# Computational Models of American Politics

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Kollman, Miller, & Page (APSR, 1992)

# Introduction

- Original spatial models and subsequent extensions rely on unrealistic assumptions to produce equilibria.
- These models assume that political parties are self-interested, have complete information, and can locate optimal strategies regardless of complexity.
- Examine boundedly rational parties in a model of two-party spatial elections.
- Model parties as incompletely informed and adaptive.
- Parties incrementally move toward better regions of the space using search algorithms.

# Research Questions

- Do informational and computational constraints lead to arbitrary outcomes, with winning party platforms scattered throughout the policy space?
- Do boundedly rational parties converge toward centrist platforms?
- Do challengers always defeat incumbents?
- Does altering the preferences of parties from vote maximizing to winning with ideals affect the behavior of parties?

# Voter Utilities

- Two parties compete for votes ($V$) in an $n$-dimensional issue space.
- Voter's preferences are represented by ideal positions and strengths on $n$ issues.
- For each issue there are $k$ possible positions and $s$ possible strengths.
- Voter's utility from a party's platform is:

$$u_j(y) = -\sum_{i=1}^{n} s_{ji}(x_{ji} - y_i)^2 \tag{1}$$

  where $s_{ji}$ is the $j$th voter's strength (preference intensity) on the $i$th issue, $x_{ji}$ is the $j$th voter's ideal point, and $y_i$ is the party's position on the $i$th issue.
- Voter's strengths and ideal points are independently and uniformly distributed.
- Each voter casts a ballot for the party providing the highest utility.

# Political Parties

- Parties are initially represented by a randomly selected "ideal" platform.
- Assume parties have uniform strengths across all issues.

# Political Parties

- Parties are initially represented by a randomly selected "ideal" platform.
- Assume parties have uniform strengths across all issues.
- Consider two types: ambitious and ideological.
- Ambitious: only care about winning elections.
- Ideological: also want to win elections but want to win with a platform close to their ideal platform.

# Political Parties

- Ambitious parties attempt to maximize votes because a larger margin of victory may make them more difficult to defeat in subsequent elections.
- Ideological parties primary goal is to win the election and once secured, attempt to get as close to their ideal platform as possible.

# Elections

- During each election, the incumbent party's platform is fixed.
- The challenger party attempts to find a platform that defeats the incumbent.
- In the first election the incumbent party remains at its ideal platform.
- In subsequent elections, the incumbent remains at the platform where it won the previous election.
- The challenger party attempts to defeat the incumbent by choosing a new platform.

# Campaigns

- Parties do not know voter utility functions.
- The challenger party tests new platforms on voters who have perfect information about both platforms (think political polling).
- The challenger receives feedback from voters in the form of vote totals based on a comparison of the current platform to the incumbent.
- The challenger then adapts their platforms, trying to defeat the incumbent.
- Campaigns are of a finite length, so parties are limited in the number of polls they can conduct.
- During any platform adaptation, the parties are limited by the number of issues they can change and the degree of change on each issue.

# Search Procedures

- Three types of parties:
  - random adaptive parties (RAPs)
  - climbing adaptive parties (CAPs)
  - genetic adaptive parties (GAPs)
- The search procedures are mechanisms for the party to choose the platform it presents to the voters against the incumbent.

# Search Procedures

**RAPs**

- Least adaptive.
- Randomly generate $L$ (length of campaign) platforms in the neighborhood of their previous platform and choose the platform that receives the most votes against the incumbent.

# Search Procedures

### CAPs

- Begin with current platform and experiment, slightly changing positions on a few issues.
- If new platform fares better against the incumbent than the previous one, the party switches to the new platform.
- These platform tests are hill-climbing iterations, where $L$ equals the number of hill-climbing iterations before the election.
- Select a candidate and adapt the candidate's platform to the electorate's views by conducting polls.

# Search Procedures

GAPs

- Use a genetic algorithm to guide their search.
- Potential candidates shift positions by both borrowing from competitors and by testing their own alterations.

# Search Procedures

GAPs

- Genetic algorithm has three procedures (assume 12 platforms).
  1. Reproduction: randomly select (with replacement) 12 pairs of candidates from the list and reproduce only the preferred member from the list.
  2. Crossover: randomly arrange the candidates in pairs. Each candidate randomly decides (with $p = 0.5$) whether or not to change positions on a few issues. If they decide to switch, they exchange groups of positions.
  3. Mutation: each candidate can randomly alter positions on an issue or two.
- Each application of the three procedures is called a generation.
- Each generation is two units of campaign length since both crossover and mutation involve candidates altering platforms.
- At the end of $L$ ($L/2$ generations), the party chooses the best-to-date platform.

# Outcomes of Interest

- Evaluate democratic outcomes using a measure of the goodness of each outcome called centrality:

$$c(y) = \frac{\sum_{j=1}^{V} u_j(median)}{\sum_{j=1}^{V} u_j(y)} \tag{2}$$

- The numerator is the sum of the utilities of the individual voters if the winning party were located at the median on all issues.
- The denominator is the sum of the utilities of the individual voters resulting from the winning party in the election.
- The closer the winning candidate is to the weighted center of voter preferences the more responsive the democratic outcome.

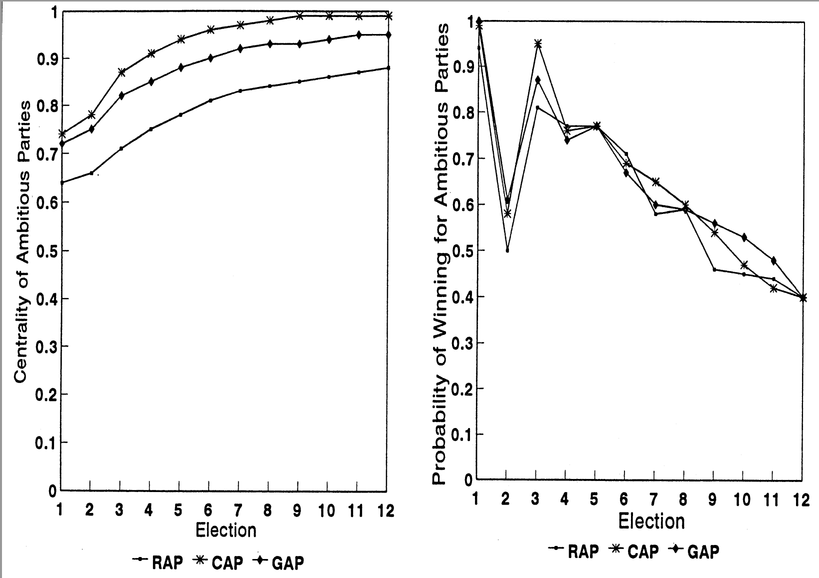
## Outcomes of Interest

- The ability of ambitious and ideological parties to defeat the incumbent.
- How far ideological parties must stray from their ideal platform to do so.
- The effect of the length of campaigns, which represents the amount of information parties have about voters before an election.

# Parameter Settings

- Choose parameter values that seem realistic in the study of democratic elections.
  - Voter types ($V$): 251
  - Number of issues ($n$): 15
  - Positions per issue ($k$): 7
  - Strengths ($s_{ji}$): 3
  - Elections: 12
  - Campaign length ($L$): 40
- Ran 200 simulations for each party and type of algorithm.

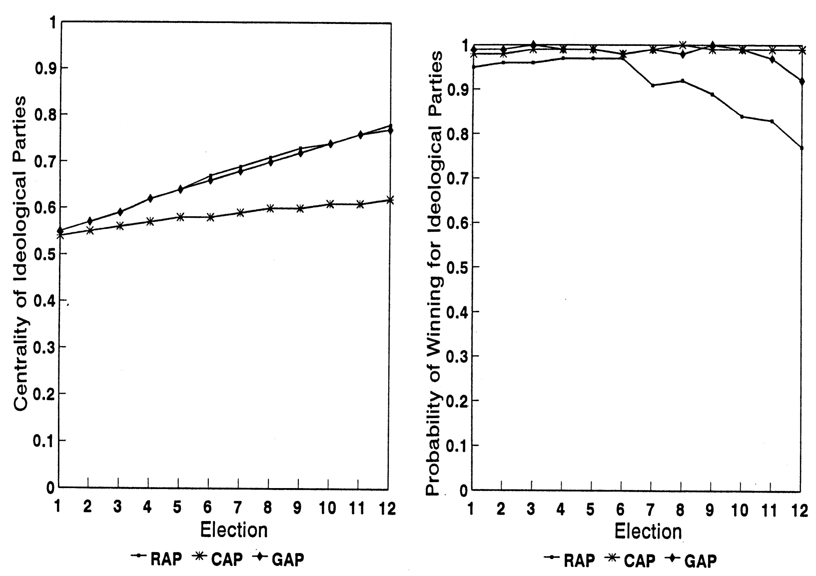
# Results: Ambitious Parties



# Results: Ambitious Parties

- Across all three algorithms, ambitious parties moved in directions of higher centrality (more responsive democratic outcome) as the number of elections increases.
- Across all three algorithms, ambitious challengers have more difficulty defeating incumbents as the number of elections increases.
- Incumbency advantage could be due to the challenger's lack of information, limitations of adaptive search, and the positions of incumbents' previously adapted platforms.

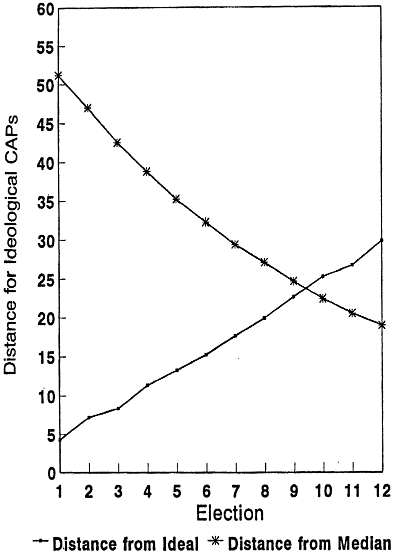
# Results: Ideological Parties

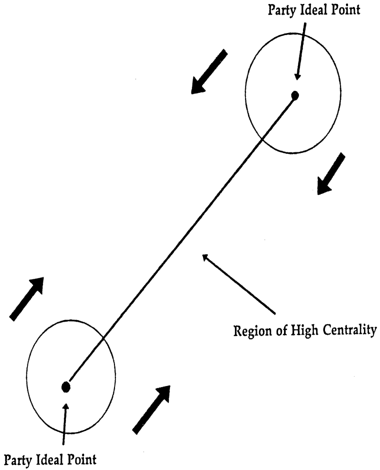


# Results: Ideological Parties

- Compared to ambitious parties, ideological parties have lower centrality.
- Although centrality does increase as the number of elections increase, there is less variance over elections compared to ambitious parties.
- In contrast the ambitious parties, the probability of ideological parties winning stays high as the number of elections increase (except for RAPs).
- CAPs are more likely to win than RAPs and GAPs (and with lower centrality).

# Results: Ideological Parties

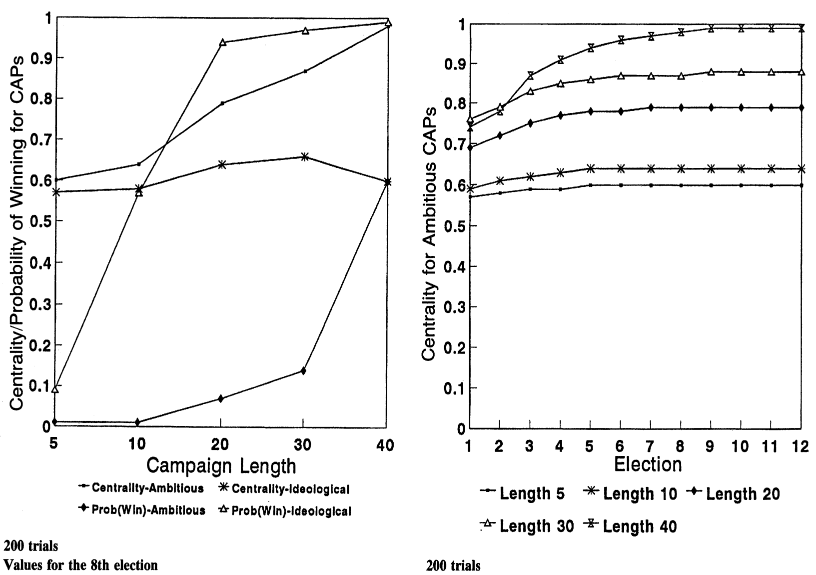


## Results: Ideological Parties

- For all three algorithms, the distance to party ideals increases incrementally while the distance to the median decreases as the number of elections increases.
- *Dumbell Waltz*:
    - Challenging party searches in a neighborhood of its ideal platform until it finds a winning platform.
    - This neighborhood slowly converges to areas of high centrality.
    - Winning platforms consist of two disjoint neighborhoods (one near each ideal platform) and resembles a dumbbell.
    - The ends of the dumbbell slowly converge as the number of elections increases.

# Results: Campaign Length



# Results: Campaign Length

- Recall that increasing the length of the campaign increases the ability of parties to learn about, and adapt to, voters' collective preferences.
- Both centrality and the probability of winning tend to increase as the length of campaigns increases.
- Increasing campaign length for ambitious CAPs qualitatively increases centrality.
- For ideological parties, centrality varies only slightly with campaign length because more informed ideological parties are able to locate winning platforms near their ideal platforms.

# Conclusions

- Boundedly rational parties (even ideological ones) will converge to central regions of the issue space in a Downsian fashion.
- In a two-party system, even simple RAPs can lead to normatively appealing outcomes (high centrality).
- Ambitious parties reach higher centrality than ideological parties.
- All three search procedures for both types of parties produced similar outcomes.
- This means there may exist large equivalence classes of adaptive behavior by parties that may allow researchers to undertake a unified analysis.
- A boundedly rational party that adapts in a complex issue space may not be able to defeat a well-positioned incumbent.

Take-Away Points

- Why ABM?
- Very general model.
- Simple rules.

Ensley, Tofias, & de Marchi (AJPS, 2009)

# Introduction

- Kollman, Miller, & Page (1992) show that it may be difficult for a challenger to beat a well-positioned incumbent *even if* a winning platform exists.
- Offer an empirical test of Kollman, Miller, & Page's adaptive parties model.
- Question: does electoral competition decrease with increasing complexity in the electorate?

# Measuring District Complexity

- In the adaptive parties model, candidates (parties) pick a platform in the political landscape.
- The political landscape represents aggregated voter preferences over the platforms of the two candidates.
- Given the lack of information and a multi-dimensional policy space, candidates do not have the ability to analytically solve for an optimal platform.
- Thus, candidates search electoral landscapes for winning platforms.

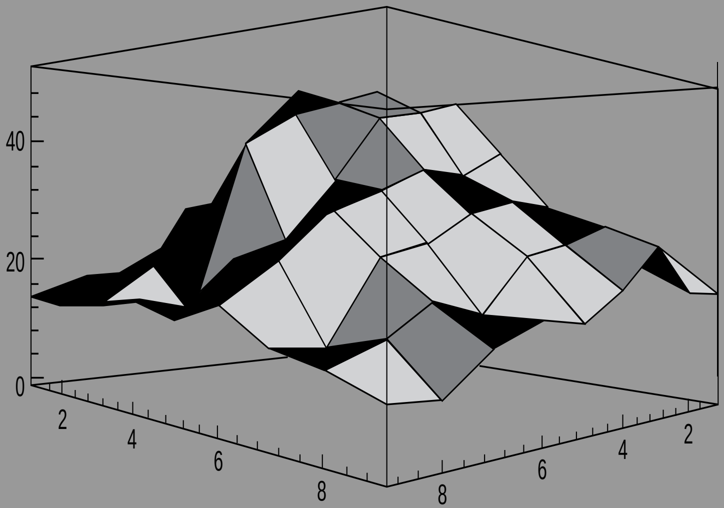
# Measuring District Complexity

- The issue space forms an adaptive landscape.
- Electoral landscapes are like geographical landscapes, where regions of greater height represent policy platforms that will be more successful than lower regions.

# Measuring District Complexity

- The complexity of a given landscape is characterized by measures of dimensionality and ruggedness.
- Higher dimensional policy spaces are more difficult to search than lower dimensional spaces, and rugged landscapes may have many local optima.
- Alternatively, simple landscapes are one dimensional and may have a single peak or an optimal platform location for a challenger.

# Measuring District Complexity



# Measuring District Complexity

- To test the adaptive parties hypothesis they create a measure of complexity based on the policy preferences of the electorate.
- Use the 2000 National Annenberg Election Study (NAES) to investigate elections in House districts.
- Use the NAES to measure preferences at the microlevel and then aggregate up to the district level to create a measure of complexity.

# Measuring District Complexity

- Two main dimensions of voter preferences are recovered using a principal components factor analysis.
- The measure of district complexity is based on the correlation between the social-welfare and cultural dimensions.
- Each respondent's preference along these two dimensions is measured, and then aggregated to compute the score for each House district.

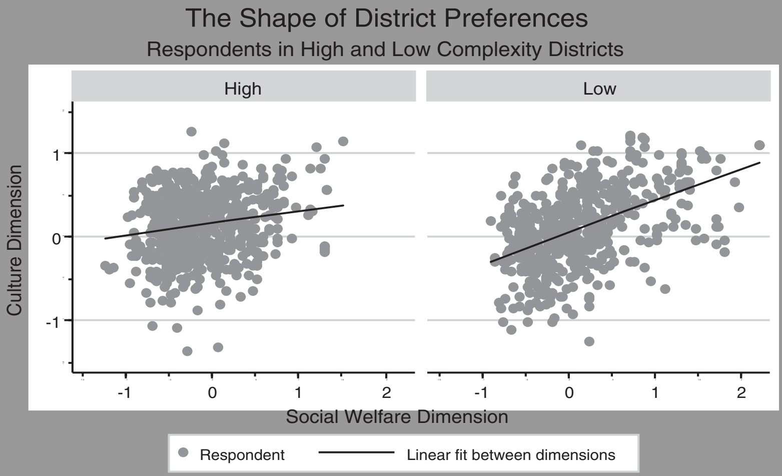
# Measuring District Complexity

- Evidence shows that at least two dimensions are needed to to describe the preferences of voters.
- Thus, there is no way that an incumbent can secure victory by choosing a single "best" platform.
- What matters is the relative quality of the incumbent's choice, which depends on the complexity of the problem faced by the candidates.

## Measuring District Complexity

- The correlation of respondents' positions on the two dimensions is a good measure of complexity.
- If the two dimensions are perfectly correlated, then knowing a voter's position on one dimension is equivalent to knowing his or her position on the other dimension.
- In this situation, and assuming that the incumbent is to some degree fixed, the challenger faces a relatively easy task of finding a superior platform.
- If the two dimensions are uncorrelated, the knowledge of a voter's position on one dimension provides no information about a voter's attitudes on the other dimension.
- The lower the correlation between the two dimensions, the more difficult it is for a challenger to locate a platform that beats an incumbent.
- In short, as the correlation between the two dimensions decreases, the electoral landscape complexity increases.

# Measuring District Complexity




The high complexity example district is PA-7 and the low complexity example is MI-11. *Data Source*: 2000 National Annenberg Election Study.

# Research Design

- Dependent Variables: 1) whether district complexity influences the probability that a quality challenger emerged (i.e., one with previous office-holding experience). If district complexity influences an incumbent's electoral prospects, we would expect that quality challengers would be less likely to emerge as district complexity increases;

# Research Design

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- Independent Variable: inverse of the absolute correlation between the social-welfare and cultural dimensions as the measure of district complexity.

# Results: Quality Challenger

**TABLE 2 Probit Regression of Challenger Quality Emergence**

| Independent Variable | Coefficient | Standard Error |
|---|---|---|
| Complexity | −2.07** | 0.99 |
| Republican Incumbent | 11.04** | 3.08 |
| Social Welfare | −0.77 | 2.16 |
| Republican Incumbent × Social Welfare | −0.23 | 2.73 |
| Cultural | −1.93 | 1.25 |
| Republican Incumbent × Cultural | 4.65** | 1.88 |
| Partisanship | 1.39** | 0.63 |
| Republican Incumbent × Partisanship | −2.84** | 0.79 |
| Sullivan Index | −11.72 | 9.57 |
| Social Welfare Roll Call | 0.18 | 1.07 |
| Republican Incumbent × S.W. Roll Call | −0.27 | 1.52 |
| Cultural Roll Call | 0.41 | 0.40 |

## Results: Quality Challenger

- Quality challengers should be more likely to enter races when conditions are favorable (i.e., when the electoral landscape is less complex).
- The negative and statistically significant coefficient on complexity supports this hypothesis.
- Holding other variables at their mean values, the predicted probability of a quality challenger entering the race is 10% (30%) in a district with a complexity score two standard deviations below (above) the mean.

# Results: Incumbent Vote Share

**TABLE 3 Regression Models of Incumbent Share of Two-Party Vote**

| | OLS | | 2SLS† | |
|---|---|---|---|---|
| **Independent Variable** | **Coef.** | **SE** | **Coef.** | **SE** |
| Complexity | 6.18** | 2.84 | 6.94* | 4.17 |
| Incumbent Spending | −0.46 | 0.50 | 1.39 | 1.46 |
| Challenger Spending | −2.59** | 0.15 | −4.97** | 0.81 |
| Republican Incumbent | −38.47** | 7.99 | −17.74 | 14.06 |
| Social Welfare | −13.49** | 6.54 | −8.80 | 7.95 |
| Republican Incumbent × Social Welfare | 15.59* | 8.05 | 7.51 | 11.71 |
| Cultural | −7.56* | 4.00 | −4.81 | 4.14 |
| Republican Incumbent × Cultural | 16.04** | 5.34 | 13.51* | 7.54 |
| Partisanship | −7.03** | 1.76 | −4.05 | 2.56 |
| Republican Incumbent × Partisanship | 10.61** | 2.10 | 4.34 | 3.78 |
| Sullivan Index | 22.88 | 23.08 | 41.78 | 39.07 |
| Social Welfare Roll Call | −2.72 | 2.54 | 1.68 | 3.60 |
| Republican Incumbent × S.W. Roll Call | −2.49 | 3.45 | −3.70 | 5.40 |
| Cultural Roll Call | 2.33** | 1.11 | 0.10 | 1.74 |
| Republican Incumbent × Cult. Roll Call | −2.55 | 1.60 | −0.54 | 2.76 |
| Challenger Quality | −0.39 | 0.61 | 1.84* | 1.14 |
| Freshman | −0.97 | 0.90 | 0.27 | 1.14 |
| Constant | 115.08** | 11.25 | 101.41** | 23.01 |
| N | 327 | | 272 | |
| $R^2$ | 0.79 | | 0.63 | |
| Anderson Exogeneity Test | – | | 27.5** | |

Data weighted by the number of respondents per House district.
Entries are coefficient estimates and heteroskedasticity-robust standard errors.
** $p < 0.05$; * $p < 0.10$.
† Instrumented: Incumbent Spending, Lagged Challenger Spending.
Excluded instruments: Lagged Incumbent Spending, Lagged Challenger Party Spending (see Appendix B for first-stage regressions).

# Results: Incumbent Vote Share

- The positive and statistically significant coefficient on complexity indicates that as the district becomes more complex the incumbent's vote share goes up.
- If we compare a district with a complexity score two standard deviations below the mean to a district with a score two standard deviations above the mean, there is a 2.5% difference in the incumbent's expected vote share.

# Conclusions

- As district complexity increases, a quality challenger is less likely to enter the race.
- As district complexity increases, the incumbent's vote share increases.
- Incumbent's benefit from district complexity.

Take-Away Points

- Attempt to test a computational model.