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# Prominence, Symmetry, or Other?

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A simple offer game is considered. Various game theoretic solutions are noted. The results of a series of informal games are noted. Two different solutions are consistently selected by individuals with little game theoretic experience: the symmetric split and the salient point. This raises questions concerning both the Stone and the Schelling ideas on salient points and various normative game theoretic solutions. The deep unanswered question is why two different solutions are selected. What are the tradeoffs and why? *Journal of Economic Literature* Classification Numbers: C78, C91 © 1994 Academic Press, Inc.

## 1. HISTORY

Some years ago Stone (1958) reported a simple experiment in *Econometrica*. He presented 34 diagrams of the variety shown in Fig. 1 to bargainers. They were similar in the sense that each had at least one prominent point. The players were required to draw a horizontal and a vertical line on the diagram. If the intersection of the lines was within or on the boundary of the diagram each player received the payoff associated with his coordinate of the intersection. Schelling (1960) in his discussion of games requiring coordination suggested the importance of a focal or prominent point in helping individuals coordinate their actions.

## 2. THE SETUP

Since 1980 I have run a more or less informal experiment in class, highly related to the Stone experiment and the Schelling remarks. The basic difference is that these games were used as part of a series of games for



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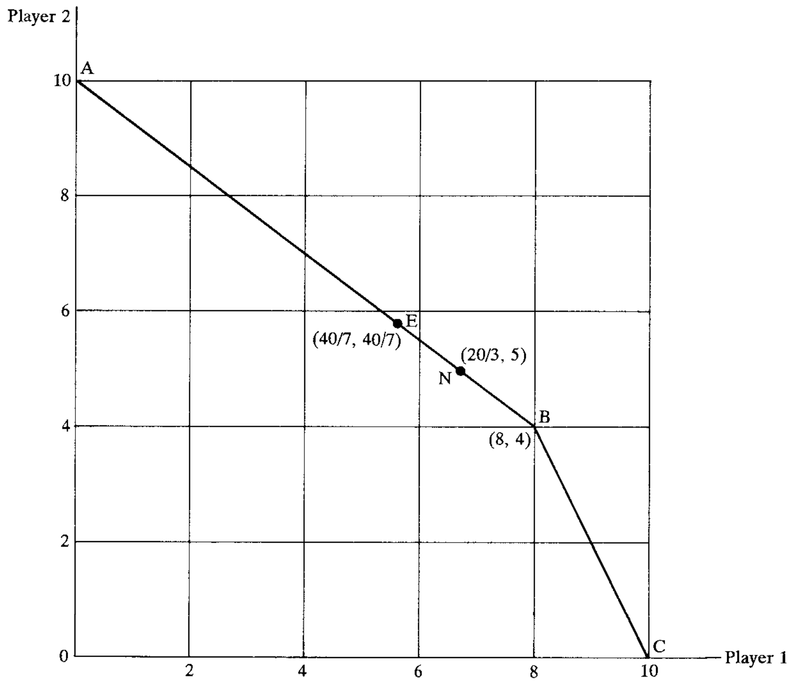


FIG. 1. Diagram given to students with the addition of points A, E, N, B, and C. The instructions to the students were as follows: Players 1 and 2 move simultaneously without knowledge of the other's moves. You are Player 2, your strategy is to draw a horizontal line. Player 1 will draw a vertical line. If the two lines intersect within (or on the boundary of) the diagram, that is your payoff. If it is outside, you both obtain zero.

teaching purposes in class. They were all played for payoffs which were only a part of a grade; i.e., 20% of the grade depended on the actions and explanations given by the players in a series of games. Furthermore, rather than actually match pairs against each other, all players played only the role of Player 2 and were told that they were being matched against an unseen, unknown player.

The same game has been run nine times between 1980 and 1991.

## Some Theory

One can argue that there is one clear salient point on the surface ABC, the point B where the slope changes. This has coordinates (8,4). This point is also the joint maximum of the payoffs with comparable utility.

TABLE I

NUMBER OF STUDENTS CHOOSING THE GIVEN POINT VALUES

| Point | 1980 | 1981 | 1983 | 1984 | 1985 | 1988 | 1989 | 1991S | 1991F | Σ |
|---|---|---|---|---|---|---|---|---|---|---|
| <4.0 | 0 | 1 | 2 | 0 | 1 | 0 | 2 | 0 | 1 | 7 |
| 4.0 | 16* | 11* | 8* | 6* | 10* | 15* | 10* | 7* | 14* | 97* |
| 4.5 | 1 | 1 | 0– | 1 | 0 | 0 | 0 | 0 | 0 | 3 |
| 5.0 | 5′ | 9′ | 0′ | 3′ | 5′ | 2′ | 5′ | 2′ | 4′ | 35′ |
| 5.7 | 9+ | 10+ | 12+ | 8+ | 8+ | 24+ | 9+ | 10+ | 8+ | 98+ |
| 6.0 | 5 | 1 | 2 | 1 | 1 | 4 | 1 | 1 | 0 | 16 |
| >6.0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |
| Total | 37 | 33 | 24 | 19 | 25 | 46 | 27 | 20 | 27 | 258 |

Another point, E, which was not marked on the diagram given to the students but is displayed in Fig. 1, is "natural" as the equal division point obtained by drawing a 45° line from the origin to intersect the boundary. This has coordinates of (40/7, 40/7). In this simple situation E is also the Kalai–Smorodinsky solution and one solution to the maximum $(P_1 - P_2)$.

The Nash bargaining solution, N, is the point at which the players maximize the product of their payoffs. In this instance a little calculation shows that the boundary is made up of two lines given by $3x + 4y = 40$ and $y + 2x = 20$. The product of payoffs is maximized at (20/3, 5). For the second player 5 is also midway between 0 and 10.

All of the students played the game before they had any lectures on bargaining or fair division theory. The question addressed was how would the students play in this game and what, if any, predictive value would these three points E, N, and B have? All points on the optimal surface are Nash equilibria.

## 4. EXPERIMENTAL RESULTS

Table I displays the raw data for the nine runs of this game. I did not keep track of no-reply or missing data or the one or two instances where a multiple reply made the action unclear.

A glance at the raw data shows a reasonably consistent pattern from year to year.

Aggregating all of the data, we obtain a frequency diagram as shown in Fig. 2. Of the 258 data points 97, or approximately 37.6%, were at B, the prominent point; 98, or 38%, were at E, the equal split; and 35, or 13.6%, were at N, the point which maximizes joint product (and is midway between 0 and 10).

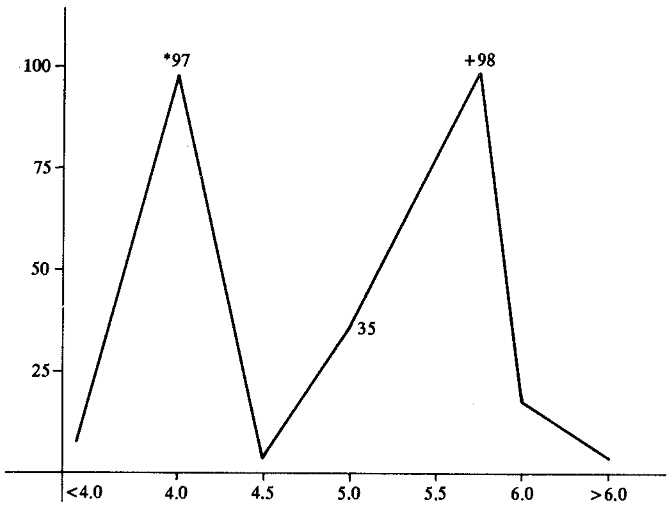


FIG. 2. (*) Line through B. (+) Line through intersection of AB and the bisector of AOC.

These results suggest that for coordinating devices in one-shot games individuals supply their own prior context and thus are able to use symmetry or prominence as an expected common signal. The bargaining solution N provides no immediate unsophisticated clues. The written comments of the students also indicate these interpretations. A sample of these comments is provided in the Appendix.

## APPENDIX

### *1991*

"I've split the difference ... because I don't expect Player 1 to think I'll take less than he/she. I expect $P_1$ to be reasonable and predict a 50/50 split, so that we will both win." (5.7)

"This is a nearly certain payoff of 4. I could assume risk and try for six, but that would mean my opponent would be willing to give up 4 points on the chance that I am unwilling to give up two." (4)

"I choose 5 in hope that the other player would not be extraordinarily greedy in his bid. He could choose up to 7 and still be successful."

"I would choose a line at 4 because it would be very unlikely that Player 1 would draw his vertical line beyond 8, where the chance of intersecting is quite low. In short, I would prefer a certain (fairly) payoff of 4 to an uncertain payoff of 6-10."

"Draw at 4 in spirit of cooperation; this maximizes the total payoff. Obviously, carries the implicit assumption that Player 1 also expects me to use this cooperative strategy."

"I would draw the horizontal line at 4 because I would expect the player drawing the vertical line to jointly recognize point B as the joint maximum and to accordingly draw vertically at 8—in which case I can do no better than 4."

"I choose the value of $y = 5$. We have to assume the two players have a common utility function which I assume is $x \cdot y$. Hence, we should solve max $x \cdot y$ s.t. $(x \cdot y)$ in the area."

"My line ---- This line achieves maximum absolute gain in condition that both sides hate relative loss."

"I would select the horizontal line $y = 4$ because substantial part of its line is included within the boundary. This makes me more certain that my payoff would not be 0. Moreover, I think that Player 1 will not select a vertical line $x$, with $x > 8$, because he will have high probability to get 0 payoff. However, my decision would be easier and more ? if I knew the probability distribution of the movements of Player $x$."

"I pick 4 because 1's greatest payoff is at 8. This is so because it is the point farthest towards upper right hand corner (also, it is the greatest combined payoff). Given an equal likelihood of any choice I may make, 8 provides 1 the highest payoff. I therefore am forced to choose my highest payoff at 4."

"Since if I choose 4, I am sure I will get 4. If I choose 6, the chance of getting 6 is smaller. → the expected value of choosing 6 is smaller than that of choosing 4."

## REFERENCES

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