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The Mighty Stood Tall
Yet Only Few Measured It Perfectly

Book Review

Schelling's Game Theory: How to Make Decisions

Edited by Robert V. Dodge, *Oxford University Press, 2012. 292 pp. ISBN 978-0-199857203*

> *The basic problems of economics are simple; the hard part is to recognize simplicity when you see it. The next hardest part is to present simplicity as common sense rather than ivory tower insensitivity. Theory needs to teach more of both.*
> [Harry G. Johnson, "The Study of Theory," *A.E.R. Papers and Proc.* 64 (May 1974): 324]

Thomas Schelling, who is rhetorically referred to as the Mighty in the title of this paper, won the Nobel Memorial Prize in Economic Sciences, sharing with Robert Aumann, in 2005 for "having enhanced our understanding of conflict and cooperation through game-theory analysis." Unlike Robert Aumann, who has made high-brow theoretic pioneer contributions to both economics and mathematics, Thomas Schelling, in his unique writing style, makes path-breaking contributions to the strategy of conflict, with ample applications to foreign affairs, national security, nuclear strategy, and arms control. Borrowing words from Harry G. Johnson, the hard part is to recognize simplicity of their gems when we see it, let alone delivering such simplicity as common sense to our students including freshmen who take serious interest in social sciences. Can we accomplish those tasks? This book sheds some light in the affirmative way.

Guilty as charged, perhaps, I always feel that some innovative thoughts even in plain English at the time of creation should be reorganized in a way that young economists and students alike nowadays can have easier access to them. In this regard, two big names pop out of my mind, Thomas Schelling and James A. Mirrlees (winning the Nobel Prize in 1996), while lifetime's writing styles of Robert Aumann, Gérard Debreu (a Laureate in 1983), and Kenneth J. Arrow (a Laureate in 1972) literally leave no room for followers to improve, in my biased opinion, of course. Robert V. Dodge, who is a former student of Schelling at Harvard, digests and re-constructs what (almost exactly) Schelling taught for about 45 years in (modern) language that a broad audience can comprehend in a delightful manner. His great effort leads to the book under review, which I am taking great interest and having

pleasure in doing so.

Picture this: Many years ago generations of Harvard students admired Schelling the Mighty from a distance yet probably only few took pain on taking notes. Clearly Dodge was one of them. Let's see how this book succeeds in presenting the simplicity of Schelling's game theory as common sense.

The forward is written by Schelling who admits that his expectation is an exciting set of ideas for the general public, like a bed-time light reading if I may gather. He also feels that Dodge wants to write a book for his (elite) high school students in Singapore. The writing project must be a long journey and the outcome is described as simple as "it is fun" by Schelling. The book is a collection of lecture notes for students with a variety of background, broken down into a series of sections that introduce concepts that affect us. They are generally grouped but not progressive. Hence, chapters can be read in any order you like. While reading several chapters I am often bored a bit in the beginning but soon become excited because I spot gems here and there. The wisdom and numerous illustrations drawn from the real world jump out of those pages, just like what happened while Schelling was pacing back and forth across the stage in his classroom. As it is meant to be a collection, the missing of a good organization for this book does not bother me.

Chapter 1, with a brief yet vivid introduction of Thomas Schelling and his signature course along with a humorous entry, provides an excellent kickoff for this book. In this chapter, the author claims, "this book seeks to make the methods and skills Schelling has offered at an elite level available to a general audience." I am not sure about it mainly because that typical college students around me perhaps are not well motivated nor with appropriate reading skills as compared with Dodge's students in Singapore.

In what follows, this review will be confined to the suitability for general audience, which should include college students who have some interest in social sciences. To be justified shortly, my recommendation does come with minor reservation.

Chapter 1 ends with a supplement by a brilliant economist who is also a well-read blogger, Steven Levitt. Mixed with humor in excellent taste and possibly (false?) modesty, Levitt recalls that he fell asleep easily in Schelling's class even he had taken the front row seat for the purpose of commitment. Apparently, Dodge chose a completely different path, on which he probably had found himself quite lonely. Otherwise this book won't see the light of the day. But here comes the trade-off. The price paid for closely tracking what Schelling delivered in class is the inevitable overlooking of trying some new bottles that are attractive in price and quality for good wine. Some elaborations will be given below.

After reproducing Levitt's humorous 2005 New York Times column, the author moves on to Chapter 2 giving an introduction to strategic thought. Yet the flow in Chapter 2 can be made better. For instance, when one raises his voice to be heard, it often adds the total noise of the voices as others do the same, and they negate each other. Excellent illustration notwithstanding, a simple classroom experiment design can be of help. I like how the incompatibility between individual rationality (built on

self-interest maximization) and (group) rationality based on cooperation serving the interests of a group is introduced. First a TV season show is used to illustrate prisoners' dilemma. Next, the 2008 movie "The Dark Knight" is brought up but I feel that more should be added to complete the task. Let player one be the decision maker (or delegate) for the group of prominent citizens (as hostages) on one ferry; player two be the decision maker for the group of dangerous convicts whom the city fears and the Joker plans to set free on another ferry. Each ferry is loaded with explosives, and the trigger to detonate each is on the other ferry. The Joker informs both groups that the only way for them to save themselves is to set off the explosives on the opposite ferry, and if neither side does so, he will destroy both at midnight. By quantifying this scenario, we have payoff functions, π_1 and π_2, defined by: $\pi_1(\textit{set off}, \textit{set off}) := 0$, $\pi_1(\textit{set off}, \textit{not set off}) := 1$, $\pi_1(\textit{not set off}, \textit{set off}) := 0$, $\pi_1(\textit{not set off}, \textit{not set off}) := 0$, $\pi_2(\textit{set off}, \textit{set off}) := 0$, $\pi_2(\textit{set off}, \textit{not set off}) := 0$, $\pi_2(\textit{not set off}, \textit{set off}) := 1$, and $\pi_2(\textit{not set off}, \textit{not set off}) := 0$, representing a simplest two-person symmetric game (in strategic form). Clearly, "set off" is a dominant strategy for each in the sense that either player will push the button no matter what the other does. Note that we call $(\textit{set off}, \textit{set off})$ a Nash equilibrium because that when one player pushes the button, the other has no reason not to push the button. In addition, $(\textit{set off}, \textit{not set off})$ is a Nash equilibrium due to $\pi_1(\textit{set off}, \textit{not set off}) \geq \pi_1(\textit{not set off}, \textit{not set off})$ and $\pi_2(\textit{set off}, \textit{not set off}) \geq \pi_2(\textit{set off}, \textit{set off})$, saying that neither of them has the incentive to unilaterally deviate from $(\textit{set off}, \textit{not set off})$. Likewise, $(\textit{not set off}, \textit{set off})$ is a Nash equilibrium. Here we have three Nash equilibria, $(\textit{set off}, \textit{set off})$, $(\textit{set off}, \textit{not set off})$, and $(\textit{not set off}, \textit{set off})$, where the first is coined as "Nash equilibrium that is Pareto inferior or inefficient" while the other two equilibria are Pareto efficient. In light of the mindset of those convicts, the Joker probably believes that $(\textit{not set off}, \textit{set off})$ will be realized at best. Of course, at worst, the strategy pair $(\textit{set off}, \textit{set off})$ will lead to the death of all hostages at once. In any event, good guys will die. However, group rationality makes people in both ferries choose not to push buttons, giving Batman enough time to beat the Joker and save all hostages. This is a very good example illustrating that there might be more beyond notions of dominant strategy, Nash equilibrium, equilibrium selection, and Pareto efficiency. The analogy can be found in some motion pictures where two rivals with pistols are aiming at each other in short distance when both are trapped in quicksand very likely making them buried alive in any second. Usually they will hold fire and work together to get out of the quicksand first, even they know that "fire" is the unique dominant strategy.

Might skip Chapter 3 just for now. Chapter 4 goes from p.29 to p.43 yet the supplement entitled A History and Explanation of Game Theory from *The Logic of Life* by Tim Harford occupies p.31 thru p.43. I would like to see things done differently. Chapters 5 thru 16 are fairly standard, introducing basic concepts such as two-by-two game matrix, strategies, tactics, self-command, interaction, dollar auction, musical chairs, prisoners' dilemma, cooperation, coordination, collective choice, commons and fair division.

Allow me to illustrate my points made earlier by sticking to Ch.12, the prisoner's dilemma, which is now often coined as prisoners' dilemma. Dodge (or should I say Schelling?) starts with a brief account of contributions first made by M. Flood and M. Dresher, then A. Alchian and J. D. Williams. Imagine that Alchian as player one while William as player two play a simple two-by-two matrix game repeatedly where each could choose to cooperate or defect (but not both). The matrix (or game in strategic form) is given as Table 12.1 on p.138. The labeling (see the order of listing strategies) is kind of confusing, so are payoff pairs assigned to each outcome. Results in that series of repeated games are not documented to satisfy readers' curiosity. Dodge moves on to report how A. Tucker's invention in a seminar at Stanford, leading to the nowadays well known prisoners' dilemma. Table 12.2 on p.140 has a better look than its predecessor. The awkward labeling problem is gone too.

And my points? In my early days of teaching of prisoners' dilemma, following the steps of wise people, I often tell the story about the 1967 movie Bonnie and Clyde. Next, a simplest model-building comes in handy as follows. Let Bonnie be player one while Clyde as Player two. If both implicate (which is "defect" in this book), each will be put in jail for 20 years. If both have sealed lips (which is "cooperate with each other" in this book), each will be sentenced for 1 year only. If Bonnie (*resp.* Clyde) implicates while Clyde (*resp.* Bonnie) not, Bonnie (*resp.* Clyde) will be set free (due to plea bargain and witness protection plan) while Clyde (*resp.* Bonnie) will spend the next 40 years in jail. By $20 < 40$ and $0 < 1$, we know that "implicate" is the unique dominant strategy of either player in the sense that no matter what the partner-in-crime chooses, "implicate" always maximizes one's self-interest. I can move on to say that (*implicate*, *implicate*) is what J. Nash would predict because that neither has the incentive to deviate from it. Of course, the other three ordered pairs of strategies are not Nash equilibria. Yet they are Pareto efficient. Furthermore, by π_i(*implicate*, *implicate*) $< \pi_i$(*not implicate*, *not implicate*), where π_i stands for the payoff function of player i of {1, 2} and bearing in mind that longer sentence means less satisfaction (or lower payoff), we just find a Nash equilibrium which is Pareto dominated by the strategy pair (*not implicate*, *not implicate*), which resembles the joint action of tacit collusion. The word "dilemma" is now well justified. Once students are reminded of the key assumptions of "payoffs matter only in the ordinal sense" and "each cares about own payoffs", I can retell the story about two kids with two options in making wishes, selfish or altruistic. The former means asking God for 1 dollar; the latter means asking God to give 3 dollars to another kid instead. [I found this brilliant example with warm glow in Aumann (1987) and could not let it go ever since. I often call it Aumann's version of prisoners' dilemma.]

In my recent teaching, I begin by asking students to play a simple n-person game, coined as G(reen) vs. R(ed) game. It is a game I slightly modify from the literature on the tragedy of commons, for instance, Marinoff (1999). Instructions on how to play specify payoff as follows. All students must choose either G or R (but not both) simultaneously and independently. If you pick G while G is chosen by the majority, you earn 1 (dollar or point). If you pick G while R is chosen by the majority, you earn 4. If you pick R while G (*resp.* R) is chosen by the majority, you earn 0 (*resp.* 3). Any

student with a quick mind might ask: what is the majority's choice if we have the same number in G and R, where n is even? The added rule is simple: for instance, we specify $\pi_1(G, G, G, R, R, R) := 4$ and $\pi_6(G, G, G, R, R, R) := 0$. Why? Imagine that six people put on 3 green hats and 3 red hats in the dark. Coming out of the cave, the person with green hat on only sees 2 green hats and 3 red hats, hence the majority choice is R to her; the person with red hat on only sees 3 green hats and 2 red hats, hence the majority choice is G to her. Here I shall skip the findings and the interpretations on their changing strategies over time, let alone having dots connected to the punctual and non-punctual equilibria as a cultural trait *a la* K. Basu and J. W. Weinbull. Finally I ask what happens if n is reduced to 2, which is exactly the prisoners' dilemma game *a la* Aumann. In general equilibrium literature, we see cloning or replicating, here it is just the opposite.

In sum, I might just stick to the second approach: after playing the repeated n-person G vs. R games and explaining findings, I narrow down to the case of $n = 2$, telling Aumann's version, and finally converting it into Tucker's version, supplemented by that 1967 movie. At this junction, historical account given in this book will be useful. More examples such as arms race and price war follow naturally. May readers find those new bottles acceptable or even attractive to some extent.

Tipping point is well covered in Chapter 18, which was invented by Schelling long before Gladwell made it popular in economics. This treatment can hardly be found elsewhere and it has my recommendation. Chapter 16 is about commons (or common resources). The contemporary treatment of this term is by first defining excludability and rivalry. If the consumption of a good or service satisfies non-excludability and rivalry, it is classified as a common good. Driving on a congested freeway with no tolls is a good example. It can be found in some popular economics principles textbooks such as Mankiw (2015) but not in the book under review.

My suggestions might go beyond the duty of a reviewer or not be called for. Yet, to imitate Schelling's humor in the forward, there are things Dodge deems important that are not mentioned; there are things he would never think about that are here. All in all, this book is in the spirit of game theory, whether or not it is game theory, as put by Schelling. And I concur with enthusiasm, hoping that this review is done in the spirit of (teaching and learning) applied game theory.

Often people joke about academic journals by saying something like "some journal articles have only two readers, and one of them happens to be the author." If I do not recall my own writing, who in the world will be doing it? In Wei (2011), the reported frustration in searching for a suitable text for my undergraduate elective course "Applied Game Theory" should now vanish in light of this interesting book.

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