Laboratory Experiments[1]

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December 15, 2005

[1]The financial support of the National Science Foundation and the Center for Economic Policy Studies at Princeton University is gratefully acknowledged. I wish to thank many coauthors for sharing their insights about political economy experiments. I am especially indebted to Richard McKelvey. The editors provided helpful comments on an earlier draft.

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1 Introduction and Overview

Most of the laboratory research in political science follows the style that was pioneered in experimental economics a half-century ago by Vernon Smith. The connection between this style of political science experimentation and economics experimentation parallels the connection between economic theory and formal political theory.

This is no accident. In both cases, researchers who were trained primarily as theorists - but interested in learning whether the theories were reliable - turned to laboratory experiments to test their theories, because they felt adequate field data was unavailable. These experiments had three key features. First, they required the construction of isolated (laboratory) environments that operated under specific, tightly controlled, well-defined institutional rules. Second, incentives were created for the participants in these environments in a way that matched incentives that existed for the imaginary agents in theoretical models. Third, the theoretical models to be studied had precise *context-free* implications about behavior in any such environment so defined, and these predictions were quantifiable and therefore directly testable in these laboratory.

In fact, one of the key innovators of political science experimentation is Charles Plott, who conducted early economics experiments as well, to test the effect of economic institutions and rules on trade and exchange. It was a short but important step to use the same methods to compare different political institutions and rules vis-a-vis policy outcomes. Just as economic theory had models that made *quantitative* predictions about behavior in markets, formal political theories had begun to make precise quantitative predictions about behavior in non-market settings, such as elections, committees, and juries.

It is also no accident that this brand of experimentation followed rather than preceded similar research in economics. The lag in political science experimentation relative to economics reflects a similar lag in developing rigorous theory.

This chapter will be organized around a rough classification of four kinds of political science experiments that use the political economy/formal theory approach. This is obviously not an exhaustive list, and the discussion is intended to draw out the main insights from these experiments rather than being comprehensive (this would require a book-length chapter) They are: (1) *committee decision making*; (2) *elections and candidate competition*; (3) *information aggregation and committees*; and (4) *voter turnout and participation games.*

The initial political economy experiments investigated the most fundamental principle of the theory of committees: *committees operating under majority rule will choose Condorcet winners when they exist.* At first glance, this seems almost like an obvious point, but it turns out to depend in very subtle ways on what is meant by "operating under majority rule." Testing this basic hypothesis is as fundamental to political science as the discoveries by Vernon Smith that markets organized as double auctions result in competitive equilibrium prices and quantities – and that markets organized in other ways may not converge to competitive equilibrium. The bottom line for both kinds of experiments – the first political science experiments and the first economics experiments – was the quantitative equilibrium theories work pretty well in some settings, but institutions matter. While there was lots of casual evidence and qualitative historical analysis, laboratory experiments provided the first non-circumstantial evidence that institutions matter – and identified exactly how. Besides being non-circumstantial evidence, it also provided us with *replicable* evidence, and with *precise comparative static tests* about how changing preferences and institutions lead to changes in committee outcomes. And these effects could be clearly identified as causal, in the sense that preferences and institutions created in the laboratory are, by design, *exogenously specified and controlled*, while with the inherent limitations of historical data, one can only make weaker claims about correlations between preferences, institutions, and outcomes. Controlled laboratory experimentation circumvent problems of spurious correlation and endogeneity.

The next section of this chapter will examine two quite different approaches to the study of committee decision making. First it will explore and discuss in more detail the findings from this first line of political science experiments, which, in addition to studying institutions, also focus on questions of testing or improving *cooperative* game theoretic solution concepts . Second, we will discuss more recent experiments on committee bargaining that are designed to test theories from *noncooperative* game theory, focusing mainly on questions of distributive politics where Condorcet winners do not exist, in contrast to the earlier focus on the Downs-Hotelling spatial model with Euclidean preferences.

The second wave of political science experiments, which followed quickly after the experiments on the majority rule core, investigated the question of Condorcet winners in the context of competitive elections rather than small committees. These studies address a wide range of questions, all of which have received the attention of empirical political scientists for decades. The key questions we will focus on here are: retrospective voting; the Downsian model of spatial convergence of candidate platforms in competitive elections; the importance of polls in transmitting information to voters and coordinating voting behavior in multicandidate elections; and asymmetric competition that leads to candidate divergence.

More recently, both formal theorists and experimentalists have become interested in the problem of information aggregation in committees. The problem was posed originally by Condorcet and has become known as the Condorcet jury problem. Each member holds a piece of information about the true state of the world. The committee is charged with making a decision, and the correct decision depends on the state of the world. We will discuss briefly the experimental findings for Condorcet juries, and related issues of information aggregation through social learning.

An independent line of research, but one which has significant implications for mass elections, investigates factors affecting voter turnout. More generally, this includes participation games, and a wide range related phenomena involving coordination problems such as the volunteer's dilemma. Experimental studies of abstract games, in particular the game of chicken and the battle of the sexes, are also closely related. The third section of this chapter will try to highlight some of the insights and regularities across this wide range of experimental research.

2 Experiments in Committee decision making

This section discusses: (i) the earliest experiments that study the majority rule core and other concepts central to cooperative game theory; and (ii) more recent experiments that study committee bargaining under majority rule. Both of these kinds of experiments study allocation problems where the members have conflicting preferences over the possible outcomes.

2.1 Committee Bargaining in Multidimensional Policy Spaces

This line of research, beginning with the landmark article by Fiorina and Plott (1978), explores two distinctly different kinds of questions. First, it tests the basic theory of the core in small committees, and examines it's robustness with respect to the fine details of committee procedure.[1] This can be thought of as a "comparative statics" questions. The theory says that as preferences and/or procedures change in certain ways, outcomes from committee deliberation should change in corresponding ways. Second, it explores what happens in case the core fails to exist. We know from Plott (1967), McKelvey (1976,1979) and Schofield (1983), that nonexistence problems are rampant in these environments.

The basic theoretical structure in most of these experiments is the following. The set of feasible alternatives, A, is a convex concave subset of $\Re^2$, usually a square or rectangle.[2] There is a finite set of members of the committee, $I = \{1, ..., i, ..., n\}$ with Euclidean preferences, where n is an odd number for most experiments. Therefore, the environment is fully specified by $[A, I, x]$, where $x = (x^1, ..., x^i, ..., x^n) \subseteq A^n$ is the profile of members' ideal

[1] The core is a concept developed in cooperative game theory as the set of outcomes that are stable with respect to coalitional deviation under some well-defined institution. This is fomally modeled as a game in characteristic function form. An outcome is in the core if there doesn't exist some alternative feasible outcome that makes some subset (coalition) of individuals better off and that cannot be blocked by the larger group.

[2] In the actual experiments, the outcome space is given by a finite grid of points on the plane.

points. For any such environment, we can define the simple majority rule binary relation. For any pair of alternatives, $a, b \in A$, we write $a \succ b$ if a majority of the members of I strictly prefer a to b. In this case, we say a *defeats* b under majority rule. If a does not defeat b, we write $b \succeq a$. The majority rule *core*, or the set of *Condorcet winners*, $C \subseteq A$, includes precisely those alternatives that are undefeated under majority rule. That is $C = \{c \in A \mid c \succeq a \ \forall a \in A\}$. An implication of the results in Plott (1967) is that in these environments, if n is odd and the x^i are all distinct, then (i) the core coincides with one of the member's ideal points, call it x^{i^*} and (ii) the other members can be paired up in such a way that for each pair, the line connecting the ideal points of the pair pass through x^{i^*}. The condition is sometimes referred to as *pairwise symmetry*, and has a natural generalization to environments with arbitrary quasi-concave and continuous preferences with ideal points, in terms of pairs of utility gradients at the core point.[3]

2.2 Fiorina and Plott (1978)

Fiorina and Plott (1978) created sixty-five five-member laboratory committees, each of which deliberated under a simplified version of Roberts' Rules. The policy space included a fine grid of points in a two dimensional policy space. The two dimensions in the model correspond to policy choices, such as spending on defense and tax rates, but no labels as such were used in the experiments in order to maintain a neutral context. The policy space was, literally, the blackboard. Preferences were induced using monetary payments that depended on the outcome and differed across subjects. Iso-payment contours (indifference curves) were either concentric circles or ellipses, so this method extended to committee environments the *induced value* approach pioneered by Smith (1976) in market settings. Deliberation by each committee started at a status quo point that generated low payoffs for all members. Members could raise their hands and propose alternative points; a vote between the status quo and the alternative ensued, with the alternative replacing the new status quo point if it passed by receiving a majority of votes. This process could continue indefinitely, as long as members made new proposals. At any point, a member could make a motion to adjourn. If the motion to adjourn passed, the session ended and subjects were paid based on the last alternative that had passed (or the original status quo, if no alternative ever passed). The main treatment variable in the initial experiment was the preference profile, using two preference profiles for which a core existed and one where a core did not exist.[4] In the treatment where a core point did not exist, the ideal point of one voter was shifted a small distance, breaking

[3] Some experiments have been conducted using elliptical indifference curves, rather than circular (Euclidean). In this case the gradient version of pairwise symmetry applies.

[4] There also some some minor treatment variations regarding payoff magnitudes and communication limitations.

pairwise symmetry. Thus, this treatment was designed to test whether the discontinuous nature of core existence would lead to a discontinuous change in committee outcomes. It was an important variation to investigate, since results by McKelvey on global cycling (or "chaos") were widely interpreted at the time as implying anything can happen in the absence of a core point.

The principal findings were:

1. **Core Clustering.** When it exists, the core is the best predictor among 16 competing hypotheses to explain committee outcomes. While few outcomes are *exactly* at the core point, the outcomes tend to cluster nearby the core point, when it exists.

2. **Robustness.** The secondary treatments had little effect, although there was greater variance of outcomes when payoff magnitudes were low (low incentives).

3. **Continuity.** When the core point did not exist, but the preference profile was close to admitting a core point, the outcomes still clustered around a region in the policy space in much the same way as was observed when a core point existed! Thus, it appears that the distribution of committee outcomes varies continuously with the preference profile of the members.

The third of these observations is perhaps the most important. Why? The theory of the core is not a behavioral theory, but simply a property of the majority rule binary relation. The deliberation procedure, while simple to describe, is virtually impossible to model as an extensive form game. There is no theory of who makes proposals, no theory of how people vote on proposals, no theory of adjournment, and so forth. That is, Fiorina and Plott (1978) *and subsequent studies along the same line* investigate environments and procedures for which there is no accepted *behavioral* model to describe or predict individual actions. These are experiments that test axiomatic theories of social choice, not behavioral theories.[5]

2.3 The robustness of core clustering.

With few exceptions, subsequent research has reinforced most of the conclusions above. Berl et al. (1976) investigate some variations on the original Fiorina and Plott (1978) study, showing robustness to a number of factors including additional variations in preferences (using city block metric preferences).[6] In a later study, McKelvey and Ordeshook (1984)

[5]Fiorina and Plott and later studies suggest alternative hypotheses that are suggestive of a behavioral model (such as fairness), but do not construct or test such models.

[6]In spite of the earlier publication date, the experiments reported in Berl et al. (1976) were motivated by an early version of Fiorina and Plott (1978).

restrict agendas to issue-by-issue voting; they find that outcomes still cluster around the core. This, together with the findings about limitations on debate/communication illustrate how robust core clustering is with respect to significant procedural variation.[7]

Rick Wilson and his coauthors have conducted a range of different variations on Fiorina and Plott One of the most interesting assessed everyone on the committee a fixed cost (called an "agenda access cost") whenever a proposal is successful (Herzberg and Wilson 1991). This has two interesting and countervailing effects. First, it expands the set of core outcomes. For example in the Fiorina and Plott environment without a core, a core point exists even with small access costs. The second effect, is more subtle. Because changes are more costly, members are more reluctant to vote for *any* change, and this creates a drag on the process. Voters might vote against a change that makes them better off in the short run, because they fear the change will lead to further changes incurring additional costs. The findings therefore are mixed. For example, if a core already exists in the absence of access costs, then imposing access costs leads to more dispersion in the final outcomes, a negative effect. Outcomes still cluster near the core, but with more scatter, and occasionally the process fails entirely, without every moving away from the initial (bad) status quo. These experiments are instructive because they suggest behavioral models of individual behavior, such as risk aversion. They also suggest that individuals are not myopic in their voting decisions, but anticipate the future consequences of current votes.

Plott conducted additional experiments showing that the results replicate to larger committees[8] and also for committees where there was agenda control by one or more of its members. In Kormendi and Plott (1982), one member of a five member committee serves as a gatekeeper (called a "convener" in the paper) who was allowed to offer or unilaterally block proposals, in an environment with the same preferences as one of the Fiorina and Plott core treatments. This agenda power restriction changes the core, since blocking coalitions must include the agenda setter. The core expands and becomes the line segment between the original core point and the agenda setter's ideal point. The outcomes line up closely with the core predictions. Hence these experiments show that the majority rule core, modified to account for changes in proposal procedures, continues to predict committee outcomes. An important corollary is that subtle changes in procedures can cause dramatic changes in outcomes, as predicted by game theory.

There are some exceptions to the robustness of core clustering. One striking result is described in Eavey and Miller (1984a), which follows up on an earlier experiment by Isaac and Plott (1978).[9] Isaac and Plott studied 3 person committees with a convener, but with

[7]With issue-by-issue voting, a new alternative can alter the status quo on only one dimension.

[8]Plott (1991) replicates the FP results for committees with between 23 and 45 members.

[9]McKelvey and Ordeshook (1981) also find evidence that core selection depends on fine details of the

only a finite set of possible outcomes, so the environment was not framed to the subjects as a two dimensional policy space. There is a unique core, which predicts outcomes very well. Eavey and Miller point out that the core in that experiment was also a *fair* outcome that gives something to everyone. They designed a "critical" experiment in which the fair outcome is different from the core, and both are unique. They find that fair outcome was selected 8 out of 10 times, and the core was only selected twice. Eavey and Miller conclude that interpersonal comparisons (fairness, altruism, universalism) can affect outcomes in committees. Their result presaged the recent wave of social preference models in behavioral economics.

2.4 Committee Bargaining with fixed extensive forms

Eavey and Miller (1984b) modified the convener design by allowing the convener to make exactly one proposal, and then the committee adjourns. That is, an agenda setter makes a take it or leave it offer to the committee, when then decides between the offer and the status quo, according to majority rule. This is precisely the game form studied in Romer and Rosenthal (1978), called *the setter model*. It is modeled as an extensive form game in two stages. In the first state, the setter makes a proposal. In the second stage, there is a vote by the committee to accept or reject the setter's proposal. Then the game ends. The perfect equilibrium of the game is for the setter to propose the alternative he prefers most, among those proposals that at least a majority (weakly) prefers to the status quo. This proposal passes in equilibrium.

Eavey and Miller used both a discrete setting and a one-dimensional policy space and found little support for the setter model. Rather than extracting all the rents, the monopolistic setter offers proposals that leave something on the table for other committee members; another indication of fairness, and possibly social preferences.

This mirrors similar findings for two person committees with strict majority rule, otherwise known as the *ultimatum bargaining game*. In that game, one player proposes a split of a fixed amount of money. The second person either accepts the split or rejects it. If he rejects, both players receive 0. The subgame perfect equilibrium is for the proposer to offer either zero or the smallest positive amount, and for the responder to accept the offer. That rarely happens. The modal offer is an equal split and the mean offer is about 60-40. Many explanations have been offered for this clear violation of subgame perfect equilibrium.

The Rubinstein (1982) and Baron-Ferejohn (1989) bargaining models are comparable to the ultimatum game and the setter model, respectively, but in a divide-the-pie, or distributive politics, environment. The only difference is that the game does not end after the proposer makes a proposal, but continues in some fashion (usually with the proposer changing over

preference profile.

time) in the event the proposal is rejected. In versions of these games that have been conducted in the laboratory, the theoretical equilibrium has three essential properties:

1. **Proposer Advantage:** A committee member is better off if they are the proposer than if they are not the proposer.

2. **No Delay**: The first proposal is always accepted in equilibrium.

3. **Full rent extraction**: The offer to the other members of the committee (or the other bargainer in the two person case) is such that those voting for the proposal are exactly indifferent between voting for and against. Coalitions should be minimal winning.

There have been several laboratory studies of the Baron-Ferejohn bargaining model, and all have reached qualitatively similar conclusions that were foreshadowed by the Eavey-Miller experiment with the setter model. *Models that predict full rent extraction predict poorly if responders are allowed to veto the outcome, either individually, or as part of a blocking coalition.* This means the proposer in all of these settings must trade off the value of better proposal against the risk of having it voted down. But this risk implies that there must be delay, due to the unpredictability about the responder's behavior, and because different proposers will tolerate risk differently and have different beliefs. But there should still be a proposer advantage; and there is, although diminished somewhat because of the blocking threat.

There is insufficient space to cover the vast number of experimental studies of bargaining, both bilateral and multilateral. For bilateral bargaining, recommended reading is Roth (1995) and Camerer (2004, Ch. 4). For committee bargaining a la Baron-Ferejohn, see McKelvey (1991), Diermeier and Morton (2005), and Frchette, Kagel, and Morelli (2005). In all these experiments, where members often have different voting weights, one observes the same three qualitative findings: proposer advantage, delay, and only partial rent extraction.

3 Elections and Candidate Competition

The second wave of political science experiments, which followed quickly on the heels of committee experiments on the majority rule core, investigated the question of Condorcet winners in the context of competitive elections rather than small committees. These studies address many of the same questions that have received the attention of empirical political scientists. The key questions we will focus on here are: spatial convergence of candidate platforms in competitive elections; retrospective voting; and the importance of polls in transmitting information to voters and coordinating voting behavior in multicandidate elections.

3.1 Competitive elections and the Median Voter Theorem

The median voter theorem says that under certain conditions, in two candidate winner take all elections, candidate platforms will converge to the ideal point of the median voter. The theorem applies under fairly general conditions in one dimensional policy spaces with single peaked preferences, and under more stringent conditions in multidimensional policy spaces. Basically, if Condorcet winners exist, they are elected. Does this happen? Casual evidence indicates significant divergence of candidate and party platforms, even in winner take all elections. Laboratory experiments can help us understand why this may happen by informing us about what conditions are essential for convergences and which are inessential.

There has been extensive work on candidate competition in the one dimensional world with single peaked preferences and various conditions of information. The main contributors to this effort are McKelvey and Ordeshook, and much of this is detailed in their 1990 survey. I will cover only the basics here. First, in two dimensional policy spaces when a Condorcet winner exists, the candidates converge to that point. There is a process of learning and adjustment over time, but, just as competitive markets eventually converge to the competitive price, platforms in competitive elections converge to the Condorcet winner. Their original experiments showing this (McKelvey and Ordeshook 1982) were conducted with full information. Candidates knew the preferences of all voters and voters knew the platforms of the candidates. Candidates did not have policy preferences.

Through an ingenious series of subsequent experiments on spatial competition, McKelvey and Ordeshook (1985a, 1985b) pursued a variety of issues, mostly related to the question of how much information was required of voters and candidates in order for competitive elections to converge to the Condorcet winner. Perhaps the most striking experiment was reported in McKelvey and Ordeshook (1985b). These experiments used a single policy dimension, but candidates had no information about voters, and only a few of the voters in the experiment knew where the candidates located. The key information transmission devices they explored were polls and interest group endorsements. In a theoretical model of information aggregation adapted from the rational expectations theory of markets, they proved that this information alone is sufficient to reveal enough to voters that even uninformed voters behave optimally – i.e., as if they were fully informed.[10] A corollary of this is that the candidates will converge over time to the location of the median voter. They find strong support for the hypothesis of full revelation to voters, and also find support for candidate convergence. However, in an extension of this experiment to two dimensions, candidate convergence is slower; only half the candidates converge to the Condorcet winner with replication.

[10]Voters also are assumed to know approximately where they stand relative to rest of the electorate on a left right scale. But they don't need any information about the candidates per se.

A second set of experiments explores whether median outcomes can arise purely from retrospective voting. The earlier set of experiments with rational expectations and polls was forward looking and evaluation of candidates was prospective. In Collier et al. (1987), voters observe only the payoff they receive from the winning candidate after the fact – not even the platform adopted by the winning candidate, nor the platform of the losing candidate! There are no campaigns or polls. Voters either re-elect the incumbent or elect an unknown challenger. Candidates are better informed: they observe all the platforms that their opponent has adopted in the past, as well as the past election results. But candidates are given no information about the distribution of voter ideal points. They find that on average candidates converge to the median, even without much information.

One of the implications of these results is that it is irrational for voters to gather costly information, if other sources of information such as polls, endorsements, and word-of-mouth are virtually free. This point is made in Collier et al. (1989). That paper and Williams (1991) explore voter behavior and candidate convergence by extending these experimental environments by giving voters the option to gather costly information about candidates.

These experiments establish two important facts. First, even in laboratory elections where the stakes are low, election outcomes are well-approximated by median voter theory. The Condorcet winner (core) is an excellent predictor of competitive election outcomes. Second, this result is robust with respect to the information voters have about candidates and the information candidates have about voters. Precious little information is needed – a result that mirrors laboratory demonstrations that markets converge quickly to competitive equilibrium prices and quantities, even with poor information and few traders.

There has been great concern voice by political scientists and pundits about low levels of information in the electorate. One reason for this concern is a widely shared belief that these information failures can doom competitive democratic processes. The McKelvey and Ordeshook series of experiments dispels this doomsday view. Just as financial markets can operate efficiently with relatively few informed traders, or with many slightly informed traders, the forces of political competition can lead to election outcomes that reflect public opinion, even in information poor environments.

3.2 Multicandidate elections

In many elections, more than two candidates are competing for a single position using plurality rule. In these *multicandidate* elections, there is a natural ambiguity facing voters and in fact, almost anything can happen in equilibrium. The reason is that there are many Nash equilibrium voting strategies. To see this, just consider a three candidate election, with the candidates, A, B, and C having three distinct positions on a one-dimensional issue scale, say the interval $[-1, 1]$. Suppose there is a very large number of voters with ideal points scattered along the interval. Voters know their own ideal point, but have only probabilistic information about the other voters. Then, for any pair of candidates, $\{i, j\}$ there is a Bayesian equilibrium in which only these two candidates receive any votes, with each voter voting for whichever of the two is closer to their ideal point. This is an equilibrium because it never (instrumentally) pays to vote for a candidate who nobody else is voting for. Indeed there can be some other equilibria, too (Palfrey 1989, Myerson and Weber 1993), but 2-candidate equilibria are the only ones that are stable (Fey 1997). Voters face a coordination problem. Which two candidates are going to be receiving votes? Will a Condorcet winner be chosen if it exists?

Forsythe et al. (1993, 1996) explore these and other questions in a series of experiments. Their laboratory elections had three categories of voters defined by different preference orders over the three candidates. One group preferred A to B to C. The second group preferred B to A to C, and the third group ranked C first and was indifferent between A and B. The third group was the largest, but was less than half the population. Groups one and two were the same size. Hence, if voters voted for their first choice, C will win, but C is a *Condorcet loser*[11], since it is defeated by both A and B in pairwise votes. There are many equilibria, including the three two-candidate equilibria noted above, but because of a special configuration of preferences and because there is complete information, sincere voting is also an equilibrium.

First, they note that without any coordinating device, there is coordination failure. Some voters in groups one and two vote strategically (i.e., for their second choice, trying to avoid C) but many don't, and the strategic behavior is poorly coordinated, so as a result the Condorcet loser wins 90% of the elections!

Second, they look at three kinds of coordinating devices: polls, past elections, and ballot position. Polls allow the voters in groups 1 and 2 to coordinate their votes behind either candidate A or candidate B. This is indeed what happens. The Condorcet loser wins only 33 percent of the elections. Moreover, when either A or B is first ranked in the poll, the Condorcet loser wins only 16 percent of the time. Election history also helped with coordination. There was a small bandwagon effect between A and B. Whichever was winning in past elections tended to win in future polls. Ballot position had an effect on voting strategies, but the effect was too small to effect election outcomes.

Their second paper looks at alternative voting procedures, comparing plurality rule to the Borda Count (BC) and Approval Voting (AV). Both procedures worked better than plurality rule, in the sense that the Condorcet loser was more easily defeated. Both procedures tended to result in relatively close three-way races with A or B usually winning. Plurality, in contrast, produced close three-way races, but with C usually winning.

[11] A Condorecet losing candidate is one who is defeated in a pairwise vote with any of the other candidates.

This line of work has been extended in a number of directions. For example, Gerber, Morton, and Rietz (1998) look at cumulative voting in multimember districts to see if it can ameliorate problems of minority under-representation. Theoretically, it should due to the similar problems of strategic voting and coordination. They run an experiment and find it makes a difference, and the data supports the main theoretical results.

In these studies, only voter behavior is examined, since there are no candidates in the experiment. Plott (1991) reports experiments with 3-way plurality races where candidates choose positions in a policy space, and voter ideal points are located so an equilibrium exists. He finds that candidates tend to cluster near the equilibrium point.

3.3 Asymmetric Contests

In many elections, candidates are asymmetric. A widely cited source of asymmetry is incumbency. It is generally thought that incumbents have a significant advantage over challengers, above and beyond any advantage (or disadvantage) they may have due to spatial location. Other sources of asymmetries include valence characteristics of candidates, such as a familiar name, movie or athletic star status, height, articulateness, and personality traits. The two key aspects of these valence characteristics are: (1) most voters value them, independent of the candidate platforms; and (2) they are fixed, rather than being chosen by the candidates. With strategic competition, candidate asymmetries have interesting and systematic implications for equilibrium platforms. These asymmetric contests have been studied recently both theoretically and empirically in game theoretic models by Erikson and Palfrey (2000), Ansolabehere and Snyder (1999), Groseclose (2001), Aragones and Palfrey (2002, 2004, 2005), and others.

Groseclose (2002) and Aragones and Palfrey (2003, 2005) show that valence asymmetries lead to candidate *divergence*, even in one-dimensional spatial models. The equilibria, which can be either mixed strategy equilibria or pure strategy equilibria (if candidates have policy preferences and there is enough exogenous uncertainty) have two interesting features. First, a disadvantaged candidate will tend to locate at more extreme locations in the policy space than the advantaged candidate. Second, the extent to which this happens depends on the distribution of voters, in a systematic way. As the distribution of voter ideal points becomes more polarized (e.g., a bimodal distribution), the disadvantaged candidate moves toward the center, while the advantaged candidate moves in the opposite direction, and adopts more extreme positions.

Aragones and Palfrey (2004) report the results of an experiment designed to test whether these systematic effects can be measured in a simplified spatial competition environment. Candidates simultaneously choose one of three locations, {L,C,R}. The location of the median voter is unknown, but they both know the distribution of voters. The median is located at C with probability α, and located at either L or R with probability $(1-\alpha)/2$. Candidate 1 is the advantaged candidate; he wins if the median voter is indifferent (in policy space) between the two candidates, which happens if the candidates locate in the same position, or if one chooses L and the other R. Their main treatment variable is α, the probability the median is located at C, which in different sessions takes on values of either 1/5, 1/3, or 3/5. The equilibrium is characterized by a pair of probabilities of locating at the central location, one for the advantaged candidate (p) and one for the disadvantaged candidate (q). These equilibrium probabilities are ordered as follows.

$$0 < q_{3/5} < q_{1/3} < q_{1/5} < \frac{1}{3} < p_{3/5} < p_{1/3} < p_{1/5} < 1$$

The data perfectly reproduce this ordering of candidate locations, for all treatments. The result appears to be robust, and has been replicated successfully with different subject pools and instruction protocols.

4 Information aggregation in committees

The standard model for information aggregation in committees is one in which a like minded group of individuals must choose a policy whose (common) payoff depends on an unknown state of the world. But the committee has limited information about the state of the world. To compound matters, this information is decentralized, with each member having some piece of information. The task of the committee is to try to boil down this information into a decision that would be as efficient as the decision of a rational Bayesian who had access to all the scattered pieces of information. Using a model with two states of the world and two alternatives, Condorcet argued that majority rule would be the most efficient voting method to solve this problem. While his 2x2 model has become standard, his approach and conclusions about the superiority of majority rule has met with criticism because he assumed voters would vote sincerely. That is, if a voter's private information indicated policy A is probably better than B, they will vote for A regardless of the voting rule. However, since the work of Austen-Smith and Banks (1996), this assumption is now known to be flawed, in the sense that rational players would not necessarily vote that way. Nash equilibria of the voting game can involve complicated strategies, and can lead to perverse outcomes. Moreover, the equilibrium strategies are highly sensitive to the voting rule itself.

The key experimental paper in this line of research is Guarnaschelli et al. (2000). That paper was inspired by the Feddersen and Pesendorfer (1998) result that the rule of unanimity in juries is flawed, since the Nash equilibrium may lead to a higher probability of convicting the innocent than sub-unanimity rules, including majority rule. Furthermore, the problem can be worse in larger juries than smaller juries. This directly contradicts the standard jurisprudential argument for unanimity rules and large (12-member) juries. Naive intuition suggests that raising the hurdle for conviction will reduce the chances of a false conviction. But that intuition relies on an assumption that voting behavior is unaffected by the voting rule, in particular, voters are nonstrategic. Game theoretic reasoning says the opposite: when the hurdle for conviction is raised, voters are less willing to vote to acquit.

There are at least three reasons to be skeptical of the behavioral predictions of Nash equilibrium in this setting. First, if the naive intuition of legal scholars and great thinkers like Condorcet is that voters will be sincere, then why wouldn't voters also follow the same intuitive reasoning? Second, the strategic reasoning underlying the Nash equilibrium is quite complicated, and its computation requires, among other things, repeated application of Bayes' rule and conditioning on low probability events (pivot probabilities). There is ample evidence from experimental psychology that judgements of low probability events are flawed, and that individuals often fail to apply Bayes' rule correctly. Third, the equilibrium is in mixed strategies, and there is laboratory data in other contexts indicating that Nash equilibrium does not predict that well in games with mixed strategy equilibria.

In fact, it was a fourth reason that motivated the experiment: *Quantal Response Equilibrium* (or *QRE*, McKelvey and Palfrey 1995, 1998) makes much different predictions about the effects of size and the voting rule compared to Nash equilibrium. The QRE model assumes the players are strategic, and are aware other players are also strategic, but players are not perfect maximizers.[12] Rather than always choosing optimally, players choose better strategies more often than worse strategies, but there is a stochastic component to their choices, so inferior strategies are sometimes selected. With the additional stochastic term in the picture, standard jurisprudential arguments emerge as properties of the equilibrium: majority rule should lead to more false convictions than unanimity, and larger unanimous juries produce fewer false convictions than smaller unanimous juries.

A central finding in Guarnaschelli et al. (2000) is that the predictions of QRE capture the main features of the data quite well, both with respect to comparative statics and quantitatively, and most of the Nash equilibrium comparative static predictions fail. But perhaps more interesting is what the data say about the three "obvious" reasons to be suspicious of the Nash equilibrium behavior. (1) Do voters follow the same naive intuition as legal scholars and great thinkers? No. They behave strategically.[13] (2) Is the strategic reasoning too complicated for voters in the laboratory to behave according to theory? No. Their strategic behavior is consistent with the Logit version of QRE, which requires even more complicated

[12]The model reduces to Nash equilibrium if players are perfect maximizers.

[13]Ladha, Miller, and Oppenheimer (1995) also find evidence of strategic voting in information aggregation experiments.

computation than the Nash equilibrium. (3) Does the fact that the equilibrium is in mixed strategies lead to problems? No. In fact, QRE assumes that behavior in inherently stochastic and accurately predicts the probability distribution of aggregate behavior. Analysis of individual behavior in these experiments uncovers a wide diversity of patterns of individual choice behavior. Aggregate behavior is consistent with the interpretation of mixed strategy equilibria (or QRE) as an "equilibrium in beliefs."

Others have investigated variations on this basic jury model. Hung and Plott (2001) look at majority rule juries that vote sequentially rather than simultaneously and obtain results similar to earlier experiments with simultaneous voting.[14] This provides some support for the theoretical result of Dekel and Piccione (2000) that the order of voting does not matter in this game.

Morton and Williams (1999, 2001) run experiments that are a hybrid of the Hung-Plott sequential elections and earlier experiments described above on multicandidate elections. Just as polls coordinate information for voters, so can sequential elections. Indeed this is exactly the idea behind bandwagons in primary campaigns. Voters of the same party converge on the candidate who seems most likely to win in the general election (ceteris paribus). Different voters have different hunches about the electability of the candidates and so the question is whether this information is gradually aggregated over sequential elections. Their experiments show that voters do indeed learn from earlier results.[15],

A related set of questions falls under the heading of social learning and information cascades. These information aggregation problems are relevant to political science, economics, sociology, and finance. Using the same information structure as Condorcet juries, a sequence of decision makers chooses a private action, whose payoff depends on the state of the world. They have a piece of information, and are able to observe the choices of some subset of the other decision makers. In the canonical version (Bikhchandani et al. 1992), the decision makers move in sequence and can observe all the previous choices. In these models, it is easy to have information traps, where after a few moves all decision makers choose the same action, regardless of their private signal. This happens because the information contained in the actions by a few early movers quickly swamps the information content of the small piece of private information. These are called *herds*, or *information cascades*. Several experiments have been conducted to test whether these information cascades can be observed in the laboratory. Anderson and Holt (1997) do observe such phenomena, even though they only consider sequences of 6 decision makers. Hung and Plott (2001) successfully replicate these findings.

[14]In these experiments the majority rule Nash equilibrium is sincere voting.

[15]A somewhat different bandwagon model (more closely aligned with the standard jury setup) has been studied theoretically by Fey (1997) and Callander (2003).

However, these herds turn out to be quite fragile. A subsequent experiment by Goeree et al. (2004) looks at longer sequences of 20 and 40 decision makers. They find that while herds do form, they usually collapse very quickly, leading to a cycle of herd formation and collapse. Beliefs do not become stuck, so the information trap is avoided. For example, they find that herds on the "correct" action are more durable than herds on the incorrect action, and as a result there is a tendency for information cascades to "self-correct." Furthermore, they find a decreasing hazard rate: the probability a cascade collapses is a decreasing function of how long it has already lasted. In a companion paper Goeree et al. (2003) prove that these and several other features of the cascade cycles are consistent with the same QRE model that was applied earlier to the jury experiments. In a QRE, there is full information revelation in the limit, as the number of decision makers in the sequence becomes large.

5 Voter Turnout and Participation

Fiorina (1990) dubbed it "The paradox that ate rational choice theory." A typical statement of the paradox is the following. In mass elections, if a significant fraction of voters were to turn out to vote, the probability any voter is pivotal is approximately equal to zero. But if the probability of being pivotal is zero, it is irrational to vote because the expected benefits will be outweighed by any tiny cost associated with voting. Hence the fact that we see significant turnout in large elections is inconsistent with rational choice theory. A common (but misguided) inference from this is that rational choice theory is not a useful approach to understanding political participation.

Palfrey and Rosenthal (1983) take issue with the logic of the paradox. They point out that turnout should be modeled as a "participation game", and that zero turnout is *not* an equilibrium of the game, even with rather high voting costs. In fact, as the number of eligible voters becomes large (even in the millions or hundreds of millions), they prove the existence of Nash equilibria where two-party elections are expected to be quite close and in some cases equilibrium turnout can be nearly 100%. Those high turnout equilibria also have some other intuitive properties; for example, the minority party turns out at a higher rate than the majority party.

Schram and Sonnemans (1996) present results from an experiment designed to not only test the Palfrey-Rosenthal theory of turnout, but also to compare turnout in winner-take-all (W) elections to turnout in proportional representation (PR). They studied 2 party elections with 12, 14, or 28 voters in each election. The main findings were:

1. Turnout in the early W elections started around 50%, and declined to around 20% by the last election. The decline was steady, and it's not clear whether it would have declined even further with more experience.

2. Turnout in the early PR elections started around 30%, and declined to around 20% in the last two elections. The decline was very gradual in these elections, and it's not clear whether it would have declined even further with more experience.

3. The effects of electorate size and party size are negligible.

One puzzling feature of their data is that initial turnout rates in the PR elections were so much lower than initial turnout rates in the W elections. A possible explanation is coordination failure and multiple equilibria. While both voting rules have multiple equilibria, it is only the W elections for which equilibria exist with *high* turnout rates (above 50%). My interpretation of these experiments is that the severe multiple equilibrium problems identified by the theory present tremendous strategic ambiguity to the subjects and render the data almost useless for evaluating the effect of voting rules and electorate size on turnout. Despite this shortcoming, the experiments provide an interesting source of data for understanding coordination failure and the dynamics of behavior in coordination games.

Levine and Palfrey (2005) take a different approach to addressing comparative statics questions about the effect of electorate size, relative party size, and voting cost on turnout in W elections. Their design follows Palfrey and Rosenthal (1985), where all voters in a party have the same benefit of winning, but each voter has a privately known voting cost that is an independent draw from a commonly known distribution of costs. The equilibria of these games, involves cutpoint strategies, whereby voters in party j with costs less than a critical cost, c_j^* vote and voters with costs greater than c_j^* abstain.

They conduct an experiment where electorate size can take on values of 3, 9, 27, and 51 and the cost distribution is chosen so as to avoid multiple equilibria. For each electorate size, N, there are two party size treatments, called *toss-up* (T) and *landslide* (L). In the T treatment, the larger party has $N_B = \frac{N+1}{2}$ members and the smaller party has $N_A = \frac{N-1}{2}$ members. In the L treatment, the larger party has $N_B = \frac{2N}{3}$ members and the smaller party has $N_A = \frac{N}{3}$ members. This produces a 4×2 design.[16] In all elections, there is a unique Bayesian Nash equilibrium. The comparative statics of the equilibrium are simple and intuitive. There are three main effects.

1. **The Size Effect:** Turnout should be decreasing in N for both parties.

2. **The Competition Effect:** Turnout should be higher for both parties in the T treatment than in the L treatment.

3. **The Underdog Effect:** Turnout should be higher for the smaller party than the larger party, with the exception of $N = 3$, an unusual case where the larger party has higher equilibrium turnout.

[16] When $N = 3$, the toss-up and landslide treatments are the same.

The aggregate results conclusively support the Bayesian Nash equilibrium comparative statics. All differences in turnout rates have the theoretically predicted sign, except for $27T - 51T$, where the differences for both parties are negligible (less than 0.01). Table 1 below compares the observed turnout rates to the Bayesian Nash equilibrium predictions.

Table 1 here.

All of the predicted qualitative comparative statics results are observed. The results are also very close quantitatively to the equilibrium predictions, with one caveat. The turnout probabilities are slightly less responsive to the treatment parameters than equilibrium theory predicts. This is particularly noticeable for the largest electorate, where the turnout probabilities are significantly greater than the predicted ones. These attenuated treatment effects are consistent with QRE, which, in particular predicts *higher* turnout than the Nash predictions for large electorates, and *lower* turnout in the $N = 3$ treatment.

There are two other kinds of laboratory experiments that are related to the voter turnout question. The first of these is voluntary contribution public good games, where individuals can sacrifice some personal earnings for the benefit of other group members. The most striking results are seen in experiments where it is a dominant strategy for to contribute nothing, as in the Prisoners Dilemma. This has a long tradition, and the interested reader is referred to the excellent (but now somewhat dated) survey by John Ledyard (1995). This research has identified an array of environmental, institutional, psychological, and sociological factors that influence the degree of cooperation in these games. This variety reflects the many disciplines that have contributed (and continue to contribute) experimental research in this area.

The second group of related experiments examine threshold public goods games. In these games, there is a single group and each member faces a participation cost. If the total number of participants exceeds a known fixed threshold, then everyone in the group receives a prize, and the value of the prize exceeds the participation cost. These are generalizations of the game of chicken and the stag hunt games, rather than the prisoners dilemma game. The voter turnout game is only slightly more complicated, with the threshold of each party being endogenously determined by the turnout choices of the other party. Thus it is as if there were a random threshold.[17] A series of experiments by Palfrey and Rosenthal (1991a, 1991b, 1994) study incomplete information versions of the these games (analogous to the Levine-Palfrey incomplete information versions of turnout game) and explore the effects of communication and repeated play. They find that the Nash predictions are fairly accurate, but there is strong evidence that the players have biased beliefs about the contribution behavior of their opponents: the behave as if they think the other members of the group are

[17] See Suleiman et al. (2001).

more generous than is actually the case. Goeree and Holt (2005) investigate a more general class of games that include these threshold games.

6 Concluding thoughts

The short length of this chapter required leaving some gaping holes in the political economy laboratory experimental literature. To complete the picture of political science experimentation (or at least the "economic" brand of such) would require an much deeper discussion of the all the above topics, especially the early experiments on committee bargaining in a spatial setting.

What is on the horizon in the coming decade of laboratory research in political economy? Using history as a guide, laboratory experiments in political economy will follow the current trends in theory. Thus, for example, new experiments relating to *the design of optimal voting procedures in committees* are a good bet, since there has been a flurry of theoretical research on this recently. In fact, we are beginning to see some experiments along this line, such as Hortala-Vallve (2004) and Casella, et al. (2003, 2005), which explore the behavior of laboratory committees using novel voting methods that allow members to express strength of preference. The research on *deliberation and information transmission in committees with conflicting preferences* (e.g., Austen-Smith and Feddersen 2005, Meirowitz 2004) suggest a wave of experiments that would be a hybrid of the early committee experiments and the more recent experiments on information aggregation in juries. A third set of experiments is suggested by theoretical models of *endogenous candidate entry.* These could blend insights from the earlier experiments on candidate spatial competition and more recent experiments on entry and coordination in abstract games. To date there have been no experiments that investigate citizen-candidate models of political competition, and other models of competition where entry and candidate policy preferences are important factors. Fourth, in the study of both politics and economics, there is a new behavioral revolution in theory that relaxes the model of perfect rationality, borrowing liberally from results in experimental psychology. This theoretical approach will surely be complemented and enriched even more by laboratory experiments in the coming years.

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Table 1: Comparison of Nash Equilibrium Turnout Rates and Data ($p = turnout$). Levine and Palfrey (2005)

N	N_A	N_B	p_A^{Data}	p_A^{Nash}	p_B^{Data}	p_B^{Nash}
3	1	2	.530 (.017)	.537	.593 (.012)	.640
9L	3	6	.436 (.013)	.413	.398 (.009)	.374
9T	4	5	.479 (.012)	.460	.451 (.010)	.452
27L	9	18	.377 (.011)	.270	.282 (.007)	.228
27T	13	14	.385(.009)	.302	.356 (.009)	.297
51L	17	34	.333 (.011)	.206	.266 (.008)	.171
51T	25	26	.390 (.010)	.238	.362 (.009)	.235