Beyond the Prisoners' Dilemma

Making Game Theory a Useful Part of Undergraduate International Relations Classes[1]

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While game theory has a well-established place in the international relations literature, it still has not found a similar place in the undergraduate classroom. With few exceptions, it only appears in introductory textbooks as the nuclear arms race application of the prisoners' dilemma.

The fault for this gap, I believe, lies with those of us who use game theory in our own work. We have failed to lay out exactly what game theory can offer the undergraduate curriculum, and have not demonstrated how to integrate it into a standard class. In this paper, I hope to correct this situation by describing what game theory can add to undergraduate understanding and offering concrete advise for its implementation.[2]

Before continuing, it may be helpful to distinguish between simulation and game theory in the classroom. Simulation is an active learning technique in which students play specific roles in situations designed to parallel real-world events. Negotiation situations are the most common type of simulations (Starkey and Blake: 2001), simulating UN meetings, WTO rounds, NSC decision-making, and the like. The presence of computers in the classroom has expanded opportunities for complex simulations, since they can handle the 'behind the scenes' administrative work that instructors formerly had to deal with. Game theory, on the other hand, moves in the opposite direction, to simple models of human behavior. When used in the classroom, it appears as highly abstract versions of real-world events. Where the primary goal of simulation is improving student understanding of specific issues and discovering a new perspective on them, the goal of using game theory is to help students progress towards understanding a generalizable logic of international events (Morrow: 1994).

This distinction poses a challenge for anyone interested in using game theory in the classroom. We have known for more than twenty years that classroom simulations enhance

[2] This paper draws heavily on the author's experience using Bueno de Mesquita's textbook *Principles of International Politics* (2006). It stands as an exception to the situation described here because it successfully integrates game theory into an introductory course on international relations. In this paper, I take a step back from Bueno de Mesquita's approach to propose integration "for the rest of us"—integration that does not ask students to understand information sets or Bayes' Rule (I have enough trouble getting my upper-level methods students to understand Bayes' Rule, much less my freshman IR students).

student retention of issue knowledge. On the other hand, the abstraction of games--settings such as partners in crime, spouses guessing where to go for an evening out. or fishermen deciding how big a catch to take--means that they don't directly increase students' knowledge of international relations. For a game experience to be meaningful, students must be able to see how the same logic applies in a variety of circumstances. For example, devoting 20 minutes of a class on the nuclear arms race to letting students play the PD with each other offers little value-added unless the students see that it can *also* help them understand the Europe-wide choice to mobilize armies in response to a skirmish between Austria and Serbia in 1914, or understand how countries choose between protectionism and free trade, for example. To make game theory a useful part of student learning, then, an instructor must do five things: 1) ensure that students recognize the logic each game reveals, 2) incorporate those logics into lectures on a variety of topics, 3) use different games to present multiple logics, 4) ensure the students understand which logic applies in different situations, and 5) convey to students the concrete implications of different logics.

At first glance this list may give the impression that game theory is more trouble than it is worth, but in this paper I hope to show that is not the case. On the contrary, it is possible to use game theory to improve student learning without rewriting a course wholesale or dropping content. The paper proceeds in three sections. The next section examines the place of game theory in current international relations pedagogy, followed by an exposition of what game theory can add to the curriculum. In the final section of the paper, I describe four categories of games--prisoners' dilemma, brinkmanship, battle-of-the-sexes, and common pool resource problems--and explain how they can fit into a standard international relations course.

Game theoretical pedagogy in international relations

The 1970s and 1980s saw considerable scholarship on games in the classroom, focused on the role of active learning. Typically lumping games and simulations together, teachers came to value in-

class exercises for a variety of reasons. They offer greater opportunities for student interaction than a standard lecture, especially in large sections (Raines and Rochester: 2003). Research has shown that students retain more of what they learn when they have the chance to use it themselves (Boyer, Caprioli, Denemark, Hanson, and Lamy: 2000). Competitive peer interaction provides students with a motivation to master the material as well (McKeachie, Pintrich, Lin, and Schmidt: 1986). Not insignificantly, they are also an enjoyable change of pace for both students and teachers. Accompanying that discussion was a growing library of "ready-to-use" games for the classroom, appearing journals such as *Simulation and Gaming* and *Political Science* (later *PS*).

Meanwhile, momentum was building for the use of game theory in research. Beginning with Schelling's (1960) groundbreaking work applying game theory to international conflict, work has expanded to alliance theory (Morrow: 1994), War (Bueno de Mesquita and Lalman: 1992) and nuclear deterrence (Powell: 1990), to name just three studies that have each spawned a secondary literature. It has also expanded to international political economy as well, as far afield as the relationship between politics and growth in renaissance Genoa (Grief: 1998)

Nevertheless, while game theory became has integrated with the larger stream of research, it has failed to break its isolation in the pedagogical literature (Asal: 2005). A recent collection titled *The New International Studies Classroom* offers an unfortunate example. Among its chapters are five different activities for use in an international relations class, with detailed instructions for use with a particular sub-topic of the course--but nowhere does the book offer a way to link these together in the context of a semester, or connect them in the student experience.

This paper is not the first to recognize the gap between research and teaching. Asal (2005) notes the lack of a literature on integrating games into international relations courses, and undertakes to lay out possible methods. While he offers useful suggestions for organizing class around in-class exercises, he doesn't address the larger questions of how to integrate them into the course content. What topics can a game teach well? How can one make connections between games across different weeks of the semester? Without answers to these questions, he is left with

the assertion that games can be "important adjuncts" to a course, relegating game theory to the role of an occasional color box, largely unconnected to the bigger picture.

This is visible in contemporary international relations textbooks. Many texts, such as Russett, Starr, and Kinsella (2000), Mingst (2001), Ray and Kaabro (2002), Clemens (2004), and Goldstein (2005) include only a brief discussion of the prisoners' dilemma with their coverage of the nuclear arms race (hence the title of this paper).[3] Others separate it from the course content in a "color box" (Baylis and Smith: 2005), mention "zero-sum games" in passing with little explanation (Roskin and Berry: 2005), or omit it altogether (Minx and Hawley: 1998; Tetreault and Lipschutz: 2005; Kelleher and Klien: 2006; Rourke and Boyer: 2006). Lamborn and Lepgold (2003) provide two rewarding chapters on strategic action and game theory, but only as a retrospective, rather than incorporating it throughout the semester.

We can evaluate this treatment in light of what is required to make game theory useful in the classroom. Game theory-based texts like Bueno de Mesquita and Sobel make sense, as do game theory free texts like Tetreault and Lipschutz (2003). Those in the middle, however, spend time on game theory without giving students the context to make it useful.

Some authors have addressed this issue directly. Morgan (2003) offers one answer, suggesting that the experienced subjectivity of simulations makes them well suited to teaching Social Constructavist and other critical theory.[4] In addition, CQ Press has published a pair of textbooks that make game theory a foundation of the course, Bueno de Mesquita's (2006) and Sobel's (2006), but their level of sophistication poses a challenge for introductory international relations classes at most universities.

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[3] Russett, Starr and Kinsella do mention the Prisoners' dilemma in the context of international trade as well.

[4] The number of game theorists intent on teaching their students constructivism may be limited, but Morgan's suggestion of pairing student involvement in games with a textbook that emphasizes subjectivity, such as Tetreault and Lipschutz's *International Relations as if People Mattered* might make for a fascinating course. Still, Rochester (2003) cautions that we should be wary of using simulations for ideological reasons--teaching democracy, as it were.

In next section of this paper I carve out a middle ground between isolation and specialized treatment, discussing one set of ideas about what game theory can add to the curriculum of a standard introductory international relations course.

What game theory brings to the undergraduate curriculum

Game theory does have its doubters--witness the APSA *Perestroika* controversy--but bringing game theory into a course can help in two ways: offering opportunities for active learning and by helping students understand difficult concepts. As the research mentioned above shows, implementing in-class exercises has the potential to improve student learning, and even skeptics agree mixing some activities into a lecture course can be helpful (Raines and Rochester: 2003).

Bredermeir and Greenblat (1981) argue that this is especially true for abstract concepts. As any teacher knows, abstract concepts are difficult for many students to grasp, requiring careful explanation and plenty of examples. Participatory game theory activities, on the other hand, allow students to experience concepts directly, giving them a reference to use when listening to explanations (Boyer: 2000). This makes it useful whenever an instructor wishes to present abstract concepts.

While it could be applied to a plethora of concepts, in this paper I suggest using game theory to modify the standard international relations curriculum as it appears in standard textbooks to help students understand three key concepts: 1) international events are the product of many different actors interacting, not single actor's choices, 2) in such situations, actors under uncertainty face perverse incentives, and 3) the importance of communication and monitoring. These three were chosen to bridge the gap between the theoretical perspectives-based approach in most textbooks and what actually happens in international politics.

1) International events as the product of interaction

Most textbooks follow the broader literature by focusing on the "great debate" between realism and liberalism in international relations theory.[5] This approach brings structure to a course and makes scholarship accessible to students, but it leaves them with an incomplete picture of international relations. Both theories (and constructivism is no different) focus on the creation of state interests. What do states want and why do they want it? Typically, this translates to a debate about whether states are pursuing security or prosperity, but how these preferences--however created--connect to actual outcomes is not clearly articulated. That question is left to the obligatory chapter on "power," where students learn to calculate which countries are more powerful, and examine situations where a seemingly less powerful state gets its way. This leads them to see events in terms of which state "wins," or produces its desired outcome.

American students, I suspect, are particularly vulnerable to this fallacy (as may be American policymakers). Living in the most powerful country in the world, it is easy to believe that we have the strength to determine outcomes unilaterally.

Bringing game theory into the classroom can help students understand how events are the outcome of multiple actors' strategies, not a single actor's choices.[6] Simple games like the prisoners' dilemma or CPR problems offer students a chance to experience how their fate lies in how their choices interact with others'.

2) Perverse incentives

As Mancur Olson (1965) pointed out, the logic of collective action has surprising implications; no matter how badly an actor wants a given outcome, it may be best off doing nothing, or even acting to contrary. A pedagogical focus on state preferences, however, ignores this issue, leaving students with the idea that state action faithfully reflects the state's preferences about an issue (e.g.

[5] This is not limited to introductory textbooks. For example, Brawley's (2005) text for upper-level IPE students follows the same pattern.
[6] Scholars commonly recognize the outcome/choice distinction, but unfortunately, that has not trickled down to undergraduate texts.

if policy makers in state A really cared about the environment, they would implement treaty Y). Game theory teaches us, however, that even in situations where a cooperative outcome is best for the group, non-cooperation may be better for individual actors.

In my experience, students who don't have the advantage of a game theoretical perspective rationalize this behavior by disparaging policy-makers (e.g. "they only care about the short-term," or "the military-industrial complex creates the arms race for its own profit"). Once students have personally experienced the logic of such perverse incentives, however, they tend to show greater understanding of such problematic behavior, and of the difficulty in correcting it.

3) The importance of communication

When I was an undergraduate dreaming of a career in the Foreign Service, it struck me as strange that my international relations classes never discussed what graduates in the field actually did.[7] A focus on preference creation and policy decisions gives the impression that international politics is the realm of senior politicians and their appointees, leaving young people to wonder what role they could possibly play. This is not necessarily bad, because a survey course can't teach everything, but bringing in game theory can show the importance of communication and monitoring--activities with entry-level opportunities.

Game theory in the classroom can help students understand the usefulness of international communication in two ways. The research in economics from which much game theory arises refers to communication as "cheap talk," implying that its unreliableness forces actors to discount it. This is reinforced in most textbooks, where outcomes appear decided by national preferences and power, and international discussions are epiphenomenal. On the contrary, experimental evidence backed up by empirical studies reveals that communication makes cooperation easier

[7] Raines (2003) mentions in passing that the use of active learning reduces the number of students left wondering "what do political science graduates actually do?"

even without binding promises.[8] Similarly, Putnam (1988) persuasively argues that national preferences only predict outcomes within a range of overlapping possibilities, with the actual outcomes determined by negotiation (what appears in game theory as "coordination games"). Letting students experience the difference that communication gives them insight into what diplomats and other international relations professionals actually do.

A related issue is monitoring. While not communication *per se*, it fits in the same category of activities with no direct impact on international events. Unlike military activities or economic policy, it is easy to dismiss as unimportant. Any veteran of Model UN simulations will probably remember rejecting plans to create a "study group" as meaningless gestures, but instructors can use game theory to show students how useful they can be. Similarly, many international relations students are interested in working for NGOs, especially the more idealistic ones, but in my experience, have little idea what this would actually entail. Making this point in class helps them gain a sense of how their own work might make a difference.

[8] Ostrom *et al* (1992) remains the best entry to this literature.

Using Game Theory in the Classroom

A useful approach to implementing game theory is to insert into the middle of a standard lecture class, because research that shows student retention is higher when classroom time is broken up into smaller segments rather than an hour-long lecture (O'Leary: 2002). After letting the students play the game, it is important to spend sufficient time debriefing before moving on to make connections between the game and the surrounding lecture. Asal (2005) offers more detail on the mechanics of running games in class.

Rather than duplicating his work, I offer some suggestions for how to use four different games during a standard IR course. I assume readers have some familiarity with the fundamentals of game theory. For those who do not, but are interested in learning more, Dixit and Nalebuff's (1991) *Thinking Strategically* is the best place to start. Because there are so many different ways to implement each game (and hopefully interested instructors will have tried one or another in the past), I do not offer any "classroom-ready" games here.

Category: Prisoner's Dilemma

This is the most widely known example of game theory, modeling a situation where actors can gain by cooperating, but can individually gain more from the "sucker's payoff" when one party cheats and the other (the sucker) cooperates. Fear of becoming a sucker leads both parties to cheat preemptively, making them both worse off than they would have if they had cooperated. While simple enough to present and play quickly--and short enough to allow students to play multiple rounds in a single setting--it can be used to illustrate all three of the concepts described above.

At its most basic, the prisoners dilemma can be used to show how achieving best outcomes requires the active cooperation of both parties. Once students think seriously about their strategy, they realize that the key variable is whether their partner (opponent) can be trusted. When

playing with a friend or someone else they trust, students can choose to cooperate, and presumably gain mutual benefits. Without that trust, they will be forced into cheating in self-defense. Whichever situation holds, this helps them understand how actors must take others' expected actions into account, because otherwise they are likely to do poorly.

This leads naturally into the security dilemma. The idea that building up one's military strength can make one *less* secure is counter-intuitive until students learn to see security as an outcome rather than an individual choice. After playing the prisoners' dilemma, it is easier for them to see how other countries might see a--ostensibly defensive--military buildup as "I'm getting into position to maximize the "sucker's payoff" if I attack you." Having faced the same danger, students then see why surrounding countries have to respond with their own buildup, leaving all parties in the cheat-cheat outcome of military expenses with no increase in security. This provides them with a vivid example of how the "preference -> action" model espoused by non-game theory textbooks fails to capture the dynamics of international relations.

This is closely related to how the prisoners' dilemma illustrates perverse incentives by showing that Adam Smith was wrong--actors pursuing their individual self-interest do not necessarily make either themselves or the collective better off.[9] When students compare scores during the debriefing stage, it should become apparent that few were able to approach their maximum possible score. One or two may have successfully cooperated each time, and a few glib individuals may have collected sucker payoffs each time, but most students will have mixed results after playing multiple rounds. A discussion of why this occurs leads students to realize that their low scores weren't the result of ignorance or ineptitude, but of the incentive to cheat inherent in the situation.

This is the prisoners' dilemma's most common role, explaining why the US and USSR built such immense nuclear arsenals. Superficially, the arms race seems irrational, a series of unwise

[9] Showing students the scene from *A Beautiful Mind,* where John Nash persuades his friends to ignore the blond and go after her four brunette friends instead, teaches this point in a way that even the most difficult students can appreciate.

decisions of both countries' leaders, but the prisoners' dilemma experience allows students to see why each step made sense from the perspective of the two countries--even though both realized their actions were counter-productive.

Since uncertainty about the partner is at the heart of the dilemma, it makes a good place to introduce the utility of communication. With no communication, students are more likely to assume the worst about their partner's intentions.

Continuing the nuclear race application, the prisoners' dilemma with communication brings to life Reagan's dictum of "trust, but verify." From the time of Nixon onwards, both sides were interested in escaping the security dilemma trap, but uncertainty about the other made it difficult to proceed. Arms reductions were dangerous because the other might secretly preserve the weapons they had promised to eliminate, putting them in position to reap the sucker's payoff. Verification--such as clauses in the INF and START treaties allowing countries to have representatives watch the weapon destruction--lets countries choose the cooperate option with confidence.

A more sophisticated treatment of communication in the prisoners' dilemma introduces the idea of reputation. If the instructor runs the game two ways, once with no talking allowed and once with students allowed to say whatever they want (either run sequentially or by dividing the class in two), the students should recognize that talk itself does not make cooperation automatic. People--and countries--can lie. Once they understand this, run the game again but insist the students play repeated rounds with the same partner instead of switching. This time, the difference should be apparent between silence and communication.

The wide applicability of the prisoners' dilemma makes it a popular choice for introducing students to game theory. It is simple enough to for them to understand quickly, and its implications can be striking enough to convince students that game theory is worth further study. It can easily fit into lectures on many different subjects, including:

- Security Dilemma

•Arms Races

•Nuclear Deterrence

•Economic Cartels (OPEC, for example)

•Tariff Protection

Category: Battle of the Sexes

Alternately described as the "beer or quiche" game, this game presents a situation where two actors realize they can gain from cooperation, but gain different amounts depending on the form of that cooperation. Each wants to cooperate, but on its own preferred outcome rather than the other's. This leads to a "coordination" game where the two actors need to coordinate their behavior lest they each follow their own preferences and end up not cooperating--the worst possible outcome.

This game is especially useful for showing the utility of communication. Played silently, each player has to guess which strategy the other player will choose and try to match it--usually with mixed results. Allowing the parties to talk however, gives them the opportunity to agree on an outcome beforehand. If the students only play one iteration this may not be helpful, but if they play enough times to make reciprocity possible, all students should be successful in maximizing their score. This leads naturally to a discussion of what diplomats actually do, because a great deal of their activities are spent coordinating policies and perceptions with foreign governments

The principal application for this game is in understanding international organizations. Many American students have a low opinion of the United Nations, based on what they know from the news, which is typically limited to actions of the Security Council. The Battle of the Sexes helps them understand how useful the other parts of the UN can be. Most of the alphabet soup of organizations that are under the UN umbrella fill this coordination role. In my own

classes I use the Universal Postal Union as an example, and Baylis and Smith (2005) use the Civil Aviation Organization, but most any will do.

Comparison with the incentives in the prisoners' dilemma makes a useful addition to a presentation on super-nationalism and trans-nationalism. Solving problems of trust--represented by the prisoner's dilemma--may require a third party to enforce agreements (simulated by an instructor's statement that all promises are binding), but coordination does not, all it requires is enough time for the parties to reach an agreement (and either repeated iterations or side-payments for them to bargain over). This insight makes it easier to understand the different forms international organizations take. Situations modeled by the prisoners' dilemma demand super-national solutions to protect against betrayal. For example, organizations tasked with security issues where trust is important--such as the UNSC--are given teeth to enforce their proscriptions, and those without--like the League of Nations--typically fail. Situations like the Battle of the Sexes where parties have little incentive to cheat, however, give rise to trans-national solutions. Organizations like the UPU, for example, have no need to use force.

Relevant contexts for this game could include:

- International Organizations
- The EU's transformation from trans-national to super-national as its scope grows
- Network effects (decisions to join different trade blocs, for example)

Category: Brinkmanship

The Cuban Missile Crisis gave rise to whole categories of games, based on the logic of pushing an opponent to make decisions in the face of a risk of disaster.[10] Also called chicken, brinkmanship

[10] Instructors who used *A Beautiful Mind* earlier might want to use the *Maltese Falcon* here. Before threatening Bogart with a revolver that only has one chamber loaded, Sydney Greenstreet articulates the basic pattern--neither side wants disaster, but whoever is willing to accept a greater risk of disaster has the other at a disadvantage.

relies on chance, the possibility that actors seeking to gain an advantage will accidentally provoke disaster that neither wants.[11] It makes threats credible--in the Cuban Missile Crisis, for example, neither Khrushchev nor Kennedy could credibly threaten a nuclear launch, but Kennedy successfully put Khrushchev in a situation where he faced an unacceptably high risk of unintended nuclear war.

Brinkmanship helps students understand how perverse incentives can lead actors to outcomes that no one wants. Many situations contain an element of random risk, allowing actors to push the situation closer to the edge in order to force the other party back down or risk disaster. Even though the disaster would make both parties worse off, then, each does actually have an incentive to court danger. In hindsight, this behavior may seem irrational or mistaken, but after students experience the same incentives those policymakers faced, the questionable policies make sense.

This appeared in the 2006 Israel-Hezbollah war. Afterwards, Hezbollah chief Nasrallah said in a BBC interview that if he had known the Israelis would respond to the kidnapping of three soldiers with an invasion, he would never have sanctioned the kidnapping. In hindsight it was a

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[11] While the prisoners' dilemma and battle of the sexes are easy to run in class, the other two categories of games are more difficult. In my experience, the tricky part of in-class brinkmanship is arranging the random chance of disaster that brinkmanship relies on for its effect. I have had success with the following technique, but others may work equally well.

Each player starts out with a score of 10, and play proceeds in a series of rounds. During each round, both players will have chance to make risky provocations. Each player can choose a value for their preparations between 0-5. Both players should write it down secretly, then reveal it simultaneously. If both people write down 0 for two consecutive rounds the game is over and they keep whatever points they currently have.

If at least one person wrote a number bigger than 0, then each player subtracts his provocation number from the other's score and adds the sum to his own. For example, on the first round Joe writes 2 and Cecilia writes 4. Their scores at the end of the round would be Joe: 8 Cecilia 12. Scores can go negative.

After this, each player must secretly write down a set of numbers (from 1-50). Write down as many numbers as your provocation value (e.g. Joe writes 2 and Cecilia writes 4). It is important to enforce the rule that students cannot consult about what numbers to write down for this step. Then, each person reveals what he/she wrote. If the numbers you wrote match those written by your opponent (written in this round or an earlier one), then there is a disaster and the game ends with a significant penalty for both players. Subtract the smaller player's score from both scores. That produces a final score for each player. This produces a situation where increasing provocation offers increasing benefits, but also a greater chance of disaster.

mistake, but a brinkmanship game helps students understand how the thought of gaining prestige and influence in the Palestinian community led him to step too close to the brink.

It should be obvious to the students how using brinkmanship makes others' actions crucial, because it relies on a belief about the other's willingness to accept risk. A brinkmanship strategy that works against the United States, for example, would make little sense used against a terrorist network whose members are comfortable with the possibility of their own death.

The democratic West have traditionally been seen as vulnerable to this perception, as the history of US-North Korean interaction. The media often portrays Kim Jong-Il as "crazy" and "irrational," but his actions make perfect sense once one applies the logic of brinkmanship. Kim is quite aware of South Korea and the United States' overwhelming military superiority, but he also knows that war would be a disaster for both sides. His provocative nuclear tests, missile tests, and covert operations push the peninsula closer to war, forcing his opponents to decide whether resisting him is worth the increased risk of a war that would devastate South Korea. So far his opponents have always blinked first, making him look not only rational, but clever as well.

The logic of brinkmanship isn't limited to conflict. For example, the German central bank practiced it after WWI, telling the Allies that Germany couldn't afford to pay reparations--by raising inflation to rates that risked hyperinflation, it was forcing the Allies to make a choice between partial forgiveness or risking financial disaster and the probable loss of all reparation income (Ferguson: 2002). While the motives are less explicit, this same logic could be used to discuss debt forgiveness in today's world, or the strategies that led to derailment of WTO negotiations for the last five years. Relevant contexts might include:

- War Initiation
- Debt Forgiveness
- Crisis Resolution
- Any bargaining situation where failure is dangerous for both sides

Category: CPR problems

Common Pool Resource problems occur when many actors can draw from a single, but limited, source. In these situations, actors can control the amount of resources they draw from the common pool, but their choice has implications for everyone, because the pool cannot sustain unlimited withdraws from all actors. Each actor has a choice between withdrawing at a sustainable rate or cheating, and withdrawing more for his own personal benefit. Even at that maximum rate, no one actor can endanger the common pool, but if many actors cheat, the pool will be depleted, punishing cheaters and cooperators alike.[12] Like each of the other games, this forces students to see the importance of other actors' strategies in determining outcomes, but it is especially useful for helping them understand perverse incentives and the importance of communication.

The fact that one person can get away with cheating but too many cheaters cause disaster leads to perverse incentives for each individual. Individually, their choice has no direct impact on the final outcome, which means that they can get away with cheating. On the other hand, if they cooperate and too many others cheat, they suffer the consequences too. As in the prisoners' dilemma, each individual is better off cheating *no matter what anyone else does*. If they cooperate,

[12] As with Brinkmanship, in-class implementation can be tricky. In my classes, I have used the following procedure, incorporated into a scenario of fisherman drawing from a common, but limited stock.
Each group must have a recorder. That person will keep track of how many fish (I use lobsters) are left. At the beginning of the game there are 150 lobsters in the bay. At the beginning of each round, the recorder announces how many lobsters are left. Each fisherman (including the recorder) secretly writes down how many lobsters they'll catch that season. Each fisherman may take up to 10 per round. Then, the recorder will find out how many *total* lobsters were taken, without learning how much any *individual* took.

On a piece of paper, the recorder secretly makes a few (0-10) tally marks. She should remember that number. Then add as many tally marks as she harvested lobsters, and pass it to the left (The ease of monitoring can be adjusted by allowing students to take zero lobsters or putting a floor on how many they can take). That person will add as many tally marks as the lobsters they caught, then pass it to the left. This will continue all the way around the group. When it gets back to the recorder, she should count the total tally marks, then subtract the amount she originally put down. That will be the total harvested that season. Each lobster taken out by a fishermen reduces the total population by 1. At the end of each season the population grows by 10%. Add that increase, then tell the group the new total and do it again.

then the individual gets his suckers payoff, and if they cheat, then at least he "got while the getting' was good."

This is obviously applicable to many environmental problems—the classic "tragedy of the commons." Fisheries, oil supplies, even global warming can be phrased in these terms. Without an understanding of the perverse incentives generated by CPR problems, students are forced to conclude that non-compliance with environmental protection plans is driven by some combination of unconcern or ignorance. Once they themselves are placed in a similar situation, though, it is easy for them to realize that even concerned, knowledgeable actors can rationally pursue unsustainable policies. This realization leads them to see how difficult it is to solve these problems, and the role of communication and monitoring in any potential solution.

Convincing actors to cooperate requires two steps: first to forgo the opportunity of benefit of cheating, and second, that their sacrifice will be meaningful because others will cooperate also. After all, if everyone else cheats, then cooperation is no more meaningful than throwing one's self on one's sword. How the first part takes place is beyond the scope of this paper and usually relies on content-specific information (research studies that prove the ozone-damaging effects of CFCs, for example), but the second part typically relies on monitoring (and communicating those observations to all players)

Giving students the opportunity to monitor each other during play reveals how effective a solution it can be. Groups that successfully monitor each other are much more likely to preserve their resource and score highly. Typically, during debriefing members of successful groups mention how group members threatened potential cheaters. Members of a CPR community, even a temporary simulated one, have a variety of ways to sanction each other, ways which can be very powerful in the real world, where members often have extensive social interaction outside of resource extraction. The key here is that such threats are only meaningful if members can monitor each other's takes. This conclusion leads naturally to a discussion of how NGOs and UN study groups can play an important role in solving world problems. By monitoring national

or private actors, those groups can ensure compliance even if the groups themselves have no direct power. This can help students understand how NGO careers fit usefully into solving international problems.

Environmental problems are the only CPR issues. Any public good can be phrased as a CPR issue (where cooperating is contributing and cheating is free riding). Classic examples of this in international relations include:

- Provision of a liberal trading order, and
- Collective security

Conclusion

Game theory is much more than the prisoners' dilemma, but international relations pedagogy hasn't caught up. Introductory textbooks offer instructors a choice between treating game theory as a marginal diversion or one or two texts that rely extensively on game theory, to a degree that students at most universities will stumble on the technical issues before grasping the content. This is unfortunate, because using game theory in class can help students grasp difficult concepts even with highly technical presentations.

In this paper I lay out how four different games can help instructors convey three important concepts: strategic action, perverse incentives, and the importance of communication, in an effort to help bridge the gap between a theoretically based curriculum and real-world events. Integrating in-class games into lecture, with follow up in subsequent classes, can give students an accessible handle for these abstract concepts. Hopefully these suggestions will help international relations instructors go beyond the prisoners' dilemma to make game theory a useful item in their pedagogical toolbox.

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