The Power of An Outside Option that Generates a Focal Point: An Experimental Investigation*

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Abstract:

Existing experimental studies have shown that an outside option, when offered to one of the two players who later participate in a battle-of-the-sexes game, facilitates coordination by making the equilibrium that favors the same player focal. Since the other player's payoff in the outside option was lower than that in the focal point, it is possible that there was a reciprocal motive of the other player to coordinate on the focal point. Then it is possible that the actual power of the outside option to generate the focal point was either lower or non-existent. The current paper reports results of an experiment designed to test for the focal point effect of the outside option by controlling for the reciprocal motive of the other player. The results confirm that the outside option can generate the focal point even when the reciprocal motive is absent. In fact, the saliency of the focal point is higher after controlling for reciprocity.

Keywords: Coordination, Focal Point, Outside Option.

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1. Introduction

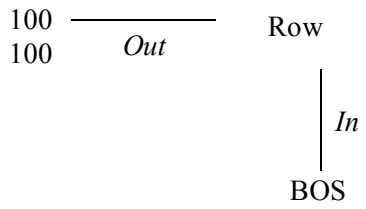
Previous experimental studies (Cooper, DeJong, Forsythe and Ross, 1993 and Shahriar, 2009) have shown that an outside option, when offered to one of the two players in a battle-of-the-sexes (BOS) game, can facilitate coordination by making the equilibrium that favors the same player focal. Since the outside option gives both the players lower payoffs than the focal point does, it is not clear whether it is solely the outside option or it is also the reciprocity of the other player (the player who is not offered the outside option) that generates the focal point. The objective of the current paper is to experimentally investigate the actual focal-point generating power of the asymmetrically offered outside option mentioned above. Specifically, the paper tests (1) whether a reciprocal motive of the player who is not offered the outside option contributes towards making the focal point more salient, and (2) whether the focal point at all exists when such a reciprocal motive is absent.

Consider the BOS game in Figure 1. It is a symmetric 2x2 coordination game in which two players (Row and Column) simultaneously and independently choose between two strategies – 1 and 2. The game has two pure-strategy Nash equilibria; (1,2) and (2,1).[1] In the mixed-strategy Nash equilibrium, both players choose strategy 1 with ¼ probability and obtain an expected payoff of 150 points. Now, consider the game BOS-100 in Figure 2. This is a two-stage game in which an outside option is offered to the Row player in the first stage. If she decides to take the outside option by choosing *Out*, then the game ends; both players receive 100 points. If, instead, the Row player chooses *In*, then the players play the BOS subgame. BOS-100 has two pure-strategy subgame perfect Nash equilibria (SPNE) – $((In,1),\ 2)$ and $((In,2),\ 1)$.

Figure 1: BOS.

		Column 1	Column 2
Row	1	0, 0	200, 600
	2	600, 200	0, 0

Figure 2: BOS-100.



Cooper et al. (1993) and Shahriar (2009) report results from experiments on BOS and BOS-100. Table 1 below shows their results from the last 11 rounds.[2] The coordination problem in BOS is evident in both the studies. Conditional on a subgame equilibrium being played, we cannot reject the hypothesis that the two equilibria are equally likely in BOS ($\chi^2 = 0.53$, $p = 0.47$ and $\chi^2 = 0.45$, $p = 0.50$ in Cooper et al., 1993 and Shahriar, 2009, respectively).[3] In BOS-100, the Row player seldom takes the outside option. Conditional on the subgame being played, the relative frequency of the Row player's favorable outcome (2,1) is higher in BOS-100 than in BOS and this difference is significant ($\chi^2 = 64.29$, $p < 0.01$ and $\chi^2 = 8.35$, $p < 0.01$ in Cooper et al., 1993 and

[1] The elements in a strategy profile correspond to strategy choices by Row and Column, respectively.
[2] There were 165 observations in total in the last 11 rounds of each treatment in both the studies.
[3] All the tests reported in this paper are two-tail Chi-square tests.

Shahriar, 2009, respectively). This shows that the (2,1) outcome is a focal point in BOS-100.[4]

Table 1: Results of Experiments from the Last 11 Rounds of BOS and BOS-100.

	Games	Outcomes			
		Outside Option	(2, 1)	(1, 2)	Disequilibrium: (1,1) and (2,2)
Cooper el. al (1993)	BOS	-	31 (19%)	37 (22%)	97 (59%)
	BOS-100	3	102 (63%)	5 (3%)	55 (34%)
Shahriar (2009)	BOS	-	37 (22%)	43 (26%)	85 (48%)
	BOS-100	9	59 (38%)	26 (17%)	71 (45%)

Note: Figures in the parentheses show the frequency distribution in each treatment among four outcomes – (1, 2), (2, 1), (1, 1) and (2, 2).

Notice, however, that the Column player's payoffs in both the subgame equilibria are higher than her payoff in the outside option in BOS-100. So, when the Row player rejects the outside option, the Column player may appreciate the decision and reciprocate by trying to coordinate on the equilibrium favorable to the Row player. The Column player will, therefore, choose strategy 1 in the subgame. Now, if the Row player correctly anticipates the Column player's intended play following the rejection of the outside option, she will reject the outside option and choose strategy 2 in the subgame; the (2,1) outcome will result in. So, the saliency of the focal point that we observed in Table 1 might partly be a result of reciprocity by the Column player and it is also possible that the outside option may not result in the focal point when the reciprocal motive of the Column player to coordinate on (2,1) is absent.

The goal of the current paper is to check the possibilities mentioned above. The paper considers a game similar to BOS-100 in which an outside option is offered to the Row player. The outside option, however, gives the Column player a payoff higher than that in (2,1). The results from the experiment on this game show that, even when there is no reciprocal motive for the Column player to choose strategy 1, the outside option still makes the (2,1) outcome focal. The paper thus contributes to the literature on focal points by confirming the focal-point generating power of an asymmetrically offered outside option in the BOS game.[5]

[4] Notice that the forward induction argument does not apply in BOS-100 as the Row player is unable to signal her intended play in the subgame by rejecting the outside option. See Kohlberg and Mertens (1986) and Van Damme (1989) for discussions on forward induction.

[5] For a survey on coordination and focal points, see Camerer (2003).

The rest of this paper is organized as follows. Section 2 describes the experimental design, Section 3 discusses the results from the experiment and Section 4 makes some concluding remarks.

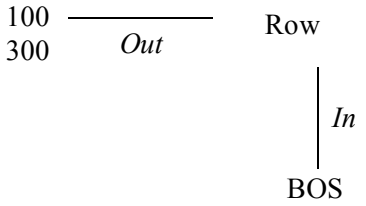
2. Experimental Design

In order to test for a confounding effect of the reciprocal motive mentioned above, we consider the M-BOS-100 game in Figure 3. In the first stage, the Row player decides between an outside option and playing the BOS subgame. If she takes the outside option by choosing *Out*, then the game ends; the Row player receives 100 points and the Column player receives 300 points. This game has the same two pure-strategy SPNE's as BOS-100 – $\big((In,1),\ 2\big)$ and $\big((In,2),\ 1\big)$.

Notice that the M-BOS-100 game shares the same asymmetric feature as BOS-100 – the outside option is offered only to the Row player in both games. So, if an asymmetrically offered outside option is able to generate a focal point, then the same focal point should arise in both games. In M-BOS-100, however, the Column player receives a higher payoff in the outside option than in the (2,1) outcome. This game thus leaves out the possibility of any reciprocal motive of the Column player to coordinate on (2,1).

The experimental design used in this paper is adopted from Cooper et al. (1993) and Shahriar (2009). Three sessions are run; each session recruited 11 subjects. Upon arrival at the lab, a subject was seated in front of a computer terminal and was given a copy of the instructions.[6] The instructions were also read aloud. Each session consisted of 22 rounds of M-BOS-100 and lasted for about an hour.

Figure 3: M-BOS-100.



In each round, one subject was matched with another subject. Thus, in each round there were 5 pairs; one subject was sitting out. Within each of the 5 pairs in a round, one subject was assigned the role of Row and the other Column.[7] In a random manner, each subject played exactly twice with another subject (once as Row and once as Column) and seated out once during the entire session. So, in each session, each subject participated in 20 rounds; playing as Row in 10 rounds and Column in the other 10 rounds.

At the end of each round in a session, a subject earned points according to the choices made. This point determined the probability of winning in a binary lottery with

[6] A copy of the instructions is available at www-rohan.sdsu.edu/~qshahria/Instruction-M-BOS-100.pdf.
[7] At the beginning of each round, subjects were privately informed of their assigned roles via the computer terminals in front of them.

two outcomes – \$0 and \$3. To implement the lottery, at the end of each round, the computer generated random numbers between 0 and 1000 for each subject separately. If this number was less than or equal to the points a subject received in that round, then the subject earned \$3; she earned \$0 otherwise.[8] Through out the session each subject accumulated her earnings which were paid in cash at the end of the session. The average earnings were about \$20.

The experiment was run at the Economic Science Lab (ESL) at the University of Arizona. 33 undergraduate students were recruited for the experiment. All the sessions were computerized using zTree (Fischbacher, 2007).

3. Results

The results from the experiment on M-BOS-100 along with those on BOS and BOS-100 from Shahriar (2009) are summarized in Tables 2 and 3.[9] Table 2 reports separately the frequencies of the outcomes in the first and the last 11 rounds of the sessions; the latter in italics. In a similar manner, Table 3 lists the frequencies of strategies played.

Table 2: Frequencies of Outcomes in First and Last 11 Rounds (Last 11 Rounds in Italics).

Treatment	**Outside Option**	**Outcomes in the Subgame**			
		(2, 1)	**(1, 2)**	**(1, 1)**	**(2, 2)**
BOS	-	36 (21.8%) ***37 (22.4%)***	45 (27.3%) ***43 (26.1%)***	25 (15.2%) ***21 (12.7%)***	59 (35.8%) ***64 (38.8%)***
BOS-100	22 (13.3%) ***9 (5.5%)***	41 (28.7%) ***59 (37.8%)***	31 (21.7%) ***26 (16.7%)***	13 (9.1%) ***19 (12.2%)***	58 (40.6%) ***52 (33.3%)***
M-BOS-100	29 (17.6%) ***20 (12.1%)***	47 (34.6%) ***75 (51.7%)***	20 (14.7%) ***13 (9.0%)***	17 (12.5%) ***14 (9.7%)***	52 (38.2%) ***43 (29.6%)***

Note: Percentages are given in parentheses; for outcomes in the subgame, the percentages show the distribution of the outcomes only within the subgame. The percentages for the outside option show the proportion of 165 observations in which the outside option was taken.

Conditional on a subgame equilibrium being played in M-BOS-100 (Table 2), we can reject the hypothesis that the two subgame equilibria are equally likely ($\chi^2_{first} = 10.88$,

[8] The points a subject received in a round divided by 1000 gave the probability of winning \$3. So, higher points gave higher probability of winning.

[9] The experiments reported in this study and those in Shahriar (2009) are run using the same subject pool and the same experimental design and protocol. So, the results are comparable across studies.

$p < 0.01$ and $\chi^2_{last} = 43.68$, $p < 0.01$).[10] Conditional on the subgame being played, the relative frequency of the subgame equilibrium (2,1) that favors the Row player is significantly higher in M-BOS-100 than in BOS ($\chi^2_{first} = 5.44$, $p = 0.02$ and $\chi^2_{last} = 27.46$, $p < 0.01$). These test results show that, similar to what we saw in BOS-100, the outside option offered to the Row player makes the (2,1) outcome a focal point also in M-BOS-100.

Table 3: Frequencies of Strategies Played in First and Last 11 Rounds (Last 11 Rounds in Italics).

Treatment	Outside Option	Row's Subgame Play		Column's Subgame Play	
		Str. 1	Str. 2	Str. 1	Str. 2
BOS	-	70 (42.4%) ***64 (38.8%)***	95 (57.6%) ***101 (61.2%)***	61 (37.0%) ***58 (35.2%)***	104 (63.0%) ***107 (64.8%)***
BOS-100	22 (13.3%) ***9 (2.7%)***	44 (30.8%) ***45 (28.8%)***	99 (69.2%) ***111 (71.2%)***	54 (37.8%) ***78 (50.0%)***	89 (62.2%) ***78 (50.0%)***
M-BOS-100	29 (17.6%) ***20 (12.1%)***	37 (27.2%) ***27 (18.6%)***	99 (72.8%) ***118 (81.4%)***	64 (47.1%) ***89 (61.4%)***	72 (52.9%) ***56 (38.6%)***

The focal point effect of the outside option can also be seen in terms of the frequencies with which players choose their strategies. Conditional on the subgame being played, in M-BOS-100 compared to BOS, the Row player chooses strategy 2 with significantly higher proportions in both halves of the sessions ($\chi^2_{first} = 6.89$, $p < 0.01$ and $\chi^2_{last} = 14.18$, $p < 0.01$) and the Column player chooses strategy 1 with significantly higher proportions in the second half of the sessions ($\chi^2_{first} = 2.72$, $p = 0.10$ and $\chi^2_{last} = 20.25$, $p < 0.01$).

The results discussed above confirm the focal point effect of the outside option in M-BOS-100. The results also verify that the outside option can generate the focal point even when there is no reciprocal motive for the Column player to coordinate on (2,1). It is, however, interesting to see that the saliency of the focal point has actually gone up in M-BOS-100 compared to that in BOS-100. The Column player's inequality aversion can be a possible explanation for this observation.

If the Column player is inequality averse, then it is possible that she prefers an equitable payoff distribution more than an unequal distribution in which she has a higher payoff. With equal payoffs in the outside option of BOS-100, an inequality-averse Column player may prefer the outside option to (2,1).[11] So, when the Row player rejects

[10] Within the parenthesis, we report the test results for the first and the last 11 rounds, respectively. In the remainder of the paper, whenever we report two results in this manner the results are to be interpreted this way.

[11] Using both Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) models, one can easily show that an inequality-averse Column player may prefer the outside option to (2,1) in BOS-100.

the outside option and chooses to play the BOS subgame, the Column player may perceive this as "unfair" and may choose strategy 2 to punish the Row player. Notice that, in BOS-100, 27% of the time the Column player chooses strategy 2.

Since the outside option in M-BOS-100 gives unequal payoffs, an inequality-averse Column player may prefer it to the outside option in BOS-100 and may therefore perceive it to be *less* unfair when the Row player rejects the outside option in M-BOS-100. In that case, the Column player will respond to the focal point effect more by choosing strategy 1 with a higher proportion. The Row player, in anticipation of the Column player's play, will also choose strategy 2 with a higher proportion. The saliency of the focal point can thus be higher in M-BOS-100 than in BOS-100.[12]

4. Conclusion

The goal of this paper was to check for the actual focal-point generating power of an outside option which is asymmetrically offered before players participate in a BOS game. The experimental results in Cooper et al. (1993) and Shahriar (2009) have shown that, when an outside option is offered to one of the two players in a BOS game, the equilibrium in the BOS game that favors the same player emerges as a focal point. It was, however, not clear from these earlier studies whether the focal point effect was magnified by a confounding effect of a reciprocal motive of the other player. The results from the experiment in this paper show that the outside option can generate the focal point even when there is no reciprocal motive of the other player to coordinate on the focal point. In fact, the saliency of the focal is higher in the experiment discussed here. The paper proposes inequality aversion as a possible explanation for this finding. Future extensions of this study can focus on testing this conjecture.

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[12] Notice that social preferences of the players cannot explain the high level of coordination on (2,1) observed in M-BOS-100 compared to BOS; a focal point argument is still the only explanation.

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