Chapter 1: Introduction to Strategic Reasoning

Notes to the Instructor to accompany
Games, Strategies, and Decision Making, Second Edition
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I. Ideas for Class Discussion

Introducing the Concept of Strategic Interdependence
To begin the first class, you may want to distinguish situations with and without strategic interdependence and highlight the preponderance of social situations permeated with strategic interdependence.

- **Gambling casino.** Ask the students to identify situations inside the casino that involve strategic interdependence. A slot machine? No. A 21 (or blackjack) table? No, even though 21 involves at least two players with the capacity to strategize. Poker? Definitely. With a slot machine, thought processes are one-sided in that the slot machine is preprogrammed. The same is true with 21, even though the dealer is human. The dealer is required to play according to certain rules so that, in deciding how to behave, the dealer does not need to take into account how other players are going to behave. Someone playing a slot machine or going against a dealer in 21 is concerned only with a reasoning process that involves the probabilities associated with a slot machine and with the rule that a dealer must follow in the drawing of a card. With poker, each player must think about the reasoning processes of the other players, who are similarly thinking about their own reasoning processes. The reasoning process itself enters into the reasoning process. Infinite regress is present in poker but not in 21, and surely not when dropping quarters into a slot machine.
- **Stories in the newspaper.** Bring in a newspaper and identify the game-theoretic settings in some of the stories. Ask students to find a game-theoretic setting in the present week's newspaper and bring it to next week's class.

Is Game Theory Useful in Real Life?
Point out examples of the use of game theory in real-world settings, including business and politics.

The use of game theory in spectrum auctions in the United States and the U.K. is particularly compelling.[1] Of the FCC airwaves auctions, John McMillan wrote in the *Journal of Economic Perspectives*:[2]

[1]A useful reference is Paul Klemperer, *Auctions: Theory and Practice* (Princeton, NJ: Princeton University Press, 2004).
[2]John McMillan, "Selling Spectrum Rights," *Journal of Economic Perspectives,* 8 (1994), 145–162.

> "It has shades of the '49 California gold rush," remarked one industry observer. "It's the 21st century equivalent of the Oklahoma land rush," said another.[3] The sought-after item is the radio spectrum, which the U.S. government has put on the auction block. The wavelengths on offer, formerly reserved for the military, are to be used for newly invented personal communications services. . . . The auction is one of the biggest and most complicated in history. The spectrum on offer is estimated by the Office of Management and Budget (1993, p. 21) to be worth $10.6 billion. Thousands of spectrum licenses are for sale.

The objects up for sale in the FCC airwaves auctions were chunks of the electromagnetic spectrum owned by the government. The bidders were sellers of personal communication services like cell phone companies, paging services, wireless Internet providers, and so on. Since there were complementarities between different chunks of the spectrum, it was not immediately obvious what the best auction format for selling them was. Both the auctioneer (which was the government) and the bidders sought advice from game theorists. McMillan conjectures that the FCC auctions represented the most massive use of the advice of game theorists since the last revolution in the telephone industry, which was the breakup of AT&T by the U.S. Department of Justice in the 1980s.

An excellent source on the role of game theorists in the FCC airwaves auctions is the 1996 article by McAfee and McMillan in the *Journal of Economic Perspectives,*[4] in which the authors point out that the FCC chose, at the recommendation of the game theorists it had hired, the simultaneous ascending auction over the more standard sealed-bid auction format. In the end, the simultaneous ascending format turned out to be a better and more efficient option for allocating interdependent items, like chunks of the spectrum, than the sealed-bid format. As a result of the crucial input of game theorists in the auctions, game theory suddenly came into the limelight. McAfee and McMillan wrote:

> Billions of dollars worth of spectrum licenses were being sold by the U.S. government, using a novel auction form designed by economic theorists. Suddenly, game theory became news. William Safire in the *New York Times* called it "the greatest auction in history." *The Economist* remarked, "When government auctioneers need worldly advice, where can they turn? To mathematical economists, of course . . . As for the firms that want to get their hands on a sliver of the airwaves, their best bet is to go out first and hire themselves a good game theorist." *Fortune* said it was the "most dramatic example of game theory's new power. . . . It was a triumph, not only for the FCC and the taxpayers, but also for game theory (and game theorists)." *Forbes* said, "Game theory, long an intellectual pastime, came into its own as a business tool." The *Wall Street Journal* said, "Game theory is hot."[5]

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[3]Cited by McMillan as *Business Week*, November 29, 1993, p. 128; and Tom Wheeler, president of the Cellular Telecommunications Industry Association, in the *Financial Times*, October 18, 1993, p. VIII.

[4] R. P. McAfee and J. McMillan, "Analyzing the Airwaves Auctions," *Journal of Economic Perspectives*, 10(1), 1996, 159–175.

[5]McAfee and McMillan report the citations for this paragraph as *New York Times*, March 16, 1995, p. A17; *The Economist*, July 23, 1994, p. 70; *Fortune*, February 6, 1995, p. 36; *Forbes*, July 3, 1995, p. 62; *Wall Street Journal*, February 13, 1995, p. A19.

The following quotations may also prove helpful for conveying the value of game theory as perceived by practitioners and journalists.

- "Game theory forces you to see a business situation over many periods from two perspectives: yours and your competitor's." Judy Lewent, CFO of Merck [Quoted in "Scientific Management at Work: An Interview with CFO Judy Lewent," *Harvard Business Review*, January–February 1994, p. 97.]
- "Game theory teaches people to think several moves ahead. With computers, it has become a practical business tool." ["Playing Poker with Craig McCaw," *Forbes*, July 3, 1995, p. 62.]
- "One of the reasons that game theory has finally been discovered by managers is the rapidity with which companies can now respond to changes in products, technologies and prices. Game theory helps you pay attention to your interactions with competitors, customers and suppliers, and to focus on the end-game so that your near-term actions promote your long-term interest by influencing what these 'players' do." [F. William Barnett, "Making Game Theory Work in Practice," *Wall Street Journal*, February 13, 1995.]
- "Most major commercial insurers and reinsurers are using terrorism modelling today," says Robert Hartwig, chief economist at the Insurance Information Institute. Risk Management Solutions, one of the companies that sells the models, . . . uses game theory . . . in its models. It argues that, as security increases around prime targets, rational terrorists will seek out softer targets." [Jenny Wiggins, "Game Theory Helps Insurers to Judge the Risks of Terror," *Financial Times*, September 8, 2004.]
- "The FCC readies an airwave auction by boning up on game theory." [*Business Week*, March 14, 1994.]

Theory of Mind Mechanism

- When do children get a ToMM?
- Do nonhuman primates have a ToMM? Though there is some evidence that chimpanzees have a ToMM, it does not appear that monkeys do. For an explanation of the type of experiment conducted, see Robert M. Seyfarth and Dorothy L. Cheney, "Meaning and Mind in Monkeys," *Scientific American*, December 1992.

The Value of Mathematical Modeling

- Convince the students of the value of mathematical modeling as opposed to narrative reasoning.[6] The latter can be sloppy and loose, while the former has many virtues.
  - It provides an "audit trail" whereby the accuracy of an argument can readily be checked. One can easily determine what is being assumed and what is being inferred; which conclusions are logical implications and which are fallacious.

[6]This discussion is based on Colin F. Camerer, "Does Strategy Research Need Game Theory?" *Strategic Management Journal*, 12 (1991), 137–52.

- It allows new results to be built on the foundations laid by earlier models, that is, it promotes cumulative learning.
- It is a method for creating novel insights that may not have been initially foreseen.
- It provides a common language that allows related results to be compared.

- It will be useful to clarify the difference between modeling a situation *literally* as opposed to *metaphorically*. With the Game of Concentration, we model the game down to the very last details. That is an example of literal modeling. The Prisoners' Dilemma applied to a nuclear arms race is an example of a metaphorical model.

What Students Should Expect to Learn in This Class

- What are the deliverables of a game-theoretic model? Does it deliver sharp predictions or more general insights? Usually, it delivers the latter.
- In the Game of Concentration with perfect memory, let n denote the number of cards on the board and k denote the number of cards that have been turned over and remain on the board (that is, the cards whose identities are known but which have not yet been removed). After the first card is chosen, if there is a previously turned card that matches it, then optimal behavior requires that card be chosen as the second card in order to make a match. Optimal (more specifically, Nash equilibrium) behavior for the selection of the first card and of the second card (when the first card does not match a previously turned card on the board) has been proven to be:
  - if $n+k$ is even and $k \geq 1$ or if $k = 1$ and $n = 6$, then choose as the first card one that has not previously been flipped; and if the first card does not match a previously flipped card, then choose as the second card one that has previously been flipped.
  - if $n+k$ is odd and $k \geq 2(n+1)/3$, then choose two previously flipped cards.
  - in any other situation (that is, for any other values for n and k), choose as the first card one that has not previously been flipped and, if it doesn't match a previously flipped card, then choose as the second card one that has not previously been flipped.

  Game-theoretic models will typically *not* deliver answers that make such precise recommendations or predictions as just described for the Game of Concentration. Rather, we can expect insight into some broad properties of optimal play and an explanation as to why it is optimal.

II. Games to Play in Class

The Centipede Game

Select two volunteers to play the Centipede game (described in the text in Chapter 8, Section 8.5.1) with 20 single-dollar bills. Upon completing the game, ask what might have been going on in the participants' heads. Revisit the outcome when you get to the discussion of the Centipede game later in the course.

This can be a good game with which to start the very first class. It'll get students into the right frame of mind, and they love being paid!

III. Multimedia Presentation

The Princess Bride

To show students an example of a situation that involves strategic thinking and thinking one step ahead, either recite this dialogue from *The Princess Bride* (1987) or show the video clip in class.

> *Man in Black*: All right: where is the poison? The battle of wits has begun. It ends when you decide and we both drink, and find out who is right and who is dead.
>
> *Vizzini*: But it's so simple. All I have to do is divine from what I know of you. Are you the sort of man who would put the poison into his own goblet, or his enemy's? Now, a clever man would put the poison into his own goblet, because he would know that only a great fool would reach for what he was given. I'm not a great fool, so I can clearly not choose the wine in front of you. But you must have known I was not a great fool; you would have counted on it, so I can clearly not choose the wine in front of me.[7]

[7]From the movie *The Princess Bride* (1987). The dialogue is from www.imsdb.com/scripts/Princess-Bride,-The.html.