outperform those of individuals by exploiting the well-known framework of the "Dollar Auction Game", proposed by Martin Shubikin (1971). The game involves a promoter who auctions off a dollar to the highest bidder. The dollar is auctioned through a modified "English Auction": both the winner and the second-highest bidder have to pay their own bid, but only the highest bidder obtains the dollar. Whenever both players submit a bid, these rules create potential for a perverse mechanism in which players commit themselves to higher and higher bids in order to preserve their prior investment. Then, a mutually reinforcing behaviour might be in place, leading players to fall prey into the overbidding trap, and implyingthe paradox that one-dollar is sold for more than its value.

In some way the dollar auction game also resembles the winner's curse (Thaler, 1988). The latter is a well-known behavioral bias in which decision makers are naïve and fail to behave rationally in the attempt to acquire an item. As a consequence, and against theory predictions, people systematically end up with loss-making purchases[2] in common value auctions.

In its simplicity, the dollar auction game provides a meaningful representation of many economic scenarios, for example that involving companies in a competition for acquiring oil extraction rights. One further example is that of the so called "Concorde Trap": after the Second World War, US, England, France and the Soviet Union reached an agreement regarding the creation of a supersonic airplane, the "Concorde". It would have been the first high-speed flight. Even though, due to a sharp increase in production and management costs, the Concorde project was loss generating, the involved States did not break out the venture since they had invested too much in it to leave the table.

The latter as well as further evidence[3] show that people decision-making is affected by non-negligible sunk costs, which are reflected in the effort to continue an investment beyond the rationality of a representative profit maximize agent. The origins of sunk costs are not clear at all. Teger (1980) argues that the sunk costs and self-commitment are, in some way, related to the feel of having invested too much to quit. Thaler (1980) explains sunk costs in the light of the prospect theory (Kahneman and Tversky, 1979). Indeed, starting from a reference point, after an unsuccessful investment has been made, people shift somewhere in the convex trunk of their utility function. At that point, while losses do not result in significant decreases in value, gains would lead to large increases in value. Then, risking negligible losses to seek significant gains seems a good deal. Staw (1981) shows that further commitment after bad decisions does occur since people are averse to admit that prior money was wasted.

It is pretty evident as the dollar auction is a powerful game in that it creates potential for detecting and measuring the impact of sunk costs on subjects' decision making. This is the reason why this article adopts this game to contribute to the diatribe regarding groups and individuals decisions. Are groups more inclined than individuals to avoid overbidding and self-commitment to bad investments? In this sense, are groups' decisions superior relative to

[1]Comprehensive surveys comparing group and individual decision making can be found in Charness and Sutter (2012) and Temerario (2014)

[2]eBay auctions, mineral right auctions and corporate takeovers are widespread examples.

[3]See Arkes and Blunder (1985)

individuals' decisions? To the best of our knowledge, this work is the first shedding light on individuals and group decisions in such a framework.

In a class experiment involving seventy people, Murnighan (2002) auctioned off a 20$ bill. He reported that, after intensive subjects' activity, the last two bidders did not stop bidding at the break-even point (20$) but they kept on bidding, with the aim of driving the other bidder out. At the end of the game, the winner paid 54$ for a 20$ bill. Murnighan (2002) also reported other very extreme class experiments in which the winner ended up with paying 2,000$ for a 20$ dollar auctioned value.

O'Neill (1986) shows that upper-bounded bids prevent subjects from falling prey into the escalation phenomenon, since they anticipate the contingency of incurring in a loss.

In a revisited version of the dollar auction game, Migheli (2012) finds that, although escalation does not occur, some participants are willing to pay more than the value of thecoin. He argues that, probably, loss-related costs are counter balanced by the "intangible reward of glory and fame" coming from winning the auctioned good.

As far as individual *vs.* team decision-making is concerned, a wide range of experimental games has been used to investigate whether groups perform better then individuals in isolation. Charness and Sutter (2012) and Temerario (2014) provide comprehensive surveys in this area. Results in this field are far from being convergent. Some studies (see for example Kocher and Sutter, 2005) show that groups outperform individuals in a wide set of situations. In line with this strand, Cooper and Kagel (2005, 2009) report that groups outcomes in strategic task are sharply better than those of the most skilled member of the group. Blinder and Morgan (2005), involving teams and stand-alone individuals in both a statistical urn problem and a monetary policy experiment, support the evidence that not only teams perform better than individuals but, surprisingly, groups decision making is not slower than that of individuals. Then, two heads are better than one. On the other side, some literature (see Kerr at al. 1996) reports no evident differences between teams and individuals decisions. Sutter et al. (2009) compare three-member groups and individuals decision in an English auction framework with private and common value. Contrarily to previously mentioned literature, they find that groups fall into the winner's curse trap more frequently than individuals, thus earning lower profits. Sutter et al. (2009) relate their achievement to a different approach of groups and individuals toward competition, arguing that competition among groups is more ruthless than competition among individuals. In a recent contribution, Casari et al. (2015) compare three-member groups and individuals' performance in an "Acquiring a Company" task. In order to track the main forces leading the different choices of groups and individuals, the team decision making process is split up into three steps: first, each subject presents an individual proposal; secondly, subjects go through a group chat step and, as a last step, the decision itself takes place. Moreover, the difficulty level[4] of the task is changed to provide insights on when groups outperform individuals. Casari et al. (2015) show that results are crucially task dependent. While in the simple task groups perform better than individuals, since they reduce the winner's curse and place better bids than stand-alone individuals, in the difficult task individuals decisions are superior relative to those made by groups. This achievement is explained by the evidence that disagreement within a group was generally resolved with the median (and not with the best, i.e. the "truth wins rule") proposal. Then, in the easy task case, groups make better decisions just because the subjects with the wrong answer are the minority. This result provides the interesting evidence that the choice of having individuals or groups as decision unit is strongly context dependent.

[4] While in the easy level of the task themajority of subjects can solve the problem, in the difficult version only a minority can succeed.

Shupp and Williams (2008) evaluate risk aversion using price data elicited by a willingness to pay mechanism for risky prospects. They find that the variance of risk preferences is generally smaller for groups than individuals and the average group is more risk averse than the average individuals in high-risk situations. Morone and Morone (2014) estimated and compared subjects and dyads preferences toward risk[5]. In addition, Morone et al. (2012) show that subject choices in the first-period play a key role in determining subjects' behavior in the repeated game, so experience teaches something and the initial choice is crucial in tracking the pathway to follow, and overall, groups behave more rationally, in the sense that they were always closer to the Nash equilibrium.

Leavitt (1989) showed that collective decisions should be more efficient than individual ones. He recognizes three causes to support this idea: it satisfies the human's need of social membership,groups seem to be more creative than individuals and they are able to correct their mistake, putting toghether different information. In the same year, the psychologist Irving L. Janis came up with a different pattern. He showed that sometime groups convey to a sub-optimal equilibrium caused by impulsive choices. He called his theory "Groupthink". It is a phenomenon in which the need for agreement and conformity in the group results in an irrational decision-making outcome; this behaviour can be particularly dangerous if coupled with escalation phenomenon.

In the next section we report the experimental design, in section 3 some theoretical background, and our results are presented. Finally section 4 concludes.

2. Experimental design and lab procedure

The experiment was conducted at the ESSE laboratory in Bari and programmed in z-Tree (Fischbacher, 2007). 48 subjects participated to the experiment, and they were randomly allocated to two different treatments, i.e. an individuals' treatment (IT) and a two-member groups' treatment (GT). 32 subjects played the group treatment. They were randomly gathered into 16 two-member groups and randomly matched with the same opponent during the whole lab session. Then, eight different auctions took place in the GT. 16 subjects got involved in the IT. Each of them was randomly matched with an opponent and played the whole auction session in isolation against the same opponent. Then, also in the IT, eight different auctions were played. The rules wereas follows: the highest bidder obtained 10 ECU[6], the lowest bidder lost and had to pay his latest bid. The auction was initially opened for 30seconds; whenever each subject posted a bid, the time auction was restored for other 30 seconds and, if nobody raised up his bid until the end of the 30 seconds, the auction was stopped and players had to pay according with their latest bids. In each treatment subjects played the game over 10 periods. Thereafter, one period was randomly selected for payment; the exchange rate was 1 ECU to 0.1 €. At the end of each lab session, all participants filled in a questioner. The experimental instructions and the questioner are reported in Appendix A, box A1 and A2 respectively.

3. Theoretical aspects andExperimental Results

The auction is set up as a sequential game. The Nash Equilibrium is reached respectively whenever the faster bidder offers the minimum request to obtain the euro (i.e. 0.1 ECU) and the opponent leaves the auction. Whether subjects rise up their bids, they will lose the track of their losses.

[5] For a thoughtful survey see Temerario (2014).
[6] The ECU (Experimental Currency Unit) is the currency used to conduct the experiment.

Our research pursues a dual scope. As a first point, we aim at testing whether the sub-game perfect Nash equilibrium (SPNE) solution of the game holds. Since the game theoretical optimal strategy is different for losers (L) and winners (W), our analysis keeps the two categories separated. Thereafter, within each category, we focus on both groups and individual decision-making. The second goal is to assess whether groups and individuals' choices do rely on different underlying criteria, i.e. whether group decisions are on average superior to individual decisions[7].

Following the above schedule, we first test whether our experimental data confirm the theoretical Nash equilibrium prediction of the game. Tables B1, B2, B3, B4 in Appendix B report the bid distribution for each dyad over the ten periods. Data are grouped by winners and losers and, within each of the latter categories, by groups and individuals. Accordingly, descriptive statistics are illustrated in Box-Plot C1, and Box-Plot C2 in Appendix C. As far as losers are concerned, a one sample t-test (n = 80) is performed to assess whether their bids are, on average, equal to 0 ECU. Similarly, as far as winners are concerned, the one sample t-test (n = 80) is carried out to test whether winners' proposals are, on average, equal to the minimum allowed value, i.e.0.1 ECU. The analysis is worked out for both groups and individuals. The results show that theory fails. Indeed, both losers and winners' average bids are significantly diverse from the respective theoretical prediction. This achievement holds[8] for both stand alone and dyad choices (LGB: t = 7.45, *** $p<0.01$; LIB: t = 6.51, *** $p<0.01$; WGB: t = 12.64, *** $p<0.01$; WIB: t = 8.70, *** $p<0.01$).

Result 1: Both groups and individuals do not behave in accordance with the theoretical prediction of the game.

Anyway, our first result pushes us further to investigate if subjects' decisions differ depending on whether people play individually or in groups of two elements. In Figure 1 and Figure 2 we report the period-by-period median bid for both losers and winners, controlling for individual and group play. The black dash line represents the theoretical prediction of the game.

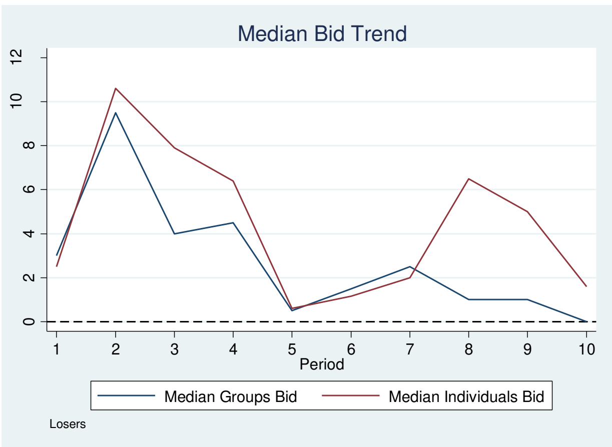


Figure 1

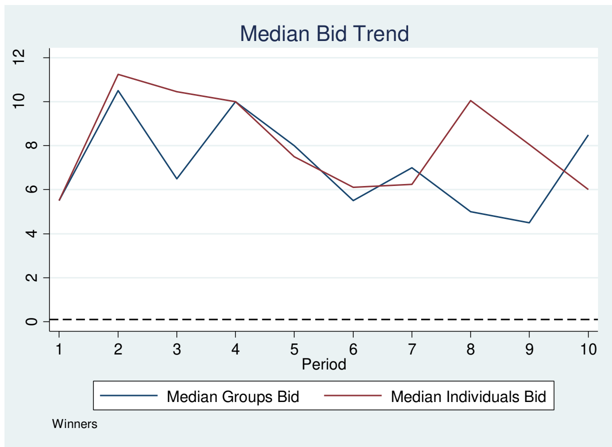


Figure 2

[7] This evidence is largely supported in the related literature. See, for example, Blinder and Morgan (2005)

[8] Full t-tests are reported in Appendix D

Interestingly, we can see that, both in the losers and winners instances, groups median bids are most of the times lower and, hence, closer to the Nash equilibrium than individuals median bids. We perform a two-sample-mean comparison test (n = 80, see Table E1 and E2, Appendix E) to assess whether subjects' bids are, on average, lower when the game is played in groups. The results are affirmative. Taking into consideration losers bids, we find that groups bids are, on average, significantly lower than individuals' bids (** $p<0.05$). The same result is detected when winners' bids are accounted for (** $p<0.05$).

Furthermore, by employing the root mean squared error (*RMSE*) index, we test the error margin between subjects' bids and the theoretical prediction of the game. The employed measure computes the average squared deviation of actual bids over the theoretical equilibrium value. In other words, the *RMSE* is used as an index of proximity of the observed bids from theoretical value.

$$RMSE = \left[\frac{1}{n} \sum_{i=1}^{n} \left(B_O - B_N \right)^2 \right]^{\frac{1}{2}}$$

where:

- B_O represents the observed bid
- B_N represents the Nash equilibrium predicted bid
- n stands for the number of observations within each period

Then, the more actual bids approximate the equilibrium value, the lower the *RMSE* is.

Accounting for losers, Figure 3 shows the *RMSE* distribution box-plot of actual bids toward the equilibrium bid. As we can note, when the game is played in groups, the *RMSE* distribution is downward shifted. Then, groups bids track the theoretical equilibrium closer than individuals bids. A non-parametric Mann-Whitney U test (n = 10, table 1) shows that this difference is statistically significant (* $p<0.1$).

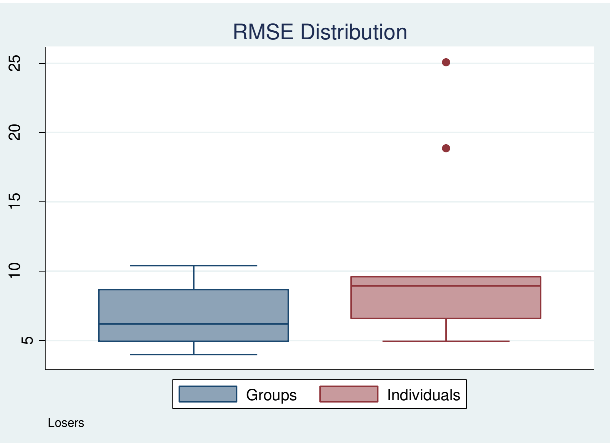


Figure 3

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

Player	obs	rank sum	expected
Groups	10	83	105
Individuals	10	127	105
combined	20	210	210

```
unadjusted variance      175.00
adjustment for ties        0.00
                       ---------
adjusted variance        175.00

Ho: RMSE(Player==Groups) = RMSE(Player==Individuals)
             z =  -1.663
    Prob > |z| =   0.0963
```

Table 1

Similarly, as far as winners are concerned, figure 4 shows that groups behaviour approximates the theoretical prediction much better than individuals' behaviour. A non-parametric Mann-Whitney U test (n = 10, table 2) shows that this result is statistically significant (** $p<0.05$).

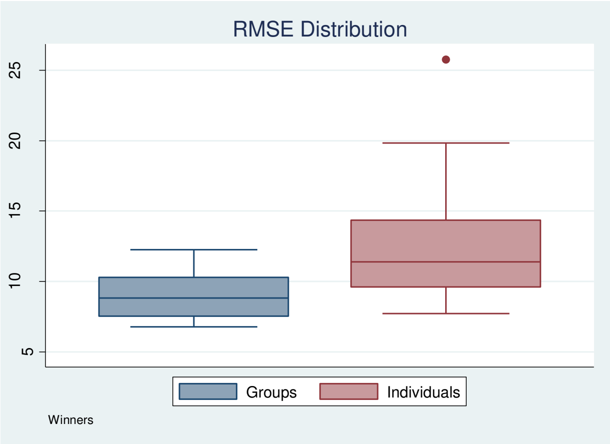


Figure 4

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

Player	obs	rank sum	expected
Groups	10	78	105
Individuals	10	132	105
combined	20	210	210

```
unadjusted variance      175.00
adjustment for ties        0.00
                         ------
adjusted variance        175.00

Ho: RMSE(Player==Groups) = RMSE(Player==Individuals)
             z =  -2.041
    Prob > |z| =   0.0413
```

Table 2

Result 2: In both the winners and losers instances, groups bid closer to the theoretical equilibrium than individuals.

In Figure 5, Table 3 - Figure 6, Table 4 we report the comparison between losers *vs.* winners in the two treatments. Indeed losers are closer to the Nash equilibrium in both treatments. This result is in line with the winner's curse.

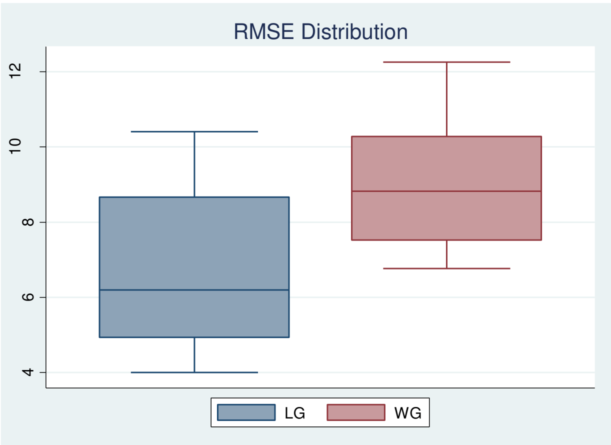


Figure 5

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

Player	obs	rank sum	expected
LG	10	78	105
WG	10	132	105
combined	20	210	210

```
unadjusted variance      175.00
adjustment for ties        0.00
                         ------
adjusted variance        175.00

Ho: RMSE(Player==LG) = RMSE(Player==WG)
             z =  -2.041
    Prob > |z| =   0.0413
```

Table 3

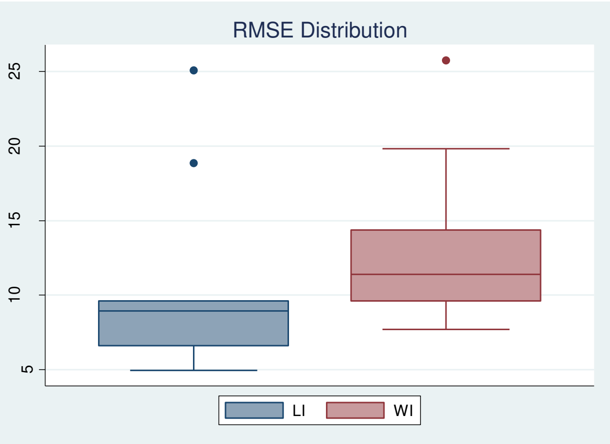


Figure 6

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

Player	obs	rank sum	expected
LI	10	78	105
WI	10	132	105
combined	20	210	210

unadjusted variance	175.00
adjustment for ties	0.00
adjusted variance	175.00

Ho: RMSE(Player==LI) = RMSE(Player==WI)
z = -2.041
Prob > |z| = 0.0413

Table 4

At the end of the treatment, subjects answer to three simple questions: (1) "Have you offered more or less than one euro?"; (2) "Why do you follow this pattern?"; (3) "Does experience lead you to switch to another strategy?". We report information gathered in the questioner into a "statements cloud" (see Figure 7), in order to put in evidence the key words and the most meaningful statements. They report that inexperience is crucial in the first periods because they are unaware about the mechanism of the game and the strategy of their opponents. Finally, in some cases a learning process slowed down the size of bids and cleaned their decision-making process up, but sometimes subjects took a wrong position. A sunk cost effect (in most cases they reveal that they are moved by their wish to minimize the losses) blind the right equilibrium.

Figure 7: statements cloud

4. Conclusion

In this paper we compared individuals and groups behavior in a particular auction, i.e. the dollar auction. We got two results; (i) both groups and individuals do not behave in accordance with the theoretical prediction of the game, but (ii) groups bid closer to the theoretical equilibrium than individuals.The escalation of commitment is a topic that regards our daily routine and each decision making process, indeed a great part of our choice is influenced by a sunk cost effects. It is difficult to find a break event point between the cost of our past and the actual benefits of our future gains (or losses). However a collective mechanism takes to a gradual dimming of this problem and it partially succeeds to avoid the paradox of the game.

References

Blinder, A. S. and J. Morgan, (2005). "Are Two Heads Better than One? Monetary Policy by Committee", Journal of Money, Credit, and Banking, pp.789-812.

Casari, M., C. Jackson, and J. Zhang, (2015). "Same Process, Different Outcomes: Group Performance in an Acquiring a Company Experiment", IZA Discussion Papers 9614, Institute for the Study of Labor (IZA).

Charness, G., M. Sutter, (2012). "Groups Make Better Self-Interested Decisions", Journal of Economic Perspectives, 26(3): 157-76.

Cooper, D. J., J. H. Kagel, (2005). "Are Two Heads Better than One? Team versus Individual Play in Signaling Games" The American Economic Review, Vol. 95, No. 3, pp. 477-509

Cooper, D. J., J. H. Kagel,(2009). "Equilibrium selection in signaling games with teams: Forward induction or faster adaptive learning?", Research in Economics, Elsevier, vol. 63(4), pages 216-224, December.

Fischbacher, U., (2007). "z-Tree: Zurich toolbox for ready-made economic experiments", Experimental Economics, Springer, vol. 10(2), pages 171-178.

Janis, I. L. (1982). Groupthink: Psychological Studies of Policy Decisions and Fiascoes. Second Edition.

Kahneman, D., A. Tversky, (1979). "Prospect Theory: An Analysis of Decision under Risk", Econometrica, 47(2), pp. 263-291.

Kerr, N. L., R. J. Maccoun, G. P. Kramer (1996) "Bias in judgment: Comparing individuals and groups", Psychological Review 103(4):687-719.

Kocher, M. C., M. Sutter, (2005). "The decision maker matters: Individual versus group behaviour in experimental beauty-contest games", The Economic Journal 115 (500), 200-223

Leavitt, H. J. (1989). Suppose we took groups seriously. Readings in managerial psychology, 410.

Migheli, M., (2012), "It is not just escalation: The one dollar game revisited". Journal of Behavioral and Experimental Economics, Elsevier, vol. 41(4), pages 434-438.

Morone, A. and P. Morone, "Guessing Games and People Behaviours: WhatCan we Learn?", in: M. Abdellaboui and J.D. Hey (eds.), Advances in Decision Making under Risk and Uncertainty, Springer, 2008

Morone, A. and P. Morone, "Estimating Individual and Group Preference Functionals Using Experimental Data". Theory and Decision, 2014, 1–20.

Morone, A., P. Morone, A.R. Germani, "Individual and group behavior in the traveler's dilemma: An experimental study", Journal of Behavioral and Experimental Economics. Volume 49, April 2014, Pages 1–7

Murnighan, J. K., "A Very Extreme Case of the Dollar Auction", Journal of Management Education February 2002 vol. 26 no. 1 56-69

O'Neill, B.(1986). "International escalation and the dollar auction". The Journal of Conflict Resolution 30 (1), 33–50.

Shubik, M. (1971). "The Dollar Auction Game: A Paradox in Noncooperative Behavior and Escalation". Journal of Conflict Resolution 15 (1): 109–111.

Shupp, R. S., and A. W. Williams. "Risk preference differentials of small groups and individuals", The Economic Journal, 118 (525), 2008, 258–283.

Staw, B. M. (1981). The escalation of commitment to a course of action. Academy of management Review, 6(4), 577-587.

Sutter, M., M. G. Kocher, S. Strauss, (2009). "Individuals and teams in auctions", Oxford Economic Papers, Oxford University Press, vol. 61(2), pages 380-394, April.

Teger, A.I. (1980). "Too much invested to Quit", New York: Pergamon Press

Temerario, T., 2014. "Individual and Group Behaviour Toward Risk: A Short Survey", MPRA Paper 58079, University Library of Munich, Germany.

Thaler, R. H. (1988). "Anomalies: The Winner's Curse", Journal of Economic Perspectives 2 (1): 191–202.

Appendix A

Box A1: Instructions

In this experiment you take part in an auction to win 1 euro. You compete against one opponent. The auction rules are as follows:

-The promoter auctions off 10 ECU (Experimental Currency Unit);

-The auction follows a competitive mechanism, it will start from a price of 0 ECU;

- In order to win the auction you have to submit at least one bid;

-You have 30 seconds to raise up your latest bid, you can raise your bid by 0.1 ECU at a time, there are no upper limits.

-If you do not raise up your bid within 30 seconds since your opponent's bid has been posted, the auction ends. Both the winner and the loser have to pay their latest bid to the auctioneer, but only the winner obtains 10 ECU. You will play the auction 10 times (periods) against the same opponent. Thereafter, one period will be randomly selected and you will be paid what you earned in that period. The exchange rate is 1 ECU = 0.1€.

At the end of the experiment you will be asked to fill in a questionnaire.

A screenshot of the experiment layout.

Box A2: Questioner

Questions:

"Have you offered more or less than one euro?"

"Why do you follow this pattern?"

"Does experience leadyou to switch to anotherstrategy?"

Most meaningful answers:

"Replication over periods helped us to change our strategy."
"We never bidded more than 8 ECU."
"We met a risk averse opponent, then we never over-bidded."
"We over-bidded because of our opponent's strategy."
"We wished to reduce our losses, but inexperience led us to offer more than 10 ECU."
"We have been influenced by our opponent raising his bids"
"We played in order to reduce our losses."
"From time to time we changed our strategy."
"We never changed our strategy."
"We understood that our opponent knew the mechanism of the game."
"We over-bidded because, in this way, we reduced our losses."
"We played moved by thewish to reduce our losses."
"We were conditioned by time."
"We modified our strategy according to our opponent's behavior."
"We needed more attempts to understand the game."
"Experience helped us to improveour strategy."
"We never changed our strategy."
"I bidded to increase my gain."
"The other player realized that, if he had bet 9 ECU and I had replied with 10 ECU, it would have been cheaper to lose 1 ECU raising up his bid to 11 ECU than losing 9 ECU leaving the auction."
"I played moved by the purpose to earn more, paying the promoter as few as possible."
"For more than 10 ECU, the loss is lower if you win the auction."
"I observed my opponent's attitude to commit himself to higher and higher bids, for this reason I stopped bidding when my losses were small."
"My aim was to win in order to avoid losses."
"My strategy consisted in bidding as few as possible to tone down losses, but my opponent did not accept it."

Appendix B

Losers Groups Bids (LGB)								
Period	Dyad 1	Dyad 2	Dyad 3	Dyad 4	Dyad 5	Dyad 6	Dyad 7	Dyad 8
1	6	6	3	0	10	1	3	2
2	3	14	10	0	11.1	12	4	9
3	5	8	5	3	12.2	2	0	0
4	5	22	10	2	3.6	4	15	0
5	5	1	11	0	0	2	0	0
6	5	1	20	2	0	0	1	13
7	7	1	4	12	0	0	0	18
8	6	1	8	0	0	1	1	12
9	1	1	11	2	0	0	1	0
10	7	1	17	0	0	0	0	0

Table B1

Losers Individuals Bids (LIB)								
Period	**Dyad 1**	**Dyad 2**	**Dyad 3**	**Dyad 4**	**Dyad 5**	**Dyad 6**	**Dyad 7**	**Dyad 8**
1	**0.1**	**9**	**8**	**1**	**2**	**3**	**0.1**	**6**
2	**59**	**30**	**4**	**20**	**10**	**3**	**1**	**11.2**
3	**44**	**11**	**2**	**2**	**4**	**5**	**10.8**	**25**
4	**1.9**	**0**	**9**	**6.8**	**6**	**9**	**1.1**	**10**
5	**0.2**	**0**	**4**	**17**	**20**	**1**	**0.2**	**0**
6	**0.3**	**0**	**0**	**15**	**10**	**9**	**0.2**	**2**
7	**0.5**	**0**	**2**	**0**	**2**	**11**	**2**	**9.4**
8	**11**	**0**	**3**	**10**	**3**	**17**	**14.5**	**1**
9	**10**	**0**	**1**	**21.5**	**10**	**4**	**0**	**6**
10	**0.1**	**0**	**10**	**20.1**	**0**	**8**	**1.5**	**1.7**

Table B2

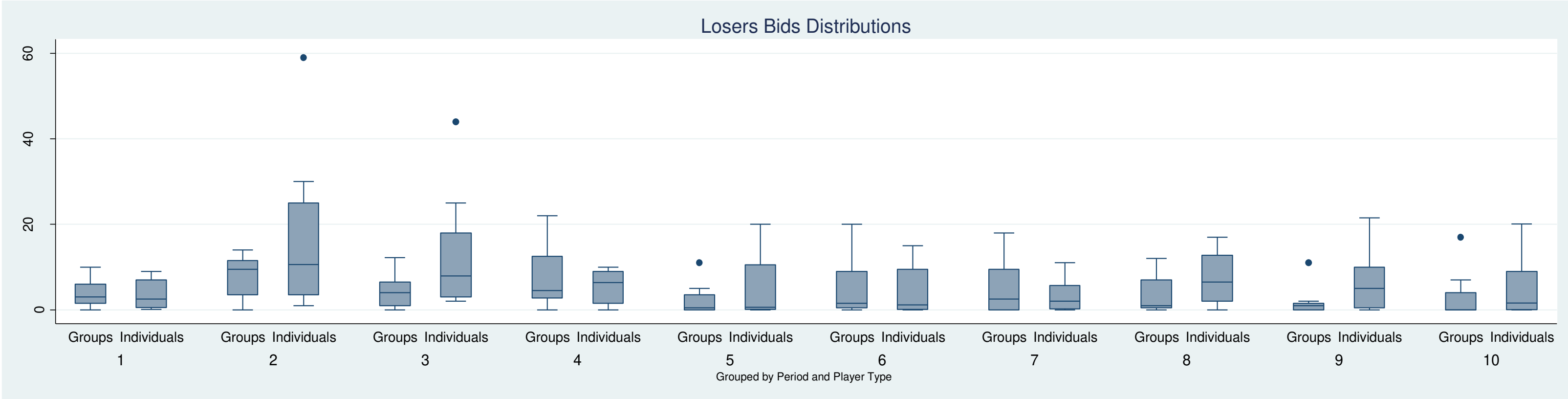
Winners Groups Bids (WGB)								
Period	**Dyad 1**	**Dyad 2**	**Dyad 3**	**Dyad 4**	**Dyad 5**	**Dyad 6**	**Dyad 7**	**Dyad 8**
1	7	8	4	2	11	10	4	3
2	4	15	11	2	11.2	13	10	10
3	6	10	6	7	12.3	4	0	10
4	6	23	11	10	3.7	10	16	8
5	6	4	12	10	1	10	0	12
6	6	2	21	5	1	10	2	17
7	8	2	6	13	1	10	1	20
8	7	2	10	3	1	10	2	14
9	5	2	12	4	1	9	2	10
10	8	2	20	2	1	9	9	10

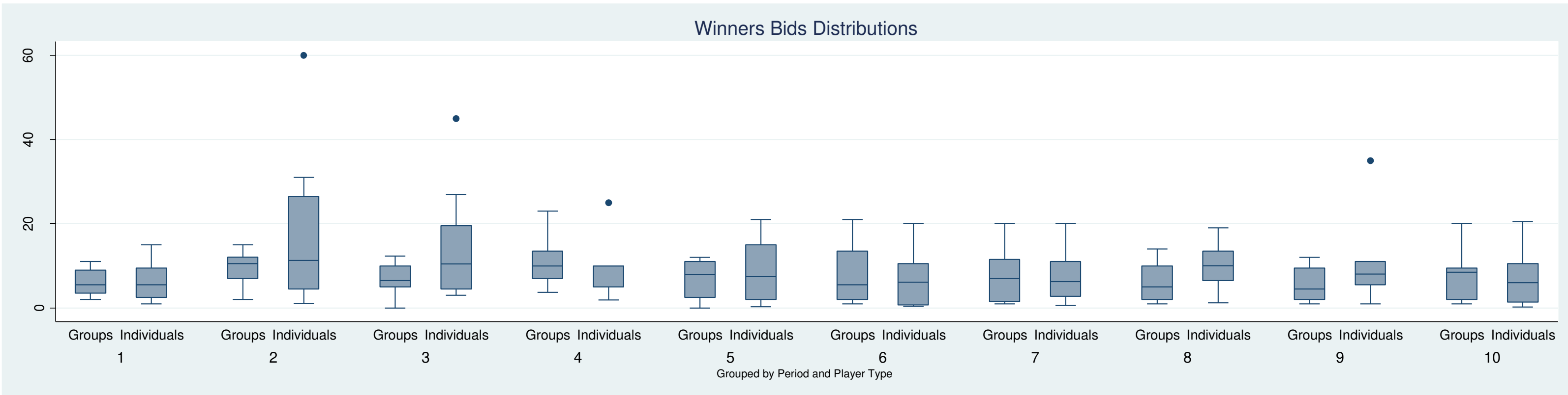
Table B3

Winners Individuals Bids (WIB)								
Period	**Dyad 1**	**Dyad 2**	**Dyad 3**	**Dyad 4**	**Dyad 5**	**Dyad 6**	**Dyad 7**	**Dyad 8**
1	**15**	**10**	**9**	**2**	**3**	**4**	**1**	**7**
2	**60**	**31**	**5**	**22**	**11**	**4**	**1.1**	**11.5**
3	**45**	**12**	**3**	**3**	**10**	**6**	**10.9**	**27**
4	**1.9**	**10**	**10**	**10**	**8**	**10**	**2**	**25**
5	**0.3**	**10**	**5**	**20**	**21**	**3**	**1**	**10**
6	**0.4**	**10**	**1**	**20**	**11**	**10**	**0.5**	**2.2**
7	**0.6**	**10**	**3**	**20**	**3**	**12**	**2.5**	**9.5**
8	**12**	**10**	**9**	**10.1**	**4**	**19**	**15**	**1.2**
9	**11**	**10**	**5**	**35**	**11**	**6**	**1**	**6.1**
10	**0.2**	**10**	**11**	**20.5**	**1**	**10**	**2**	**1.8**

Table B4

Appendix C


Losers Bids Distributions
0
20
40
60
Groups Individuals
1
2
3
4
5
6
7
8
9
10
Grouped by Period and Player Type


Winners Bids Distributions
0
20
40
60
Groups Individuals
1
2
3
4
5
6
7
8
9
10
Grouped by Period and Player Type

Appendix D

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
     LGB |      80     4.54875    .6098765    5.454901    3.334821    5.762679
------------------------------------------------------------------------------
    mean = mean(LGB)                                              t =   7.4585
Ho: mean = 0                                     degrees of freedom =       79

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
     LIB |      80      7.1775    1.101518    9.852276    4.984983    9.370017
------------------------------------------------------------------------------
    mean = mean(LIB)                                              t =   6.5160
Ho: mean = 0                                     degrees of freedom =       79

    Ha: mean < 0                 Ha: mean != 0                 Ha: mean > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
     WGB |      80        7.54     .588429    5.263069    6.368761    8.711239
------------------------------------------------------------------------------
    mean = mean(WGB)                                              t =  12.6438
Ho: mean = 0.1                                   degrees of freedom =       79

    Ha: mean < 0.1               Ha: mean != 0.1               Ha: mean > 0.1
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

```
One-sample t test
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
     WIB |      80     9.97875    1.134557    10.14779     7.72047    12.23703
------------------------------------------------------------------------------
    mean = mean(WIB)                                              t =   8.7071
Ho: mean = 0.1                                   degrees of freedom =       79

    Ha: mean < 0.1               Ha: mean != 0.1               Ha: mean > 0.1
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

Appendix E

Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
LGB	80	4.54875	.6098765	5.454901	3.334821	5.762679
LIB	80	7.1775	1.101518	9.852276	4.984983	9.370017
combined	160	5.863125	.6361568	8.046818	4.606718	7.119532
diff		-2.62875	1.259083		-5.120973	-.1365267

diff = mean(LGB) - mean(LIB)   t = -2.0878
Ho: diff = 0   Satterthwaite's degrees of freedom = 123.274

Ha: diff < 0   Ha: diff != 0   Ha: diff > 0
Pr(T < t) = 0.0194   Pr(|T| > |t|) = 0.0389   Pr(T > t) = 0.9806

Table E1

Two-sample t test with unequal variances

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
WGB	80	7.54	.588429	5.263069	6.368761	8.711239
WIB	80	9.97875	1.134557	10.14779	7.72047	12.23703
combined	160	8.759375	.6443217	8.150096	7.486842	10.03191
diff		-2.43875	1.278072		-4.969542	.0920417

diff = mean(WGB) - mean(WIB)   t = -1.9081
Ho: diff = 0   Satterthwaite's degrees of freedom = 118.633

Ha: diff < 0   Ha: diff != 0   Ha: diff > 0
Pr(T < t) = 0.0294   Pr(|T| > |t|) = 0.0588   Pr(T > t) = 0.9706

Table E2