Prisoners of Reason

Game Theory and Neoliberal Political Economy

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Contents

2

Prisoner's Dilemma

Puzzles with the structure of the prisoner's dilemma were devised and discussed by Merrill Flood and Melvin Dresher in 1950, as part of the Rand Corporation's investigations into game theory (*which Rand pursued because of possible applications to global nuclear strategy*). The title "prisoner's dilemma" and the version with prison sentences as payoffs are due to Albert Tucker, who wanted to make Flood and Dresher's ideas more accessible to an audience of Stanford psychologists. Although Flood and Dresher didn't themselves rush to publicize their ideas in external journal articles, the puzzle attracted widespread attention in a variety of disciplines. Christian Donninger reports that "more than a thousand articles" about it were published in the sixties and seventies. A bibliography (Axelrod and D'Ambrosio) of writings between 1988 and 1994 that pertain to Robert Axelrod's research on the subject lists 209 entries. Since then the flow has shown no signs of abating.

Steven Kuhn, 2014[1]

The *Prisoner's Dilemma* turned out to be one of game theory's great advertisements. The elucidation of this paradox, and the demonstration of how each player brings about a collectively self-defeating outcome, because she is *rational* in pursuing her own interests, was one of game theory's early achievements which established its reputation among the social scientists.

Shaun Hargreaves Heap and Yanis Varoufakis, 2004[2]

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[1] Steven Kuhn, "Prisoner's Dilemma," *Stanford Encyclopedia of Philosophy*, available online at http://plato.stanford.edu/entries/prisoner-dilemma/, dated 2007, revised 2014, 1–2/49, accessed June 30, 2015; italics added to show how this nuclear security claim for significance is an ongoing feature of presenting game theory; Christian Donninger, "Is It Always Efficient to be Nice?" in *Paradoxical Effects of Social Behavior*, ed. by Anatol Rapoport, Andreas Diekmann, and Peter Mitter (Heidelberg: Physica Verlag, 1986), 123–134; Robert Axelrod and Lisa D'Ambrosio, "Bibliography for the Evolution of Cooperation," *Journal of Conflict Resolution* (1995) 39, 190. For another statement of the wide attention the Prisoner's Dilemma game received, see Elinor Ostrom, *Governing the Commons* (New York: Cambridge University Press, 1990), preface.

[2] Shaun Hargreaves Heap and Yanis Varoufakis, *Game Theory*, 2nd ed. (London: Routledge, 2004), 37–38.

Incidences of "prisoner 's dilemma" and "prisoners ' dilemma" in
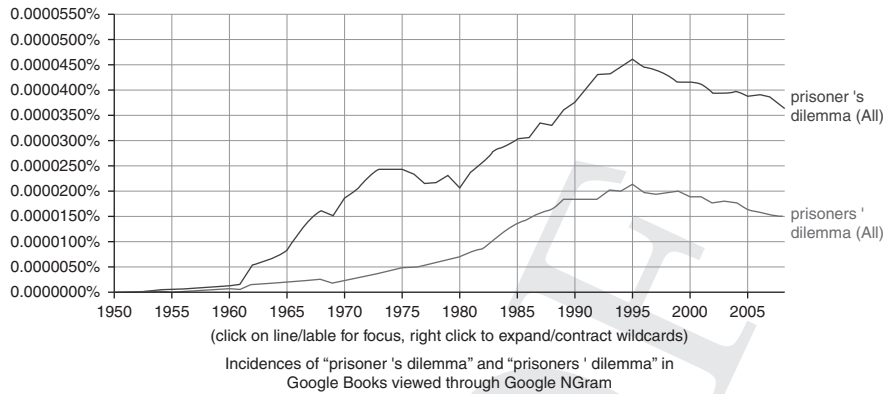Google Books viewed through Google NGram

FIGURE 1. Ongoing Engagement with Prisoner's Dilemma, 1950–2010
This figure was made by running the Google N-Gram function.

As these opening quotes acknowledge, the Prisoner's Dilemma (PD) represents a core puzzle within the formal mathematics of game theory.[3] Its rise in conspicuity is evident figure 2.1 above demonstrating a relatively steady rise in incidences of the phrase's usage between 1960 to 1995, with a stable presence persisting into the twenty first century. This famous two-person "game," with a stock narrative cast in terms of two prisoners who each independently must choose whether to remain silent or speak, each advancing self-interest at the expense of the other and thereby achieving a mutually suboptimal outcome, mires any social interaction it is applied to into perplexity. The logic of this game proves the inverse of Adam Smith's invisible hand: individuals acting on self-interest will achieve a mutually suboptimal outcome. However, as this chapter illuminates, the assumptions underlying game theory drive this conclusion.

The Prisoner's Dilemma is not only a core problem at the heart of analytic game theory, but it has also been applied to model and explain numerous phenomena throughout politics and economics.[4] The nuclear security dilemma, subject of Chapters 3, "Assurance," and 4, "Deterrence," was the first concrete problem for

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[3] The best collection of essays on the analytic puzzle of the PD is Richmond Campbell and Lanning Sowden, eds., *Paradoxes of Rationality and Cooperation* (Vancouver: University of British Columbia Press, 1985); for a discussion spanning the analytic game theory and empirical applications, see Anatol Rapoport and Albert M. Chammah, *Prisoner's Dilemma* (Ann Arbor: University of Michigan Press, 1970). Figure 2.1 is made using Google's ngram function with the vertical axis reflecting the percentage of all the two word phrases in the English corpus searchable by Google represented by "Prisoner's Dilemma" and "Prisoners' Dilemma" between 1950 and 2010. For reference to the development of the Prisoner's Dilemma phraseology by Merrill Flood and Melvin Dresher working at the RAND Corporation in 1950 see Steven Kuhn, "Prisoner's Dilemma," *Stanford Encyclopedia of Philosophy*, (first published September 4, 1997, and revised August 29, 2014), available online: http://plato.stanford.edu/entries/prisoner-dilemma/ accessed August 1, 2015.

[4] Hargreaves Heap and Varoufakis, *Game Theory*, 175–178; Elinor Ostrom, *Governing the Commons* (New York: Cambridge University Press, 1990), 1–20.

which game theorists found the Prisoner's Dilemma apt. In the same vein, by the end of the 1960s, game theorists found the Prisoner's Dilemma model useful for analyzing arms control and bargaining over weapons reduction. In the 1970s, theorists developed a treatment of bargaining in the context of market exchange in terms of the PD game. By extending the model to an exactly repeating scenario, and also by extending it to encompass any number of individuals, theorists modeled the problem of achieving a social contract as a multiple-person, indefinitely repeating, Prisoner's Dilemma.[5] Theorists also found the PD model well suited to model market failure, collective action, free riding, and public goods and to analyze the general rationale for government.[6] Some theorists have analyzed voting as a many-agent PD.[7] Climate change, pollution, individuals' decisions to get vaccinated or to stand up at sporting events are also studied with this model.[8] It is difficult to overemphasize the amount of attention the PD has received, and the numerous social interactions that have been modeled with it.[9] Finally, survival situations such as famine or the competition for nutritional value under conditions of natural selection have been modeled with the PD.[10]

This chapter lays the groundwork for understanding the recent conceptual movement from the classical liberal social contract of mutual prosperity to the neoliberal social contract of conjoint depletion. In brief, this transformation in approach follows the game theoretical dismissal of the classical liberal view that actors will respect others' right to exist and, when assured that others will do likewise, are inclined to keep the agreements they voluntarily made. In its place, game theory holds that rational actors will forge agreements premised on their ability to harm others, and will moreover break their word with impunity, even after others have kept theirs. Game theory does not acknowledge that side constraints on action, the logic of appropriateness, commitment, promising, or fair play provide valid motives for action. It generally replaces normative agreement and voluntary compliance with coercive bargaining and leveraged enforcement. The pages ahead show how the specific means of tracking value, in terms of the expected utility of outcomes, necessary in game theory render it imperative that these classical liberal modes of action, encompassing perfect and imperfect duties, as well as solidarity, lose their coherence.

  5 The clearest statement of the relationship between the Nash Bargaining Solution and noncooperative game theory is Ken Binmore's introduction to John Forbes Nash, *Essays on Game Theory* (New York: Edward Elgar, 1997), ix–x; on the *n*-person Prisoner's Dilemma and collective action, see Russell Hardin, *Collective Action* (Baltimore: Resources for the Future, 1982).
  6 See, e.g., how Dennis C. Mueller's *Public Choice III* (Cambridge: Cambridge University Press, 2003) begins by the Prisoner's Dilemma model as providing the motive underlying the "origins of the state," 9–14.
  7 For example, Joachim I. Krueger and Melissa Acevedo, "A Game-Theoretic View of Voting," *Journal of Social Issues* (2008), 64:3, 467–485.
  8 Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 175–178.
  9 Searching "Google Books" yields more than 4.5 million hits for "Prisoner's Dilemma."
 10 Partha Dasgupta, *Inquiry into Well-Being and Destitution* (Oxford: Oxford University Press, 1993), on the use of bargaining theory in terms of nutrition, see 324–336.

Thus, in learning game theory, the Prisoner's Dilemma game, and its exten-
sive applications to mundane problems throughout politics and economics,
students who master this material will learn to limit their horizons regarding
legitimate action as they conform to the tacit assumptions underlying strategic
rationality. These assumptions not only rule out the classical liberal family of
perfect duties but also contradict unbounded realms of experiential value, the
ethos of solidarity and joint maximization, in addition to the classical liberal
imperfect duties of charity and beneficence. This chapter renders explicit these
latent assumptions that are evident on inspection but are not typically directly
discussed in either teaching or applying the Prisoner's Dilemma game or non-
cooperative game theory more generally.

The first section provides a discursive introduction to the logical structure of
the Prisoner's Dilemma. This discussion is wholly didactic and cannot do justice
to the formal apparatus required to specify the game. The second section intro-
duces the means of assessing value, or expected utility, in game theory, and the
third section presents the standard means of teaching the PD. The fourth section
discusses the relationship between bargaining and the Prisoner's Dilemma, which
was originally articulated within the context of nuclear arms control, and lays the
groundwork for introducing the PD model of the social contract.

This chapter on the Prisoner's Dilemma directly addresses only the one-time
play game and leaves discussion of the formalized many-person PD to Chapter 9,
"Collective Action," and the indefinitely repeating PD game for Chapter 11,
"Tit for Tat." I isolate treatment of the single-play PD because it has sufficient
theoretical complexity that it warrants focus.[11] Moreover, the iterated PD, as
game theorists refer to the repeated scenario, and the multi-agent PD amplify
the underlying assumptions of game theory because it strictly relies on, if not
interpersonally transferable utility in many contexts, then certainly at a mini-
mum, expected utility theory. Even though many regard the indefinitely
repeated PD and Robert Axelrod's Tit for Tat solution as magic bullets to
demonstrate that cooperation can emerge under the limited assumptions of
strategic rationality and narrow self-interest, this solution depends on perfectly
repeating play with little significance for large-scale, multiple-agent political
economy.[12] This is because on the one hand, a mutually beneficial solution to

[11] This concurs with the judgment of Campbell and Sowden, eds., *Paradoxes of Rationality*, 1985,
      16 of 20 papers discuss single-play PDs.
[12] On the limitations of the cooperative solution to the indefinitely repeated PD, see Russell Hardin,
      "Individual Sanctions, Collective Benefits," in Campbell and Sowden, eds., *Paradoxes of
      Rationality*, 1985, 339–354; Daniel M. Hausman and Michael S. McPherson, *Economic
      Analysis, Moral Philosophy, and Public Policy*, 2nd ed. (New York: Cambridge University
      Press, 2006), 243–245, note in these authors' treatments how rapidly discussion of social justice
      and the repeated PD moves into discussion of evolutionary biology and the characteristics of
      successful invaders of groups with behavioral tactics conforming to cooperation (at 244); Ken
      Binmore also moves swiftly to the repeated PD within an evolutionary context, glancing on the
      utility assumptions required for this treatment, *Natural Justice* (Oxford: Oxford University
      Press, 2005), 72–92. For further discussion see Chapter 11, "Tit for Tat."

the repeated PD requires exact repetition with the same two actors over an indefinite yet potentially lengthy time horizon; on the other hand, guaranteed solutions for two-person non-zero-sum noncooperative games require mixed strategies, and are not limited to a single solution.[13]

PRISONER'S DILEMMA: THE NARRATIVE[14]

You and your coconspirator have been captured by the authorities. You are separated and each given the choice between confessing and remaining silent. One of four possible outcomes will occur. If you talk while your partner remains silent, you go free. If you both remain silent, you each receive one year in prison. If you both confess, you each receive a five-year sentence. If you remain silent while your partner confesses, you face a ten-year sentence while your partner goes free. What do you do?

There are different ways to reason through which action to take. Let us consider them each in turn.

Commando: I need to remain silent to protect my partner, my country, and my honor. I have been trained to remain silent, and whatever the price may be, I will remain silent.

Team Member: As a coconspirator, I identify myself as part of a team. Although I may personally do better if I confess, we do better as a team by remaining silent. Thus, it is obvious that I should remain silent, and I choose to remain silent.[15]

Platonic Reasoner: Reason is universal. I know myself and my preferences as well as my coconspirator and his preferences. All must reason alike in like circumstances, so we must choose the same act. We will either converge on both confessing or both remaining silent. Obviously, the latter is superior. Therefore, I remain silent, confident in my partner's identical reasoning capability.[16]

Assurance Seeker: If I knew my partner would remain silent, I would too. But I am afraid that under the pressure of confrontation with the authorities, my partner will not have the wherewithal to remain silent. Although *I would*

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[13] With respect to the former point, a clear treatment is found in the "14 Indefinite Iteration," entry on "Prisoner's Dilemma, "*Stanford Encyclopedia of Philosophy,*" Stephen Kuhn, 2014, accessed January 5, 2015; on the second point, see Anatol Rapoport, *Fights, Games, and Debates* (Ann Arbor: University of Michigan Press, 1960), 184–185; the Prisoner's Dilemma game does not necessarily have a symmetric payoff.

[14] See, e.g., R. Duncan Luce and Howard Raiffa, *Games and Decisions* (New York: Wiley, 1958), 94–95; Luce and Raiffa wrote the early definitive text on game theory, and it retains its insightfulness today; see also Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 172–173.

[15] Michael Bacharach investigates this manner of reasoning, which is distinct from the premise of individualistic maximization assumed in orthodox game theory, *Beyond Individual Choice: Teams and Frames in Game Theory*, ed. by Natalie Gold and Robert Sugden (Princeton, NJ: Princeton University Press, 2006).

[16] Reasoning by symmetry is widely dismissed by game theorists, see Lawrence H. Davis, "Is the Symmetry Argument Valid?" in Campbell and Sowden, eds., *Paradoxes of Rationality*, 1985, 255–263; Ken Binmore views Kant's categorical imperative as a variant on symmetrical reasoning, which he refers to as magical thinking, *Natural Justice*, 2005, 63.

definitely stay silent if assured my partner would, my fear of being left alone in prison for ten years is so great that I choose to confess to protect myself from this terrible outcome.

Homo Strategicus: The strategy of confessing over remaining silent is better for me, regardless of what my partner chooses. If I confess and my partner does too, then I will just get five years instead of ten. If I confess and my partner refuses to talk, then I will walk away scot-free. Unfortunately, we'll probably both end up with five-year sentences, and not one-year sentences, but this is the logical outcome of being rational.[17]

Most game theorists endorse only this last solution to the Prisoner's Dilemma game: each actor chooses to confess ("defect"), regardless of what the other does.[18] The importance of this result for modern decision theory cannot be exaggerated. *Each actor faces no dilemma of choice because each still chooses to defect, even if fully guaranteed that the other will cooperate.*[19] The larger collective social dilemma arises because individuals' maximization of expected gain results in mutual impoverishment. In the world construed as a Prisoner's Dilemma, every actor most prefers to sucker everyone else.

Game theorists have formalized this narrative and corresponding quandary into the game called the Prisoner's Dilemma. It has become a familiar conceptual artifact of expertise in strategic rationality and represents a familiar pattern of two-person moves and countermoves like tic-tac-toe, although with simultaneous rather than sequential play. The PD is typically represented in a simple form: one individual's choice is represented by rows, and the other individual's choice by columns. Each actor has the choice of remaining silent (cooperating) or confessing (defecting). Given that each person can choose one of two acts, a total of four combinations are possible. Table 1 is a normal presentation of this iconic game.[20] Given the reward structure of this "game," if I am Prisoner 2, I can choose between confessing and not confessing. Regardless of what Prisoner 1 opts to do, I am better off by confessing. If Prisoner 1 chooses to confess, then Prisoner 2 is better off confessing and getting eight years rather than ten; if Prisoner's 1 chooses to cooperate, then Prisoner 2 is better off confessing and getting three months rather than one year. Clearly, the prisoners only care about a mutually evident, salient feature of their decision environment: personal jail

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[17] Game theorists concur that this is the dominant or only rational strategy: each is better off defecting whatever choice the other takes; Luce and Raiffa, *Games and Decisions*, 1958, 94–97.

[18] A subaltern position on the Prisoner's Dilemma game reflects the idea that reason should be universal, reflected by the previously mentioned Platonic Reasoner scenario; Davis, "Is the Symmetry Argument Valid," 1985. However, mainstream game theory assumes that each individual must reason independently and maximize gain independently. The only solution is thus the one in which one gains the most regardless of what the other agent decides to do. See Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 184; see also Luce and Raiffa, *Games and Decisions*, 1958, 95–102. For more on the subaltern position on the Prisoner's Dilemma game, see Paul Erickson, *The World the Game Theorists Made* (Chicago: University of Chicago Press, 2015).

[19] Binmore is adamant on this point, *Natural Justice*, 2005, 63–64.

[20] Taken from Luce and Raiffa, *Games and Decisions*, 1958, 95; note that games can also be expressed as decision trees, which is referred to as the extensive form of the game.

TABLE 1. *Matrix Representation of Prisoner's Dilemma*

		Prisoner 2	
		Not Confess	**Confess**
Prisoner 1	**Not Confess**	1 year each	10 years for Prisoner 1, 3 months for Prisoner 2
	Confess	3 months for Prisoner 1 10 years for Prisoner 2	8 years each

Player 1's choices reflected in rows; Player 2's choices reflected in columns

time, and this serves as each person's criterion of judgment.[21] The prisoners only evaluate personal rewards and do not contemplate how they are brought about, that is, by making the other individual worse off.[22] The prisoners are, most game theorists presume, unable to maximize as a team and thereby mutually achieve one year of jail time each instead of eight years.[23] Finally, neither has any motive to contribute to the greater good or to seek to benefit the other.[24] These assumptions ignore whether empirical actors actually view their behavior as bound by these rules and whether actors' subjective assessment of the significance of their decision environment reflects other features of the choice environment, such as the quality of actors' intentions or means by which the outcome is achieved. Thus, game theoretic analysis cannot encompass non-consequentialist motives derived from commitment, principle, or deontic constraint.[25] Neither does the standard PD treatment permit the

[21] Defining the pure PD game requires stating for certain that both actors would prefer a repeating situation of mutual cooperation rather than a repeating alternation between being the unilateral winner and the sucker; for discussion, see section 6, "Cardinal Payoffs," Kuhn, "Prisoner's Dilemma," 2014. This can be done by adding up each individual's rewards separately, without comparing their intensity across individuals, yet this lends itself to each player having an observable metric of value correlating to each choice (hence a mathematically precise payoff), which reinforces the tendency to permit a concrete measure of success, such as cash value, to stand in for subjective value (again permitting an affine transformation).

[22] This assumption is breathtaking for shifting the significance of the intelligibility of meaning from shared understanding developed by interaction to the view that "each player is to behave independently, without any collaboration or communication, with other players"; see Nicola Giocoli, "Nash Equilibrium," *History of Political Economy* (2004) 36:4, 639–666, at 645.

[23] Hausman and McPherson, *Economic Analysis*, 2006, underscores this point at 250.

[24] Ken Binmore argues that if actors were concerned about others' payoffs, then this information could be directly added into the decision maker's expected utility function; *Natural Justice*, 2006, 63–64; however, in fact, estimating how much additional welfare an individual gets from enhancing another actor's expected utility is not straightforward and deviates from the fundamental assumption that payoffs track salient features of outcomes; see Hausman and McPherson, *Economic Analysis*, 2006, 250.

[25] Hausman and McPherson, *Economic Analysis*, 2006, 210–11; see also Joseph Heath, *Following the Rules* (New York: Oxford University Press, 2011), 35–41 (although Heath seeks to extend formal modeling to incorporate deontic constraints).

consideration of non-fungible value, joint maximization, or gratuitous altruism. If agents reject any one of these assumptions, the inexorable logic of the Prisoner's Dilemma game is dispelled.

It may seem that if only the two prisoners were able to talk and reach an agreement, they would both remain silent.[26] This, however, is a logical impossibility in the game because all players' preference for less jail time over more jail time is assumed to reflect the only pertinent information they uses to weigh their choices.[27] Therefore, even after agreeing to cooperate when back in their cells, both reach the same conclusion as before: confessing is superior, no matter what the other does. Even though the name of the game suggests some sort of angst in decision making, both agents are resolute in their dominant strategy of defecting independent of any consideration of what the other might do. Neither actor faces any moral or prudential quandary of choice.[28] The jointly suboptimal outcome results when the players follow the rules of conduct standardized throughout most operationalized game theory.[29] Even if the PD were derived from an assurance dilemma (discussed in depth in Chapter 3, "Assurance") in which as the "Assurance Seeker" vignette depicted at the beginning of the chapter shows, each actor really prefers to cooperate but defects like an actor with PD preferences, standard game theory does not disambiguate this crucial possibility because it fails to emphasize the bright-line test that assurance seekers always cooperate once guaranteed the other's cooperation. Instead, orthodox game theory holds that when confronted by a Prisoner's Dilemma specified by salient fungible payoffs, it is rational for every actor to defect, regardless of whether or not the other agent defects or cooperates.

THE PRISONER'S DILEMMA GAME: A MORE FORMAL PRESENTATION

As related earlier, the standard introduction of the Prisoner's Dilemma presents its characteristic payoff matrix and assumes that every actor solely acts individualistically to maximize his or her instrumentally salient rewards, therefore making defection the only rational choice. One of the difficulties in discussing game theory generally, and the Prisoner's Dilemma specifically, is that the PD can be introduced as though it were as simple as tic-tac-toe. This section introduces the concept of expected utility theory that was first articulated by von Neumann and Morgenstern in a technical appendix to *Theory of Games and Economic Behavior*.[30] This formal treatment of actors' anticipated satisfaction limits what

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[26] See discussion in Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 174.

[27] This is a primary feature of noncooperative game theory; for discussion, see Rapoport and Chammah, *Prisoner's Dilemma*, 1970, 25.

[28] Binmore, *Natural Justice*, 2006, 64.

[29] Heath, *Following the Rules*, 2011, 39.

[30] John von Neumann and Oskar Morgenstern, *Theory of Games and Economic Behavior* (Princeton, NJ: Princeton University Press, 1944), Section 3, "Theory of Games and Economic

can count in their subjective evaluations of worth and is necessary to solve many games. Actors' preferences over outcomes are referred to as expected utility functions that must obey restricted formal rules. In addition, actors must follow a decision rule, which typically prescribes a form of individualistic maximization. Maximizing average expected utility, maximizing the greatest possibility of gain, or maximizing the worst-possible outcome (referred to as "maximin") are all possible decision rules in noncooperative game theory.[31]

Game theory is densely mathematical and impeccable as an abstract analytic system. Creating formal models that meet the rarified axioms governing game theory and yet can be applied to social circumstances requires the introduction of simplifying assumptions.[32] These simplifying suppositions, discussed ahead, are introduced to ensure that the social world can be subject to rigorous mathematical analysis. Game theorists strive to identify a solution concept or a determinate outcome of a game that is referred to as an equilibrium. Von Neumann developed the "minimax" equilibrium concept, which is unique in every zero-sum game, in which each player maximizes his best worst-possible outcome and simultaneously minimizes his opponent's best-possible outcome, irrespective of the opponent's choice. John Forbes Nash Jr.'s alternative equilibrium concept of mutual-best-reply, which also applies more generally to non-zero-sum games, identifies a set of players' strategies that are mutually reinforcing because no single actor could improve his outcome by having selected a different strategy.[33] Many non-zero-sum games have no single determinate solution, regardless of how the equilibrium concept is defined. However, in the Prisoner's Dilemma game, both von Neumann's and Nash's equilibria are definitive and identical: both actors select to defect.

When theorists apply the Prisoner's Dilemma game to diverse situations throughout civil society, political economy, and international relations, they must simplify the world of social interaction to fit within game theory. This necessarily compromises the existential richness of individuals' experience.[34] Mathematical tractability, or the demands of applying the theory, entails making specific assumptions about payoffs, or value.[35] Von Neumann established

Behavior"; for discussion, see Nicola Giocoli, "Do Prudent Agents Play Lotteries: Von Neumann's Contributions to the Theory of Rational Behavior," *Journal for the History of Economic Thought* (March 2006) 28:1, 95–102, 101–102.

[31] Nicola Giocoli presents the clearest distinction between rules governing the rationality (or consistency) of preferences in expected utility theory and rules governing the rationality of action choice. See "Do Prudent Agents Play Lotteries."

[32] Luce and Raiffa, *Games and Decisions*, 1958, acknowledge this point directly, 26.

[33] On the Nash Equilibrium, see Giocoli, "Nash Equilibrium," 2004.

[34] Luce and Raiffa openly acknowledge this point: "Although not 'all life is a game,' at least not in our sense, we cannot fail to recognize that people are constantly jockeying to better their lot in a manner which is quite analogous to playing in an extremely complicated many-person game," *Game and Decisions*, 1958, 105.

[35] Rapoport acknowledges this point, and the prescription nature of game theory, in *Fights, Games, and Debates*, 1970, 164, 182.

the precedent, still the default, of directly associating the tangible payoffs that are convenient for observation and measurement with agents' subjective utility rankings.[36] This radical move promotes the belief that the Prisoner's Dilemma is not just a logical construction but also a phenomenon that inheres in the world anytime fungible rewards can be construed as reflecting its payoff matrix. Even though, rational choice theory states that everything an individual values can be reflected in individuals' preference rankings (expected utility functions), the means of tracking value in applied game theory categorically restricts to varying degrees the considerations strategic rational actors can incorporate into judgment.[37] Hence, this seemingly encompassing treatment of value actually operates as an imperative to limit what features of the decision environment can count in rational actors' decisions. Therefore, those operationalizing strategic rationality in concrete circumstances may not even see how this practice legitimizes conduct that only maximizes fungible rewards on an individualistic basis and negates normative, shared, or other-regarding conduct.[38] Hence, game theory favors consequentialism and excludes the logic of appropriateness, usually assumes an interpersonally transferable source of value, emphasizes individualistic maximization, and dismisses charitable actions without some tangible benefit to the benefactor.

Game theory relies on specific guidelines for tracking value. It is possible to stipulate a rudimentary game simply by using numbers to indicate actors' preferences over outcomes.[39] Table 2 depicts the iconic Cold War arms race, with higher numbers reflecting more preferable states.[40] This game theoretic payoff matrix has the characteristic Prisoner's Dilemma form. Note that the preferences may seem to pertain only to features of the world impacting that agent. This is not the case because even though individuals' payoffs are the primary basis for individual choice, outcomes are causally interdependent. The US is not indifferent between two states of being armed. The US most prefers

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[36] Giocoli directly addresses this important point in "Do Prudent Agents Play Lotteries," 2006, 102–103.

[37] This point is crucial, although subtle: in parametric decision theory, incorporating subjective sentiment about processes by which ends are achieved into expected utility functions may be possible; however, this is impossible in game theory because (1) actors only appraise outcomes independently of how they arise and (2) this appraisal focuses on salient instrumentally relevant features of the decision environment, i.e., outcomes could equally well arise by the roll of a die or by deliberate choice. Myerson makes the imperative claim that expected utility functions incorporate all considerations of value in expected utility functions with the implication of ruling out of consideration experiential elements not subject to this type of appraisal; Roger B. Myerson, *Game Theory: Analysis of Conflict* (Cambridge, MA: Harvard University Press, 1991), 7–8; see also Donald C. Hubin, "The Groundless Normativity of Instrumental Rationality," *Journal of Philosophy* (2001) 98:9, 445–468.

[38] For a lengthy discussion see Martin Hollis, *Trust within Reason* (Cambridge: Cambridge University Press, 1998); one current trend is to identify dispositions that are not motives associated with utility maximization; for discussion, see Hausman and McPherson, *Economic Analysis*, 2006, 210.

[39] For discussion of ordinal preference rankings, without numeric intensities of desire, see Steven Kuhn "Symmetric 2x2 PDs with Ordinal Payoffs," entry on "Prisoner's Dilemma," 2014.

[40] Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 37.

TABLE 2. *Iconic Cold War Arms Race Prisoner's Dilemma Game*

		USSR	
		Disarm	**Arm**
US	Disarm	2,2	0,3
	Arm	3,0	1,1

US is the row player; USSR is the column player.
Payoffs reflect the desirability of the outcome for each player;
  higher numbers are more desirable.
The first number in each pair reflects the U.S. (row) payoffs; the
  second number in each pair reflect the USSR (column) payoffs.

TABLE 3. *Cold War Arms Race Modeled as Stag Hunt*

		USSR	
		Disarm	**Arm**
US	Disarm	3,3	0,2
	Arm	2,0	1,1

Payoff matrix conventions are the same as in Table 3.

itself to be armed and the USSR to be disarmed. In the Prisoner's Dilemma game, each actor can only realize his most preferred state by debilitating the other. If, in the Cold War, every actor had preferred mutual disarmament over unilateral armament, then the game would have been an Assurance Game, or Stag Hunt, instead (Table 3).This payoff matrix with numeric utilities reflects that both actors most prefer mutual disarmament, both have the second choice of unilaterally arming, both have the third choice of mutually arming, and each least prefers being the only nation to disarm.

To be sufficiently useful to solve most games, the numbers specifying the payoff matrices must permit the evaluation of what ratio mix of most and least preferred outcome is equivalent to a midrange outcome.[41] For example, in the perfectly defined PD game, players must know that always cooperating yields a superior outcome to alternating between unilateral victory and unilateral ignominy *as though they were engaging in* indefinitely repeated play.[42] Thus, the formal definition of PD relies on expected utility and its treatment of value.

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[41] Rapoport, *Fights, Games, and Debates*, 1970, 180–194; Luce and Raiffa, *Games and Decisions*, 1958, 106–109.

[42] Kuhn, "Prisoner's Dilemma," has a clear discussion; a pure PD, defined in terms that agents prefer always cooperating more than alternating between unilateral defection and unilateral cooperation, is specified by the formula that CC ≥ ½ (DC + CD); on the difficulty of interpreting this requirement, see Rapoport, *Fights, Games, and Debates*, 1970, 162.

Furthermore, as will be increasingly evident ahead, the payoff matrix numbers in much applied game theory directly correlate to a measurable and observable salient feature of the decision environment and take into consideration the fully specified causal state of the outcome that simultaneously specifies the other actor's outcome.[43] Every player's outcome is physically inseparable from what the other achieves. In other words, game theory payoff matrices reflect causally interdependent states.[44] This discussion makes more sense when one understands, first, how game theory originated as an analysis of zero-sum competitions and, second, how most games of relevance to international relations, political economy, governance, and evolutionary biology rely on mathematically formalized expected utility theory that incorporates the assumption of interpersonal transferability of utility.[45] In a zero-sum game, two contestants wrestle over a fixed amount of a good (or property), so that what one individual obtains inversely correlates to what the other gets. As one player maximizes her expected gain, this player simultaneously minimizes her opponent's expected gain with mathematical precision. Operationalizing strategic rationality makes it difficult for an individual to prefer most an outcome in which both players share a fixed-sum good equally, because then these preferences over outcomes do not elegantly map onto the observable and measurable resource that characterizes the game's outcomes.[46]

Von Neumann and Morgenstern's *Theory of Games and Economic Decisions* focuses on two-person, zero-sum games in which the players wrangle over a finite and fixed amount of a utility-affording property. Von Neumann added the appendix on expected utility theory at the prompting of Morgenstern, who wanted to make their theory friendlier for economists.[47] Economists in the 1950s and 1960s were more interested in the treatment of expected utilities, which provided continuity with Daniel Bernoulli's invention of the concept to solve the St. Petersburg gambling paradox in the eighteenth century.[48] The concept of "expected utility," as opposed to straightforward "utility," provided

[43] Myerson, *Game Theory*, 1991, 22–26.

[44] Von Neumann and Morgenstern were acutely aware that their theory provided a mathematical formalism for complex interactions. See the introduction to *Theory of Games and Economic Decisions*, 1944.

[45] Myerson, *Game* Theory, 1991, 3. Von Neumann and Morgenstern introduced their expected utility theory as an appendix to *Theory of Games and Decisions*, and it relies on an objective understanding of probability. L. J. Savage subsequently introduced an alternative theory that relies on a Bayesian, or learned, account of probability. On Savage's subjective utility theory, see Nicola Giocoli, "Savage vs. Wald: Was Bayesian Decision Theory the Only Available Alternative for Postwar Economics?" June 2004, available at SSRN: http://ssrn.com/abstract=910916 or http://dx.doi.org/10.2139/ssrn.910916.

[46] Some researchers have worked to incorporate attitudes toward fairness, but this development is a distinct subfield of inquiry that is not integrated in most game theoretic presentations of or experiments with the Prisoner's Dilemma game; see, e.g., Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 162–163; Binmore, *Natural Justice*, 2005, 66–67.

[47] Giocoli, "Do Prudent Agents Play Lotteries," 2006, 102.

[48] For a brief discussion, see Luce and Raiffa, *Games and Decisions*, 1957, 19–21.

the latitude to acknowledge that individuals have differing attitudes toward probabilistic outcomes.[49] One individual may readily purchase a \$10 lottery ticket for a 1/11 chance to win \$100; yet another individual may prefer to keep \$10 for sure to a 1/9 chance to win \$100. Expected utility theory allows the incorporation of individuals' attitudes toward risk into their assessment of outcomes.[50]

Expected utility theory also permits simplifying the act of choice in situations with uncertainty (unknown odds) and risk (known odds), which is crucial because of the ubiquity of probability throughout life and in games.[51] As an example, consider a choice between walking or driving and two possible states of the world, rain or dry weather.[52] A ranking of outcomes could be strictly ordinal, without incorporating intensity of preferences. Thus, the agent could have the following preference ordering from most to least preferred: walking while dry, driving while raining, driving while dry, and walking while raining.

In most games of interest to political economists, a mere ordinal ranking of preferences is insufficient.[53] Instead, actors must know the intensity of their preferences. This example stipulates that the actor has a ranking of 10 utils for walking while dry, 6 utils for driving while wet, 1 util for driving while dry, and 0 utils for walking while wet. Although these utils are not comparable across individuals, they do express information about the intensity with which the agent in question prefers the four possible outcomes. The concept of expected utility, over and above strict utility, arises in considering both the preference for the state of the world and the probability of that state occurring. Let us assume a 50% chance of rain and a 50% chance of dry weather.[54]

[49] See Heath's discussion for a complementary treatment, *Following the Rules*, 2011, 15–23.

[50] Myerson, *Game Theory*, 1991, 12–20.

[51] Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 13. Note that expected utility theory neither uses the ordinal concept of utility from neoclassical economics nor the one assuming interpersonal comparisons of utility from Jeremy Bentham's utilitarianism. See also Nicola Giocoli, "The True Hypothesis of Daniel Bernoulli: What Did the Marginalists Really Know," *History of Economic Ideas*, 1998 (2), 7–43.

[52] This example comes from Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 11–12.

[53] Some simple games can be considered with ordinal rankings on the basis of John Nash's equilibrium concept of "mutual-best-reply." However, to technically define the Prisoner's Dilemma, to guarantee a solution, and to apply it to multiplayer and repeating games, one needs cardinal utilities, see Luce and Raiffa, *Games and Decisions*, 1957, 106–109; Kuhn "Multiple Players and Tragedy of the Commons," in "Prisoner's Dilemma," 2014.

[54] Objective probabilities, used by von Neumann and Morgenstern, *Theory of Games and Decisions* (1944) need not necessarily be assumed in game theory, but the mathematics is easier on this assumption. See, e.g., Luce and Raiffa, *Games and Decisions*, 1957, 24. An alternative is subjective expected utility theory in which actors' knowledge of the frequencies with which outcomes occur is derived from individual experience and must be updated in a feedback, learning experience. For discussion, see Giocoli, "Do Prudent Agents Play Lotteries," 2006, 105–107; L. J. Savage, *The Foundations of Statistics* (New York: John Wiley, 1954). See also Nicola Giocoli, "From Wald to Savage: *Homo Economicus* Becomes Bayesian Statistician," *Journal of the History of Behavioral Sciences* (2012) 49, 1–33.

The actor's expected utility for walking is equal to {50% likelihood dry weather multiplied by 10 utils + 50% likelihood of wet weather multiplied by 0 utils}, or a total of 5 utils. The actor's expected utility for driving is equal to {50% likelihood of dry weather multiplied by 6 utils + 50% likelihood of wet weather multiplied by 1 util}, or a total of 3.5 utils. Based on this expected utility calculation, the actor has a greater expected utility by walking. These utils do not reflect any inherent metric but do stipulate a range of satisfaction with intensities.

Additionally, expected utility theory can accommodate an actor's attitude toward risk. However, only so long as this additional concern obeys an orderly transformation from the original evaluation of utility over certain outcomes can this information be incorporated.[55] The axioms of expected utility theory depend on actors having transitive preferences over certain outcomes, and transitive preferences over lotteries of outcomes.[56] Caveats, however, apply. Significantly, expected utility theory can be applied more effectively when actors are making recurrent decisions over the same outcomes with known probabilities because, in the long run, consistent decision making will yield a positive result.[57] The axioms of expected utility theory demand consistency of choice among lotteries of outcomes so that the property of transitivity holds not only over strict preference over outcomes but also over lottery tickets over outcomes. Another caveat is that average people make choices that deviate from these axioms.[58]

Both von Neumann and Nash assume individualistic maximization in their approach to games. They did recognize that actors could cooperate in coalitions. However, they believed that when it came time for subgroups of players to divide spoils of a collaborative venture, these actors would resort to individualistic maximization. Many game theorists champion individualistic maximization because it has the additional virtue of comporting with the dictates of methodological individualism, according to which interdependent actions are analyzed by reference to individuals' independent choices and actions. Thus, they eschew cooperative game theory and celebrate John Nash's noncooperative approach.[59] This approach to understanding social interactions identifies

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[55] This formal restriction is that expected utility functions vary from certain outcomes, in view of attitudes toward risk, by adding a constant and multiplying the original utility by a constant. This is the definition of an affine transformation: $y = f(x) = Ax + B$, von Neumann and Morgenstern, *Theory of Games and Economic Behavior*, 1953, 24–25; on von Neumann and Morgenstern's original goal in introducing affine transformations, see Giocoli, "Do Prudent Agents Play Lotteries," 2006, 104–105.

[56] Luce and Raiffa specify the axioms, *Games and Decisions*, 1957, 23–31.

[57] Luce and Raiffa, *Games and Decisions*, 1957, make this point, 21; many introductions to these concepts also point out that actors' intuitions about consistent choice do not necessarily coincide with the mathematical consistency required by expected utility theory; see Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 8–18; Luce and Raiffa, *Games and Decisions*, 1957, 19–37.

[58] Allais paradox, discussed by Luce and Raiffa, *Games and Decisions*, 1957, 25; on the Ellsberg paradox, see Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 25–26.

[59] See Ken Binmore's introduction to Nash's *Essays on Game Theory* (Brookfield, VT: E. Elgar, 1996), ix–xx. See also Michael Bacharach's exploration and defense of team reasoning in

individual behavior as the source of collective outcomes. Although team reasoning does not violate methodological individualism, some game theorists worry that this alternative approach to rationality proposes that individual actors may comprise a corporate agent without clearly specifying who gets what after the team obtains its objective: how are the spoils divided? While classical liberals permit division via normative agreement, game theorists typically propose that even after initial cooperation is complete, noncooperative competition must characterize actors' subsequent pursuit of individual gain.

Summarizing, for most rational choice games, actors' expected utility functions are three times removed from reflecting every consideration that could be of value to them. First, the expected utility functions only reflect *outcomes* and not the processes by which they are obtained. Second, the expected utility functions directly correlate to the *observable and measurable reward* characterizing the payoffs. Third, this reward is often held to be *transferable* across agents; the default is precisely countable cash value.[60] In addition to maximizing some inherently scarce and objective feature of the world, strategic rationality typically recommends individualistic maximization.[61] Thus, standard game theory adopts an approach consistent with consequentialism, realism, and narrow individualism.

Learning game theory promotes a mindset that translates these fundamental tenets into guidelines for making rational choices, either in parametric environments involving risk (known odds) and uncertainty (unknown odds) or in strategic environments with other rational agents. In his advanced introduction of expected utility theory and game theory, Roger B. Myerson observes,

A *prize* in our sense could be any commodity bundle or resource allocation. We are assuming that prizes in X [a set of possible prizes that the decision could potentially achieve] have been defined so that they are mutually exclusive and exhaust the possible consequences of the decision-makers decisions. Furthermore, *we assume that each prize*

Beyond Individual Choice, 2006, which reveals how this hypothesis of shared intention and group action is a subaltern position in game theory.

[60] For the concept of interpersonally transferable utility, see von Neumann and Morgenstern, *Theory of Games and Economic Decisions*, 1953, Appendix II, 603–632. This concept should not be confused with the prohibited concept of interpersonally comparable utility. The claim is that the substance or property yielding expected utility is transferable, not that the respective agents' experiences or satisfactions thereof can be compared. For example, all agents seek money;' however, they are not assumed to each experience the reward of allotments of money in the same way. For the ready acceptance of transferable utility, usually introduced by relying on cash rewards to represent payoffs, see Ken Binmore, *Game Theory: A Very Brief Introduction* (New York: Oxford University Press), 2007.

[61] Von Neumann's original two-person zero-sum game theory was individualistic, although the decision rule he supplied was the minimax rule of securing the best-possible worst outcome by minimizing the opposition's potential gain, which leads to a stable equilibrium if both actors select this strategy. For discussion, see Nicola Giocoli, "Do Prudent Agents Play Lotteries," 2006. Giocoli argues that in game theory, actors are "hyper-individualistic" and "hyper-rational" because they act independently to achieve their goals without any reliance on others' choices, other than as a means to secure their own ends, "Nash Equilibrium," 2004.

in X represents a complete specification of all aspects the decision-maker cares about in the situation resulting from his decisions. Thus, the decision-maker should be able to assess a preference ordering over the set of lotteries, given any information that he might have about the state of the world.[62]

This statement that all considerations impinging on choice are contained in actors' expected utility functions over prizes requires that preference rankings incorporate all considerations relevant to their choices. Therefore the mathematical characteristics of these functions purchase comprehensive hold over individuals' judgment at the price of excluding important features of the world from possible evaluation. Not only does the model itself become indistinguishable from the reality it models, but this superposition of the model over the lived world gives rise to the uniquely neoliberal subject who internalizes the limiting guidelines of what can count in a rational judgment.

The conceptual mapping required to operationalize the Prisoner's Dilemma game eclipses the classical liberal worldview because it categorically ignores the means by which outcomes are realized. The expected utility functions used throughout game theory assume "that agents only invest outcomes with motivational significance."[63] Canonical rational actors are thus unable to act on principle, with commitment to agreements or promises made, or on the basis of fair play or side constraints.[64] Although these alternative rationales for action entail different causal outcomes than those sustained by strategic rationality, they become void of motivational content because they do not directly contribute to the measurable gain of decision makers. This encompassing attention on outcomes to the exclusion of processes undermines classical liberalism's dependence on procedural justice and individual's self-incurred responsibility to avoid harming others.[65]

An additional consequence of the exclusive association of utility with outcomes is that communication becomes a signaling game in which "the meaningfulness of the speech act [is] dependent upon the payoff structure of the game."[66] Actors' interests and values exist prior to social interaction.[67] Actors can only use language effectively – that is, avoid deception – when their interests are favorably and extensively aligned.[68] Thus, the game theoretic understanding

[62] Myerson, *Game Theory*, 1991, 7–8.
[63] Joseph Heath effectively discusses this topic in *Communicative Action and Rational Choice* (Cambridge, MA: MIT Press, 2001), 137; see 137–139; Heath seeks to extend orthodox game theory so that deontic constraints could be reflected in models, Heath, *Following the Rules*, 2011, 6.
[64] Heath, *Communicative Action*, 2001, 86–92.
[65] Amartya Sen, *Rationality and Freedom* (Cambridge, MA: Belknap Press, 2004), 175–181, 232–239.
[66] Heath, *Communicative Action*, 2001, 70.
[67] Hargreaves Heap and Varoufakis, *Game* Theory, 2004, 209.
[68] For discussion of David Lewis's analysis of communication based on the Prisoner's Dilemma model, see S. M. Amadae, "Normativity and Instrumentalism in David Lewis' *Convention*," *History of European Ideas* (2011) 37, 325–335; see also David Lewis, *Convention: A Philosophical Study* (Cambridge, MA: Harvard University Press, 1969).

of linguistic exchange views communication as action derived from payoff structures that permit persistent equilibria to emerge.[69] Game theory entails an instrumentalist view of language that insists both that the meaning and value of acts precede intersubjectively shared intelligibility and that communication itself is a strategic game.[70]

The formalized concepts of expected utility and individualistic maximization structure the possible horizons of meaning available to the neoliberal citizen and consumer. The canonical strategic actor must obey these guidelines of rational choice or become the experimental subject for behavioral economists who aim to systematically catalogue people's observed deviations from pure rationality. The two options available are to abide by the Platonic ideal of rational choice or to succumb to irrational behaviors that behavioral scientists can correct through choice architecture.[71] This latter approach denies the central tenet of classical liberalism, which holds that actors voluntarily participate in institutions and rule-governed practices that they tacitly or expressly agree have procedural validity.[72] Thus, the bourgeois classical liberal world of Adam Smith is displaced by a new interpretation of the meaning of action and individuals' relationships to other actors.

In this next discussion, I examine how a leading classic textbook imparts Prisoner's Dilemma pedagogy and show how learning the inherent impossibility of resolving the dilemma relies on explicitly accepting the characteristic assumptions underlying strategic rationality. These assumptions require restricting value to the horizons of game theoretic expected utility theory and accepting individualistic maximization in competition with others. This limiting perspective makes many social interactions appear to have the Prisoner's Dilemma structure. Once actors either internalize the guidelines for choice consistent with functional strategic rationality or are exposed to institutions designed in accordance with this logic, they experience numerous types of interactions as Prisoner's Dilemmas.

[69] Heath, *Communicative Action* 2001, 59–72.
[70] The opposite view is held by Donald Davidson, "The Folly of Trying to Define Truth," *Journal of Philosophy* (1996) 93, 263–278, and Jürgen Habermas, *The Theory of Communicative Action*, vols. 1 and 2, trans. by Thomas McCarthy (Cambridge, MA: MIT Press, 1984 and 1987, respectively); for discussion, see Heath, *Communicative Action*, 2001, 16–25.
[71] Richard Thaler and Cass Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness* (London: Penguin, 2009). Economist and Nobel Laureate Herbert Simon has put forward a middle ground, *Models of Bounded Rationality: Economic Analysis and Public Policy* (Cambridge, MA: MIT Press, 1984); for discussion, see Hunter Crowther-Heyck, *Herbert A. Simon: The Bounds of Reason in Modern America* (Baltimore: Johns Hopkins University Press, 2005).
[72] For discussion, see, e.g., John Rawls, "Justice as Fairness: Political Not Metaphysical," *Philosophy and Public Affairs* (1985) 14:3, 223–251.

TABLE 4. *Prisoner's Dilemma Game "G"*

		B₁	**B₂**
G:	A₁	(0.9, 0.9)	(0, 1)
	A₂	(1, 0)	(0.1, 0.1)

In Game "G," A is the row player with the choice of action
  A₁ (cooperate) and A₂ (defect).
B is column player with the choice of action B₁ (cooperate)
  and B₂ (defect).
Payoffs are the pair of numbers, highest is best, first number
  accrues to agent A; second number accrues to agent B.

STANDARD PRISONER'S DILEMMA PEDAGOGY

Howard Raiffa and Duncan Luce articulate Prisoner's Dilemma pedagogy in their immediately influential and authoritative *Games and Decisions* (1957). The matrix reward structure of the game they discuss is the one presented at the beginning of this chapter. The payoff matrix, in terms of jail time, considers only outcomes, and not any of the circumstances by which they may come about or how the prisoners subjectively evaluate the different outcomes. Right away, only the tangible rewards register in individuals' preferences over outcomes and their judgments over the right course of action.

In their presentation, Luce and Raiffa next introduce the more familiar game payoff matrix that directly uses numbers to reflect the rewards structuring a game as specified by expected utility theory. In this case, numbers without any units reflect each individual's subjective evaluation of the game's outcomes. Again, the fact that these expected utility functions are over end states and even lotteries of end states must be kept in mind.[73]

In Table 4's Prisoner's Dilemma game "G," agent A and agent B can each choose between strategy 1 and strategy 2. The outcomes are jointly determined and deliver the quantity of numeric utility in the payoff matrix to each player in the form: (Expected Utility$_A$, Expected Utility$_B$). This payoff matrix has the characteristic Prisoner's Dilemma form: every actor hopes to unilaterally opt for the first choice ("defect"), thereby leaving the other agent who cooperates with the least preferred outcome. Every agent prefers mutual cooperation to mutual defection. Every actor least prefers to be the sole cooperator, or "sucker."

At this point in learning to play the Prisoner's Dilemma game, readers have been supplied with a narrative about two conspirators who are given choices of action by a district attorney. This prosecutor apparently hopes that each will indict the other, either because each actually prefers unilateral success or because they are actually in a situation called an "Assurance Game," or "Stag Hunt," in which neither is confident in how the other will choose to act,

[73] Luce and Raiffa, *Games and Decisions*, 1957, 95.

TABLE 5. *Prisoner's Dilemma Game "H"*

		B_1	B_2
H:	A_1	(5,5)	(−4,6)
	A_2	(6,−4)	(−3,−3)

Game "H" has the same payoff matrix conventions as Game "G" in Table 4.

although both prefer joint cooperation over their unilateral defection.[74] Although this latter possibility is crucial to Thomas Schelling's application of the PD game to nuclear security, Luce and Raiffa's introductory PD pedagogy is consistent with orthodox game theory in disregarding the possibility that actors' subjective rankings deviate from material rewards.[75] Thus, even though theorists sometimes stipulate that assurance-seeking actors find themselves in a Prisoner's Dilemma because of risk, still they do not offer a means to disambiguate a situation in which actors really prefer to cooperate, despite the salience of tangible rewards, from the characteristic PD in which every actor has the first choice of suckering others. This becomes increasingly apparent as their explanation progresses.

It is standard throughout most game theory to provide numbers that reflect a concrete source of value and simultaneously represent mathematically precise and well-ordered expected utilities. Luce and Raiffa illustrate this useful way of representing the Prisoner's Dilemma game as shown in Table 5.[76] The authors succinctly state in their explication of the Prisoner's Dilemma that the game referred to as "H" results in the aforementioned game "G." They provide the following description of game H's payoff matrix:

This will be given the interpretation that an entry (−4, 6) means player 1 loses \$4 and player 2 receives \$6, and we shall suppose that each player wishes to maximize his monetary return. Note that if we take the utility of money to be linear with money and set the utility of \$6 to be 1 and of −\$4 to be 0, then the game G results from H.[77]

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[74] The Assurance Dilemma matrix is derived from an Assurance Game with rewards stipulated numerically to reflect each individual's assessment of the likelihood that the other actor may harbor Prisoner's Dilemma instead of Assurance Game preferences (preferring unilateral defection to joint cooperation). The values in this payoff matrix are multiplied by the likelihood with which each player evaluates that the other will play either "cooperate" or "defect." Thomas Schelling introduces his matrix in *Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960) to make an argument for mutual assured destruction, which is discussed in Chapter 3.

[75] Giocoli makes clear that this direct correlation between subjective preferences and tangible rewards was a move made by von Neumann to make it possible to establish and objective science of choice, "Do Prudent Agents Play Lotteries," 2006, 102–105.

[76] Luce and Raiffa, *Games and Decisions*, 1957, 95.

[77] Ibid.

Monetary value and expected utility are interchangeable here as game theory often requires for analyzing various social interactions.[78] Remarkably, this remains the game theoretic protocol used to analyze numerous social interactions. Sometimes, a tangible resource such as water, time, food calories, fitness value, or energy can substitute for money.[79]

Luce and Raiffa are well aware of the restricted elements of judgment permitted to enter into the strategic rational actor's logic for action. Only outcomes matter, particularly those observable and measurable features of the decision problem of direct relevance to each agent, and agents maximize individually. Moreover, in the most mathematically useful game in applied modeling throughout game theory, the measurable reward is directly correlated to expected utility. Luce and Raiffa introduce the necessary limitations on the value judgments defining the Prisoner's Dilemma game: only outcomes specified in cash value enter into actors' judgment and they maximize individualistically without regard for how their acts impact others. However, future authors introduce the game without carefully delineating these crucial assumptions.

Writing one of the first textbooks on game theory, Luce and Raiffa know that these limitations on judgment may strike some readers as far-fetched. What now strikes many as familiar, even necessary, seemed patently abusive in the 1950s.[80] The authors observe,

We are assuming explicitly in the following discussion that ... [the players' utility stated in terms of cash value] does reflect their preferences. If this seems too gross an abuse of the utility notion, consider players who are *only* interested in the maximization of their *own* expected monetary return, and let the numbers in the payoff matrix represent money returns.[81]

Luce and Raiffa articulate in exacting terms both the restrictions on rational judgment for the standard game theoretic strategically rational actor and the manner in which a mathematical model of rationality can only readily be applied to many contexts of interest when these simplifying assumptions are introduced. In other words, the abstract mathematicized *Homo strategicus* is only relevant to the actual study of society in cases where agents are presumed to only value personally relevant outcomes, which represent instrumentally prominent concrete rewards such as cash. Yet the standard treatment remains like

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[78] This is apparent in Binmore's *Game Theory*, 2007; for Giocoli's discussion of von Neumman on this point, see "Do Prudent Agents Play Lotteries," 2006, 102.

[79] For example, see Thomas Schelling, "Hockey Helmets, Concealed Weapons, and Daylight Saving: A Study of Binary Choices with Externalities," *Journal of Conflict Resolution* (1973) 17:3, 381–428. Cristina Bicchieri, "Covenants without Swords: Group Identity, Norms, and Communication in Social Dilemmas," *Rationality and Society* (May 2002) 14:2, 192–228; and Binmore, *Natural Justice*, 2005, 65.

[80] See the *Economist*'s claim that all decisions can be monetized, "Economic Focus: Never the Twain Shall Meet," *Economist*, February 2, 2002.

[81] Luce and Raiffa, *Games and Decisions*, 1958, 98.

TABLE 6. *High-Stakes Prisoner's Dilemma Game*

		YOU	
		The other prisoner does *not* **confess**	**The other prisoner** *does* **confess**
ME	You *don't* confess	freedom + $1,000	slow death by torture
	You *do* confess	freedom + $10,000	quick but painful death

"Me" is the row player, and "You" is the column player; payoff matrix only reflects the outcome for "Me," depending on what "You" chooses to do.

Luce and Raiffa's, and these models are used to design policies and institutions for neoliberal citizens and consumers.

In the landmark book *Paradoxes of Rationality and Cooperation*, Richmond Campbell introduces the concept of a "High-Stakes Prisoner's Dilemma" to capture the inexorable logic of the game that he believes "could arise in many other circumstances."[82] In this perilous game, the author asks us to "suppose that the first two possibilities are freedom plus $10,000 and freedom plus $1,000 while the second two are quick, but painful, death and slow death by torture" (Table 6).[83] In this game, Campbell stipulates a tangible reward system and automatically assumes that it matches up with the actors' subjective appraisal of expected utility. However, confronted with these outcomes, readers may find it obvious that, to the contrary, one should rank them in a different order: (1) neither confesses and both receive freedom plus $1,000; (2) only I confess; (3) both confess, gaining quick but painful death; and (4) only you confess. And yet throughout orthodox game theory, the mutually observable physical rewards are assumed, without a second glance, to directly reflect actors' expected utilities. The result is that actors are presumed to be in a state of Prisoner's Dilemma, whereas, in fact, they may interpret their situation to have more in common with an Assurance Game.

One's possible intuition that mutual cooperation actually results in the superior outcome for both players makes it possible to believe that the logical impasse resulting in mutual and painful death is due to each actor's doubt that the other can be depended on to remain silent. It is easy to suppose that the significance of the Prisoner's *Dilemma* rests in the fact that each would obviously cooperate to achieve mutual freedom *if assured the other would similarly cooperate*, as would be the case in either an Assurance Game, in which both actors most prefer to cooperate, or an Assurance Dilemma, in

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[82] Richmond Campbell, "Background for the Uninitiated," introduction to Campbell and Snowden, eds., *Paradoxes of Rationality and Cooperation*, 1986, 3–41, at 6.

[83] Game taken from Campbell, "Background for the Uninitiated," in Campbell and Snowden, eds., *Paradoxes of Rationality*, 3–41, at 6.

which one actor is unsure whether the other's first choice is unilateral defection or mutual cooperation.[84] In this latter game form, although both most prefer the mutually cooperative outcome over unilateral defection, neither is sure of the other's preferences, and both are aware of this lack of confidence. But the Prisoner's Dilemma, played between two perfectly rational agents who cannot achieve a mutually agreeable and available outcome, plays out the way it does because, from the perspective of the rational actor who independently maximizes personal expected utility consistent with the game's payoff matrix, the decision categorically and in principle has no relationship to risk or uncertainty. The canonical game theoretic Prisoner's Dilemma arises precisely because if either player were certain of the other's cooperation, her first choice would still be to confess, since this grants her freedom and financial gain by exporting the costs for her defection onto the other player. The bright-line test of whether agents' actual subjective preference rankings places them in a PD is whether they both would choose to defect when 100% guaranteed of the other's cooperation. Campbell's High-Stakes Prisoner's Dilemma game underscores how most games simply assume that the tangible payoff structure characterizing the game also determines individuals' preference rankings.[85]

This bizarre High-Stakes PD reaffirms the Prisoner's Dilemma pedagogy outlined earlier: actors will frequently find themselves in situations with a tangible reward structure reflecting the PD game in which the only rational outcome is to defect.[86] I doubt that most practitioners of game theory would accept that game theory necessarily endorses the view that predatory gain is preferable to reciprocal respect for others' rights of bodily integrity and private property. However, the standard assumptions used to operationalize strategic rationality in many contexts do, indeed, routinely reinforce the strategy of profiting by displacing costs on others without any discussion of either moral accountability for actions or subjects' possible preference for mutual cooperation over

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[84] For example, consider the Batman movie *Dark Knight*, produced by Christopher Nolan, 2008, in which one of the plot developments climaxes with the apparent setup of a Prisoner's Dilemma standoff with a High-Stakes material rewards payout. Two groups of hostages have been told that they can win their freedom by killing the members of the other group. However, the ultimate resolution shows that both sides actually held Assurance Game preferences.

[85] The accepted equivalence of Newcomb's Paradox and the PD demonstrates that the negative causal impact of the unilateral victory in a PD on the sucker is fully treated as an externality with no relevance to an individual's choice, see David Lewis, "Prisoners' Dilemma Is a Newcomb Problem," in Campbell and Snowden, eds., *Paradoxes of Rationality and Cooperation*, 1985, 251–255.

[86] Numerous authors conclude that PD's abound: Richard Tuck, *Free Riding* (Cambridge, MA: Harvard University Press, 2008), 22; Hargreaves Heap and Varoufakis, *Game* Theory, 2004, 175–178; Heath, *Following the Rules*, 2011, 39. Note, however, that in his investigation of games played in the Old Testament, game theorist Steven Brams only finds at most one to two PD games, *Biblical Games: Game Theory and the Hebrew Bible* (Cambridge, MA: MIT Press, 2002), index.

unilateral defection.[87] The claim that concerns of due process or other-regarding consideration can, in principle, register in actors' preference rankings may be true in parametric decision theory. However, in the expected utility theory required by game theory, only outcomes that register gain for agents count.[88] Therefore, the structures for action characteristic of classical liberalism – fair play, self-adopted rule following, commitment, perfect duty, and side constraints – are inconsistent with strategic rationality because they function independently of the material rewards that accrue to respective actors.[89] Concern for others can be assimilated into preference rankings over outcomes and also should be considered in the standard presentation of the Prisoner's Dilemma game. Yet, again, this admission would deviate from the standard game theoretic reliance on commonly sought after scarce and measurable rewards directly accruing to each actor to define expected utilities.[90]

 Experts in game theory realize these caveats. Nevertheless, a prevailing PD pedagogy has emerged, which can be imparted by teachers with less perfect and thorough knowledge of game theory and absorbed by students who will not go on to become experts themselves. This readily transmitted indoctrination presents the dilemma without specifying the simplifying assumptions that learners must tacitly endorse to perpetuate the worry that strategic rationality is non-negotiable and mutually destructive, and that Prisoner's Dilemma situations abound.[91] A superior pedagogy would clearly outline the limitations of strategic rationality, explicitly acknowledging that expected utility functions can only exhaustively incorporate actors' subjective concerns by rendering some superfluous to rational choice. Additionally, astute teachers of the Prisoner's Dilemma should clearly highlight the standard shortcut of assuming that salient

[87] The language "externality" for the cost displaced onto others for personal gain is developed within this context; for discussion see Tuck, *Free Riding*, 24–27; see also Schelling, "Hockey Helmets," 1973.

[88] On how "standard decision theory" assumes that "agents only invest outcomes with motivational significance," see Heath, *Communicative Action*, 2001, 137–139.

[89] Amartya Sen contrasts these procedural considerations from the concerns about outcomes reflected in expected utility functions; see Sen, *Rationality and Freedom*, 2004, 175–181, 232–239. See also Heath, *Communicative Action*, 2001, 86–92.

[90] Heath urges an expansion of orthodox game theory to encompass these considerations, *Following the Rules*, 2011. Binmore emphasizes that game theory can denote altruistic preferences and does not require cash value, yet both tend to use either cash or tangible value in their exposition of games, and Binmore notes that the instrumental consistency demands that rational actors must "necessarily behave as though maximizing the expected value of *something*," which grounds the payoff of games to a fungible existential property of existence, *Natural Justice*, 2005, 64–65.

[91] This is the conclusion drawn from the single-play PD, in addition to iterated PD games with a known termination point, or indefinite play scenarios in which an end point could be surmised; with respect to indefinitely played PDs with no discernable end point, many equilibria permit some degree of cooperation, with the two caveats that there is no single clear equilibrium for players to gravitate toward, and the only safe strategy in which every stage of the game has a self-contained rational strategy (coincident with mutual defection) is the only purely safe strategy; Luce and Raiffa, *Games and Decisions*, 1958, 72–102; repeated PDs are discussed in Chapter 11, along with the Tit for Tat strategy.

tangible rewards directly underlie the payoffs defining the game. Therefore, orthodox game theory does not admit as rational the type of agency characterizing classical liberalism or neoclassical economics. Both of these characteristic agents voluntarily constrain their action to be consistent with an internalized Pareto condition to act to make at least one person better off and no one worse off. In the PD, actors most prefer the state in which the other is less well off than had the two agents not interacted at all.

In the dire High-Stakes game, the classical liberal would cooperate if assured the other would also, even if paired with a stranger. If someone not only prefers, but also triggers, a stranger's slow death to get $9000, instead of $1000 and shared freedom, then this person is violating the central no-harm principle that recommends that agents respect the sanctity of each other's physical integrity. The individual who accepts the terms of this high-stakes Prisoner's Dilemma game unwittingly acquiesces to neoliberal subjectivity. The ground rules governing neoliberal subjectivity entail accepting the utility of sending another actor to death by slow torture for a $9000 gain without taking any responsibility for the role one's own decision plays in the other person's fate. The ready presentation of this high-stakes "game," inviting those exposed to participate in its logic of financial gain at the cost of another individual's extreme harm, aptly reflects the change in gestalt from the classical liberal to the neoliberal paradigm of markets and government.

The standard apparatus for teaching the Prisoner's Dilemma fails to disambiguate a PD game from an Assurance Game in which actors' appraisal of existential significance may not track interpersonally transferable expected gain in the way typically assumed. In the Assurance Game, actors prefer mutual cooperation yet may defect out of anxiety that the other actor may fail to cooperate.[92] From a revealed preference perspective, from which an actor's preferences are only known once observed during choice, the only way to detect whether the actor's preferences reflect an Assurance Game stance or Prisoner's Dilemma stance is to see whether that agent cooperates after the other individual has. The difficulty lies

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[92] In an Assurance Game (or Stag Hunt), as related in Table 3, both actors prefer to cooperate rather than defect. Yet this situation is difficult to capture if the preference for a cooperative outcome yields less tangible instrumental gain than defecting. Actors may opt to defect in an Assurance Game because this action guarantees the best worst outcome. In an Assurance Dilemma game, neither actor knows whether the other views the situation as a Prisoner's Dilemma or an Assurance Game. Using expected utility theory, sufficient suspicion about the preferences of the other actor can transform the expected payoff into the characteristic Prisoner's Dilemma game, making the rational strategy to defect. However, this game theoretic logic obscures the fact that in both the Assurance Game and the Assurance Dilemma game, each actor cooperates once it is certain that the other will or has. Chapter 3, "Assurance," follows how Thomas Schelling argued that the nuclear security dilemma, in its worst-case form, should be treated as a Prisoner's Dilemma derived from an Assurance Dilemma in view of each actor's doubt about the other's intentions. This treatment, along with the ensuing conventionalized pedagogy of introducing the PD game, has led to the characteristic confusion that the logical impasse of mutual impoverishment involves some dilemma over choice.

in determining agents' actual ranking of outcomes over and beyond the tangible payoff matrix. An effective teacher of the High-Stakes PD game, or any PD game for that matter, needs both to clarify the standard game theoretic default of permitting tangible rewards to directly reflect inherently reductionist expected utility rankings and to reaffirm that the bright-line test for whether actors actually perceive themselves to be in a Prisoner's Dilemma game instead of potentially an Assurance Game situation is if they choose to defect after the other person has already cooperated.

Campbell recognizes the apparent bizarreness of the high-stakes Prisoner's Dilemma. He writes, "If rational, you should both ... choose a quick but painful death rather than go scot-free with $1000 a piece in your pockets." Thus, he suggests that the PD game offers a logical imperative, an "ought," that actors confronted with tangible rewards characterizing the PD payoff matrix should defect. Campbell goes on to observe, "*At this point it may appear that the dilemma, however tantalizing as a logical puzzle, is too fantastic to have any practical relevance.*"[93] He agrees that *any* rendering of the Prisoner's Dilemma is "odd enough" in itself.

Nevertheless, he presses on to convince readers of the relevance of the Prisoner's Dilemma by applying it to the superpower standoff: "Two super-powers sign a nuclear disarmament pact on the shared belief that failure to disarm will result sooner or later in a nuclear holocaust in which each side will be quickly and painfully destroyed, while mutual disarmament will avoid this dreaded outcome." Campbell acknowledges that this problem has the structure of a Prisoner's Dilemma game because "each would say that its having complete nuclear superiority is a better guarantee of peace on earth than mutual nuclear disarmament, and each would explain its breaking of the agreement as a purely defensive maneuver."[94] He presents the Prisoner's Dilemma payoff matrix from the perspective of the United States as shown in Table 7.[95]

Campbell explains that "each side regards this vulnerability as a fate worse than mutual destruction, while it regards a position of complete nuclear superiority as ideal." This example illustrates that in international relations, the classical liberal's intuitive preference for bilateral agreements and symmetric deterrence yields to a neoliberal's unapologetic predilection for unilateral success, asymmetric deterrence, and nuclear hegemony. For the neoliberal approach to relationships, security is not a positive-sum good predicated on all parties striving to make choices that avoid incurring harm on other actors. Rather, strategic rationality assumes that the decision makers must displace the costs for their security and prosperity on other actors when they act to maximize their gain of scarce fungible goods in competition with others.

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[93] Campbell, in Campbell and Snowden, eds., *Paradoxes of Rationality*, 1985, 6. Emphasis added.
[94] All the quotes in this paragraph and the previous one are from Campbell, "Background for the Uninitiated," in Campbell and Snowden, eds., *Paradoxes of Rationality and Cooperation*, 1985, 6–7.
[95] Game taken from ibid., 6.

TABLE 7. *Mutual Assured Destruction (MAD) Modeled as a Prisoner's Dilemma*

		USSR	
		The other *adheres* to the agreement	The other *violates* the agreement
US	You *adhere*	No mutual destruction	A fate worse than mutual destruction
	You *violate*	The ideal upshot	Mutual destruction

US is row player; USSR is column player; payoffs are strictly considered from the perspective of what outcome the US receives and which it most prefers

Finally, in Campbell's eyes, the nuclear security dilemma provides the rationalization for why the Prisoner's Dilemma game and, by extension, game theory are useful tools for understanding social relations. The Cold War relevance of the Prisoner's Dilemma, which results in counseling an offensive and aggressive stance justified by self-defense, makes this unconventional view that rationalizes predatory gain seem not only pedestrian but also mandatory. Whereas assuming the toughest case and concentrating on actors' estimation of material gain may have provided initial impetus to delineating game theory, as subsequent chapters demonstrate, the advent of nuclear weapons does not necessarily provide a compelling reason to rethink the security of individual agents vis-à-vis one another in markets or states. Every practitioner of game theory should be clear how the reliance on individual maximization and the introduction of risk, worst-case planning, and the demands for commensurable and interpersonally transferable value to simplify calculations ultimately mire agents in a prison of strategic reason.

THE PRISONER'S DILEMMA GAME, THE NASH BARGAINING SOLUTION, AND NONCOOPERATIVE GAME THEORY

The Prisoner's Dilemma narrative, in conjunction with its name, conjures up images of stressful decision making, especially because it represents a miscarriage of a classical liberal exchange in which both actors seek a consensual, mutually beneficial trade. This section explains how the means of tracking value in much operationalized game theory normalizes the view that in routine market transactions, each actor not only prefers to but would indeed choose to sucker others if able to do so without consequences. This is the inevitable result of depending on expected utility functions that can only assess fungible payoffs independently of the means by which they are realized. This section also discusses how neoliberal theory attempts to mimic classic liberal exchange by two means. First, game theorists encompass the cooperative act of exchange within noncooperative game theory and thereby stipulate that the outcome of a bargain must derive from actors' ability to threaten negative

TABLE 8. *Neoliberal Car Sale: Exchange modeled as Prisoner's Dilemma*

	Other	
Self	*Send* the car	*Keep* the car
Send the car	Mutual exchange	Other gets cash & car
Keep the car	I get cash & car	Cash and car harmed in skirmish

In this payoff matrix, the presumption is that each actor most prefers to obtain both the cash and the car; second best, both prefer to exchange; third best, both prefer mutual defection from exchange; each actor least prefers to be suckered by having neither the cash nor the car.

repercussions.[96] Second, game theorists envision that the bargainers may perpetually encounter each other over and over with the exact same decision problem and thus have the wherewithal to punish the other actor for failing to cooperate by defecting in their next encounter.[97]

Consider the neoliberal car sale depicted in the payoff matrix in Table 8.[98] In this now widespread Prisoner's Dilemma model of exchange, both oneself and the other most prefer to get the car and the cash and leave the other with nothing. Whereas the liberal actor pursues amicable exchange, the neoliberal actor most prefers to cheat the other.[99] In the Prisoner's Dilemma application, every agent is presumed to seek sole gain for herself, thereby implicitly hoping to leave all other actors with their worst outcome, because only outcomes, distinguished by instrumentally salient permutations of the phenomena, register in expected utility functions according to this model of exchange and bargaining.[100] Therefore, the *only* motive for carrying through on the terms of a contractual agreement is the threat of punitive sanctions, and this understanding stretches from international relations through international political economy to the social contract and routine bargaining. In their penetrating analysis of contemporary economic science, Daniel Hausman and Michael

[96] Ken Binmore has an excellent discussion of this in his introduction to Nash, *Essays on Game Theory*, 1997, ix-xx.
[97] Game theory texts move quickly from the Prisoner's Dilemma model of exchange to the repeated game (Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 191–194; however, this theoretic move misses that in the classical liberal market, exchanges were often between individuals who did not know each other and would likely not encounter each other again; again, the primary difference is that in the neoliberal model of exchange, each most prefers to cheat the other and in the classical liberal exchange, each would prefer to cooperate given the other's alike cooperation.
[98] This example is drawn from Campbell, "Background for the Uninitiated," in Campbell and Sowden, eds., *Paradoxes of Rationality*, 1985, 9; Russell Hardin uses the same example in "The Utilitarian Logic of Liberalism," *Ethics* (Oct. 1986) 97:1, 47–74, at 52.
[99] Adam Smith's concept of fair play, *Theory of Moral Sentiments*, section II.ii.2.2; see also Robert Nozick on side constraints, *Anarchy, State and Utopia* (Oxford: Basil Blackwell, 1974), 28–33.
[100] Roger Myerson draws attention to the requirement of most operationalized game theory to track instrumentally "salient permutations" of the world; see his *Game Theory*, 1991, 25.

McPherson note that from this perspective, "the only thing wrong with cheating is the risk of getting caught"; furthermore, "competitive pressures do not permit firms [and other actors] the luxury of moral scruples."[101]

This section discusses how game theorists developed this mutually compromising view of market exchange early on to analyze arms control. In 1967, future Nobel Prize winners Robert J. Aumann, John C. Harsanyi, and Reinhard Selten published, with three other authors, the report *Gradual Reduction of Arms*, under the auspices of the US Arms Control and Disarmament Agency.[102] From this point onward, the classical view of the free market, which is necessarily bounded by the respect for persons, property, and contracts, was increasingly displaced by the view that bargains are facilitated by agents' power to threaten harm on others to secure better terms and subsequently enforce them.[103] While in traditional liberalism, normative agreements are self-guiding and create patterns of constructive interdependence when actors are assured others will cooperate, in postmodern neoliberalism, regularized patterns of interaction are the by-product of individual preference satisfaction and may well harm individuals and squander resources. Moreover, whereas classical liberalism entails the achievement of prudential judgment and the wherewithal to attain third-person impartial assessment of the conduct of others and ultimately of one's own conduct, the neoliberal paradigm views strategic rationality as biologically programmed into agents as a condition of their survival and replication.[104]

Reinhard Selten's contribution, coauthored with Reinhard Tietz, is analytically distinct from the other articles. These authors model a "Class of Simple Deterrence Games," assuming that nuclear war represents an "irreversible game" with "one type of atomic bomb."[105] The conclusions of Selten and Tietz's study are intuitively plausible: nations with good will toward one another are less likely to attack one another and that fewer to no atomic weapons leads to more stability than increasing stockpiles past one to several

101 Hausman and McPherson, *Economic Analysis*, 2006, 72–73; contemporary reputation mechanisms for establishing transparency are neoliberal in the sense that they do not discover a disposition or character for integrity but only serve to demonstrate a past trend that may indicate a forward trend.

102 I am indebted to Jerry Green and Helen Gavel for access to this report, written by Robert J. Aumann, John C. Harsanyi, John P. Mayberry, Michael Maschler, Herbert E. Scarf, Reinhard Selten, and Richard Stearns, *Models of Gradual Reduction of Arms*, Arms Control and Disarmament Agency, ACDA/ST-116, September 1, 1967.

103 Luce and Raiffa, *Games and Decisions*, 1958, 97–101.

104 John Nash articulated this view in his PhD thesis; for discussion, see Giacoli, "Nash Equilibrium," 2004. See also Binmore, who draws on Nash, *Natural Justice*, 2005, 23–27, 42, 73–75, 101–112.

105 "Security Equilibrium for a Modified Version of Scarf's Deterrence Model," in *Models of Gradual Reduction of Arms*, Arms Control and Disarmament Agency, ACDA/ST-116, September 1, 1967, 501–551. For contrast, see John C. Harsanyi, "A Generalized Nash Solution for Two-Person Cooperative Games with Incomplete Information," also in this report, 71–286.

weapons. Yet their modeling exercise does not dovetail with the other papers
in the volume. In exploring the implications of bargaining, those other papers
found it too mathematically cumbersome to incorporate how actors might
demonstrate concern for how other actors feel about outcomes. The Selten-
Tietz paper demonstrates a broader view of game theory, but it was the
exploration of strategic bargaining for nuclear strategy taken up by the
other authors that generated the neoliberal approach to political economy.
The demands of mathematical tractability and the fact that game theory is an
instrumental account of rationality that necessarily and directly associates
expected gain with configurations of ontologically existing phenomena have
encouraged theorists to standardize the noncooperative Prisoner's Dilemma
model of contracts, bargaining, and exchange.[106]

John Mayberry's introduction to the report, "The Notion of 'Threat' and Its
Relation to Bargaining Theories," sets forth the aggressive view of bargaining.
Appropriate for international relations, actors cannot exit a state of nature. This
means that actors gain advantage through posing credible threats to one
another and that no bargain is safe unless exposed to the constant pressure of
sanctions endogenously supplied by the participants themselves to address
compliance failures. It is worth analyzing Mayberry's introduction to the
Nash Bargaining Solution encompassed by noncooperative game theory in
detail because it is paradigmatic of neoliberal market discipline. Mayberry's
paper confirms that neoliberal political economy is predicated on the strategic
rationality of game theory, first vindicated within the context of avoiding
nuclear war by preparing to wage it. Mayberry notes that strategic rationality
is indispensable for nuclear strategy and is likewise essential to decision making
in other domains such as "the arms race (in non-nuclear weapons especially);
the Viet-Nam conflict; price competition in capital-intensive industries" and for
analyzing how castaways on an island may bargain over the food necessary to
stay alive.[107] Bargaining problems, from simple exchange to military contesta-
tion, take the Prisoner's Dilemma structure and should be solved according to
the logic of strategic rationality.

A graphic illustration of a bargain that equates players' utilities with the
potential outcomes in a bargain is presented in Figure 2.[108] The bargaining
space is defined by outcomes reflected by the respective units of gain each actor
expects. Technically speaking, a bargaining game, by which game theorists

[106] Von Neumann and Morgenstern articulate the view that value inheres in the world as an
ontological property that obeys the laws of physics, *Theory of Games and Economic
Behavior*, 1944, 1953, 2004, all editions, 16–24; for discussion, see Nicola Giocoli, "In the
Sign of the Axiomatic Method," in Richard Arena, Sheila Dow, and Mathias Klaes, eds., *Open
Economics: Economics in Relation to Other Disciplines* (London: Routledge, 2009), 129–149.
[107] Mayberry, in Aumann et al., *Models of Gradual Reduction of Arms*, 1967, 35, see also 29–32.
[108] Mayberry's "Notion of 'Threat,'", 1967, has thirteen figures demonstrating this concept; this is
a common depiction; see also Rapoport, *Fights, Games, Debates*, 4th ed., 1970, 189; Luce and
Raiffa, *Games and Decisions*, 1958, 118; Nash's original figures are in his "The Bargaining
Problem," reprinted in Nash, *Essays on Game Theory*, 1996, 155–162.
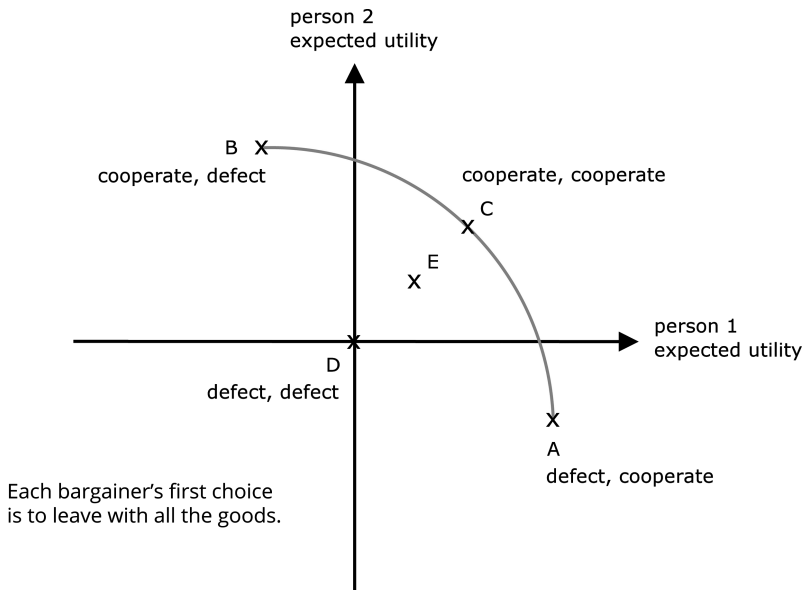
FIGURE 2. Nash Bargaining Solution as Prisoner's Dilemma Game

specify that actors could reach a mutually preferred outcome by cooperating rather than if they played noncooperatively, encompasses the characteristic PD payoff matrix, but it also include impure variants in which actors may gain more by alternatively defecting, and other games that deviate from the PD. The crucial point, however, is that in all cases the cooperative outcome is a function of the disagreement point, or the outcome that ensues when all actors defect.[109] Each point on the expected utility graph denotes the expected gain from a specific outcome. Each pair of numbers representing a point specifies the expected utility received by person 1 on the horizontal axis and person 2 on the vertical axis. Given the normal linear relationship between expected utility and tangible goods obtainable through bargaining, each point could represent an expected value of money or some other fungible source of value. Each point in the bargaining space represents either a concrete payoff or a probabilistic lottery of two other outcomes that has equal numeric expected utility. For example, to technically define the bargaining space, a specific point E could represent a 50% probability of receiving the payoff for unilateral defection plus a 50% probability of receiving the payoff for being suckered (with an evaluation equivalent to ½ {Defect, Cooperate}, + ½ {Cooperate, Defect} enumerated for each player).[110]

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[109] Myerson refers to this derivation of cooperative outcomes from noncooperative game theory "Nash's program," *Game Theory*, 1991, at 371.

[110] For an effective discussion, see Steven Kuhn, "Cardinal Payoffs," in "Prisoner's Dilemma," entry, 2014.

Throughout zero-sum and non-zero-sum game theory, solutions can often only be guaranteed to exist if the game is viewed through the lens of indefinite play and players are permitted to play each strategy in a fixed proportion to all the other strategies over time.[111]

In Figure 2, the point labeled A {Defect, Cooperate} designates player 1 defecting and player 2 cooperating; hence, player 1 gets all the possible value giving player 2 negative utility. The point labeled B {Cooperate, Defect} designates player 1 cooperating and player 2 defecting, with player 2 getting all possible value. The point labeled C designates the point at which both individuals cooperate {Cooperate, Cooperate}. The curve that traces through points B, C, and A represents the "Pareto frontier," which designates the points in the expected utility space from which one cannot improve any single actor's expected gain without diminishing that of the other actor. The inverse curve demarcating the joint set of the actors' least preferred outcomes lies in the bottom southwest quadrant of the figure.

The point designated D {Defect, Defect} represents mutual defection. In a bargaining game, the mutual defection point may be derived from the total set of possible outcomes as a mixed strategy solution to the noncooperative game.[112] This is a two-step process involving first identifying the disagreement point, and building up from that the agreement point of the bargain. This disagreement point {Defect, Defect} can be determined in three manners and thus is not uniquely specified. It can be derived from each individual securing his or her best-worst case, or maximin, outcome; it could represent a focal point of mutual salience; or it can result from each individual choosing an action to cause the opposition the greatest damage. Because the cooperative agreement point is directly deduced from the disagreement point, and each actor is content to settle for less, the worst the default outcome is, it is typically in each individual's interest to threaten the greatest harm on the other to achieve the superior cooperative outcome for oneself.[113] Whether one selects to threaten the other with the worst loss or protect oneself with the best worst-case outcome depends on which achieves the best outcome overall for the decision maker, and which strategies are credible insofar as they do not place oneself in an unrealistically vulnerable position.[114]

In the Nash bargaining solution, the identification of point D {defect, defect} is crucial because, along with the axioms defining Nash's approach, this point determines the single-point solution of the bargain, which in Figure 2 coincides with mutual cooperation. An arbitrary point, designated E in the diagram, may

[111] Luce and Raiffa, *Games and Decisions*, 1958, 106–109; Myerson follows Luce and Raiffa in first treating the repeating PD as the best example of repeating games in general, and immediately discussing bargaining as a cooperative game derived from the foundations of noncooperative game theory, *Game Theory*, 1991, 379–390.

[112] Luce and Raiffa, *Games and Decisions*, 1958, 106–109.

[113] Rapoport has the clearest discussion of this, *Fights, Games, Debates*, 1970, 186–192.

[114] Luce and Raiffa, *Games and Decisions*, 1958, 106–109.

not actually represent a concrete outcome, but instead a lottery ticket with an expected value based on, for example, a specific likelihood that one will be the sole defector and a specific likelihood that one will be the sole cooperator (a mixture of outcomes A {Cooperate, Defect} and B {Defect, Cooperate}). A Nash bargaining game requires that the field of points be filled in, and often the only way to make this possible is to invent lotteries among possible outcomes that can reflect the expected value for all conceivable points.[115] This consideration, standard throughout game theory to guarantee game solutions, restricts the features of the decision environment that can register subjective utility not only to outcomes independent of the means by which they are achieved but also to fungible properties, which accommodate attitudes toward risk.

The bargain takes on the characteristics of a Prisoner's Dilemma because, simply from the considerations of expected tangible gain, each actor is best off exiting the bargain with all the goods, leaving the other with none.[116] In this case, if one individual decides to cooperate, the other player will sucker that individual by defecting. If both fail to cooperate, then mutual defection occurs. The failure to cooperate is reflected as the "zero point," or default point signifying mutual defection in the Prisoner's Dilemma. This default can be manipulated if either or both actors can drive down the other's payoff in the case of disagreement, with the lower bound reflected by the sucker's payoff of sole cooperation against the other's defection. If secured by an enforcement mechanism to forestall individuals' inherent tendency to renege, settlement will be somewhere on the northeast frontier of the diagram and, according to Nash, is strictly delimited by the default point, or what will come to pass if no agreement is reached.[117] Game theorist Roger Myerson explains how "the payoff to player 1 . . . increase[s] as the disagreement payoff to player 2 decreases," and that therefore, "a possibility of hurting player 2 in the event of a disagreement may actually help player 1" should an agreement be

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[115] There are three levels of specificity available to define a bargaining game (cite from Luce and Raiffa).

[116] Myerson, *Game Theory*, 1991, 370–371.

[117] The Nash bargaining solution is a highly technical mathematical result similar to Kenneth Arrow's impossibility theorem. Nash is able to obtain a solution to the bargaining game because he assumes a status quo point that disregards from consideration outcomes that are less appealing to either player than the status quo point. Much of the work to solve a Nash bargaining problem goes into establishing what outcome represents the status quo point that can be determined either (1) as a focal point depending on exogenous considerations, (2) as the maximim solution to a noncooperative game, or (3) as a threat point derived from the worst outcome with which each can credibly threaten the other. Leveraging threats requires an understanding of the relative costs of threatening someone to oneself and to the other agent. For understanding, the Luce and Raiffa discussion requires reading both chap. 5 on "Two-Person Non-Zero-Sum Non-Cooperative Games," 88–113, and chap. 6 on "Two-Person Cooperative Games," 114–154; note that solving a Prisoner's Dilemma–style bargaining game with asymmetric rewards requires a randomized strategy, 115. Roger Myerson's later treatment is more concise because he combines the Nash bargaining solution and noncooperative game theory in line with Mayberry's example, *Game Theory*, 1991, chap. 8, 371–394.

reached.[118] Therefore, the hope of a mutually cooperative outcome in game theory "may give players an incentive to behave more antagonistically before the agreement is determined." John Nash formalized this "chilling effect."[119]

Beyond Nash's original barter, which he illustrated between the fictitious figures Bill and Jack over objects, and Mayberry's exploration of bargaining over terms of arms reduction, having actors bargain over monetary value became standard.[120] In what became known as the ultimatum game, there is a total sum of cash value to be distributed to players if the two can agree on how to share it. One person chooses a distribution, and the other has the power to accept or reject it. If there is agreement, the money is shared; if not, neither receives any reward.[121] Game theorists notice that it is rational for the second individual to even accept just $1 of a total $100 because that single dollar is still worth more than nothing. However, rather than settle for a perceptible though small gain, each actor has the capability to threaten that the other will get nothing by presenting a willingness to defect unless personal stakes are sufficiently high. The ability and credibility to threaten other actors is thus crucial to how much one can gain oneself. In terms of understanding the development of a uniquely neoliberal approach to interactions, markets, and governance, the key point is that in the move to apply abstract formal game theory to the lived world, all that can register in actors' rational preference rankings over outcomes and lotteries thereof is their mathematically consistent appraisal of tangible outcomes irrespective of the processes and intentions that brought them about: this neoliberal market "is therefore the final step in a process that first leaches out the moral content of a culture and then erodes the autonomy of its citizens by shaping their personal preferences."[122] This is obviously true in the case of a bargain structured by relative ratios of fungible goods accruing to each individual. Value is significant and measurable independent of social relationships and context; actors' preferences reflect structural environmentally given rewards and are not autonomously determined.[123]

Game theory extrapolates from lived experience to provide a tidy mathematical analysis of conflict.[124] However, it is less clear how formal strategic rationality oversteps the boundary from being a thought experiment to becoming a categorical imperative directly linked to survival in more mundane contexts other than a military contest.[125] The early Cold War embrace of

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[118] This and the following three quotes are from Myerson, *Game Theory*, 1991, at 386.

[119] "Two-Person Cooperative Games," *Econometrica*, (1953) 21, 128–140.

[120] "The Bargaining Problem," *Econometrica* 18 (1950), 155–162.

[121] Note that it is possible to define variations of this game. For example, the players could play repeated rounds with a discount factor reducing the total sum to be distributed in each round. Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 196–204.

[122] Binmore, *Natural Justice*, 2005, at 184.

[123] Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 209.

[124] For an early treatment, see Robert Axelrod, *Conflict of Interest: A Theory of Divergent Goals with Applications to Politics* (Chicago: Markham, 1970).

[125] Binmore discusses a "sharing food" example, *Natural Justice*, 2005, 119–121, 160–161.

hard-nosed strategic rationality to confront the Soviet Union was subsequently applied across multiple domains of decision making and choice by the late twentieth century. War, which strategists may view as a state of potentially unbounded conflict, invites the belief that command of resources is necessary for survival and propagation. In this case, the power granted by such resources stems from natural properties, governed by the laws of physics, as opposed to specific patterns of interactivity dependent on intricate norm-governed social arrangements or specific intersubjectively perpetuated interpretations of worth and significance. I further elaborate on this theme in the next chapter, "Assurance," by showing how game theory's dependence on interpersonally transferable utility renders it compatible with the international relations of realism, neorealism, and neoliberalism.

Mayberry culminates his analysis by using game theory to draw a sharp distinction between a classical liberal and neoliberal approach to bargaining. Whereas the former is normative and obeys the no-harm principle, which could be interpreted in view of individuals' maximin strategies, the latter deploys coercive threats to gain the advantage over opposition. Mayberry clearly specifies how the Nash bargaining solution can be incorporated into noncooperative game theory to support the nuclear strategy of preparing to fight and win a nuclear war. He reasons:

Nash's concept of threat and solution can reconcile and illuminate for me the inconsistent extreme views of those ultra-pacifists who say, "War is unreasonable, and we are reasonable; therefore let us not prepare for war, nor consider it as an option" and those extreme hawks who say, "If we do not prepare for war, we shall be forced to surrender, and it is ridiculous to *prepare* for war unless we *intend* to fight."[126]

Mayberry's central idea, derived from Nash's bargaining solution, is that the outcome of strategic arms control, or any settlement among protagonists, will be a function of their willingness to leverage credible threats to achieve an outcome in their favor.[127] Upholding the normative no-harm principle, which effectively represents "protect[ing] oneself against the worst the opponent can do," is a weaker strategy than the one that becomes the crux of neoliberal bargaining: "to ensure that the opponent is injured as much as possible even if his main effort is to defend himself."[128] Mayberry makes clear he views bargaining as part of relentlessly competitive non-zero-sum game theory that, within the context of arms control, prescribes leveraging coercive threats to achieve national security. He pithily states the central tenet of the nuclear utilization targeting strategy: "it is ridiculous to *prepare* for war unless we *intend* to fight."

Mayberry's analysis helps introduce Part I of *Prisoners of Reason* because he shows how game theory rationalizes the case for preparing to fight a nuclear

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[126] Mayberry, "The Notion of 'Threat,'" 1967, 46.
[127] Luce and Raiffa provide an effective discussion of this material, *Games and Decisions*, 1957, 106–109.
[128] Mayberry, "The Notion of 'Threat,'" 1967, 43.

war by arguing for the analytic necessity of making credible threats to the Soviet Union to improve US bargaining power.[129] Cooperative games, in which outcomes are the function of agreements, are encompassed by noncooperative game theory for three reasons that are consistent with the game theoretic neoliberal orientation. First, no strategic rational actor voluntarily abides by agreements made. Second, leveraging threats secures the most favorable outcome for oneself. Third, others will only uphold terms of a bargain with the constant pressure of credible threats for noncompliance.

CONCLUSION

In the vast intellectual landscape of game theory, the Prisoner's Dilemma game has become accepted as a discovery of a core puzzle at the heart of all manner of cooperative ventures: Adam Smith's invisible hand, joining trade unions, participating in public vaccinations, standing at football games, and even marriage.[130] Game theory scholars frequently present the PD as though it were as simple and straightforward as tic-tac-toe. As long as two actors' subjective preference rankings conform to the characteristic PD payoff structure, then the rational choice for each individual is to fail to cooperate, leaving both with their second-worst preference. However, many layers of analytic complexity are involved in setting up the Prisoner's Dilemma game, which, if not rendered explicit, become part of the pedagogic baggage relied on to transmit the acuteness and inevitability of the Prisoner's Dilemma trap. The result then is that teaching the PD game as a particularly useful exemplar of noncooperative game theory and using it to model situations throughout markets, governance, and international relations and to generate blueprints for institutions and practices will shape the social world in accordance with the tacit and limited assumptions required to operationalize the model.[131]

Thus, in teaching the Prisoner's Dilemma, I offer the following four recommendations.[132] These explanatory strategies make explicit the otherwise implicit assumptions packaged into standard practicable game theory. Once these suppositions, which are necessary to becoming trapped in the Prisoner's Dilemma impasse in the first place, are rendered explicit, initiates may subject

[129] In this informative RAND report, Jack L. Snyder analyzes the impact of the US nuclear strategy of flexible response in view of its likely reception by the USSR, "*The Soviet Strategic Culture: Implications for Limited Nuclear Options* (Santa Monica: RAND Corporation, September, 1977).

[130] These examples are taken from Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 175–180.

[131] In the essay on the PD, Mary Morgan concludes that the use of the PD model has become sufficiently routinized that analysts treat the model as though it were existence itself, "The Curious Case of the Prisoner's Dilemma: Model Situation? Exemplary Narrative?" in *Science without Laws* (Durham: Duke University Press, 2007), 157–188.

[132] The Prisoner's Dilemma, of course, is a pertinent and central game in noncooperative game theory; see, e.g., Luce and Raiffa, *Games and Decisions*, 1957, 88–113.

them to inspection and can opt into or out of them at will. Hence, individuals may select to become neoliberal citizens and consumers voluntarily, instead of unknowingly succumbing to or being pressured into the mentality of *Homo strategicus*.

First, educators should clarify that orthodox game theoretic payoffs only reflect outcomes and exclude the means by which outcomes are realized. Thus, it is consistent with utilitarian philosophy but distinct from Jeremy Bentham's original approach because it denies interpersonal comparability of utility or the rationality of joint instead of individualistic maximization. By itself, this restriction on the evaluation of worth negates ethical and normative characteristics of action correlating to classical liberals' first principle of mutual respect and reciprocal no-harm, whether in the form of Adam Smith's negative virtue, Immanuel Kant's perfect duty, Robert Nozick's side constraints, or John Rawls's fair play.[133] It is then self-evident that if strategic rationality is limited to its current form, neoliberal institutions built on its premise will necessarily break with the modern approach to markets and justice. The urgency associated with the nuclear security dilemma, inviting worst-case analysis and emphasizing the raw power of resources existing prior to communication, provided the precedent for discarding classical liberalism first in international relations and subsequently in the social contract, markets, and democracy.[134] Game theorists' newfound prestige and the momentum propelling strategic rationality forward shielded the germinating paradigm of neoliberal political economy from scrutiny.[135]

Second, most operationalized game theory also relies on an expected utility metric that represents not only an ontologically salient feature of the decision environment but also a scarce, commonly sought after, interpersonally

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[133] This is a point that Amartya Sen has emphasized as a heterodox amendment to rational choice theory; see *Rationality as Freedom*, 175–181, 232–239; for another approach, see Joseph Heath, *Following the Rules*, 2011; and Margaret Gilbert, *Joint Commitment: How We Make the Social World* (Oxford: Oxford University Press, 2013).

[134] Hargreaves Heap and Varoufakis make a point of noting that Roger Myerson has argued that "game theory makes pessimistic assumptions regarding the nature of rationality because its role is to study the sort of social institutions that might work well ... even when peopled by instrumentally rational egoists," *Game Theory*, 2004, 184 (uncited), and Myerson makes a point of referring to the nuclear deterrence on the first page of his *Game Theory*, 1991. However game theory is prescriptive, and individuals exposed to it will learn its rules of conduct, see, e.g., Professor Peter Nonacs, UCLA, "Why I Let My Students Cheat on Their Exam: Teaching Game Theory Is Good. Making People Live It Is Even Better," www.zocalopublicsquare.org/2013/04/15/why-i-let-my-students-cheat-on-the-final/ideas/nexus/, accessed January 6, 2015.

[135] John Rawls was one of the most adept theorists who spanned classical liberalism and the new rational choice liberalism, and it soon became clear that a commitment to both approaches was difficult, if not impossible, to entertain. See his "Justice as Fairness: Political Not Metaphysical Essay," 1985, and commentary in S. M. Amadae, *Rationalizing Capitalist Democracy* (Chicago: University of Chicago Press, 2003); for other such acknowledgments, see David Gauthier, *Morals by Agreement* (Oxford: Clarendon, 1987); Martin Hollis, *Trust within Reason* (Cambridge: Cambridge University Press, 1998).

transferable feature such as nutritional calories, energy, or cash value. This interpersonally transferable utility is surmised to have value prior to establishing intersubjective agreement on the social significance of the decision context. Thus, game theory, promoted as an exhaustive science of choice, ends up eviscerating from intelligible meaning all but affine transformations of some intersubjectively evident ontological property subject to the laws of physics. This ignores the creation of positive-sum value that can arise from complex, norm-governed patterns of social interdependence, not to mention well-being associated with potentially unlimited sources of value such as hope, healing, reconciliation, and understanding.

Third, most game theorists assume that individuals must maximize payoffs individually, in strategic competition with others. Given the excision of moral scruples and accountability, because of the superfluity of processes to the judgment of rewards under the rules of standard game theory, a population of strategic rational actors resembles dueling Maxwellian Demons, both striving to accumulate as much utility as possible on their side of a partition.[136] These neoliberal subjects cannot realize common goals of achieving a globally vibrant and sustainable world conducive to all individuals achieving the basic goods represented by Abraham Maslow's hierarchy of needs, and generating inclusive cultural wealth.[137] A classical liberal or post-neoliberal agent may accept that some decision problems are indeed defined strictly by scarce, ontologically prior resources. However, classical liberal or post-neoliberal actors may elect to collaborate against natural scarcity and maximize resources as a group, rather than against one another in an incessant mutually undermining contest.[138]

Fourth, not only does traditional political economy depend on the no-harm principle, it also recognizes a role for the imperfect duties of charity and beneficence.[139] For classical liberals, acceptance of the moral obligation of the better-off to ensure that the less well-off are not pushed to the brink of ruin is a touchstone of personal independence and autonomy. In a neoliberal world order, in which strategic rationality has the pedigree of reason, actors presume the prerogative to cannibalize others' life expectancies and qualities of life as an

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[136] In axiomatizing quantum thermodynamics before axiomatizing strategic rationality, John von Neumann used the same symbolic designation for both the expected energy of quantum particles and for individuals expected utility, "EU"; see his *Mathematical Foundations of Quantum Mechanics* (Princeton, NJ: Princeton University Press, 1996).

[137] Abraham H. Maslow, "A Theory of Human Motivation," *Psychological Review* (1943) 50:4, 370–396; George Simmel, *The Philosophy of Money* (London: Routledge Classics, 2011).

[138] Bacharach, *Beyond Individual Choice*, 2006.

[139] Adam Smith, *Theory of Moral Sentiments* (Indianapolis: Liberty Fund, 1982), VI.conl.2; for discussion, see Amadae, *Rationalizing Capitalist Democracy*, 2003, 215–216; see also Peter Singer, "Famine, Affluence, and Morality," *Philosophy and Public Affairs* (1972) 1:1, 229–243, to see how the classical liberal approach to justice and political economy lingers into the neoliberal era.

external cost to one's own success.[140] Additionally, neoliberal strategic rational actors will only conduct charity as recommended by Richard Dawkins's selfish gene theory: to secure their immortality through conspicuous and memorable acts of generosity.[141]

Neoliberal subjectivity arises from the intricate pedagogy of game theory that comes to the fore in the Prisoner's Dilemma game and is interchangeable with contemporary paradigmatic instrumental rationality.[142] Rational choice is promoted as an exhaustive science of decision making, but only by smuggling in a characteristic confusion suggesting that everything of value to agents can be reflected in their appraisals of existential worth even though this is patently not the case in life viewed as a "fixed game."[143] Without a critical and scrupulous pedagogy that carefully identifies as optional the assumptions necessary to operationalize strategic rationality, a new neoliberal understanding of capitalism will dominate the worldview of the student of game theory and inhabitant of neoliberal institutions. This reductionist perspective on agency first proved itself useful for projecting the power of national sovereignty through wielding deterrent threats of destroying other nations using nuclear weapons. Here are the barebones central elements of this worldview:

1. It entails coercive bargaining, by threatening harm on others if they do not cooperate, instead of bargaining consistent with the no-harm principle.
2. It entails the inadvertent commodification of all value and by considering that all goods of value are ultimately scarce fungible resources, thereby negating the possibility of positive-sum and unlimited experiential goods including security, social capital, and friendship.
3. It entails the view that only sanctions keep people in line with agreements they voluntarily make or laws they view as reasonable.
4. It implies that cheating and free riding, if one can get away with them, are rational.
5. It implies that information and language are purely signaling devices deployed to realize preferences over world states with value independent of social relations.
6. It implies, finally, that agents must comply with this neoliberal view because the price for resisting is either bankruptcy or the failure to survive.

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[140] Hausman and McPherson begin their book *Economic Analysis, Moral Philosophy and Public Policy*, 2006, by showing how Lawrence Summers's articulation of the principles underlying contemporary economic theory permit, even necessitate, negatively impacting the qualities and quantities of life of less well-off individuals, at 12–13; this is also true for the Kaldor-Hicks compensation principle widely used in contemporary law and economics, discussed in Chapter 8, "Consent."

[141] Richard Dawkins, *The God Delusion* (New York: Houghton Mifflin Harcourt, 2011).

[142] See, e.g., Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 8–12.

[143] Game theorists tend to refer to all life contexts as independent games or one supergame, e.g., see Binmore, *Natural Justice*, 2005, 184, who also considers that "the game of life is the infinitely repeated Prisoners' Dilemma," at 96.

2

Prisoner's Dilemma

Puzzles with the structure of the prisoner's dilemma were devised and discussed by Merrill Flood and Melvin Dresher in 1950, as part of the Rand Corporation's investigations into game theory (*which Rand pursued because of possible applications to global nuclear strategy*). The title "prisoner's dilemma" and the version with prison sentences as payoffs are due to Albert Tucker, who wanted to make Flood and Dresher's ideas more accessible to an audience of Stanford psychologists. Although Flood and Dresher didn't themselves rush to publicize their ideas in external journal articles, the puzzle attracted widespread attention in a variety of disciplines. Christian Donninger reports that "more than a thousand articles" about it were published in the sixties and seventies. A bibliography (Axelrod and D'Ambrosio) of writings between 1988 and 1994 that pertain to Robert Axelrod's research on the subject lists 209 entries. Since then the flow has shown no signs of abating.

Steven Kuhn, 2014[1]

The *Prisoner's Dilemma* turned out to be one of game theory's great advertisements. The elucidation of this paradox, and the demonstration of how each player brings about a collectively self-defeating outcome, because she is *rational* in pursuing her own interests, was one of game theory's early achievements which established its reputation among the social scientists.

Shaun Hargreaves Heap and Yanis Varoufakis, 2004[2]

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[1] Steven Kuhn, "Prisoner's Dilemma," *Stanford Encyclopedia of Philosophy*, available online at http://plato.stanford.edu/entries/prisoner-dilemma/, dated 2007, revised 2014, 1–2/49, accessed June 30, 2015; italics added to show how this nuclear security claim for significance is an ongoing feature of presenting game theory; Christian Donninger, "Is It Always Efficient to be Nice?" in *Paradoxical Effects of Social Behavior*, ed. by Anatol Rapoport, Andreas Diekmann, and Peter Mitter (Heidelberg: Physica Verlag, 1986), 123–134; Robert Axelrod and Lisa D'Ambrosio, "Bibliography for the Evolution of Cooperation," *Journal of Conflict Resolution* (1995) 39, 190. For another statement of the wide attention the Prisoner's Dilemma game received, see Elinor Ostrom, *Governing the Commons* (New York: Cambridge University Press, 1990), preface.

[2] Shaun Hargreaves Heap and Yanis Varoufakis, *Game Theory*, 2nd ed. (London: Routledge, 2004), 37–38.

(click on line/lable for focus, right click to expand/contract wildcards)

Incidences of "prisoner 's dilemma" and "prisoners ' dilemma" in
Google Books viewed through Google NGram

FIGURE 1. Ongoing Engagement with Prisoner's Dilemma, 1950–2010
This figure was made by running the Google N-Gram function.

As these opening quotes acknowledge, the Prisoner's Dilemma (PD) represents a core puzzle within the formal mathematics of game theory.[3] Its rise in conspicuity is evident figure 2.1 above demonstrating a relatively steady rise in incidences of the phrase's usage between 1960 to 1995, with a stable presence persisting into the twenty first century. This famous two-person "game," with a stock narrative cast in terms of two prisoners who each independently must choose whether to remain silent or speak, each advancing self-interest at the expense of the other and thereby achieving a mutually suboptimal outcome, mires any social interaction it is applied to into perplexity. The logic of this game proves the inverse of Adam Smith's invisible hand: individuals acting on self-interest will achieve a mutually suboptimal outcome. However, as this chapter illuminates, the assumptions underlying game theory drive this conclusion.

The Prisoner's Dilemma is not only a core problem at the heart of analytic game theory, but it has also been applied to model and explain numerous phenomena throughout politics and economics.[4] The nuclear security dilemma, subject of Chapters 3, "Assurance," and 4, "Deterrence," was the first concrete problem for

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[3] The best collection of essays on the analytic puzzle of the PD is Richmond Campbell and Lanning Sowden, eds., *Paradoxes of Rationality and Cooperation* (Vancouver: University of British Columbia Press, 1985); for a discussion spanning the analytic game theory and empirical applications, see Anatol Rapoport and Albert M. Chammah, *Prisoner's Dilemma* (Ann Arbor: University of Michigan Press, 1970). Figure 2.1 is made using Google's ngram function with the vertical axis reflecting the percentage of all the two word phrases in the English corpus searchable by Google represented by "Prisoner's Dilemma" and "Prisoners' Dilemma" between 1950 and 2010. For reference to the development of the Prisoner's Dilemma phraseology by Merrill Flood and Melvin Dresher working at the RAND Corporation in 1950 see Steven Kuhn, "Prisoner's Dilemma," *Stanford Encyclopedia of Philosophy*, (first published September 4, 1997, and revised August 29, 2014), available online: http://plato.stanford.edu/entries/prisoner-dilemma/ accessed August 1, 2015.

[4] Hargreaves Heap and Varoufakis, *Game Theory*, 175–178; Elinor Ostrom, *Governing the Commons* (New York: Cambridge University Press, 1990), 1–20.

which game theorists found the Prisoner's Dilemma apt. In the same vein, by the end of the 1960s, game theorists found the Prisoner's Dilemma model useful for analyzing arms control and bargaining over weapons reduction. In the 1970s, theorists developed a treatment of bargaining in the context of market exchange in terms of the PD game. By extending the model to an exactly repeating scenario, and also by extending it to encompass any number of individuals, theorists modeled the problem of achieving a social contract as a multiple-person, indefinitely repeating, Prisoner's Dilemma.[5] Theorists also found the PD model well suited to model market failure, collective action, free riding, and public goods and to analyze the general rationale for government.[6] Some theorists have analyzed voting as a many-agent PD.[7] Climate change, pollution, individuals' decisions to get vaccinated or to stand up at sporting events are also studied with this model.[8] It is difficult to overemphasize the amount of attention the PD has received, and the numerous social interactions that have been modeled with it.[9] Finally, survival situations such as famine or the competition for nutritional value under conditions of natural selection have been modeled with the PD.[10]

This chapter lays the groundwork for understanding the recent conceptual movement from the classical liberal social contract of mutual prosperity to the neoliberal social contract of conjoint depletion. In brief, this transformation in approach follows the game theoretical dismissal of the classical liberal view that actors will respect others' right to exist and, when assured that others will do likewise, are inclined to keep the agreements they voluntarily made. In its place, game theory holds that rational actors will forge agreements premised on their ability to harm others, and will moreover break their word with impunity, even after others have kept theirs. Game theory does not acknowledge that side constraints on action, the logic of appropriateness, commitment, promising, or fair play provide valid motives for action. It generally replaces normative agreement and voluntary compliance with coercive bargaining and leveraged enforcement. The pages ahead show how the specific means of tracking value, in terms of the expected utility of outcomes, necessary in game theory render it imperative that these classical liberal modes of action, encompassing perfect and imperfect duties, as well as solidarity, lose their coherence.

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[5] The clearest statement of the relationship between the Nash Bargaining Solution and noncooperative game theory is Ken Binmore's introduction to John Forbes Nash, *Essays on Game Theory* (New York: Edward Elgar, 1997), ix–x; on the *n*-person Prisoner's Dilemma and collective action, see Russell Hardin, *Collective Action* (Baltimore: Resources for the Future, 1982).

[6] See, e.g., how Dennis C. Mueller's *Public Choice III* (Cambridge: Cambridge University Press, 2003) begins by the Prisoner's Dilemma model as providing the motive underlying the "origins of the state," 9–14.

[7] For example, Joachim I. Krueger and Melissa Acevedo, "A Game-Theoretic View of Voting," *Journal of Social Issues* (2008), 64:3, 467–485.

[8] Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 175–178.

[9] Searching "Google Books" yields more than 4.5 million hits for "Prisoner's Dilemma."

[10] Partha Dasgupta, *Inquiry into Well-Being and Destitution* (Oxford: Oxford University Press, 1993), on the use of bargaining theory in terms of nutrition, see 324–336.

Thus, in learning game theory, the Prisoner's Dilemma game, and its extensive applications to mundane problems throughout politics and economics, students who master this material will learn to limit their horizons regarding legitimate action as they conform to the tacit assumptions underlying strategic rationality. These assumptions not only rule out the classical liberal family of perfect duties but also contradict unbounded realms of experiential value, the ethos of solidarity and joint maximization, in addition to the classical liberal imperfect duties of charity and beneficence. This chapter renders explicit these latent assumptions that are evident on inspection but are not typically directly discussed in either teaching or applying the Prisoner's Dilemma game or non-cooperative game theory more generally.

The first section provides a discursive introduction to the logical structure of the Prisoner's Dilemma. This discussion is wholly didactic and cannot do justice to the formal apparatus required to specify the game. The second section introduces the means of assessing value, or expected utility, in game theory, and the third section presents the standard means of teaching the PD. The fourth section discusses the relationship between bargaining and the Prisoner's Dilemma, which was originally articulated within the context of nuclear arms control, and lays the groundwork for introducing the PD model of the social contract.

This chapter on the Prisoner's Dilemma directly addresses only the one-time play game and leaves discussion of the formalized many-person PD to Chapter 9, "Collective Action," and the indefinitely repeating PD game for Chapter 11, "Tit for Tat." I isolate treatment of the single-play PD because it has sufficient theoretical complexity that it warrants focus.[11] Moreover, the iterated PD, as game theorists refer to the repeated scenario, and the multi-agent PD amplify the underlying assumptions of game theory because it strictly relies on, if not interpersonally transferable utility in many contexts, then certainly at a minimum, expected utility theory. Even though many regard the indefinitely repeated PD and Robert Axelrod's Tit for Tat solution as magic bullets to demonstrate that cooperation can emerge under the limited assumptions of strategic rationality and narrow self-interest, this solution depends on perfectly repeating play with little significance for large-scale, multiple-agent political economy.[12] This is because on the one hand, a mutually beneficial solution to

[11] This concurs with the judgment of Campbell and Sowden, eds., *Paradoxes of Rationality*, 1985, 16 of 20 papers discuss single-play PDs.

[12] On the limitations of the cooperative solution to the indefinitely repeated PD, see Russell Hardin, "Individual Sanctions, Collective Benefits," in Campbell and Sowden, eds., *Paradoxes of Rationality*, 1985, 339–354; Daniel M. Hausman and Michael S. McPherson, *Economic Analysis, Moral Philosophy, and Public Policy*, 2nd ed. (New York: Cambridge University Press, 2006), 243–245, note in these authors' treatments how rapidly discussion of social justice and the repeated PD moves into discussion of evolutionary biology and the characteristics of successful invaders of groups with behavioral tactics conforming to cooperation (at 244); Ken Binmore also moves swiftly to the repeated PD within an evolutionary context, glancing on the utility assumptions required for this treatment, *Natural Justice* (Oxford: Oxford University Press, 2005), 72–92. For further discussion see Chapter 11, "Tit for Tat."

the repeated PD requires exact repetition with the same two actors over an indefinite yet potentially lengthy time horizon; on the other hand, guaranteed solutions for two-person non-zero-sum noncooperative games require mixed strategies, and are not limited to a single solution.[13]

PRISONER'S DILEMMA: THE NARRATIVE[14]

You and your coconspirator have been captured by the authorities. You are separated and each given the choice between confessing and remaining silent. One of four possible outcomes will occur. If you talk while your partner remains silent, you go free. If you both remain silent, you each receive one year in prison. If you both confess, you each receive a five-year sentence. If you remain silent while your partner confesses, you face a ten-year sentence while your partner goes free. What do you do?

There are different ways to reason through which action to take. Let us consider them each in turn.

Commando: I need to remain silent to protect my partner, my country, and my honor. I have been trained to remain silent, and whatever the price may be, I will remain silent.

Team Member: As a coconspirator, I identify myself as part of a team. Although I may personally do better if I confess, we do better as a team by remaining silent. Thus, it is obvious that I should remain silent, and I choose to remain silent.[15]

Platonic Reasoner: Reason is universal. I know myself and my preferences as well as my coconspirator and his preferences. All must reason alike in like circumstances, so we must choose the same act. We will either converge on both confessing or both remaining silent. Obviously, the latter is superior. Therefore, I remain silent, confident in my partner's identical reasoning capability.[16]

Assurance Seeker: If I knew my partner would remain silent, I would too. But I am afraid that under the pressure of confrontation with the authorities, my partner will not have the wherewithal to remain silent. Although *I would*

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[13] With respect to the former point, a clear treatment is found in the "14 Indefinite Iteration," entry on "Prisoner's Dilemma, "*Stanford Encyclopedia of Philosophy,*" Stephen Kuhn, 2014, accessed January 5, 2015; on the second point, see Anatol Rapoport, *Fights, Games, and Debates* (Ann Arbor: University of Michigan Press, 1960), 184–185; the Prisoner's Dilemma game does not necessarily have a symmetric payoff.

[14] See, e.g., R. Duncan Luce and Howard Raiffa, *Games and Decisions* (New York: Wiley, 1958), 94–95; Luce and Raiffa wrote the early definitive text on game theory, and it retains its insightfulness today; see also Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 172–173.

[15] Michael Bacharach investigates this manner of reasoning, which is distinct from the premise of individualistic maximization assumed in orthodox game theory, *Beyond Individual Choice: Teams and Frames in Game Theory*, ed. by Natalie Gold and Robert Sugden (Princeton, NJ: Princeton University Press, 2006).

[16] Reasoning by symmetry is widely dismissed by game theorists, see Lawrence H. Davis, "Is the Symmetry Argument Valid?" in Campbell and Sowden, eds., *Paradoxes of Rationality*, 1985, 255–263; Ken Binmore views Kant's categorical imperative as a variant on symmetrical reasoning, which he refers to as magical thinking, *Natural Justice*, 2005, 63.

definitely stay silent if assured my partner would, my fear of being left alone in prison for ten years is so great that I choose to confess to protect myself from this terrible outcome.

Homo Strategicus: The strategy of confessing over remaining silent is better for me, regardless of what my partner chooses. If I confess and my partner does too, then I will just get five years instead of ten. If I confess and my partner refuses to talk, then I will walk away scot-free. Unfortunately, we'll probably both end up with five-year sentences, and not one-year sentences, but this is the logical outcome of being rational.[17]

Most game theorists endorse only this last solution to the Prisoner's Dilemma game: each actor chooses to confess ("defect"), regardless of what the other does.[18] The importance of this result for modern decision theory cannot be exaggerated. *Each actor faces no dilemma of choice because each still chooses to defect, even if fully guaranteed that the other will cooperate.*[19] The larger collective social dilemma arises because individuals' maximization of expected gain results in mutual impoverishment. In the world construed as a Prisoner's Dilemma, every actor most prefers to sucker everyone else.

Game theorists have formalized this narrative and corresponding quandary into the game called the Prisoner's Dilemma. It has become a familiar conceptual artifact of expertise in strategic rationality and represents a familiar pattern of two-person moves and countermoves like tic-tac-toe, although with simultaneous rather than sequential play. The PD is typically represented in a simple form: one individual's choice is represented by rows, and the other individual's choice by columns. Each actor has the choice of remaining silent (cooperating) or confessing (defecting). Given that each person can choose one of two acts, a total of four combinations are possible. Table 1 is a normal presentation of this iconic game.[20] Given the reward structure of this "game," if I am Prisoner 2, I can choose between confessing and not confessing. Regardless of what Prisoner 1 opts to do, I am better off by confessing. If Prisoner 1 chooses to confess, then Prisoner 2 is better off confessing and getting eight years rather than ten; if Prisoner's 1 chooses to cooperate, then Prisoner 2 is better off confessing and getting three months rather than one year. Clearly, the prisoners only care about a mutually evident, salient feature of their decision environment: personal jail

[17] Game theorists concur that this is the dominant or only rational strategy: each is better off defecting whatever choice the other takes; Luce and Raiffa, *Games and Decisions*, 1958, 94–97.
[18] A subaltern position on the Prisoner's Dilemma game reflects the idea that reason should be universal, reflected by the previously mentioned Platonic Reasoner scenario; Davis, "Is the Symmetry Argument Valid," 1985. However, mainstream game theory assumes that each individual must reason independently and maximize gain independently. The only solution is thus the one in which one gains the most regardless of what the other agent decides to do. See Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 184; see also Luce and Raiffa, *Games and Decisions*, 1958, 95–102. For more on the subaltern position on the Prisoner's Dilemma game, see Paul Erickson, *The World the Game Theorists Made* (Chicago: University of Chicago Press, 2015).
[19] Binmore is adamant on this point, *Natural Justice*, 2005, 63–64.
[20] Taken from Luce and Raiffa, *Games and Decisions*, 1958, 95; note that games can also be expressed as decision trees, which is referred to as the extensive form of the game.

TABLE 1. *Matrix Representation of Prisoner's Dilemma*

		Prisoner 2	
		Not Confess	**Confess**
Prisoner 1	**Not Confess**	1 year each	10 years for Prisoner 1, 3 months for Prisoner 2
	Confess	3 months for Prisoner 1 10 years for Prisoner 2	8 years each

Player 1's choices reflected in rows; Player 2's choices reflected in columns

time, and this serves as each person's criterion of judgment.[21] The prisoners only evaluate personal rewards and do not contemplate how they are brought about, that is, by making the other individual worse off.[22] The prisoners are, most game theorists presume, unable to maximize as a team and thereby mutually achieve one year of jail time each instead of eight years.[23] Finally, neither has any motive to contribute to the greater good or to seek to benefit the other.[24] These assumptions ignore whether empirical actors actually view their behavior as bound by these rules and whether actors' subjective assessment of the significance of their decision environment reflects other features of the choice environment, such as the quality of actors' intentions or means by which the outcome is achieved. Thus, game theoretic analysis cannot encompass non-consequentialist motives derived from commitment, principle, or deontic constraint.[25] Neither does the standard PD treatment permit the

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[21] Defining the pure PD game requires stating for certain that both actors would prefer a repeating situation of mutual cooperation rather than a repeating alternation between being the unilateral winner and the sucker; for discussion, see section 6, "Cardinal Payoffs," Kuhn, "Prisoner's Dilemma," 2014. This can be done by adding up each individual's rewards separately, without comparing their intensity across individuals, yet this lends itself to each player having an observable metric of value correlating to each choice (hence a mathematically precise payoff), which reinforces the tendency to permit a concrete measure of success, such as cash value, to stand in for subjective value (again permitting an affine transformation).

[22] This assumption is breathtaking for shifting the significance of the intelligibility of meaning from shared understanding developed by interaction to the view that "each player is to behave independently, without any collaboration or communication, with other players"; see Nicola Giocoli, "Nash Equilibrium," *History of Political Economy* (2004) 36:4, 639–666, at 645.

[23] Hausman and McPherson, *Economic Analysis*, 2006, underscores this point at 250.

[24] Ken Binmore argues that if actors were concerned about others' payoffs, then this information could be directly added into the decision maker's expected utility function; *Natural Justice*, 2006, 63–64; however, in fact, estimating how much additional welfare an individual gets from enhancing another actor's expected utility is not straightforward and deviates from the fundamental assumption that payoffs track salient features of outcomes; see Hausman and McPherson, *Economic Analysis*, 2006, 250.

[25] Hausman and McPherson, *Economic Analysis*, 2006, 210–11; see also Joseph Heath, *Following the Rules* (New York: Oxford University Press, 2011), 35–41 (although Heath seeks to extend formal modeling to incorporate deontic constraints).

consideration of non-fungible value, joint maximization, or gratuitous altru-
ism. If agents reject any one of these assumptions, the inexorable logic of the
Prisoner's Dilemma game is dispelled.

It may seem that if only the two prisoners were able to talk and reach an
agreement, they would both remain silent.[26] This, however, is a logical impos-
sibility in the game because all players' preference for less jail time over more jail
time is assumed to reflect the only pertinent information they uses to weigh their
choices.[27] Therefore, even after agreeing to cooperate when back in their cells,
both reach the same conclusion as before: confessing is superior, no matter what
the other does. Even though the name of the game suggests some sort of angst in
decision making, both agents are resolute in their dominant strategy of defecting
independent of any consideration of what the other might do. Neither actor
faces any moral or prudential quandary of choice.[28] The jointly suboptimal
outcome results when the players follow the rules of conduct standardized
throughout most operationalized game theory.[29] Even if the PD were derived
from an assurance dilemma (discussed in depth in Chapter 3, "Assurance") in
which as the "Assurance Seeker" vignette depicted at the beginning of the
chapter shows, each actor really prefers to cooperate but defects like an actor
with PD preferences, standard game theory does not disambiguate this crucial
possibility because it fails to emphasize the bright-line test that assurance
seekers always cooperate once guaranteed the other's cooperation. Instead,
orthodox game theory holds that when confronted by a Prisoner's Dilemma
specified by salient fungible payoffs, it is rational for every actor to defect,
regardless of whether or not the other agent defects or cooperates.

THE PRISONER'S DILEMMA GAME: A MORE
FORMAL PRESENTATION

As related earlier, the standard introduction of the Prisoner's Dilemma presents
its characteristic payoff matrix and assumes that every actor solely acts indivi-
dualistically to maximize his or her instrumentally salient rewards, therefore
making defection the only rational choice. One of the difficulties in discussing
game theory generally, and the Prisoner's Dilemma specifically, is that the PD can
be introduced as though it were as simple as tic-tac-toe. This section introduces
the concept of expected utility theory that was first articulated by von Neumann
and Morgenstern in a technical appendix to *Theory of Games and Economic
Behavior*.[30] This formal treatment of actors' anticipated satisfaction limits what

[26] See discussion in Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 174.
[27] This is a primary feature of noncooperative game theory; for discussion, see Rapoport and
Chammah, *Prisoner's Dilemma*, 1970, 25.
[28] Binmore, *Natural Justice*, 2006, 64.
[29] Heath, *Following the Rules*, 2011, 39.
[30] John von Neumann and Oskar Morgenstern, *Theory of Games and Economic Behavior*
(Princeton, NJ: Princeton University Press, 1944), Section 3, "Theory of Games and Economic

can count in their subjective evaluations of worth and is necessary to solve many games. Actors' preferences over outcomes are referred to as expected utility functions that must obey restricted formal rules. In addition, actors must follow a decision rule, which typically prescribes a form of individualistic maximization. Maximizing average expected utility, maximizing the greatest possibility of gain, or maximizing the worst-possible outcome (referred to as "maximin") are all possible decision rules in noncooperative game theory.[31]

Game theory is densely mathematical and impeccable as an abstract analytic system. Creating formal models that meet the rarified axioms governing game theory and yet can be applied to social circumstances requires the introduction of simplifying assumptions.[32] These simplifying suppositions, discussed ahead, are introduced to ensure that the social world can be subject to rigorous mathematical analysis. Game theorists strive to identify a solution concept or a determinate outcome of a game that is referred to as an equilibrium. Von Neumann developed the "minimax" equilibrium concept, which is unique in every zero-sum game, in which each player maximizes his best worst-possible outcome and simultaneously minimizes his opponent's best-possible outcome, irrespective of the opponent's choice. John Forbes Nash Jr.'s alternative equilibrium concept of mutual-best-reply, which also applies more generally to non-zero-sum games, identifies a set of players' strategies that are mutually reinforcing because no single actor could improve his outcome by having selected a different strategy.[33] Many non-zero-sum games have no single determinate solution, regardless of how the equilibrium concept is defined. However, in the Prisoner's Dilemma game, both von Neumann's and Nash's equilibria are definitive and identical: both actors select to defect.

When theorists apply the Prisoner's Dilemma game to diverse situations throughout civil society, political economy, and international relations, they must simplify the world of social interaction to fit within game theory. This necessarily compromises the existential richness of individuals' experience.[34] Mathematical tractability, or the demands of applying the theory, entails making specific assumptions about payoffs, or value.[35] Von Neumann established

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Behavior"; for discussion, see Nicola Giocoli, "Do Prudent Agents Play Lotteries: Von Neumann's Contributions to the Theory of Rational Behavior," *Journal for the History of Economic Thought* (March 2006) 28:1, 95–102, 101–102.

[31] Nicola Giocoli presents the clearest distinction between rules governing the rationality (or consistency) of preferences in expected utility theory and rules governing the rationality of action choice. See "Do Prudent Agents Play Lotteries."

[32] Luce and Raiffa, *Games and Decisions*, 1958, acknowledge this point directly, 26.

[33] On the Nash Equilibrium, see Giocoli, "Nash Equilibrium," 2004.

[34] Luce and Raiffa openly acknowledge this point: "Although not 'all life is a game,' at least not in our sense, we cannot fail to recognize that people are constantly jockeying to better their lot in a manner which is quite analogous to playing in an extremely complicated many-person game," *Game and Decisions*, 1958, 105.

[35] Rapoport acknowledges this point, and the prescription nature of game theory, in *Fights, Games, and Debates*, 1970, 164, 182.

the precedent, still the default, of directly associating the tangible payoffs that are convenient for observation and measurement with agents' subjective utility rankings.[36] This radical move promotes the belief that the Prisoner's Dilemma is not just a logical construction but also a phenomenon that inheres in the world anytime fungible rewards can be construed as reflecting its payoff matrix. Even though, rational choice theory states that everything an individual values can be reflected in individuals' preference rankings (expected utility functions), the means of tracking value in applied game theory categorically restricts to varying degrees the considerations strategic rational actors can incorporate into judgment.[37] Hence, this seemingly encompassing treatment of value actually operates as an imperative to limit what features of the decision environment can count in rational actors' decisions. Therefore, those operationalizing strategic rationality in concrete circumstances may not even see how this practice legitimizes conduct that only maximizes fungible rewards on an individualistic basis and negates normative, shared, or other-regarding conduct.[38] Hence, game theory favors consequentialism and excludes the logic of appropriateness, usually assumes an interpersonally transferable source of value, emphasizes individualistic maximization, and dismisses charitable actions without some tangible benefit to the benefactor.

Game theory relies on specific guidelines for tracking value. It is possible to stipulate a rudimentary game simply by using numbers to indicate actors' preferences over outcomes.[39] Table 2 depicts the iconic Cold War arms race, with higher numbers reflecting more preferable states.[40] This game theoretic payoff matrix has the characteristic Prisoner's Dilemma form. Note that the preferences may seem to pertain only to features of the world impacting that agent. This is not the case because even though individuals' payoffs are the primary basis for individual choice, outcomes are causally interdependent. The US is not indifferent between two states of being armed. The US most prefers

[36] Giocoli directly addresses this important point in "Do Prudent Agents Play Lotteries," 2006, 102–103.

[37] This point is crucial, although subtle: in parametric decision theory, incorporating subjective sentiment about processes by which ends are achieved into expected utility functions may be possible; however, this is impossible in game theory because (1) actors only appraise outcomes independently of how they arise and (2) this appraisal focuses on salient instrumentally relevant features of the decision environment, i.e., outcomes could equally well arise by the roll of a die or by deliberate choice. Myerson makes the imperative claim that expected utility functions incorporate all considerations of value in expected utility functions with the implication of ruling out of consideration experiential elements not subject to this type of appraisal; Roger B. Myerson, *Game Theory: Analysis of Conflict* (Cambridge, MA: Harvard University Press, 1991), 7–8; see also Donald C. Hubin, "The Groundless Normativity of Instrumental Rationality," *Journal of Philosophy* (2001) 98:9, 445–468.

[38] For a lengthy discussion see Martin Hollis, *Trust within Reason* (Cambridge: Cambridge University Press, 1998); one current trend is to identify dispositions that are not motives associated with utility maximization; for discussion, see Hausman and McPherson, *Economic Analysis*, 2006, 210.

[39] For discussion of ordinal preference rankings, without numeric intensities of desire, see Steven Kuhn "Symmetric 2x2 PDs with Ordinal Payoffs," entry on "Prisoner's Dilemma," 2014.

[40] Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 37.

TABLE 2. *Iconic Cold War Arms Race Prisoner's Dilemma Game*

		USSR	
		Disarm	**Arm**
US	<u>Disarm</u>	2,2	0,3
	<u>Arm</u>	3,0	1,1

US is the row player; USSR is the column player.
Payoffs reflect the desirability of the outcome for each player;
  higher numbers are more desirable.
The first number in each pair reflects the U.S. (row) payoffs; the
  second number in each pair reflect the USSR (column) payoffs.

TABLE 3. *Cold War Arms Race Modeled as Stag Hunt*

		USSR	
		Disarm	**Arm**
US	<u>Disarm</u>	3,3	0,2
	<u>Arm</u>	2,0	1,1

Payoff matrix conventions are the same as in Table 3.

itself to be armed and the USSR to be disarmed. In the Prisoner's Dilemma game, each actor can only realize his most preferred state by debilitating the other. If, in the Cold War, every actor had preferred mutual disarmament over unilateral armament, then the game would have been an Assurance Game, or Stag Hunt, instead (Table 3).This payoff matrix with numeric utilities reflects that both actors most prefer mutual disarmament, both have the second choice of unilaterally arming, both have the third choice of mutually arming, and each least prefers being the only nation to disarm.

To be sufficiently useful to solve most games, the numbers specifying the payoff matrices must permit the evaluation of what ratio mix of most and least preferred outcome is equivalent to a midrange outcome.[41] For example, in the perfectly defined PD game, players must know that always cooperating yields a superior outcome to alternating between unilateral victory and unilateral ignominy *as though they were engaging in* indefinitely repeated play.[42] Thus, the formal definition of PD relies on expected utility and its treatment of value.

[41] Rapoport, *Fights, Games, and Debates*, 1970, 180–194; Luce and Raiffa, *Games and Decisions*, 1958, 106–109.

[42] Kuhn, "Prisoner's Dilemma," has a clear discussion; a pure PD, defined in terms that agents prefer always cooperating more than alternating between unilateral defection and unilateral cooperation, is specified by the formula that CC ≥ ½ (DC + CD); on the difficulty of interpreting this requirement, see Rapoport, *Fights, Games, and Debates*, 1970, 162.

Furthermore, as will be increasingly evident ahead, the payoff matrix numbers in much applied game theory directly correlate to a measurable and observable salient feature of the decision environment and take into consideration the fully specified causal state of the outcome that simultaneously specifies the other actor's outcome.[43] Every player's outcome is physically inseparable from what the other achieves. In other words, game theory payoff matrices reflect causally interdependent states.[44] This discussion makes more sense when one understands, first, how game theory originated as an analysis of zero-sum competitions and, second, how most games of relevance to international relations, political economy, governance, and evolutionary biology rely on mathematically formalized expected utility theory that incorporates the assumption of interpersonal transferability of utility.[45] In a zero-sum game, two contestants wrestle over a fixed amount of a good (or property), so that what one individual obtains inversely correlates to what the other gets. As one player maximizes her expected gain, this player simultaneously minimizes her opponent's expected gain with mathematical precision. Operationalizing strategic rationality makes it difficult for an individual to prefer most an outcome in which both players share a fixed-sum good equally, because then these preferences over outcomes do not elegantly map onto the observable and measurable resource that characterizes the game's outcomes.[46]

Von Neumann and Morgenstern's *Theory of Games and Economic Decisions* focuses on two-person, zero-sum games in which the players wrangle over a finite and fixed amount of a utility-affording property. Von Neumann added the appendix on expected utility theory at the prompting of Morgenstern, who wanted to make their theory friendlier for economists.[47] Economists in the 1950s and 1960s were more interested in the treatment of expected utilities, which provided continuity with Daniel Bernoulli's invention of the concept to solve the St. Petersburg gambling paradox in the eighteenth century.[48] The concept of "expected utility," as opposed to straightforward "utility," provided

[43] Myerson, *Game Theory*, 1991, 22–26.

[44] Von Neumann and Morgenstern were acutely aware that their theory provided a mathematical formalism for complex interactions. See the introduction to *Theory of Games and Economic Decisions*, 1944.

[45] Myerson, *Game* Theory, 1991, 3. Von Neumann and Morgenstern introduced their expected utility theory as an appendix to *Theory of Games and Decisions*, and it relies on an objective understanding of probability. L. J. Savage subsequently introduced an alternative theory that relies on a Bayesian, or learned, account of probability. On Savage's subjective utility theory, see Nicola Giocoli, "Savage vs. Wald: Was Bayesian Decision Theory the Only Available Alternative for Postwar Economics?" June 2004, available at SSRN: http://ssrn.com/abstract=910916 or http://dx.doi.org/10.2139/ssrn.910916.

[46] Some researchers have worked to incorporate attitudes toward fairness, but this development is a distinct subfield of inquiry that is not integrated in most game theoretic presentations of or experiments with the Prisoner's Dilemma game; see, e.g., Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 162–163; Binmore, *Natural Justice*, 2005, 66–67.

[47] Giocoli, "Do Prudent Agents Play Lotteries," 2006, 102.

[48] For a brief discussion, see Luce and Raiffa, *Games and Decisions*, 1957, 19–21.

the latitude to acknowledge that individuals have differing attitudes toward probabilistic outcomes.[49] One individual may readily purchase a \$10 lottery ticket for a 1/11 chance to win \$100; yet another individual may prefer to keep \$10 for sure to a 1/9 chance to win \$100. Expected utility theory allows the incorporation of individuals' attitudes toward risk into their assessment of outcomes.[50]

Expected utility theory also permits simplifying the act of choice in situations with uncertainty (unknown odds) and risk (known odds), which is crucial because of the ubiquity of probability throughout life and in games.[51] As an example, consider a choice between walking or driving and two possible states of the world, rain or dry weather.[52] A ranking of outcomes could be strictly ordinal, without incorporating intensity of preferences. Thus, the agent could have the following preference ordering from most to least preferred: walking while dry, driving while raining, driving while dry, and walking while raining.

In most games of interest to political economists, a mere ordinal ranking of preferences is insufficient.[53] Instead, actors must know the intensity of their preferences. This example stipulates that the actor has a ranking of 10 utils for walking while dry, 6 utils for driving while wet, 1 util for driving while dry, and 0 utils for walking while wet. Although these utils are not comparable across individuals, they do express information about the intensity with which the agent in question prefers the four possible outcomes. The concept of expected utility, over and above strict utility, arises in considering both the preference for the state of the world and the probability of that state occurring. Let us assume a 50% chance of rain and a 50% chance of dry weather.[54]

[49] See Heath's discussion for a complementary treatment, *Following the Rules*, 2011, 15–23.

[50] Myerson, *Game Theory*, 1991, 12–20.

[51] Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 13. Note that expected utility theory neither uses the ordinal concept of utility from neoclassical economics nor the one assuming interpersonal comparisons of utility from Jeremy Bentham's utilitarianism. See also Nicola Giocoli, "The True Hypothesis of Daniel Bernoulli: What Did the Marginalists Really Know," *History of Economic Ideas*, 1998 (2), 7–43.

[52] This example comes from Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 11–12.

[53] Some simple games can be considered with ordinal rankings on the basis of John Nash's equilibrium concept of "mutual-best-reply." However, to technically define the Prisoner's Dilemma, to guarantee a solution, and to apply it to multiplayer and repeating games, one needs cardinal utilities, see Luce and Raiffa, *Games and Decisions*, 1957, 106–109; Kuhn "Multiple Players and Tragedy of the Commons," in "Prisoner's Dilemma," 2014.

[54] Objective probabilities, used by von Neumann and Morgenstern, *Theory of Games and Decisions* (1944) need not necessarily be assumed in game theory, but the mathematics is easier on this assumption. See, e.g., Luce and Raiffa, *Games and Decisions*, 1957, 24. An alternative is subjective expected utility theory in which actors' knowledge of the frequencies with which outcomes occur is derived from individual experience and must be updated in a feedback, learning experience. For discussion, see Giocoli, "Do Prudent Agents Play Lotteries," 2006, 105–107; L. J. Savage, *The Foundations of Statistics* (New York: John Wiley, 1954). See also Nicola Giocoli, "From Wald to Savage: *Homo Economicus* Becomes Bayesian Statistician," *Journal of the History of Behavioral Sciences* (2012) 49, 1–33.

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individual behavior as the source of collective outcomes. Although team reasoning does not violate methodological individualism, some game theorists worry that this alternative approach to rationality proposes that individual actors may comprise a corporate agent without clearly specifying who gets what after the team obtains its objective: how are the spoils divided? While classical liberals permit division via normative agreement, game theorists typically propose that even after initial cooperation is complete, noncooperative competition must characterize actors' subsequent pursuit of individual gain.

Summarizing, for most rational choice games, actors' expected utility functions are three times removed from reflecting every consideration that could be of value to them. First, the expected utility functions only reflect *outcomes* and not the processes by which they are obtained. Second, the expected utility functions directly correlate to the *observable and measurable reward* characterizing the payoffs. Third, this reward is often held to be *transferable* across agents; the default is precisely countable cash value.[60] In addition to maximizing some inherently scarce and objective feature of the world, strategic rationality typically recommends individualistic maximization.[61] Thus, standard game theory adopts an approach consistent with consequentialism, realism, and narrow individualism.

Learning game theory promotes a mindset that translates these fundamental tenets into guidelines for making rational choices, either in parametric environments involving risk (known odds) and uncertainty (unknown odds) or in strategic environments with other rational agents. In his advanced introduction of expected utility theory and game theory, Roger B. Myerson observes,

A *prize* in our sense could be any commodity bundle or resource allocation. We are assuming that prizes in X [a set of possible prizes that the decision could potentially achieve] have been defined so that they are mutually exclusive and exhaust the possible consequences of the decision-makers decisions. Furthermore, *we assume that each prize*

Beyond Individual Choice, 2006, which reveals how this hypothesis of shared intention and group action is a subaltern position in game theory.

[60] For the concept of interpersonally transferable utility, see von Neumann and Morgenstern, *Theory of Games and Economic Decisions*, 1953, Appendix II, 603–632. This concept should not be confused with the prohibited concept of interpersonally comparable utility. The claim is that the substance or property yielding expected utility is transferable, not that the respective agents' experiences or satisfactions thereof can be compared. For example, all agents seek money;' however, they are not assumed to each experience the reward of allotments of money in the same way. For the ready acceptance of transferable utility, usually introduced by relying on cash rewards to represent payoffs, see Ken Binmore, *Game Theory: A Very Brief Introduction* (New York: Oxford University Press), 2007.

[61] Von Neumann's original two-person zero-sum game theory was individualistic, although the decision rule he supplied was the minimax rule of securing the best-possible worst outcome by minimizing the opposition's potential gain, which leads to a stable equilibrium if both actors select this strategy. For discussion, see Nicola Giocoli, "Do Prudent Agents Play Lotteries," 2006. Giocoli argues that in game theory, actors are "hyper-individualistic" and "hyper-rational" because they act independently to achieve their goals without any reliance on others' choices, other than as a means to secure their own ends, "Nash Equilibrium," 2004.

in X represents a complete specification of all aspects the decision-maker cares about in the situation resulting from his decisions. Thus, the decision-maker should be able to assess a preference ordering over the set of lotteries, given any information that he might have about the state of the world.[62]

This statement that all considerations impinging on choice are contained in actors' expected utility functions over prizes requires that preference rankings incorporate all considerations relevant to their choices. Therefore the mathematical characteristics of these functions purchase comprehensive hold over individuals' judgment at the price of excluding important features of the world from possible evaluation. Not only does the model itself become indistinguishable from the reality it models, but this superposition of the model over the lived world gives rise to the uniquely neoliberal subject who internalizes the limiting guidelines of what can count in a rational judgment.

The conceptual mapping required to operationalize the Prisoner's Dilemma game eclipses the classical liberal worldview because it categorically ignores the means by which outcomes are realized. The expected utility functions used throughout game theory assume "that agents only invest outcomes with motivational significance."[63] Canonical rational actors are thus unable to act on principle, with commitment to agreements or promises made, or on the basis of fair play or side constraints.[64] Although these alternative rationales for action entail different causal outcomes than those sustained by strategic rationality, they become void of motivational content because they do not directly contribute to the measurable gain of decision makers. This encompassing attention on outcomes to the exclusion of processes undermines classical liberalism's dependence on procedural justice and individual's self-incurred responsibility to avoid harming others.[65]

An additional consequence of the exclusive association of utility with outcomes is that communication becomes a signaling game in which "the meaningfulness of the speech act [is] dependent upon the payoff structure of the game."[66] Actors' interests and values exist prior to social interaction.[67] Actors can only use language effectively – that is, avoid deception – when their interests are favorably and extensively aligned.[68] Thus, the game theoretic understanding

[62] Myerson, *Game Theory*, 1991, 7–8.
[63] Joseph Heath effectively discusses this topic in *Communicative Action and Rational Choice* (Cambridge, MA: MIT Press, 2001), 137; see 137–139; Heath seeks to extend orthodox game theory so that deontic constraints could be reflected in models, Heath, *Following the Rules*, 2011, 6.
[64] Heath, *Communicative Action*, 2001, 86–92.
[65] Amartya Sen, *Rationality and Freedom* (Cambridge, MA: Belknap Press, 2004), 175–181, 232–239.
[66] Heath, *Communicative Action*, 2001, 70.
[67] Hargreaves Heap and Varoufakis, *Game* Theory, 2004, 209.
[68] For discussion of David Lewis's analysis of communication based on the Prisoner's Dilemma model, see S. M. Amadae, "Normativity and Instrumentalism in David Lewis' *Convention*," *History of European Ideas* (2011) 37, 325–335; see also David Lewis, *Convention: A Philosophical Study* (Cambridge, MA: Harvard University Press, 1969).

of linguistic exchange views communication as action derived from payoff structures that permit persistent equilibria to emerge.[69] Game theory entails an instrumentalist view of language that insists both that the meaning and value of acts precede intersubjectively shared intelligibility and that communication itself is a strategic game.[70]

The formalized concepts of expected utility and individualistic maximization structure the possible horizons of meaning available to the neoliberal citizen and consumer. The canonical strategic actor must obey these guidelines of rational choice or become the experimental subject for behavioral economists who aim to systematically catalogue people's observed deviations from pure rationality. The two options available are to abide by the Platonic ideal of rational choice or to succumb to irrational behaviors that behavioral scientists can correct through choice architecture.[71] This latter approach denies the central tenet of classical liberalism, which holds that actors voluntarily participate in institutions and rule-governed practices that they tacitly or expressly agree have procedural validity.[72] Thus, the bourgeois classical liberal world of Adam Smith is displaced by a new interpretation of the meaning of action and individuals' relationships to other actors.

In this next discussion, I examine how a leading classic textbook imparts Prisoner's Dilemma pedagogy and show how learning the inherent impossibility of resolving the dilemma relies on explicitly accepting the characteristic assumptions underlying strategic rationality. These assumptions require restricting value to the horizons of game theoretic expected utility theory and accepting individualistic maximization in competition with others. This limiting perspective makes many social interactions appear to have the Prisoner's Dilemma structure. Once actors either internalize the guidelines for choice consistent with functional strategic rationality or are exposed to institutions designed in accordance with this logic, they experience numerous types of interactions as Prisoner's Dilemmas.

[69] Heath, *Communicative Action* 2001, 59–72.
[70] The opposite view is held by Donald Davidson, "The Folly of Trying to Define Truth," *Journal of Philosophy* (1996) 93, 263–278, and Jürgen Habermas, *The Theory of Communicative Action*, vols. 1 and 2, trans. by Thomas McCarthy (Cambridge, MA: MIT Press, 1984 and 1987, respectively); for discussion, see Heath, *Communicative Action*, 2001, 16–25.
[71] Richard Thaler and Cass Sunstein, *Nudge: Improving Decisions about Health, Wealth, and Happiness* (London: Penguin, 2009). Economist and Nobel Laureate Herbert Simon has put forward a middle ground, *Models of Bounded Rationality: Economic Analysis and Public Policy* (Cambridge, MA: MIT Press, 1984); for discussion, see Hunter Crowther-Heyck, *Herbert A. Simon: The Bounds of Reason in Modern America* (Baltimore: Johns Hopkins University Press, 2005).
[72] For discussion, see, e.g., John Rawls, "Justice as Fairness: Political Not Metaphysical," *Philosophy and Public Affairs* (1985) 14:3, 223–251.

TABLE 4. *Prisoner's Dilemma Game "G"*

		B_1	B_2
G:	A_1	(0.9, 0.9)	(0, 1)
	A_2	(1, 0)	(0.1, 0.1)

In Game "G," A is the row player with the choice of action
  A_1 (cooperate) and A_2 (defect).
B is column player with the choice of action B_1 (cooperate)
  and B_2 (defect).
Payoffs are the pair of numbers, highest is best, first number
  accrues to agent A; second number accrues to agent B.

STANDARD PRISONER'S DILEMMA PEDAGOGY

Howard Raiffa and Duncan Luce articulate Prisoner's Dilemma pedagogy in their immediately influential and authoritative *Games and Decisions* (1957). The matrix reward structure of the game they discuss is the one presented at the beginning of this chapter. The payoff matrix, in terms of jail time, considers only outcomes, and not any of the circumstances by which they may come about or how the prisoners subjectively evaluate the different outcomes. Right away, only the tangible rewards register in individuals' preferences over outcomes and their judgments over the right course of action.

In their presentation, Luce and Raiffa next introduce the more familiar game payoff matrix that directly uses numbers to reflect the rewards structuring a game as specified by expected utility theory. In this case, numbers without any units reflect each individual's subjective evaluation of the game's outcomes. Again, the fact that these expected utility functions are over end states and even lotteries of end states must be kept in mind.[73]

In Table 4's Prisoner's Dilemma game "G," agent A and agent B can each choose between strategy 1 and strategy 2. The outcomes are jointly determined and deliver the quantity of numeric utility in the payoff matrix to each player in the form: (Expected Utility$_A$, Expected Utility$_B$). This payoff matrix has the characteristic Prisoner's Dilemma form: every actor hopes to unilaterally opt for the first choice ("defect"), thereby leaving the other agent who cooperates with the least preferred outcome. Every agent prefers mutual cooperation to mutual defection. Every actor least prefers to be the sole cooperator, or "sucker."

At this point in learning to play the Prisoner's Dilemma game, readers have been supplied with a narrative about two conspirators who are given choices of action by a district attorney. This prosecutor apparently hopes that each will indict the other, either because each actually prefers unilateral success or because they are actually in a situation called an "Assurance Game," or "Stag Hunt," in which neither is confident in how the other will choose to act,

[73] Luce and Raiffa, *Games and Decisions*, 1957, 95.

TABLE 5. *Prisoner's Dilemma Game "H"*

		B₁	B₂
H:	A₁	(5,5)	(−4,6)
	A₂	(6,−4)	(−3,−3)

*Game "H" has the same payoff matrix conventions as
  Game "G" in* Table 4.

although both prefer joint cooperation over their unilateral defection.[74]
Although this latter possibility is crucial to Thomas Schelling's application of
the PD game to nuclear security, Luce and Raiffa's introductory PD pedagogy is
consistent with orthodox game theory in disregarding the possibility that
actors' subjective rankings deviate from material rewards.[75] Thus, even though
theorists sometimes stipulate that assurance-seeking actors find themselves in a
Prisoner's Dilemma because of risk, still they do not offer a means to disambig-
uate a situation in which actors really prefer to cooperate, despite the salience of
tangible rewards, from the characteristic PD in which every actor has the first
choice of suckering others. This becomes increasingly apparent as their expla-
nation progresses.

It is standard throughout most game theory to provide numbers that reflect a
concrete source of value and simultaneously represent mathematically precise
and well-ordered expected utilities. Luce and Raiffa illustrate this useful way of
representing the Prisoner's Dilemma game as shown in Table 5.[76] The authors
succinctly state in their explication of the Prisoner's Dilemma that the game
referred to as "H" results in the aforementioned game "G." They provide the
following description of game H's payoff matrix:

This will be given the interpretation that an entry (−4, 6) means player 1 loses \$4 and
player 2 receives \$6, and we shall suppose that each player wishes to maximize his
monetary return. Note that if we take the utility of money to be linear with money and set
the utility of \$6 to be 1 and of −\$4 to be 0, then the game G results from H.[77]

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[74] The Assurance Dilemma matrix is derived from an Assurance Game with rewards stipulated
numerically to reflect each individual's assessment of the likelihood that the other actor may
harbor Prisoner's Dilemma instead of Assurance Game preferences (preferring unilateral defection
to joint cooperation). The values in this payoff matrix are multiplied by the likelihood with which
each player evaluates that the other will play either "cooperate" or "defect." Thomas Schelling
introduces his matrix in *Strategy of Conflict* (Cambridge, MA: Harvard University Press, 1960) to
make an argument for mutual assured destruction, which is discussed in Chapter 3.

[75] Giocoli makes clear that this direct correlation between subjective preferences and tangible
rewards was a move made by von Neumann to make it possible to establish and objective
science of choice, "Do Prudent Agents Play Lotteries," 2006, 102–105.

[76] Luce and Raiffa, *Games and Decisions*, 1957, 95.

[77] Ibid.

Monetary value and expected utility are interchangeable here as game theory often requires for analyzing various social interactions.[78] Remarkably, this remains the game theoretic protocol used to analyze numerous social interactions. Sometimes, a tangible resource such as water, time, food calories, fitness value, or energy can substitute for money.[79]

Luce and Raiffa are well aware of the restricted elements of judgment permitted to enter into the strategic rational actor's logic for action. Only outcomes matter, particularly those observable and measurable features of the decision problem of direct relevance to each agent, and agents maximize individually. Moreover, in the most mathematically useful game in applied modeling throughout game theory, the measurable reward is directly correlated to expected utility. Luce and Raiffa introduce the necessary limitations on the value judgments defining the Prisoner's Dilemma game: only outcomes specified in cash value enter into actors' judgment and they maximize individualistically without regard for how their acts impact others. However, future authors introduce the game without carefully delineating these crucial assumptions.

Writing one of the first textbooks on game theory, Luce and Raiffa know that these limitations on judgment may strike some readers as far-fetched. What now strikes many as familiar, even necessary, seemed patently abusive in the 1950s.[80] The authors observe,

We are assuming explicitly in the following discussion that ... [the players' utility stated in terms of cash value] does reflect their preferences. If this seems too gross an abuse of the utility notion, consider players who are *only* interested in the maximization of their *own* expected monetary return, and let the numbers in the payoff matrix represent money returns.[81]

Luce and Raiffa articulate in exacting terms both the restrictions on rational judgment for the standard game theoretic strategically rational actor and the manner in which a mathematical model of rationality can only readily be applied to many contexts of interest when these simplifying assumptions are introduced. In other words, the abstract mathematicized *Homo strategicus* is only relevant to the actual study of society in cases where agents are presumed to only value personally relevant outcomes, which represent instrumentally prominent concrete rewards such as cash. Yet the standard treatment remains like

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[78] This is apparent in Binmore's *Game Theory*, 2007; for Giocoli's discussion of von Neumman on this point, see "Do Prudent Agents Play Lotteries," 2006, 102.

[79] For example, see Thomas Schelling, "Hockey Helmets, Concealed Weapons, and Daylight Saving: A Study of Binary Choices with Externalities," *Journal of Conflict Resolution* (1973) 17:3, 381–428. Cristina Bicchieri, "Covenants without Swords: Group Identity, Norms, and Communication in Social Dilemmas," *Rationality and Society* (May 2002) 14:2, 192–228; and Binmore, *Natural Justice*, 2005, 65.

[80] See the *Economist*'s claim that all decisions can be monetized, "Economic Focus: Never the Twain Shall Meet," *Economist*, February 2, 2002.

[81] Luce and Raiffa, *Games and Decisions*, 1958, 98.

TABLE 6. *High-Stakes Prisoner's Dilemma Game*

		YOU	
		The other prisoner does *not* confess	**The other prisoner *does* confess**
ME	You *don't* confess	freedom + $1,000	slow death by torture
	You *do* confess	freedom + $10,000	quick but painful death

"Me" is the row player, and "You" is the column player; payoff matrix only reflects the outcome for "Me," depending on what "You" chooses to do.

Luce and Raiffa's, and these models are used to design policies and institutions for neoliberal citizens and consumers.

In the landmark book *Paradoxes of Rationality and Cooperation*, Richmond Campbell introduces the concept of a "High-Stakes Prisoner's Dilemma" to capture the inexorable logic of the game that he believes "could arise in many other circumstances."[82] In this perilous game, the author asks us to "suppose that the first two possibilities are freedom plus $10,000 and freedom plus $1,000 while the second two are quick, but painful, death and slow death by torture" (Table 6).[83] In this game, Campbell stipulates a tangible reward system and automatically assumes that it matches up with the actors' subjective appraisal of expected utility. However, confronted with these outcomes, readers may find it obvious that, to the contrary, one should rank them in a different order: (1) neither confesses and both receive freedom plus $1,000; (2) only I confess; (3) both confess, gaining quick but painful death; and (4) only you confess. And yet throughout orthodox game theory, the mutually observable physical rewards are assumed, without a second glance, to directly reflect actors' expected utilities. The result is that actors are presumed to be in a state of Prisoner's Dilemma, whereas, in fact, they may interpret their situation to have more in common with an Assurance Game.

One's possible intuition that mutual cooperation actually results in the superior outcome for both players makes it possible to believe that the logical impasse resulting in mutual and painful death is due to each actor's doubt that the other can be depended on to remain silent. It is easy to suppose that the significance of the Prisoner's *Dilemma* rests in the fact that each would obviously cooperate to achieve mutual freedom *if assured the other would similarly cooperate*, as would be the case in either an Assurance Game, in which both actors most prefer to cooperate, or an Assurance Dilemma, in

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[82] Richmond Campbell, "Background for the Uninitiated," introduction to Campbell and Snowden, eds., *Paradoxes of Rationality and Cooperation*, 1986, 3–41, at 6.

[83] Game taken from Campbell, "Background for the Uninitiated," in Campbell and Snowden, eds., *Paradoxes of Rationality*, 3–41, at 6.

which one actor is unsure whether the other's first choice is unilateral defection or mutual cooperation.[84] In this latter game form, although both most prefer the mutually cooperative outcome over unilateral defection, neither is sure of the other's preferences, and both are aware of this lack of confidence. But the Prisoner's Dilemma, played between two perfectly rational agents who cannot achieve a mutually agreeable and available outcome, plays out the way it does because, from the perspective of the rational actor who independently max-imizes personal expected utility consistent with the game's payoff matrix, the decision categorically and in principle has no relationship to risk or uncertainty. The canonical game theoretic Prisoner's Dilemma arises precisely because if either player were certain of the other's cooperation, her first choice would still be to confess, since this grants her freedom and financial gain by exporting the costs for her defection onto the other player. The bright-line test of whether agents' actual subjective preference rankings places them in a PD is whether they both would choose to defect when 100% guaranteed of the other's coop-eration. Campbell's High-Stakes Prisoner's Dilemma game underscores how most games simply assume that the tangible payoff structure characterizing the game also determines individuals' preference rankings.[85]

This bizarre High-Stakes PD reaffirms the Prisoner's Dilemma pedagogy outlined earlier: actors will frequently find themselves in situations with a tangible reward structure reflecting the PD game in which the only rational outcome is to defect.[86] I doubt that most practitioners of game theory would accept that game theory necessarily endorses the view that predatory gain is preferable to reciprocal respect for others' rights of bodily integrity and private property. However, the standard assumptions used to operationalize strategic rationality in many contexts do, indeed, routinely reinforce the strategy of profit-ing by displacing costs on others without any discussion of either moral account-ability for actions or subjects' possible preference for mutual cooperation over

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[84] For example, consider the Batman movie *Dark Knight*, produced by Christopher Nolan, 2008, in which one of the plot developments climaxes with the apparent setup of a Prisoner's Dilemma standoff with a High-Stakes material rewards payout. Two groups of hostages have been told that they can win their freedom by killing the members of the other group. However, the ultimate resolution shows that both sides actually held Assurance Game preferences.

[85] The accepted equivalence of Newcomb's Paradox and the PD demonstrates that the negative causal impact of the unilateral victory in a PD on the sucker is fully treated as an externality with no relevance to an individual's choice, see David Lewis, "Prisoners' Dilemma Is a Newcomb Problem," in Campbell and Snowden, eds., *Paradoxes of Rationality and Cooperation*, 1985, 251–255.

[86] Numerous authors conclude that PD's abound: Richard Tuck, *Free Riding* (Cambridge, MA: Harvard University Press, 2008), 22; Hargreaves Heap and Varoufakis, *Game* Theory, 2004, 175–178; Heath, *Following the Rules*, 2011, 39. Note, however, that in his investigation of games played in the Old Testament, game theorist Steven Brams only finds at most one to two PD games, *Biblical Games: Game Theory and the Hebrew Bible* (Cambridge, MA: MIT Press, 2002), index.

unilateral defection.[87] The claim that concerns of due process or other-regarding consideration can, in principle, register in actors' preference rankings may be true in parametric decision theory. However, in the expected utility theory required by game theory, only outcomes that register gain for agents count.[88] Therefore, the structures for action characteristic of classical liberalism – fair play, self-adopted rule following, commitment, perfect duty, and side constraints – are inconsistent with strategic rationality because they function independently of the material rewards that accrue to respective actors.[89] Concern for others can be assimilated into preference rankings over outcomes and also should be considered in the standard presentation of the Prisoner's Dilemma game. Yet, again, this admission would deviate from the standard game theoretic reliance on commonly sought after scarce and measurable rewards directly accruing to each actor to define expected utilities.[90]

Experts in game theory realize these caveats. Nevertheless, a prevailing PD pedagogy has emerged, which can be imparted by teachers with less perfect and thorough knowledge of game theory and absorbed by students who will not go on to become experts themselves. This readily transmitted indoctrination presents the dilemma without specifying the simplifying assumptions that learners must tacitly endorse to perpetuate the worry that strategic rationality is non-negotiable and mutually destructive, and that Prisoner's Dilemma situations abound.[91] A superior pedagogy would clearly outline the limitations of strategic rationality, explicitly acknowledging that expected utility functions can only exhaustively incorporate actors' subjective concerns by rendering some superfluous to rational choice. Additionally, astute teachers of the Prisoner's Dilemma should clearly highlight the standard shortcut of assuming that salient

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[87] The language "externality" for the cost displaced onto others for personal gain is developed within this context; for discussion see Tuck, *Free Riding*, 24–27; see also Schelling, "Hockey Helmets," 1973.

[88] On how "standard decision theory" assumes that "agents only invest outcomes with motivational significance," see Heath, *Communicative Action*, 2001, 137–139.

[89] Amartya Sen contrasts these procedural considerations from the concerns about outcomes reflected in expected utility functions; see Sen, *Rationality and Freedom*, 2004, 175–181, 232–239. See also Heath, *Communicative Action*, 2001, 86–92.

[90] Heath urges an expansion of orthodox game theory to encompass these considerations, *Following the Rules*, 2011. Binmore emphasizes that game theory can denote altruistic preferences and does not require cash value, yet both tend to use either cash or tangible value in their exposition of games, and Binmore notes that the instrumental consistency demands that rational actors must "necessarily behave as though maximizing the expected value of *something*," which grounds the payoff of games to a fungible existential property of existence, *Natural Justice*, 2005, 64–65.

[91] This is the conclusion drawn from the single-play PD, in addition to iterated PD games with a known termination point, or indefinite play scenarios in which an end point could be surmised; with respect to indefinitely played PDs with no discernable end point, many equilibria permit some degree of cooperation, with the two caveats that there is no single clear equilibrium for players to gravitate toward, and the only safe strategy in which every stage of the game has a self-contained rational strategy (coincident with mutual defection) is the only purely safe strategy; Luce and Raiffa, *Games and Decisions*, 1958, 72–102; repeated PDs are discussed in Chapter 11, along with the Tit for Tat strategy.

in determining agents' actual ranking of outcomes over and beyond the tangible payoff matrix. An effective teacher of the High-Stakes PD game, or any PD game for that matter, needs both to clarify the standard game theoretic default of permitting tangible rewards to directly reflect inherently reductionist expected utility rankings and to reaffirm that the bright-line test for whether actors actually perceive themselves to be in a Prisoner's Dilemma game instead of potentially an Assurance Game situation is if they choose to defect after the other person has already cooperated.

Campbell recognizes the apparent bizarreness of the high-stakes Prisoner's Dilemma. He writes, "If rational, you should both ... choose a quick but painful death rather than go scot-free with $1000 a piece in your pockets." Thus, he suggests that the PD game offers a logical imperative, an "ought," that actors confronted with tangible rewards characterizing the PD payoff matrix should defect. Campbell goes on to observe, "*At this point it may appear that the dilemma, however tantalizing as a logical puzzle, is too fantastic to have any practical relevance*."[93] He agrees that *any* rendering of the Prisoner's Dilemma is "odd enough" in itself.

Nevertheless, he presses on to convince readers of the relevance of the Prisoner's Dilemma by applying it to the superpower standoff: "Two superpowers sign a nuclear disarmament pact on the shared belief that failure to disarm will result sooner or later in a nuclear holocaust in which each side will be quickly and painfully destroyed, while mutual disarmament will avoid this dreaded outcome." Campbell acknowledges that this problem has the structure of a Prisoner's Dilemma game because "each would say that its having complete nuclear superiority is a better guarantee of peace on earth than mutual nuclear disarmament, and each would explain its breaking of the agreement as a purely defensive maneuver."[94] He presents the Prisoner's Dilemma payoff matrix from the perspective of the United States as shown in Table 7.[95]

Campbell explains that "each side regards this vulnerability as a fate worse than mutual destruction, while it regards a position of complete nuclear superiority as ideal." This example illustrates that in international relations, the classical liberal's intuitive preference for bilateral agreements and symmetric deterrence yields to a neoliberal's unapologetic predilection for unilateral success, asymmetric deterrence, and nuclear hegemony. For the neoliberal approach to relationships, security is not a positive-sum good predicated on all parties striving to make choices that avoid incurring harm on other actors. Rather, strategic rationality assumes that the decision makers must displace the costs for their security and prosperity on other actors when they act to maximize their gain of scarce fungible goods in competition with others.

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[93] Campbell, in Campbell and Snowden, eds., *Paradoxes of Rationality*, 1985, 6. Emphasis added.
[94] All the quotes in this paragraph and the previous one are from Campbell, "Background for the Uninitiated," in Campbell and Snowden, eds., *Paradoxes of Rationality and Cooperation*, 1985, 6–7.
[95] Game taken from ibid., 6.

TABLE 7. *Mutual Assured Destruction (MAD) Modeled as a Prisoner's Dilemma*

		USSR	
		The other *adheres* to the agreement	The other *violates* the agreement
US	You *adhere*	No mutual destruction	A fate worse than mutual destruction
	You *violate*	The ideal upshot	Mutual destruction

US is row player; USSR is column player; payoffs are strictly considered from the perspective of what outcome the US receives and which it most prefers

Finally, in Campbell's eyes, the nuclear security dilemma provides the rationalization for why the Prisoner's Dilemma game and, by extension, game theory are useful tools for understanding social relations. The Cold War relevance of the Prisoner's Dilemma, which results in counseling an offensive and aggressive stance justified by self-defense, makes this unconventional view that rationalizes predatory gain seem not only pedestrian but also mandatory. Whereas assuming the toughest case and concentrating on actors' estimation of material gain may have provided initial impetus to delineating game theory, as subsequent chapters demonstrate, the advent of nuclear weapons does not necessarily provide a compelling reason to rethink the security of individual agents vis-à-vis one another in markets or states. Every practitioner of game theory should be clear how the reliance on individual maximization and the introduction of risk, worst-case planning, and the demands for commensurable and interpersonally transferable value to simplify calculations ultimately mire agents in a prison of strategic reason.

THE PRISONER'S DILEMMA GAME, THE NASH BARGAINING SOLUTION, AND NONCOOPERATIVE GAME THEORY

The Prisoner's Dilemma narrative, in conjunction with its name, conjures up images of stressful decision making, especially because it represents a miscarriage of a classical liberal exchange in which both actors seek a consensual, mutually beneficial trade. This section explains how the means of tracking value in much operationalized game theory normalizes the view that in routine market transactions, each actor not only prefers to but would indeed choose to sucker others if able to do so without consequences. This is the inevitable result of depending on expected utility functions that can only assess fungible payoffs independently of the means by which they are realized. This section also discusses how neoliberal theory attempts to mimic classic liberal exchange by two means. First, game theorists encompass the cooperative act of exchange within noncooperative game theory and thereby stipulate that the outcome of a bargain must derive from actors' ability to threaten negative

table 8. *Neoliberal Car Sale: Exchange modeled as Prisoner's Dilemma*

	Other	
Self	*Send* the car	*Keep* the car
Send the car	Mutual exchange	Other gets cash & car
Keep the car	I get cash & car	Cash and car harmed in skirmish

In this payoff matrix, the presumption is that each actor most prefers to obtain both the cash and the car; second best, both prefer to exchange; third best, both prefer mutual defection from exchange; each actor least prefers to be suckered by having neither the cash nor the car.

repercussions.[96] Second, game theorists envision that the bargainers may perpetually encounter each other over and over with the exact same decision problem and thus have the wherewithal to punish the other actor for failing to cooperate by defecting in their next encounter.[97]

Consider the neoliberal car sale depicted in the payoff matrix in Table 8.[98] In this now widespread Prisoner's Dilemma model of exchange, both oneself and the other most prefer to get the car and the cash and leave the other with nothing. Whereas the liberal actor pursues amicable exchange, the neoliberal actor most prefers to cheat the other.[99] In the Prisoner's Dilemma application, every agent is presumed to seek sole gain for herself, thereby implicitly hoping to leave all other actors with their worst outcome, because only outcomes, distinguished by instrumentally salient permutations of the phenomena, register in expected utility functions according to this model of exchange and bargaining.[100] Therefore, the *only* motive for carrying through on the terms of a contractual agreement is the threat of punitive sanctions, and this understanding stretches from international relations through international political economy to the social contract and routine bargaining. In their penetrating analysis of contemporary economic science, Daniel Hausman and Michael

[96] Ken Binmore has an excellent discussion of this in his introduction to Nash, *Essays on Game Theory*, 1997, ix-xx.

[97] Game theory texts move quickly from the Prisoner's Dilemma model of exchange to the repeated game (Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 191–194; however, this theoretic move misses that in the classical liberal market, exchanges were often between individuals who did not know each other and would likely not encounter each other again; again, the primary difference is that in the neoliberal model of exchange, each most prefers to cheat the other and in the classical liberal exchange, each would prefer to cooperate given the other's alike cooperation.

[98] This example is drawn from Campbell, "Background for the Uninitiated," in Campbell and Sowden, eds., *Paradoxes of Rationality*, 1985, 9; Russell Hardin uses the same example in "The Utilitarian Logic of Liberalism," *Ethics* (Oct. 1986) 97:1, 47–74, at 52.

[99] Adam Smith's concept of fair play, *Theory of Moral Sentiments*, section II.ii.2.2; see also Robert Nozick on side constraints, *Anarchy, State and Utopia* (Oxford: Basil Blackwell, 1974), 28–33.

[100] Roger Myerson draws attention to the requirement of most operationalized game theory to track instrumentally "salient permutations" of the world; see his *Game Theory*, 1991, 25.

McPherson note that from this perspective, "the only thing wrong with cheating is the risk of getting caught"; furthermore, "competitive pressures do not permit firms [and other actors] the luxury of moral scruples."[101]

This section discusses how game theorists developed this mutually compromising view of market exchange early on to analyze arms control. In 1967, future Nobel Prize winners Robert J. Aumann, John C. Harsanyi, and Reinhard Selten published, with three other authors, the report *Gradual Reduction of Arms*, under the auspices of the US Arms Control and Disarmament Agency.[102] From this point onward, the classical view of the free market, which is necessarily bounded by the respect for persons, property, and contracts, was increasingly displaced by the view that bargains are facilitated by agents' power to threaten harm on others to secure better terms and subsequently enforce them.[103] While in traditional liberalism, normative agreements are self-guiding and create patterns of constructive interdependence when actors are assured others will cooperate, in postmodern neoliberalism, regularized patterns of interaction are the by-product of individual preference satisfaction and may well harm individuals and squander resources. Moreover, whereas classical liberalism entails the achievement of prudential judgment and the wherewithal to attain third-person impartial assessment of the conduct of others and ultimately of one's own conduct, the neoliberal paradigm views strategic rationality as biologically programmed into agents as a condition of their survival and replication.[104]

Reinhard Selten's contribution, coauthored with Reinhard Tietz, is analytically distinct from the other articles. These authors model a "Class of Simple Deterrence Games," assuming that nuclear war represents an "irreversible game" with "one type of atomic bomb."[105] The conclusions of Selten and Tietz's study are intuitively plausible: nations with good will toward one another are less likely to attack one another and that fewer to no atomic weapons leads to more stability than increasing stockpiles past one to several

[101] Hausman and McPherson, *Economic Analysis*, 2006, 72–73; contemporary reputation mechanisms for establishing transparency are neoliberal in the sense that they do not discover a disposition or character for integrity but only serve to demonstrate a past trend that may indicate a forward trend.

[102] I am indebted to Jerry Green and Helen Gavel for access to this report, written by Robert J. Aumann, John C. Harsanyi, John P. Mayberry, Michael Maschler, Herbert E. Scarf, Reinhard Selten, and Richard Stearns, *Models of Gradual Reduction of Arms*, Arms Control and Disarmament Agency, ACDA/ST-116, September 1, 1967.

[103] Luce and Raiffa, *Games and Decisions*, 1958, 97–101.

[104] John Nash articulated this view in his PhD thesis; for discussion, see Giacoli, "Nash Equilibrium," 2004. See also Binmore, who draws on Nash, *Natural Justice*, 2005, 23–27, 42, 73–75, 101–112.

[105] "Security Equilibrium for a Modified Version of Scarf's Deterrence Model," in *Models of Gradual Reduction of Arms*, Arms Control and Disarmament Agency, ACDA/ST-116, September 1, 1967, 501–551. For contrast, see John C. Harsanyi, "A Generalized Nash Solution for Two-Person Cooperative Games with Incomplete Information," also in this report, 71–286.

weapons. Yet their modeling exercise does not dovetail with the other papers in the volume. In exploring the implications of bargaining, those other papers found it too mathematically cumbersome to incorporate how actors might demonstrate concern for how other actors feel about outcomes. The Selten-Tietz paper demonstrates a broader view of game theory, but it was the exploration of strategic bargaining for nuclear strategy taken up by the other authors that generated the neoliberal approach to political economy. The demands of mathematical tractability and the fact that game theory is an instrumental account of rationality that necessarily and directly associates expected gain with configurations of ontologically existing phenomena have encouraged theorists to standardize the noncooperative Prisoner's Dilemma model of contracts, bargaining, and exchange.[106]

John Mayberry's introduction to the report, "The Notion of 'Threat' and Its Relation to Bargaining Theories," sets forth the aggressive view of bargaining. Appropriate for international relations, actors cannot exit a state of nature. This means that actors gain advantage through posing credible threats to one another and that no bargain is safe unless exposed to the constant pressure of sanctions endogenously supplied by the participants themselves to address compliance failures. It is worth analyzing Mayberry's introduction to the Nash Bargaining Solution encompassed by noncooperative game theory in detail because it is paradigmatic of neoliberal market discipline. Mayberry's paper confirms that neoliberal political economy is predicated on the strategic rationality of game theory, first vindicated within the context of avoiding nuclear war by preparing to wage it. Mayberry notes that strategic rationality is indispensable for nuclear strategy and is likewise essential to decision making in other domains such as "the arms race (in non-nuclear weapons especially); the Viet-Nam conflict; price competition in capital-intensive industries" and for analyzing how castaways on an island may bargain over the food necessary to stay alive.[107] Bargaining problems, from simple exchange to military contestation, take the Prisoner's Dilemma structure and should be solved according to the logic of strategic rationality.

A graphic illustration of a bargain that equates players' utilities with the potential outcomes in a bargain is presented in Figure 2.[108] The bargaining space is defined by outcomes reflected by the respective units of gain each actor expects. Technically speaking, a bargaining game, by which game theorists

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[106] Von Neumann and Morgenstern articulate the view that value inheres in the world as an ontological property that obeys the laws of physics, *Theory of Games and Economic Behavior*, 1944, 1953, 2004, all editions, 16–24; for discussion, see Nicola Giocoli, "In the Sign of the Axiomatic Method," in Richard Arena, Sheila Dow, and Mathias Klaes, eds., *Open Economics: Economics in Relation to Other Disciplines* (London: Routledge, 2009), 129–149.

[107] Mayberry, in Aumann et al., *Models of Gradual Reduction of Arms*, 1967, 35, see also 29–32.

[108] Mayberry's "Notion of 'Threat,'", 1967, has thirteen figures demonstrating this concept; this is a common depiction; see also Rapoport, *Fights, Games, Debates*, 4th ed., 1970, 189; Luce and Raiffa, *Games and Decisions*, 1958, 118; Nash's original figures are in his "The Bargaining Problem," reprinted in Nash, *Essays on Game Theory*, 1996, 155–162.

person 2
expected utility

B X

cooperate, defect

cooperate, cooperate

C
X

E
X

person 1
expected utility

D
defect, defect

X
A
defect, cooperate

Each bargainer's first choice
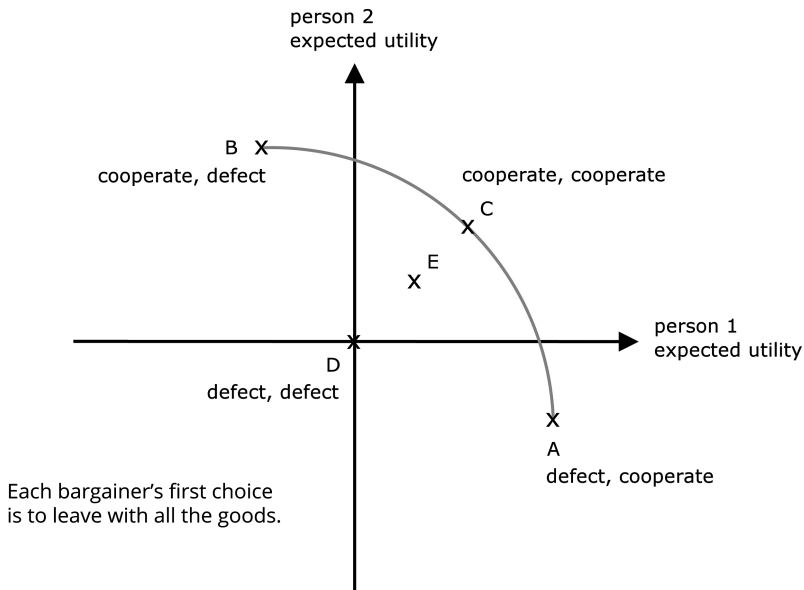is to leave with all the goods.

FIGURE 2. Nash Bargaining Solution as Prisoner's Dilemma Game

specify that actors could reach a mutually preferred outcome by cooperating rather than if they played noncooperatively, encompasses the characteristic PD payoff matrix, but it also include impure variants in which actors may gain more by alternatively defecting, and other games that deviate from the PD. The crucial point, however, is that in all cases the cooperative outcome is a function of the disagreement point, or the outcome that ensues when all actors defect.[109] Each point on the expected utility graph denotes the expected gain from a specific outcome. Each pair of numbers representing a point specifies the expected utility received by person 1 on the horizontal axis and person 2 on the vertical axis. Given the normal linear relationship between expected utility and tangible goods obtainable through bargaining, each point could represent an expected value of money or some other fungible source of value. Each point in the bargaining space represents either a concrete payoff or a probabilistic lottery of two other outcomes that has equal numeric expected utility. For example, to technically define the bargaining space, a specific point E could represent a 50% probability of receiving the payoff for unilateral defection plus a 50% probability of receiving the payoff for being suckered (with an evaluation equivalent to ½ {Defect, Cooperate}, + ½ {Cooperate, Defect} enumerated for each player).[110]

[109] Myerson refers to this derivation of cooperative outcomes from noncooperative game theory "Nash's program," *Game Theory*, 1991, at 371.
[110] For an effective discussion, see Steven Kuhn, "Cardinal Payoffs," in "Prisoner's Dilemma," entry, 2014.

Throughout zero-sum and non-zero-sum game theory, solutions can often only be guaranteed to exist if the game is viewed through the lens of indefinite play and players are permitted to play each strategy in a fixed proportion to all the other strategies over time.[111]

In Figure 2, the point labeled A {Defect, Cooperate} designates player 1 defecting and player 2 cooperating; hence, player 1 gets all the possible value giving player 2 negative utility. The point labeled B {Cooperate, Defect} designates player 1 cooperating and player 2 defecting, with player 2 getting all possible value. The point labeled C designates the point at which both individuals cooperate {Cooperate, Cooperate}. The curve that traces through points B, C, and A represents the "Pareto frontier," which designates the points in the expected utility space from which one cannot improve any single actor's expected gain without diminishing that of the other actor. The inverse curve demarcating the joint set of the actors' least preferred outcomes lies in the bottom southwest quadrant of the figure.

The point designated D {Defect, Defect} represents mutual defection. In a bargaining game, the mutual defection point may be derived from the total set of possible outcomes as a mixed strategy solution to the noncooperative game.[112] This is a two-step process involving first identifying the disagreement point, and building up from that the agreement point of the bargain. This disagreement point {Defect, Defect} can be determined in three manners and thus is not uniquely specified. It can be derived from each individual securing his or her best-worst case, or maximin, outcome; it could represent a focal point of mutual salience; or it can result from each individual choosing an action to cause the opposition the greatest damage. Because the cooperative agreement point is directly deduced from the disagreement point, and each actor is content to settle for less, the worst the default outcome is, it is typically in each individual's interest to threaten the greatest harm on the other to achieve the superior cooperative outcome for oneself.[113] Whether one selects to threaten the other with the worst loss or protect oneself with the best worst-case outcome depends on which achieves the best outcome overall for the decision maker, and which strategies are credible insofar as they do not place oneself in an unrealistically vulnerable position.[114]

In the Nash bargaining solution, the identification of point D {defect, defect} is crucial because, along with the axioms defining Nash's approach, this point determines the single-point solution of the bargain, which in Figure 2 coincides with mutual cooperation. An arbitrary point, designated E in the diagram, may

[111] Luce and Raiffa, *Games and Decisions*, 1958, 106–109; Myerson follows Luce and Raiffa in first treating the repeating PD as the best example of repeating games in general, and immediately discussing bargaining as a cooperative game derived from the foundations of noncooperative game theory, *Game Theory*, 1991, 379–390.

[112] Luce and Raiffa, *Games and Decisions*, 1958, 106–109.

[113] Rapoport has the clearest discussion of this, *Fights, Games, Debates*, 1970, 186–192.

[114] Luce and Raiffa, *Games and Decisions*, 1958, 106–109.

not actually represent a concrete outcome, but instead a lottery ticket with an expected value based on, for example, a specific likelihood that one will be the sole defector and a specific likelihood that one will be the sole cooperator (a mixture of outcomes A {Cooperate, Defect} and B {Defect, Cooperate}). A Nash bargaining game requires that the field of points be filled in, and often the only way to make this possible is to invent lotteries among possible outcomes that can reflect the expected value for all conceivable points.[115] This consideration, standard throughout game theory to guarantee game solutions, restricts the features of the decision environment that can register subjective utility not only to outcomes independent of the means by which they are achieved but also to fungible properties, which accommodate attitudes toward risk.

The bargain takes on the characteristics of a Prisoner's Dilemma because, simply from the considerations of expected tangible gain, each actor is best off exiting the bargain with all the goods, leaving the other with none.[116] In this case, if one individual decides to cooperate, the other player will sucker that individual by defecting. If both fail to cooperate, then mutual defection occurs. The failure to cooperate is reflected as the "zero point," or default point signifying mutual defection in the Prisoner's Dilemma. This default can be manipulated if either or both actors can drive down the other's payoff in the case of disagreement, with the lower bound reflected by the sucker's payoff of sole cooperation against the other's defection. If secured by an enforcement mechanism to forestall individuals' inherent tendency to renege, settlement will be somewhere on the northeast frontier of the diagram and, according to Nash, is strictly delimited by the default point, or what will come to pass if no agreement is reached.[117] Game theorist Roger Myerson explains how "the payoff to player 1 ... increase[s] as the disagreement payoff to player 2 decreases," and that therefore, "a possibility of hurting player 2 in the event of a disagreement may actually help player 1" should an agreement be

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[115] There are three levels of specificity available to define a bargaining game (cite from Luce and Raiffa).

[116] Myerson, *Game Theory*, 1991, 370–371.

[117] The Nash bargaining solution is a highly technical mathematical result similar to Kenneth Arrow's impossibility theorem. Nash is able to obtain a solution to the bargaining game because he assumes a status quo point that disregards from consideration outcomes that are less appealing to either player than the status quo point. Much of the work to solve a Nash bargaining problem goes into establishing what outcome represents the status quo point that can be determined either (1) as a focal point depending on exogenous considerations, (2) as the maximim solution to a noncooperative game, or (3) as a threat point derived from the worst outcome with which each can credibly threaten the other. Leveraging threats requires an understanding of the relative costs of threatening someone to oneself and to the other agent. For understanding, the Luce and Raiffa discussion requires reading both chap. 5 on "Two-Person Non-Zero-Sum Non-Cooperative Games," 88–113, and chap. 6 on "Two-Person Cooperative Games," 114–154; note that solving a Prisoner's Dilemma–style bargaining game with asymmetric rewards requires a randomized strategy, 115. Roger Myerson's later treatment is more concise because he combines the Nash bargaining solution and noncooperative game theory in line with Mayberry's example, *Game Theory*, 1991, chap. 8, 371–394.

reached.[118] Therefore, the hope of a mutually cooperative outcome in game theory "may give players an incentive to behave more antagonistically before the agreement is determined." John Nash formalized this "chilling effect."[119]

Beyond Nash's original barter, which he illustrated between the fictitious figures Bill and Jack over objects, and Mayberry's exploration of bargaining over terms of arms reduction, having actors bargain over monetary value became standard.[120] In what became known as the ultimatum game, there is a total sum of cash value to be distributed to players if the two can agree on how to share it. One person chooses a distribution, and the other has the power to accept or reject it. If there is agreement, the money is shared; if not, neither receives any reward.[121] Game theorists notice that it is rational for the second individual to even accept just $1 of a total $100 because that single dollar is still worth more than nothing. However, rather than settle for a perceptible though small gain, each actor has the capability to threaten that the other will get nothing by presenting a willingness to defect unless personal stakes are sufficiently high. The ability and credibility to threaten other actors is thus crucial to how much one can gain oneself. In terms of understanding the development of a uniquely neoliberal approach to interactions, markets, and governance, the key point is that in the move to apply abstract formal game theory to the lived world, all that can register in actors' rational preference rankings over outcomes and lotteries thereof is their mathematically consistent appraisal of tangible outcomes irrespective of the processes and intentions that brought them about: this neoliberal market "is therefore the final step in a process that first leaches out the moral content of a culture and then erodes the autonomy of its citizens by shaping their personal preferences."[122] This is obviously true in the case of a bargain structured by relative ratios of fungible goods accruing to each individual. Value is significant and measurable independent of social relationships and context; actors' preferences reflect structural environmentally given rewards and are not autonomously determined.[123]

Game theory extrapolates from lived experience to provide a tidy mathematical analysis of conflict.[124] However, it is less clear how formal strategic rationality oversteps the boundary from being a thought experiment to becoming a categorical imperative directly linked to survival in more mundane contexts other than a military contest.[125] The early Cold War embrace of

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[118] This and the following three quotes are from Myerson, *Game Theory*, 1991, at 386.

[119] "Two-Person Cooperative Games," *Econometrica*, (1953) 21, 128–140.

[120] "The Bargaining Problem," *Econometrica* 18 (1950), 155–162.

[121] Note that it is possible to define variations of this game. For example, the players could play repeated rounds with a discount factor reducing the total sum to be distributed in each round. Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 196–204.

[122] Binmore, *Natural Justice*, 2005, at 184.

[123] Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 209.

[124] For an early treatment, see Robert Axelrod, *Conflict of Interest: A Theory of Divergent Goals with Applications to Politics* (Chicago: Markham, 1970).

[125] Binmore discusses a "sharing food" example, *Natural Justice*, 2005, 119–121, 160–161.

hard-nosed strategic rationality to confront the Soviet Union was subsequently applied across multiple domains of decision making and choice by the late twentieth century. War, which strategists may view as a state of potentially unbounded conflict, invites the belief that command of resources is necessary for survival and propagation. In this case, the power granted by such resources stems from natural properties, governed by the laws of physics, as opposed to specific patterns of interactivity dependent on intricate norm-governed social arrangements or specific intersubjectively perpetuated interpretations of worth and significance. I further elaborate on this theme in the next chapter, "Assurance," by showing how game theory's dependence on interpersonally transferable utility renders it compatible with the international relations of realism, neorealism, and neoliberalism.

Mayberry culminates his analysis by using game theory to draw a sharp distinction between a classical liberal and neoliberal approach to bargaining. Whereas the former is normative and obeys the no-harm principle, which could be interpreted in view of individuals' maximin strategies, the latter deploys coercive threats to gain the advantage over opposition. Mayberry clearly specifies how the Nash bargaining solution can be incorporated into noncooperative game theory to support the nuclear strategy of preparing to fight and win a nuclear war. He reasons:

Nash's concept of threat and solution can reconcile and illuminate for me the inconsistent extreme views of those ultra-pacifists who say, "War is unreasonable, and we are reasonable; therefore let us not prepare for war, nor consider it as an option" and those extreme hawks who say, "If we do not prepare for war, we shall be forced to surrender, and it is ridiculous to *prepare* for war unless we *intend* to fight."[126]

Mayberry's central idea, derived from Nash's bargaining solution, is that the outcome of strategic arms control, or any settlement among protagonists, will be a function of their willingness to leverage credible threats to achieve an outcome in their favor.[127] Upholding the normative no-harm principle, which effectively represents "protect[ing] oneself against the worst the opponent can do," is a weaker strategy than the one that becomes the crux of neoliberal bargaining: "to ensure that the opponent is injured as much as possible even if his main effort is to defend himself."[128] Mayberry makes clear he views bargaining as part of relentlessly competitive non-zero-sum game theory that, within the context of arms control, prescribes leveraging coercive threats to achieve national security. He pithily states the central tenet of the nuclear utilization targeting strategy: "it is ridiculous to *prepare* for war unless we *intend* to fight."

Mayberry's analysis helps introduce Part I of *Prisoners of Reason* because he shows how game theory rationalizes the case for preparing to fight a nuclear

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[126] Mayberry, "The Notion of 'Threat,'" 1967, 46.

[127] Luce and Raiffa provide an effective discussion of this material, *Games and Decisions*, 1957, 106–109.

[128] Mayberry, "The Notion of 'Threat,'" 1967, 43.

war by arguing for the analytic necessity of making credible threats to the Soviet Union to improve US bargaining power.[129] Cooperative games, in which outcomes are the function of agreements, are encompassed by noncooperative game theory for three reasons that are consistent with the game theoretic neoliberal orientation. First, no strategic rational actor voluntarily abides by agreements made. Second, leveraging threats secures the most favorable outcome for oneself. Third, others will only uphold terms of a bargain with the constant pressure of credible threats for noncompliance.

CONCLUSION

In the vast intellectual landscape of game theory, the Prisoner's Dilemma game has become accepted as a discovery of a core puzzle at the heart of all manner of cooperative ventures: Adam Smith's invisible hand, joining trade unions, participating in public vaccinations, standing at football games, and even marriage.[130] Game theory scholars frequently present the PD as though it were as simple and straightforward as tic-tac-toe. As long as two actors' subjective preference rankings conform to the characteristic PD payoff structure, then the rational choice for each individual is to fail to cooperate, leaving both with their second-worst preference. However, many layers of analytic complexity are involved in setting up the Prisoner's Dilemma game, which, if not rendered explicit, become part of the pedagogic baggage relied on to transmit the acuteness and inevitability of the Prisoner's Dilemma trap. The result then is that teaching the PD game as a particularly useful exemplar of noncooperative game theory and using it to model situations throughout markets, governance, and international relations and to generate blueprints for institutions and practices will shape the social world in accordance with the tacit and limited assumptions required to operationalize the model.[131]

Thus, in teaching the Prisoner's Dilemma, I offer the following four recommendations.[132] These explanatory strategies make explicit the otherwise implicit assumptions packaged into standard practicable game theory. Once these suppositions, which are necessary to becoming trapped in the Prisoner's Dilemma impasse in the first place, are rendered explicit, initiates may subject

[129] In this informative RAND report, Jack L. Snyder analyzes the impact of the US nuclear strategy of flexible response in view of its likely reception by the USSR, "*The Soviet Strategic Culture: Implications for Limited Nuclear Options* (Santa Monica: RAND Corporation, September, 1977).

[130] These examples are taken from Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 175–180.

[131] In the essay on the PD, Mary Morgan concludes that the use of the PD model has become sufficiently routinized that analysts treat the model as though it were existence itself, "The Curious Case of the Prisoner's Dilemma: Model Situation? Exemplary Narrative?" in *Science without Laws* (Durham: Duke University Press, 2007), 157–188.

[132] The Prisoner's Dilemma, of course, is a pertinent and central game in noncooperative game theory; see, e.g., Luce and Raiffa, *Games and Decisions*, 1957, 88–113.

them to inspection and can opt into or out of them at will. Hence, individuals may select to become neoliberal citizens and consumers voluntarily, instead of unknowingly succumbing to or being pressured into the mentality of *Homo strategicus*.

First, educators should clarify that orthodox game theoretic payoffs only reflect outcomes and exclude the means by which outcomes are realized. Thus, it is consistent with utilitarian philosophy but distinct from Jeremy Bentham's original approach because it denies interpersonal comparability of utility or the rationality of joint instead of individualistic maximization. By itself, this restriction on the evaluation of worth negates ethical and normative characteristics of action correlating to classical liberals' first principle of mutual respect and reciprocal no-harm, whether in the form of Adam Smith's negative virtue, Immanuel Kant's perfect duty, Robert Nozick's side constraints, or John Rawls's fair play.[133] It is then self-evident that if strategic rationality is limited to its current form, neoliberal institutions built on its premise will necessarily break with the modern approach to markets and justice. The urgency associated with the nuclear security dilemma, inviting worst-case analysis and emphasizing the raw power of resources existing prior to communication, provided the precedent for discarding classical liberalism first in international relations and subsequently in the social contract, markets, and democracy.[134] Game theorists' newfound prestige and the momentum propelling strategic rationality forward shielded the germinating paradigm of neoliberal political economy from scrutiny.[135]

Second, most operationalized game theory also relies on an expected utility metric that represents not only an ontologically salient feature of the decision environment but also a scarce, commonly sought after, interpersonally

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[133] This is a point that Amartya Sen has emphasized as a heterodox amendment to rational choice theory; see *Rationality as Freedom*, 175–181, 232–239; for another approach, see Joseph Heath, *Following the Rules*, 2011; and Margaret Gilbert, *Joint Commitment: How We Make the Social World* (Oxford: Oxford University Press, 2013).

[134] Hargreaves Heap and Varoufakis make a point of noting that Roger Myerson has argued that "game theory makes pessimistic assumptions regarding the nature of rationality because its role is to study the sort of social institutions that might work well ... even when peopled by instrumentally rational egoists," *Game Theory*, 2004, 184 (uncited), and Myerson makes a point of referring to the nuclear deterrence on the first page of his *Game Theory*, 1991. However game theory is prescriptive, and individuals exposed to it will learn its rules of conduct, see, e.g., Professor Peter Nonacs, UCLA, "Why I Let My Students Cheat on Their Exam: Teaching Game Theory Is Good. Making People Live It Is Even Better," www.zocalopublicsquare.org/2013/04/15/why-i-let-my-students-cheat-on-the-final/ideas/nexus/, accessed January 6, 2015.

[135] John Rawls was one of the most adept theorists who spanned classical liberalism and the new rational choice liberalism, and it soon became clear that a commitment to both approaches was difficult, if not impossible, to entertain. See his "Justice as Fairness: Political Not Metaphysical Essay," 1985, and commentary in S. M. Amadae, *Rationalizing Capitalist Democracy* (Chicago: University of Chicago Press, 2003); for other such acknowledgments, see David Gauthier, *Morals by Agreement* (Oxford: Clarendon, 1987); Martin Hollis, *Trust within Reason* (Cambridge: Cambridge University Press, 1998).

transferable feature such as nutritional calories, energy, or cash value. This interpersonally transferable utility is surmised to have value prior to establishing intersubjective agreement on the social significance of the decision context. Thus, game theory, promoted as an exhaustive science of choice, ends up eviscerating from intelligible meaning all but affine transformations of some intersubjectively evident ontological property subject to the laws of physics. This ignores the creation of positive-sum value that can arise from complex, norm-governed patterns of social interdependence, not to mention well-being associated with potentially unlimited sources of value such as hope, healing, reconciliation, and understanding.

Third, most game theorists assume that individuals must maximize payoffs individually, in strategic competition with others. Given the excision of moral scruples and accountability, because of the superfluity of processes to the judgment of rewards under the rules of standard game theory, a population of strategic rational actors resembles dueling Maxwellian Demons, both striving to accumulate as much utility as possible on their side of a partition.[136] These neoliberal subjects cannot realize common goals of achieving a globally vibrant and sustainable world conducive to all individuals achieving the basic goods represented by Abraham Maslow's hierarchy of needs, and generating inclusive cultural wealth.[137] A classical liberal or post-neoliberal agent may accept that some decision problems are indeed defined strictly by scarce, ontologically prior resources. However, classical liberal or post-neoliberal actors may elect to collaborate against natural scarcity and maximize resources as a group, rather than against one another in an incessant mutually undermining contest.[138]

Fourth, not only does traditional political economy depend on the no-harm principle, it also recognizes a role for the imperfect duties of charity and beneficence.[139] For classical liberals, acceptance of the moral obligation of the better-off to ensure that the less well-off are not pushed to the brink of ruin is a touchstone of personal independence and autonomy. In a neoliberal world order, in which strategic rationality has the pedigree of reason, actors presume the prerogative to cannibalize others' life expectancies and qualities of life as an

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[136] In axiomatizing quantum thermodynamics before axiomatizing strategic rationality, John von Neumann used the same symbolic designation for both the expected energy of quantum particles and for individuals expected utility, "EU"; see his *Mathematical Foundations of Quantum Mechanics* (Princeton, NJ: Princeton University Press, 1996).

[137] Abraham H. Maslow, "A Theory of Human Motivation," *Psychological Review* (1943) 50:4, 370–396; George Simmel, *The Philosophy of Money* (London: Routledge Classics, 2011).

[138] Bacharach, *Beyond Individual Choice*, 2006.

[139] Adam Smith, *Theory of Moral Sentiments* (Indianapolis: Liberty Fund, 1982), VI.conl.2; for discussion, see Amadae, *Rationalizing Capitalist Democracy*, 2003, 215–216; see also Peter Singer, "Famine, Affluence, and Morality," *Philosophy and Public Affairs* (1972) 1:1, 229–243, to see how the classical liberal approach to justice and political economy lingers into the neoliberal era.

external cost to one's own success.[140] Additionally, neoliberal strategic rational actors will only conduct charity as recommended by Richard Dawkins's selfish gene theory: to secure their immortality through conspicuous and memorable acts of generosity.[141]

Neoliberal subjectivity arises from the intricate pedagogy of game theory that comes to the fore in the Prisoner's Dilemma game and is interchangeable with contemporary paradigmatic instrumental rationality.[142] Rational choice is promoted as an exhaustive science of decision making, but only by smuggling in a characteristic confusion suggesting that everything of value to agents can be reflected in their appraisals of existential worth even though this is patently not the case in life viewed as a "fixed game."[143] Without a critical and scrupulous pedagogy that carefully identifies as optional the assumptions necessary to operationalize strategic rationality, a new neoliberal understanding of capitalism will dominate the worldview of the student of game theory and inhabitant of neoliberal institutions. This reductionist perspective on agency first proved itself useful for projecting the power of national sovereignty through wielding deterrent threats of destroying other nations using nuclear weapons. Here are the barebones central elements of this worldview:

1. It entails coercive bargaining, by threatening harm on others if they do not cooperate, instead of bargaining consistent with the no-harm principle.
2. It entails the inadvertent commodification of all value and by considering that all goods of value are ultimately scarce fungible resources, thereby negating the possibility of positive-sum and unlimited experiential goods including security, social capital, and friendship.
3. It entails the view that only sanctions keep people in line with agreements they voluntarily make or laws they view as reasonable.
4. It implies that cheating and free riding, if one can get away with them, are rational.
5. It implies that information and language are purely signaling devices deployed to realize preferences over world states with value independent of social relations.
6. It implies, finally, that agents must comply with this neoliberal view because the price for resisting is either bankruptcy or the failure to survive.

[140] Hausman and McPherson begin their book *Economic Analysis, Moral Philosophy and Public Policy*, 2006, by showing how Lawrence Summers's articulation of the principles underlying contemporary economic theory permit, even necessitate, negatively impacting the qualities and quantities of life of less well-off individuals, at 12–13; this is also true for the Kaldor-Hicks compensation principle widely used in contemporary law and economics, discussed in Chapter 8, "Consent."

[141] Richard Dawkins, *The God Delusion* (New York: Houghton Mifflin Harcourt, 2011).

[142] See, e.g., Hargreaves Heap and Varoufakis, *Game Theory*, 2004, 8–12.

[143] Game theorists tend to refer to all life contexts as independent games or one supergame, e.g., see Binmore, *Natural Justice*, 2005, 184, who also considers that "the game of life is the infinitely repeated Prisoners' Dilemma," at 96.