

# PSCI 8367: Formal Models of IR

Vanderbilt University — Professor Brenton Kenkel

Fall 2024

This course provides an overview of the formal theoretical literature on international politics, with a disproportionate but not exclusive focus on theories of conflict. Because international political outcomes are the product of strategic interaction among states, formal models and game theory are invaluable tools for developing theories of international politics.

A primary goal of the course is to learn how to produce, not just consume, sophisticated models of IR.<sup>1</sup> To this end, our discussions of the readings will focus on *how* these papers arrive at their conclusions—the finer details of the modeling choices, the guts of the proofs.

## Contact

My office hours are on Tuesdays from 2:00–4:00pm in Commons 326. You can also just drop by whenever my door is open, though I may ask you to come back later if I don't have time at the moment.

You can also email me questions at [brenton.kenkel@gmail.com](mailto:brenton.kenkel@gmail.com). I try to respond to student emails within a business day. I don't often reply to emails at night or on weekends.

## Requirements

**Reading and weekly presentations.** You will read one article per week, in addition to material from William Spaniel's textbook *Formal Models of Crisis Bargaining* (Cambridge University Press, 2024). You should read this material slowly and carefully, with attention to the modeling details. Take notes while you read, and work through the math yourself to make sure you're following everything.

Each week (other than the first), two students will present portions of the week's main article at the whiteboard. We will divvy up responsibilities a week in advance. Each presentation should last about 45 minutes, leaving us some time at the end of class to discuss the paper in broader terms.

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<sup>1</sup>By sophisticated I don't mean complicated. Usually the most sophisticated models are the simplest ones.

**Problem sets.** I will assign short problem sets on a (roughly) weekly basis throughout the semester. These will mostly consist of exercises from the Spaniel textbook.

**Literature review.** You will pick a substantive topic or question in the study of IR, and then learn everything there is to know about the formal literature on that topic. (The topic you choose should probably be related to your final paper—see below.) Your literature review will be comprehensive, in that you will read literally every published formal theory paper on the topic in question. The recommended readings listed in the syllabus should provide a good starting point.

This paper is not a book report. It should be written in the style of the literature review in a published paper, though it will probably end up longer than a typical lit review section. Optimal lengths will vary, but I'm imagining 5–10 pages. You should address not only what questions the literature has answered, but also identify those that are still open.

The literature review is due at 5:00pm on Friday, October 25.

**Final paper.** You will write a final paper using a formal model to advance a novel theory of an important substantive question in international relations.<sup>2</sup> At a minimum, I expect you to have a feasible model setup and a solved equilibrium for some substantively compelling subset of the parameter space. The idea is to come away with a model framework that would be workable as the foundation of a second-year paper or dissertation chapter.

The paper should be written in the style of an academic publication. Results should be stated in the form of lemmas and propositions, and formal proofs should be supplied. Look to the papers I've assigned in this course as models for structure and content. This includes your proofs. You'll notice that good proofs are written in ordinary language, without uninterrupted walls of math. Translating the scribbles on your legal pad into something other scholars can understand is a critical part of writing formal papers.

A first draft of your final paper is due at 5:00pm on Friday, November 22. The final draft, along with an "R&R memo" summarizing how you responded to the feedback I provided on your first draft, is due at 5:00pm on Friday, December 13. You will also give a presentation of your final project on Monday, December 2, the last day of class.

#### **tl;dr**

- Presentation of results from the main reading every week.
- Short problem sets almost every week.
- Lit review due October 25.
- First draft of final paper due November 22.
- Presentation of final paper on December 2.

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<sup>2</sup>Students whose primary field is not IR may address a question in their own field, though ideally drawing from methods and models covered in this course.

- Final draft of final paper and R&R memo due December 13.

Your grade will be based on a convex combination of these things. Any time you spend worrying about your grade is time you're not spending learning to write better proofs.

## Summary of Topics and Readings

Each week has a single required paper that we will focus on in class. Most weeks also have a required chapter from Spaniel's *Formal Models of Crisis Bargaining*. At the end of the syllabus, there's an annotated section with comments and intellectual background on all of the articles, including the recommended readings.

### 1. August 26: The bargaining model of war.

*Required:* Fearon 1995.

*Textbook:* Chapters 2 and 6.

*Recommended:* Brito and Intriligator 1985; Wagner 2000; Walter 2009; Lake 2010.

### 2. September 2: Costly signaling.

*Required:* Fearon 1997.

*Textbook:* Chapter 9.

*Recommended:* Schultz 1998; Slantchev 2005; Yarhi-Milo, Kertzer and Renshon 2018.

### 3. September 9: Reputation.

*Required:* Baser 2024.

*Textbook:* Section 12.3.

*Recommended:* Acharya and Grillo 2015; Kreps and Wilson 1982; Sartori 2002; Walter 2006.

### 4. September 16: Arming.

*Required:* Meirowitz and Sartori 2008.

*Textbook:* Chapter 4.

*Recommended:* Coe 2011; Fearon 2018; Meirowitz et al. 2019.

### 5. September 23: Resource allocation.

The citations are easy to mix up—the main reading is the “Defending” Powell paper, not the “Allocating” one.

*Required:* Powell 2007b.

*Recommended:* Powell 2007a; Kovenock and Roberson 2012.

**6. September 30: Deterrence.**

*Required:* Baliga, Bueno de Mesquita and Wolitzky 2020.

*Recommended:* Powell 1989; Gurantz and Hirsch 2017.

**7. October 7: Commitment.**

*Required:* Debs and Monteiro 2014.

*Textbook:* Chapters 3–4.

*Recommended:* Powell 2006; Beviá and Corchón 2010; Dong 2024; Benson and Smith 2023.

**8. October 14: Alliances.**

*Required:* Bills and Smith 2024.

*Recommended:* Garfinkel 2004; Fang, Johnson and Leeds 2014; Wolford 2014; Benson, Meirowitz and Ramsay 2014.

**9. October 21: Domestic politics.**

*Required:* Krainin and Ramsay 2022.

*Recommended:* Jackson and Morelli 2007; Di Lonardo and Tyson 2022.

**10. October 28: Repression.**

This week's course will need to be rescheduled due to instructor travel.

*Required:* Sun 2024.

*Recommended:* Ritter 2014; Esteban, Morelli and Rohner 2015; Tyson 2018.

**11. November 4: Coordination.**

*Required:* Bueno de Mesquita and Shadmehr 2023.

*Recommended:* Bueno de Mesquita 2010; Chassang and Miquel 2010; Dragu and Lupu 2018.

**12. November 11: International institutions.**

*Required:* Awad and Riquelme 2024.

*Recommended:* Fang 2010; Ritter and Wolford 2012; Kennard 2020.

**13. November 18: Mechanism design.**

*Required:* Kenkel and Schram 2024.

*Textbook:* Chapter 11.

*Recommended:* Banks 1990; Fey and Ramsay 2007; Fey and Kenkel 2021.

## Annotated Reading List

### August 26: The bargaining model of war

**Fearon 1995.** Not the first paper to model war as the outcome of bargaining failure, yet (for good reason) the central text in the bargaining theory of war. By this stage in your PhD careers, you should already be familiar with the key substantive ideas in this paper. We will use it as an inroad to discuss bargaining with a continuum of types, comparative statics with general functional forms, and related technical issues.

**Brito and Intriligator 1985.** Ten years before Fearon 1995, this paper modeled war as a bargaining process and showed that incomplete information is necessary for negotiations to break down. So why does Fearon 1995 have 6,000 citations while this paper has only 260? (1) Fearon addressed his work to the major non-formal theories of conflict, while this paper mostly cites economists. (2) This paper is written in a wall-of-math style that would be hard for the average political scientist to parse now, let alone in 1985.

**Wagner 2000.** Fearon's model and its direct descendants treat bargaining and war as distinct processes—once negotiations break down, the game moves into a pure military phase. In reality, negotiations may continue as war is ongoing, and the goal of fighting is usually to induce the other side to concede rather than to achieve absolute victory on the battlefield. Wagner presents a roadmap for how to model the continuation of bargaining while war is ongoing. Also see his excellent book *War and the State*.

**Walter 2009.** The crisis bargaining model was originally developed to explain interstate war. But it is just as true for civil wars that fighting is costly and inefficient, and thus in theory some bargained solution ought to be preferable to all sides. Walter offers a clear review of how bargaining theory applies to civil war, including key points of distinction with the interstate context.

**Lake 2010.** Lake does a deep dive into the 2003 Iraq War, asking how well the bargaining model explains the outbreak of conflict and subsequent developments. A good extended example of how to use a case study to evaluate the strategic logic of a formal model.

### September 2: Costly signaling

**Fearon 1997.** If asymmetric information causes war, then how do we reduce information asymmetry? Fearon 1995 showed that just talking won't do the trick, due to incentives to misrepresent. Therefore, credible information transmission requires some kind of costly signal. Fearon here looks at two distinct modes of signaling, sinking costs and tying hands, concluding that the latter is generally preferable.

**Schultz 1998.** The tying hands/audience costs mechanism is generally thought of as the product of some kind of domestic interaction. Schultz provides a microfoundation for this idea, explicitly modeling the domestic political interactions that are supposed to give rise to audience costs. The political incentives of the opposition party are key here, buttressing the idea that democracies can generate higher audience costs.

**Slantchev 2005.** Military mobilization is often taken as an example of a sunk cost signal, but there is conceptual slippage here—mobilization incurs an advance cost but also may tie hands by increasing a state’s probability of victory and decreasing its *marginal* cost of fighting. Slantchev takes this seriously, modeling the multiple pathways through which mobilization affects crisis bargaining. The early chapters of his related book *Military Threats* also provide a nice overview of costly signaling theory.

**Yarhi-Milo, Kertzer and Renshon 2018.** An experimental study of costly signaling mechanisms conducted on members of the Israeli Knesset. I’ll admit to being skeptical about a lot of experimental IR because the typical experimental subject is quite different than the typical foreign policy decision maker. The sample of real-life political elites (from a context where foreign policy is a high priority) sets this paper apart.

## September 9: Reputation

**Baser 2024.** IR theorists going back to Schelling have been obsessed with building reputation, arguing that we might need to take actions that make no sense in the short run in order to preserve a reputation in the long run. But what’s the point of building up credibility unless you’re going to spend it at some point? Drawing from economic models of reputation, Baser builds a nice theory of reputation building and spending as a cyclical process in an environment where states’ types are mutable but sticky.

**Acharya and Grillo 2015.** Reputation is one of the most slippery concepts in IR theory. Does reputation just refer to what you’ve done in the past, or is it an inference others draw about what you’ll do in the future? Does acting tough automatically increase your reputation for toughness, or does this only work under particular circumstances? Acharya and Grillo help resolve some of this confusion with a Bayesian account of reputation-building.

**Kreps and Wilson 1982.** Consider an incumbent monopolist who faces a sequence of potential competitors. Deterring any one competitor from entering is not worth the cost, but it’d be worth it if you could deter *all* entrants by convincing them you’re tough. The chain store paradox is the observation that the subgame perfect equilibrium of this game involves no deterrence by the monopolist, despite the apparent incentive to act tough early on. Kreps and Wilson resolve the paradox by introducing the “crazy type” technology that Acharya and Wilson use in their analysis.

**Sartori 2002.** An alternative game-theoretic conceptualization of reputation in international relations. Players here do not have persistent types, so there are no long-run inferences being drawn as in the models inspired by the chain store paradox. Nevertheless, players coordinate their behavior in such a way that cheap talk signals today affect how a player is treated tomorrow.

**Walter 2006.** Walter applies the chain store paradox model to civil conflicts between central governments and separatist groups. There’s a nice substantive logic to this application: the idea of there being a known finite number of challengers, as in the baseline chain store model, fits well enough with a state facing separatist movements.

## September 16: Arming

**Meirowitz and Sartori 2008.** This paper accomplishes a lot. Substantively, it provides a microfoundation for why states might have asymmetric information about their military capabilities. Technically, it illustrates how to work with games with unobserved actions, as well as how to analyze general bargaining protocols rather than assuming negotiations proceed in a very specific way.

**Coe 2011.** The efficiency puzzle identified in Fearon 1995 is that war is costly, so bargaining ought to produce solutions that are mutually preferable to fighting. But, as Coe points out, maintaining peace in the long run typically entails some investment in arms, which is itself costly and inefficient. Isn't it better to spend \$100 billion one time to rid an adversary forever than to spend \$10 billion every year to deter them?

**Fearon 2018.** Fearon considers a dynamic setting where each country must make a costly investment in arms to deter predation by a competitor. Whereas Coe establishes that these arming costs might lead states to prefer war, Fearon focuses on the equilibrium level of arms spending and its determinants.

**Meirowitz et al. 2019.** If the costs of arming are an important drain on human welfare, as Coe argues, then we ought to figure out how to reduce militarization. Drawing from the economic analysis of bargaining with incomplete information, Meirowitz and coauthors show how a particular form of third-party mediation may effectively reduce incentives for militarization in a way that unmediated communication could not accomplish.

## September 23: Resource allocation

**Powell 2007b.** Many strategic problems in international relations, and political economy more broadly, take the form of a "Colonel Blotto game": you have limited resources to allocate among multiple objectives, facing adversaries also competing for the same objectives. Powell considers a fairly tractable Blotto game here, where one player has the continuous choice of how much defensive power to allocate to each objective, while the attacker makes a discrete choice of which objective to attack. The paper is framed around terrorism, but the modeling framework has broader applications.

**Powell 2007a.** A companion paper that considers a Blotto setting with asymmetric information, where the defender has private knowledge about the underlying vulnerability of each objective. This creates a dilemma for the defender: all else equal she would like to reinforce a vulnerable objective, but doing so might tip off the attacker about the vulnerability.

**Kovenock and Roberson 2012.** This is a reasonably comprehensive review essay about Blotto games, written for a technical audience. Use this paper as a reference if you're looking for a particular type of setup or assumption; it's not well suited for a front-to-back read.

## September 30: Deterrence

**Baliga, Bueno de Mesquita and Wolitzky 2020.** How can you design a strategy to react to cyberattacks, given that you may not know whether you were attacked, nor who attacked you? This is precisely the kind of complex strategic question that game theory can help us think through. This paper is obviously substantively important, and it also nicely illustrates how to extract meaningful and communicable results from a fairly involved modeling setup.

**Powell 1989.** Powell takes on one of the deterrence problems that motivated the invention of game theory in the first place: how can a state use its own nuclear arsenal to deter an attack, when it cannot credibly commit to launch a nuclear attack that will result in its own destruction? Powell models how a back-and-forth sequence of limited strikes can leave a state with “nothing left to lose”, thereby making its nuclear threat credible.

**Gurantz and Hirsch 2017.** Deterrence models are typically concerned with how the defending state can establish the credibility of its threat to retaliate. This model looks at a different informational angle, where the uncertainty is over the extent of the attacker’s intentions. Perhaps surprisingly, this form of uncertainty enables weak defenders to credibly threaten retaliation against small transgressions: only an extremely hostile challenger would want to attack if retaliation is assured, and a weak defender would rather fight a highly hostile adversary now than later.

## October 7: Commitment

**Debs and Monteiro 2014.** I could probably fill an entire course with formal papers illustrating how anticipated future power shifts create an incentive for preventive war. This article stands out for both substantive and technical reasons. Substantively, it highlights the importance of the distinction between exogenous and endogenous power shifts. Technically, it builds on the incomplete information and militarization models we have already encountered, incorporating the possibility of preventive conflict.

**Powell 2006.** The standard reference for arguments about shifting power and preventive war. This is the rare Powell paper where I actually don’t think the modeling is the center of the action. The most important part is the observation that a common logic of inefficiency due to “lock in” incentives underlies a wide variety of political economy theories with diverse substantive applications.

**Beviá and Corchón 2010.** Even if we strip away dynamic concerns about shifting power, there’s a kind of commitment problem inherent even in static crisis bargaining models. After one state makes concessions to stop an attack by another, what’s to stop the prospective attacker from pocketing the transfer and attacking to grab even more? Beviá and Corchón provide a simple political economy foundation for why transfer agreements can be self-enforcing.



**Dong 2024.** Technically similar to Debs and Monteiro in terms of looking at how the interaction of uncertainty and shifting power affects crisis bargaining, but with a distinct substantive focus on the inferences states draw from delays in negotiations.

**Benson and Smith 2023.** A nice bridge between our units on commitment problems and alliances, Benson and Smith show how a protracted process of alliance formation can create an incentive for preventive war.

## **October 14: Alliances**

**Bils and Smith 2024.** I struggled with which paper from the Smith Cinematic Universe to put as the single requirement for alliances week—you should really read all of them. I ultimately decided on this paper because it nicely illustrates an important principle for building models: generality in your functional form or distributional assumptions, besides being important for the robustness of your results, can actually make it easier to write proofs and explain the logic of your findings. I also like the way Bils and Smith connect the model results to quantitative empirics.

**Garfinkel 2004.** Most formal analyses of alliances take the composition of alliances as given, or reduce the problem to one of a single state choosing whether to intervene in an otherwise bilateral conflict. That's a sensible choice for many applications, as endogenizing the alliance formation process is conceptually and mathematically difficult. That difficult stuff is precisely what Garfinkel takes on in this paper.

**Fang, Johnson and Leeds 2014.** I think of this as the workhorse model of crisis bargaining between alliances: if you want to write down a formal model to explore some substantive question about alliance politics, the extensive form here is a pretty good place to start.

**Wolford 2014.** Wolford incorporates a costly signaling logic into a model of military coalitions, identifying an interesting “handicap signaling” tradeoff: forming a coalition may directly aid your bargaining power by increasing your effective power, while indirectly undercutting it by signaling you weren't strong enough to go it alone.

**Benson, Meirowitz and Ramsay 2014.** This paper approaches alliances from the standpoint of insurance contract theory. I see this as a standout example of the “political economy of conflict” approach, insofar as it takes political incentives and economic theory equally seriously.

## **October 21: Domestic politics**

**Krainin and Ramsay 2022.** The “prize” is usually treated as a completely abstract object in crisis bargaining models. This paper gets a lot of leverage by being just a bit less abstract, looking at bargaining over a bundle that includes some private goods that are rivalrous within the country that gains them and some club goods that are not. This allows for an analysis of how regime type affects war, without getting too deeply bogged down in modeling the internal politics of democracies versus autocracies.

**Jackson and Morelli 2007.** A simple but powerful model of how the internal division of costs and rewards from an international crisis affects incentives to go to war.

**Di Lonardo and Tyson 2022.** This paper studies how agency problems induced by domestic political turnover interact with the deterrence and commitment problems we've studied in earlier weeks. And like most of Tyson's IR work, a good illustration of how to use a parsimonious, easy-to-explain, easy-to-solve model to make a powerful argument.

## **October 28: Repression**

**Sun 2024.** This paper shows how indiscriminate repression might be a complement to targeted repression, rather than an alternative strategy for governments that don't have the capacity to target. From a modeling perspective, this paper does well incorporating economic microfoundations into a theory of an important political process.

**Ritter 2014.** Another simple but powerful model, using a contest framework to explain the strategic spillover effects between public dissent and government repression. Also an excellent example of how to *write* a formal paper, both in terms of justifying the assumptions and explaining the results.

**Esteban, Morelli and Rohner 2015.** An economics approach to explaining why governments may kill large numbers of their own citizens. Unlike many of the abstract bargaining models we've read, this model is directly tailored to extract empirical predictions and test them with data.

**Tyson 2018.** It can be hard to know when the "unitary actor" assumption is an appropriate simplification and when it is not. In this paper, Tyson makes a compelling case that we need to understand intrastate agency problems in order to properly understand government repression and civilian responses.

## **November 4: Coordination**

**Bueno de Mesquita and Shadmehr 2023.** One of my favorite things about this paper is just the model setup, collapsing the complex question of "material" versus "psychological" motivations from protest into one of rivalrousness versus non-rivalrousness of the reward. It is also a digestible illustration of the global game technology, not to mention being another example of good writing in the presentation of formal results.

**Bueno de Mesquita 2010.** The substantive concerns and modeling technology in this older Bueno de Mesquita paper are closely related to those in the more recent paper with Shadmehr, so I would recommend reading them in tandem. Also pay attention to the way both papers derive and talk about empirical implications, which differs (in a good way) from the more standard "here's a comparative static to run a regression on" approach.

**Chassang and Miquel 2010.** A global games approach to questions about deterrence and conflict in international politics.

**Dragu and Lupu 2018.** A simpler approach to coordination that doesn't rely on the global game technology. Notice that the authors do not treat multiple equilibria as a nuisance to be refined away, but rather as an important component of the substantive theory.

## November 11: International institutions

**Awad and Riquelme 2024.** One of the key questions about international organizations is what they can accomplish that states acting on their own cannot. The answer cannot be that these organizations provide some kind of unconditional benefit, as then we'd be unable to explain circumstances where states *don't* act through international organizations. Awad and Riquelme provide a compelling informational explanation for why states sometimes—and only sometimes—delegate to IOs.

**Fang 2010.** Fang builds on the Rubinstein alternating-offers bargaining model to model states' choices to seek third-party dispute resolution from an international organization. This paper is a good illustration of how to extract a lot of substantive implications from a fairly parsimonious model setup.

**Ritter and Wolford 2012.** The typical enforcement dilemma for an international institution is that a state may simply ignore the institution's decision. The dilemma is a bit different for an individual convicted by an international court, who can only evade punishment as long as they evade capture. Ritter and Wolford examine how pre-arrest bargaining can overcome this problem.

**Kennard 2020.** More of an IPE paper than an IOs paper, but you should read it and it belongs here better than in any other week. Kennard harnesses the “menu auction” modeling technology to explain why firms sometimes lobby in favor of environmental regulations that we typically think of as lowering corporate profits.

## November 18: Mechanism design

**Kenkel and Schram 2024.** Our entry in a tradition of research developing “game free” results about crisis bargaining, examining patterns of outcomes that must hold in any game with the same primitive features regardless of idiosyncratic choices about how negotiations are modeled. Our main innovation over previous research is to consider games with “hassling”-style intermediate options between total war and efficient peace.

**Banks 1990.** The original application of game free analysis to crisis bargaining theory. If I could force everyone who talks about international conflict to read (and understand) a single paper, it would be this one.

**Fey and Ramsay 2007.** Highly technical papers with walls of Greek letters aren't usually best described as “controversial” and “widely misunderstood”, yet here we are. This paper makes a convincing case that mutual optimism is not a cause of mutual war between rational (or even boundedly rational) actors. The importance of the restriction to *mutual* war cannot be understated.

**Fey and Kenkel 2021.** In the wake of Fearon 1995, there was a bit of a cottage industry of articles wondering whether Fearon’s use of an ultimatum game distorted the conclusions he reached about bargaining, incomplete information, and war. We show that the answer is no. In a wide class of crisis bargaining games with one-sided incomplete information, any pure strategy equilibrium involves a cutpoint on the type space where all low types settle at the same value and all high types fight—exactly the same outcome structure as a take-it-or-leave-it offer.

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