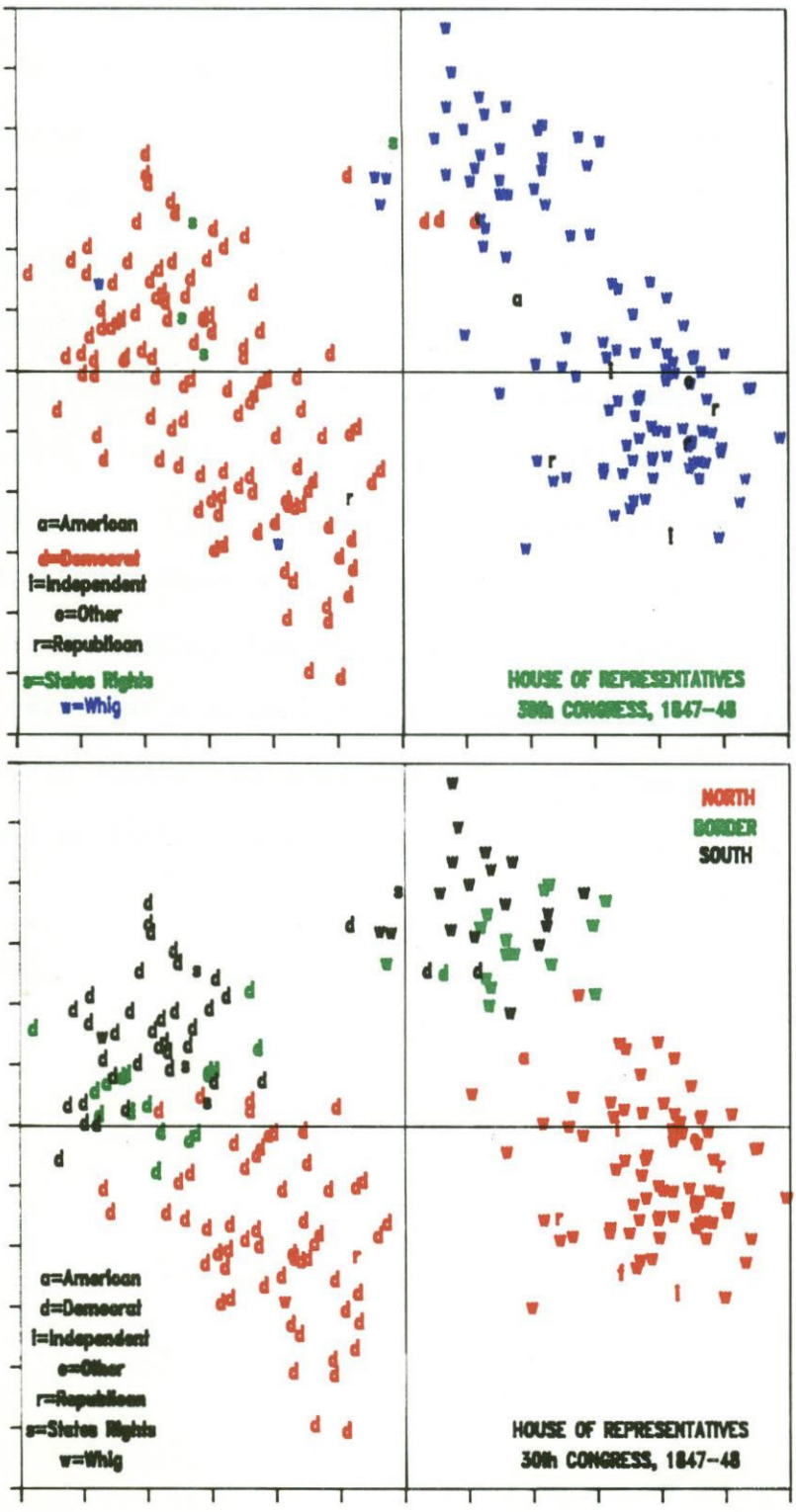
COLOR ANIMATION
OF
DYNAMIC CONGRESSIONAL VOTING MODELS

Keith T. Poole & Howard Rosenthal



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ABSTRACT

Recorded roll call voting behavior in the United States Congress from 1789 to 1985 is highly consistent with a simple spatial model of voting. At most two dimensions are required to account for roll call voting. For most of American history the first dimension divides the two major political parties. The second dimension differentiates the members by region within each party. During the brief periods when the two party system was either absent or had broken down, the first dimension became the regional dimension. Dynamic analysis reveals that replacement of members via the electoral process, more than changes in the relative position of individuals, is the key to realignment. In particular, we find that the realignments of the 1890s and 1930s did not change the primary dimension of conflict between the two major parties. Thus, at the level of roll call voting, the realignment produced by the Great Depression was not due to the immediate change in the policy content of the legislation being considered. Rather, the realignment was due to the overly large Roosevelt coalition breaking down in the 1940s over the issue of civil rights. Our analysis is in large part based upon computer animations of our estimation results.

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by

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1. Introduction

The purpose of this paper and the computer animations that it introduces is to show that a simple geometric or spatial model of voting meaningfully captures recorded roll call voting behavior in the United States Congress from 1789 to 1985. We represent legislators as points in an Euclidean spatial map. The policies that they are choosing between are also represented as points in the same spatial map. Each roll call can be thought of as two points; one corresponding to "Yea" and one corresponding to "Nay". A legislator tends to vote for the point on the map that is closest to his or her own point.

The dimensions of the space represent the basic attributes that individuals use to form their evaluations. For example, the color plots printed on the cover of this paper show the results of fitting our spatial model to the 30th House of Representatives (1847-48). The tokens represent the political party affiliations of the corresponding members. The color scheme of the top panel is based on political party while the color scheme of the bottom panel is based on regions of the United States. The horizontal dimension divides the representatives by the major political parties of the time--Democrats and Whigs--while the vertical dimension picks up the conflict between the North and South which eventually led to the Civil War.

Although this model is an abstraction, in fact the language of politics is full of spatial images which denote general philosophical tendencies of politicians. For example, a "left-winger" in American politics is someone who opposes aiding the Nicaraguan contras and favors raising the minimum wage. Their philosophical opposites on the "right" favor aiding the contras and oppose raising the minimum wage. "Centrists" try to strike a balance between the two extremes.

In this context, the words "left" and "right" and their synonyms "liberal" and "conservative" refer to packages of positions--denote, if you will, very predictable patterns of behavior--on the various issues of the day. In general, liberals today favor much greater regulation of the economy and redistribution of income from the rich to the poor than conservatives; liberals oppose increasing defense spending while conservatives favor it; liberals generally oppose military intervention overseas while conservatives are more likely to favor intervention; liberals oppose government regulation of private personal behavior (for example, a woman's right to an abortion; care of seriously deformed new born infants over the parents' objections) while conservatives favor such regulation.

In his seminal paper on the nature of belief systems, Philip Converse (1964) sought to explain how words like "left", "right", "liberal" and "conservative" denote general philosophical tendencies. The key to Converse's theory is the concept of constraint. It is a measure of the coherence or "tightness" of a belief system. Loosely speaking, it is the ability to predict, given knowledge of an individual's position on one issue, the individual's positions on all other issues. To continue the example given above, to know that a representative opposes raising the minimum wage is sufficient to predict with some confidence that the representative supports the Reagan doctrine of rolling back Communist regimes in the third world, supports a continued high level of defense spending, favors prayer in the public schools, opposes tax increases, favors right to work laws, and so on.

Converse argued that people are quite capable of knowing "what goes with what" without knowing why. That is, people can hold all the appropriate issue positions associated with a political philosophy and not be able to articulate that philosophy in a clear way. Indeed, it is difficult in the context of modern American politics to argue that there is a coherent philosophy tying

together the disparate issue positions that unite conservatives.

That there may be no "why" knitting together modern conservatism does not matter in modelling voting behavior. What matters is that the behavior be predictable (Hinich and Pollard, 1981). In other words, if politicians behave as if there was an underlying political philosophy tying together all the various issue positions they adopt, that is all that matters from a modelling standpoint. Or, as Converse puts it, what matters is that political elites experience the belief system as constrained (Converse, 1964, p.211).

The predictable patterns of behavior implied by the labels "liberal" and "conservative" are manifest in spatial maps of low dimensionality. We have found that at most two dimensions are needed to account adequately for congressional voting. In fact, during much of the period since the end of the Civil War a single dimension does very well.

That various issue positions are tied together in a predictable pattern does not mean that behavior is unchanging. New issues emerge and old issues get defined differently as circumstances change. Consequently, politicians adapt to the times. That politicians can and do change their issue positions is reflected in spatial language which refers to the dynamics of politics. Presidential candidates are spoken of as "moving towards the center" or "moderating their positions" during the general election campaign. Sometimes "moderating a position" can be a very long term process. Senator Strom Thurmond of South Carolina has certainly been a conservative throughout his career in the Senate but clearly Thurmond does not take the same positions on race issues as he did 30 years ago. For example, most conservatives would today vote in favor of the 1964 civil rights act. Indeed, since 1964 Congress as a whole may have become more "liberal" with respect to the policies embodied in the civil rights act. In this regard, the whole civil rights agenda has changed in the past quarter century. Our maps cannot pick up this

overall movement.

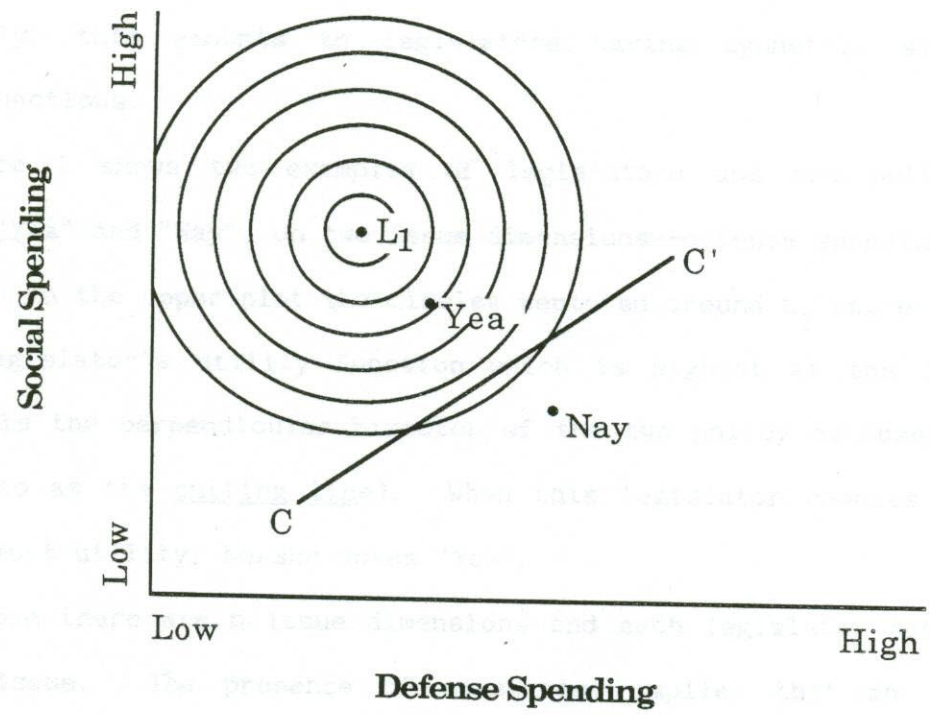
What we can see is relative movement. If we were atop the Eiffel Tower, we would be unaware that we were moving in an orbit in the solar system, but we could easily pick up a boat navigating the Seine. Examples of moving political "boats" come readily to mind. One is Senator Thurmond who navigated the channel (see Figure 8) between the Democratic and Republican parties when he changed affiliation. Another is Richard Schweiker who moved upstream, from moderate to conservative, within the Republican party, after being tapped as Ronald Reagan's vice-presidential partner in 1976.

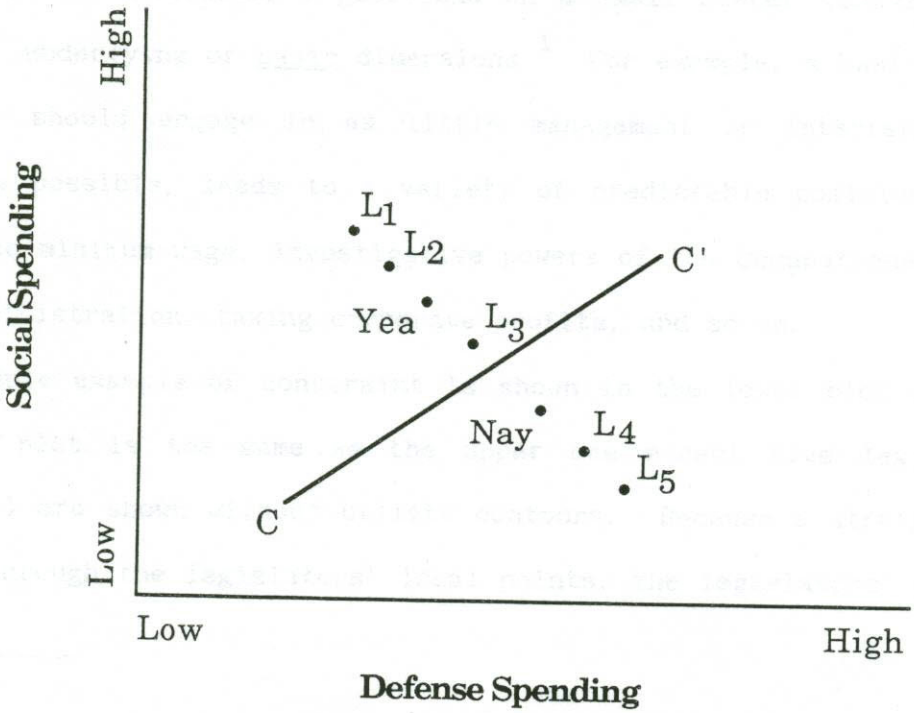
To move from these examples to a more general analysis of relative movement, the dynamic spatial model we develop in the next two sections not only assumes that voting is highly structured at any given time but also allows individuals to change positions over time. Section 2 presents the basic geometry of the model while Section 3 outlines our estimation procedure. Section 4 discusses the results of these estimations from a number of perspectives including the content of the estimated dimensions over time and the implications for the party realignment literature. Section 5 discusses the construction of computer animations of our work. We conclude the paper in Section 6.

2. A Simple Spatial Model of Congressional Voting

We assume that each issue is represented by a dimension which is an ordered set of possible policy alternatives. For example, the issue of defense spending can be represented by a dimension denominated in dollars and can range from zero to several trillion (i.e., the entire GNP). Each legislator is assumed to have a most preferred policy position or ideal point on each issue dimension. For example, even the most dedicated Hawk does not

Figure 1


High
Social Spending
Low
L1
C'
Yea
Nay
C
Low
High
Defense Spending


High
Social Spending
Low
L1
L2
C'
Yea
L3
Nay
L4
L5
C
Low
High
Defense Spending

want to spend the nation's entire GNP on defense. Suppose our dedicated Hawk most preferred a level of $400 billion. We assume this Hawk would be as unhappy with a budget of $200 billion as with a budget of $600 billion. Technically, this amounts to legislators having symmetric single peaked utility functions.

Figure 1 shows two examples of legislators and two policy outcomes (labeled "Yea" and "Nay") on two issue dimensions--defense spending and social spending. In the upper plot the circles centered around L_1 represent contours of the legislator's utility function which is highest at the ideal point. Line CC' is the perpendicular bisector of the two policy outcomes (hereafter referred to as the cutting line). When this legislator chooses the outcome with the most utility, he/she votes "Yea".

Suppose there are n issue dimensions and each legislator has a position on each issue. The presence of constraint implies that an individual's positions on the issues are highly interrelated or correlated. This means that the individual's positions on all n issues can be seen as being a function of the individual's positions on a small number (considerably less than n) of underlying or basic dimensions.[1] For example, a basic belief that government should engage in as little management or interference in the economy as possible, leads to a variety of predictable positions on issues such as the minimum wage, investigative powers of the Occupational Safety and Health Administration, taxing corporate profits, and so on.

A simple example of constraint is shown in the lower plot of Figure 1. The lower plot is the same as the upper one except five legislators (L_1 through L_5) are shown without utility contours. Because a straight line can be drawn through the legislators' ideal points, the legislators' positions on

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[1]This term was coined by Peter Ordeshook (1976).

these two issues are perfectly correlated. This means that a single basic dimension is sufficient to account for the positions.

The D-NOMINATE estimation procedure described below can be thought of as a method of recovering the basic dimensions from the observed roll call votes. To allow for error, we use a probabilistic model of voting; namely, the closer a legislator is to a policy outcome the likelier he/she will vote for that outcome. Less technically inclined readers may wish to skip directly to Section 4 which discusses the overall fit of the model.

3. Dynamic Multidimensional Nominal Three-Step Estimation (D-NOMINATE)

In terms of the algebra underlying Figure 1, let $\underline{x}_i$ be the vector of length s of basic issue positions held by legislator i. That is, s is the dimensionality of the space. Each roll call vote is represented by two policy outcomes. We denote these as the s length vectors $\underline{z}_{yj}$ and $\underline{z}_{nj}$ respectively which represent the projections of the policy outcomes on the basic dimensions. The subscripts "y" and "n" stand for "Yea" and "Nay" and the subscript j indicates the roll call.

Legislator i's utility for outcome "y" on roll call j is

$$U_{ijy} = u_{ijy} + \varepsilon_{ijy} = \beta \exp[-D^2_{ijy}] + \varepsilon_{ijy} \qquad (1)$$

where u_{ijy} is the deterministic portion of the utility function and ε_{ijy}, the stochastic portion, represents the idiosyncratic component of utility. D_{ijy} is the Euclidean distance between $\underline{x}_i$ and $\underline{z}_{yj}$ and β is a constant, common to all legislators, which acts as a "signal to noise" ratio. As β increases in value, the deterministic portion of the utility function overwhelms the stochastic portion and perfect spatial voting is the result. Conversely, as β decreases to zero, voting becomes completely random.

We assume that the stochastic term, ε, is distributed as the log of the inverse exponential--that is, the "logit" distribution. This allows the probability that legislator i votes for outcome "y" on roll call j to be written as

$$\text{Prob("Yea")} = P_{ijy} = \frac{\exp\left[u_{ijy}\right]}{\exp\left[u_{ijy}\right] + \exp\left[u_{ijy}\right]} \qquad (2)$$

Letting ℓ be the index for y and n, and using q to denote the number of roll calls, the likelihood function is

$$L = \prod_{i=1}^{p} \prod_{j=1}^{q} \prod_{\ell=1}^{2} P_{ij\ell}^{C_{ij\ell}} \qquad (3)$$

where $C_{ij\ell} = 1$ if choice ℓ is made and zero otherwise.

Equation (3) is the expression for the <u>static</u> case; that is, a single Congress. To analyze more than one Congress and allow for spatial movement, legislator coordinates are assumed to be polynomial functions of time; namely

$$\underline{x}_{it} = \underline{x}_{i0} + \underline{x}_{i1}t + \underline{x}_{i2}t^2 + \underline{x}_{i3}t^3 + \ldots + \underline{x}_{im}t^m \qquad (4)$$

where t, the unit of time, is measured in Congresses (1 to 99) and m is the degree of the polynomial. For the dynamic case, this results in the following likelihood function

$$L = \prod_{t=1}^{99} \prod_{i=1}^{p_t} \prod_{j=1}^{q_t} \prod_{\ell=1}^{2} P_{tij\ell}^{C_{tij\ell}} \qquad (5)$$

where p_t and q_t are the number of legislators and roll call votes in Congress t.

Following standard practice, we maximize (3) and (5) using conventional maximum likelihood techniques. The algorithm for maximizing (3) in the case

of one dimension (s=1) is discussed in detail in Poole and Rosenthal (1983,1985). We dubbed the original algorithm NOMINATE (shorthand for nominal three-step estimation). The algorithm for maximizing (5) in any number of dimensions is discussed in detail in Poole and Rosenthal (1989).[2] We refer to this algorithm as D-NOMINATE where the D stands for dynamic. Section 4 reports the results of the D-NOMINATE estimations.

4. Estimation Results For the Dynamic Spatial Models

In this section we discuss our estimation results from a number of perspectives. First we consider the overall fit of several models and examine the question of the number of underlying dimensions. We conclude that at most two dimensions are required to account for roll call voting. We then turn to the basic content of the two dimensions over time. Next, we compare "realigning" or transitional eras to stable periods of voting. Our findings suggest that the 1890s realignment had a greater impact on Congressional voting than the 1930s realignment. We then discuss the issue content of the dimensions of voting in the post World War II Congresses. This period is marked by a clear-cut three political party system and the emergence of the so called "Conservative Coalition" between southern Democrats and Republicans. Finally we show that the estimated spatial maps can be used to predict voting on important roll calls. We illustrate this with the 1987 vote on Judge Bork.

"Dimension" is a key concept in our presentation of the estimation results. The cover of this paper clearly contains two dimensional pictures; but there are infinite possibilities for picking two orthogonal axes to help

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[2]Poole and Rosenthal (1985, 1989) also discuss heuristics in the algorithm that override conventional likelihood maximization for non-identifiable or "near" non-identifiable parameters.

describe the picture. In the cover pictures, the two parties occupy distinct regions of the space; they are separated along a dimension that is roughly the horizontal axis. For most of American history, the two major political parties appear in distinct regions, but the separating dimension is not always horizontal. It is also usually the case that a dimension orthogonal to the party dimension picks up conflicts between regions of the United States which cut across party lines.

In 1847-48, this orthogonal conflict was clearly slavery. The cutting line for a prototypical slavery vote would run between the border state and northern clusters in the bottom panel.[3] Note, however, that, within each major party, the regions distribute along a roughly -45° line. Consequently, if we project each point onto the horizontal axis, southerners will tend to be the left of northerners. Thus, even a one dimensional model will, to some degree, be able to classify slavery votes correctly. More generally, the fact that representatives and senators distribute in a correlated, rather than a uniform (we don't get legislators uniformly spread over a circle) fashion is related to the fact, discussed below, that a one dimensional model classifies nearly as well as the two dimensional model illustrated in this paper.

A. Overall Fit of the Models

The D-NOMINATE algorithm was applied to all roll call votes cast in the House and Senate from 1789 to 1985 with at least 2.5% minority voting (e.g. a 97-3 vote if 100 Senators voted). For a given Congress, every legislator casting at least 25 votes was included. Applying these criteria, 9759 members of the House and 1714 Senators are included in our analysis. For the House,

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[3]The border states were Missouri, Kentucky, Maryland, and Delaware.

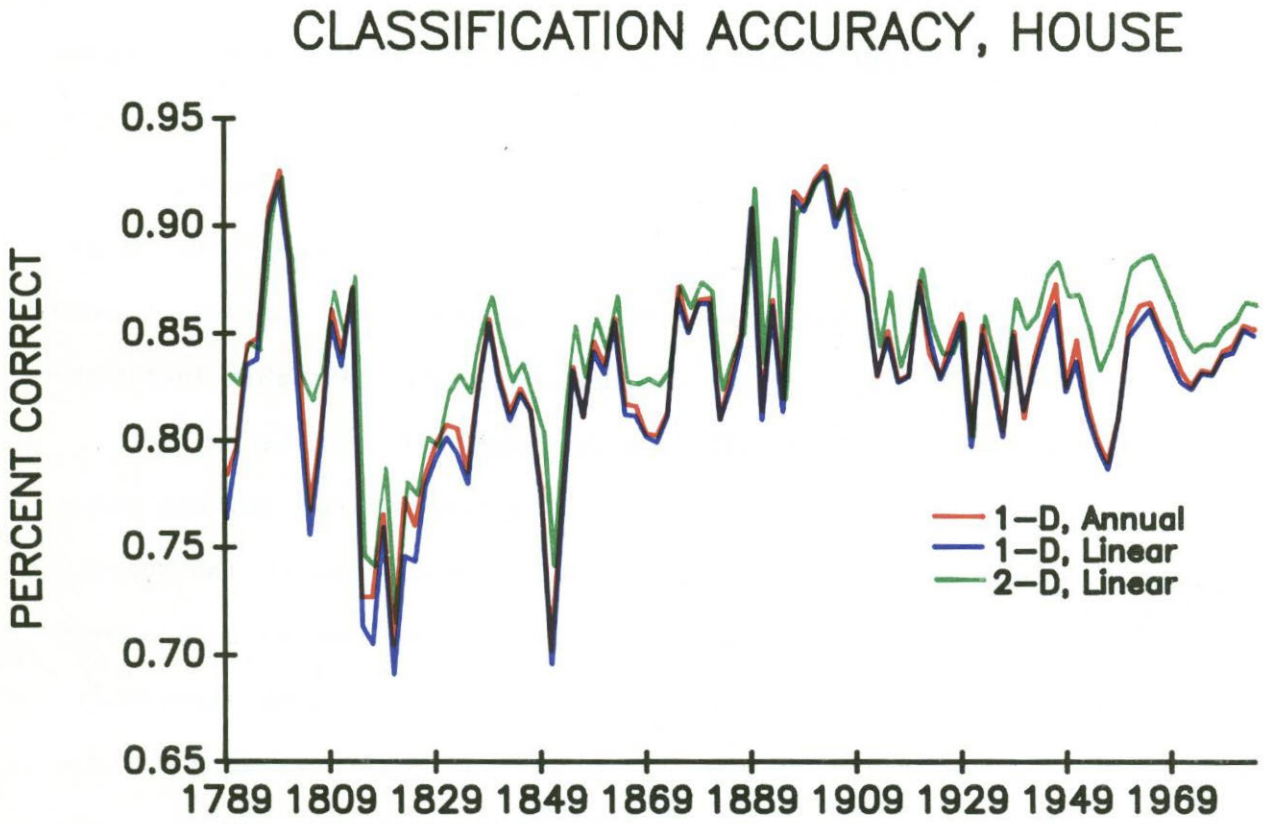
32,953 roll calls are analyzed with the total number of individual decisions being 8,110,702. For the Senate, there are 37,281 roll calls and 2,317,915 decisions. One, two, and three dimensional spatial models were estimated, and polynomials up to degree 3 (cubic) were estimated for the legislators. We found that a two dimensional model with a linear trend (i.e., s=2, m=1) accounts for about 85% of the individual decisions. Adding dimensions and/or time trend terms did not appreciably increase the fit of the model.

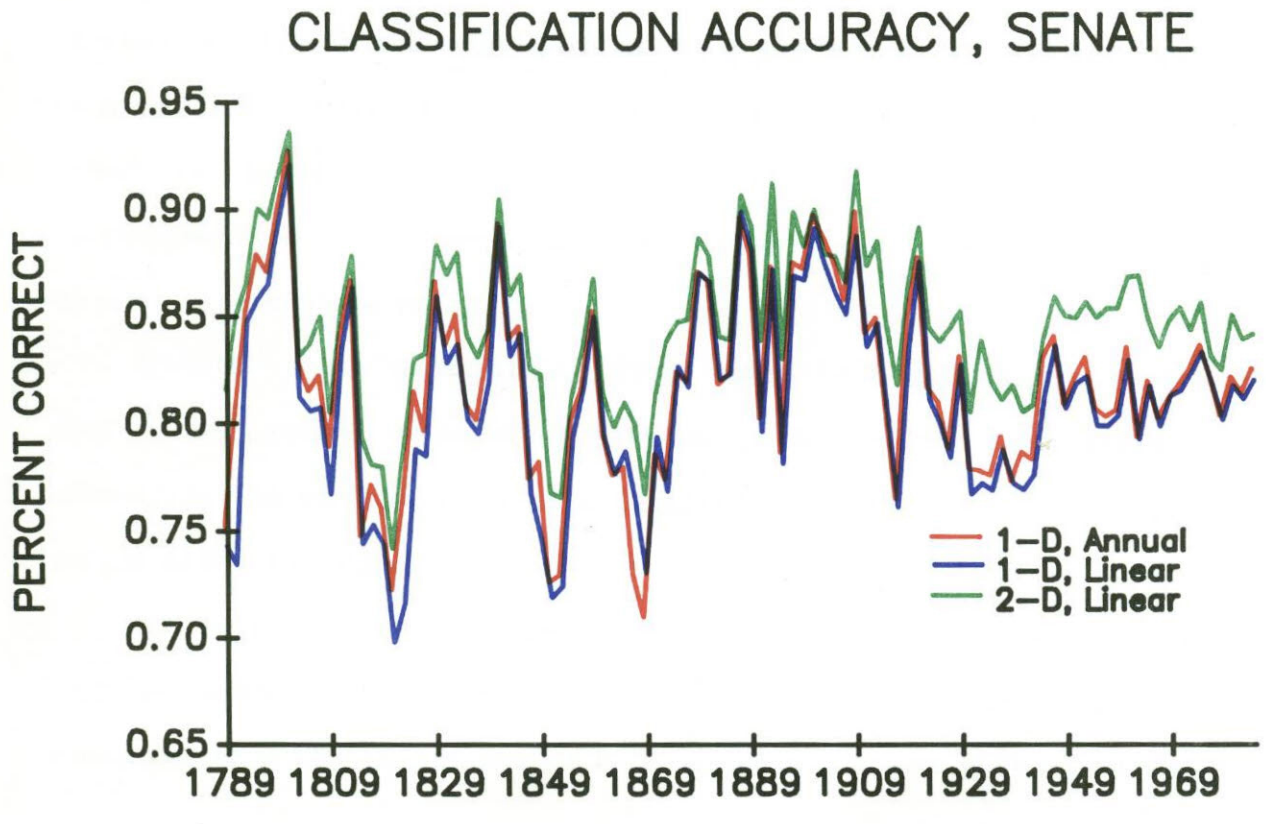
For purposes of exposition, we characterize the fit of the various spatial models in terms of the percentage of individual decisions that they correctly classify. If a legislator is estimated to be on the "Yea"/"Nay" side of the cutting line and actually votes "Yea"/"Nay", then that individual decision is correctly classified. Conversely, if a legislator is estimated to be on the "Yea" side of the cutting line and votes "Nay", then that is a classification "error". Because our models are probabilistic, D-NOMINATE does not maximize the correct classification of individual decisions. However, the number of correct classifications is highly (but not perfectly) correlated with the log of the likelihood function and is an easily understood measure. Consequently, we use it here for expository purposes.

Figure 2 displays the percentage of individual decisions correctly classified in the House and the Senate for three different models. The first, shown in red, are the classification percentages resulting from estimating the one dimensional static model, (3), separately for each of the 99 Congresses. We show this model because it provides a useful benchmark for the dynamic models. The second, in blue, are the classification percentages for a one dimensional dynamic model with linear trend (s=1, m=1). Finally, in green, are the classification percentages for a two dimensional dynamic model with linear trend (s=2, m=1).

The most striking fact about Figure 2 is how closely the classification

FIGURE 2


CLASSIFICATION ACCURACY, HOUSE
PERCENT CORRECT
0.95
0.90
0.85
0.80
0.75
0.70
0.65
1789 1809 1829 1849 1869 1889 1909 1929 1949 1969
1–D, Annual
1–D, Linear
2–D, Linear


CLASSIFICATION ACCURACY, SENATE
PERCENT CORRECT
0.95
0.90
0.85
0.80
0.75
0.70
0.65
1789 1809 1829 1849 1869 1889 1909 1929 1949 1969
1–D, Annual
1–D, Linear
2–D, Linear

lines track one another. Also striking is the similarity between the House and Senate lines. (The House and Senate results come from totally independent computer runs.) Historical circumstances rather than institutional differences are the key to the spatial model's ability to fit the data. And when a spatial model fits well, a one dimensional model with constant positions (not shown in Figure 2) picks up most of the action. The improvements in classification from adding relative movement and extra dimensions are important sidebars, but only sidebars.

By definition, in terms of log likelihood, the one dimensional static model and the two dimensional linear model will always do better than the one dimensional linear model. They also do better in terms of classification percentages except for two Senates in the 19th century. Note that the two dimensional dynamic model achieves better results than the static model for most Congresses. That is, the green line is above the red which in turn is above the blue (the red and blue are so close together at times that the lines appear black). Overall, the two dimensional linear model out performs the one dimensional linear model by 84.5 to 81.3 percent in the Senate and 85.2 to 83.0 percent in the House. The larger gain for the Senate shows up as a larger gap between the blue and green lines in the Senate plot. Adding a third dimension or another time term increases the classification percentages at most a percentage point.

Although a one dimensional linear model is a good approximation to the data, the second dimension, though weak, adds importantly to the classification percentage in most Congresses. This is especially true of the period after the end of World War II.

The models all break down during two periods. The first, from 1815 to 1825 is marked by the collapse of the Federalist party and the "Era of Good Feelings" when the United States had, in effect, a one party government. The

second period was in the early 1850s when the conflict over slavery led to the collapse of the Whig party. The close overall tracking of the various models indicates that during periods of political stability a low dimensional spatial model adequately describes roll call voting. During periods of instability, roll call voting is essentially spatially chaotic.

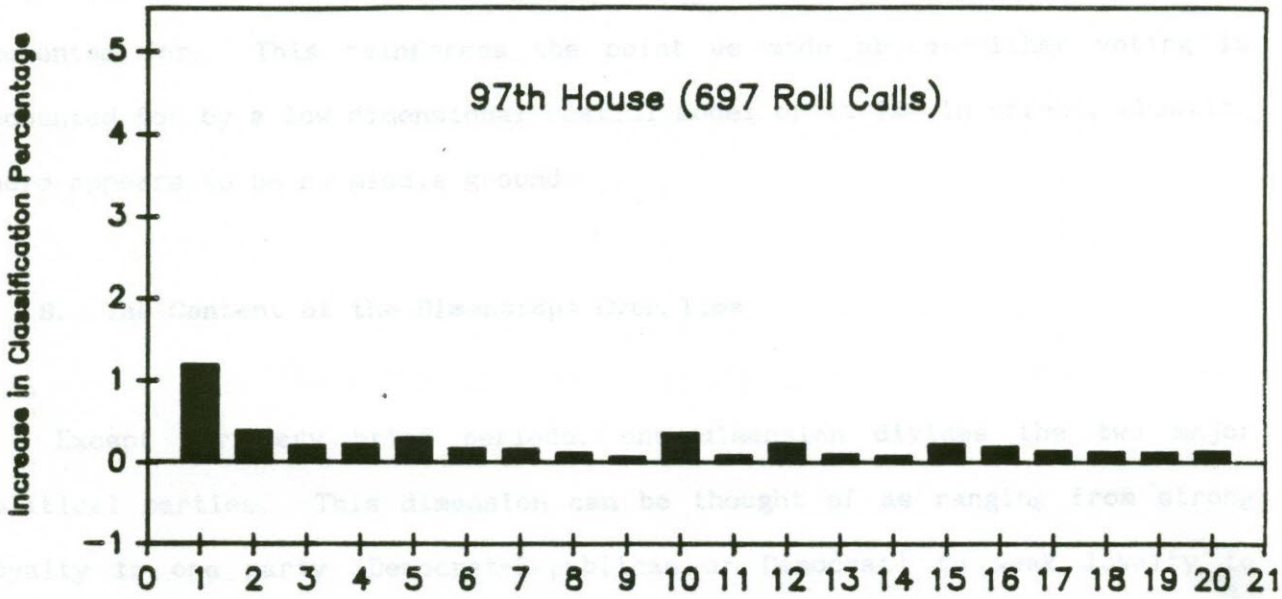
Further evidence of this is shown in Figure 3. To check the dimensionality of our dynamic models, we selected three Houses and estimated the static model up to 50 dimensions. The 32nd House (1851-52) was chosen because it was the worst fitting Congress. The 85th House (1957-58) was chosen because it was analyzed in some detail by Herbert Weisberg (1968) and, to a lesser extent, by ourselves (Poole and Rosenthal, 1985). In addition, the 85th House is part of a period when the two dimensional linear model clearly dominates the one dimensional linear model. Finally, the 97th House (1981-82) is included because it appears as if the gap between the two and one dimensional linear models is closing near the end of the time series.

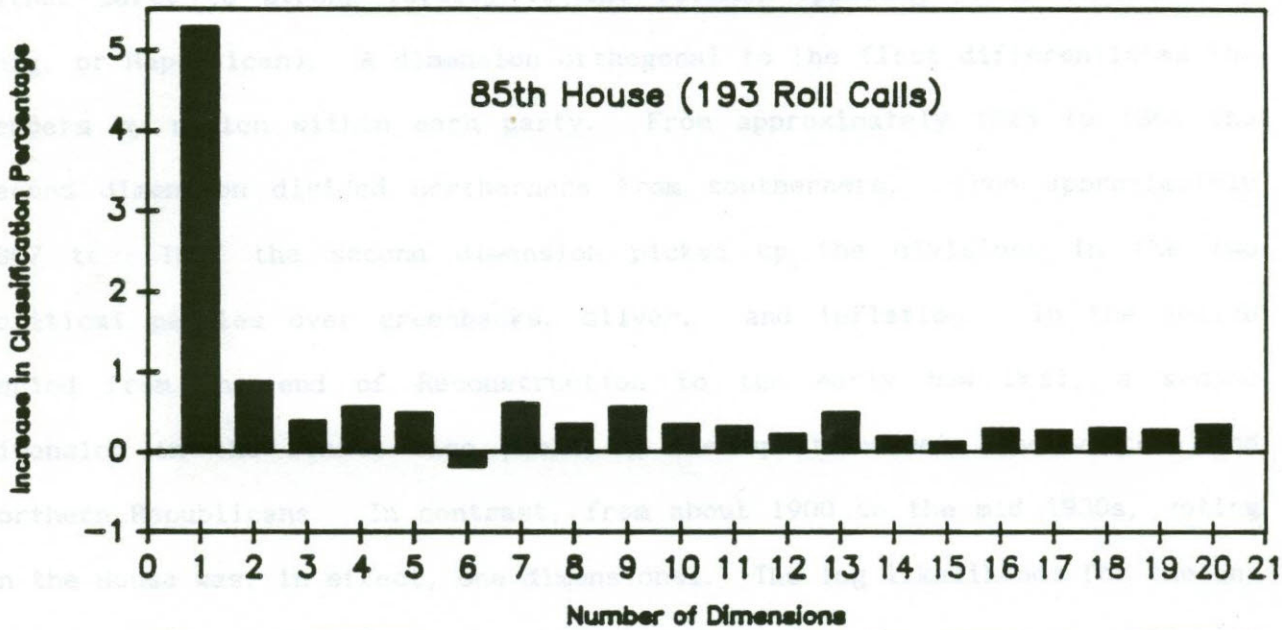
Figure 3 displays the gain in classification by dimensionality for the 2nd through the 20th dimension for each of the three selected Houses. The classification percentage for the first dimension was 70.2 for the 32nd House, 78.0 for the 85th, and 84.1 for the 97th. The bars in the graphs indicate how much the corresponding dimension adds to the total of correctly classified. (The horizontal axis is labelled such that "3" corresponds to the fourth dimension, etc.) Note that the bars do not drop off smoothly--in fact on one occasion the bar is negative--because the algorithm is maximizing log likelihood, not classification.

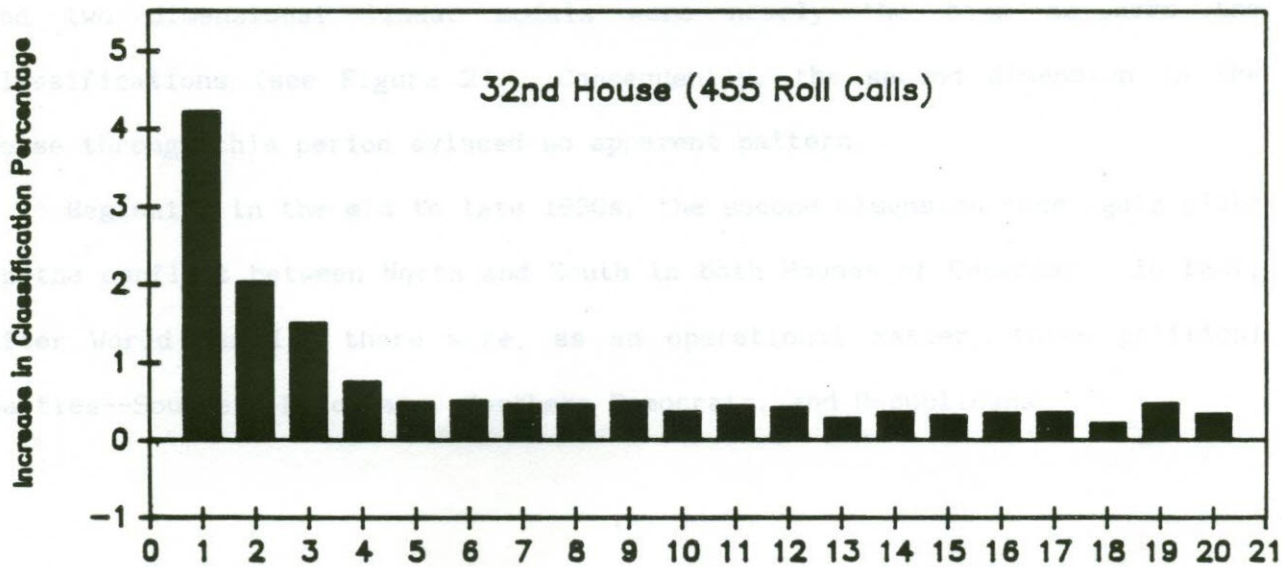
The 97th House is at most two dimensional with the second dimension being very weak. After two dimensions the added classifications are minuscule. This is a clear pattern of noise fitting beyond two dimensions. In contrast to the 97th, the 85th House is strongly two dimensional with little evidence

FIGURE 3

CLASSIFICATION GAIN BY DIMENSIONALITY







for additional dimensions. The 32nd shows evidence for up to four dimensions. However, even with four dimensions only about 78 percent of the decisions are accounted for. This reinforces the point we made above--either voting is accounted for by a low dimensional spatial model or it is, in effect, chaotic. There appears to be no middle ground.

B. The Content of the Dimensions Over Time

Except for very brief periods, one dimension divides the two major political parties. This dimension can be thought of as ranging from strong loyalty to one party (Democrat-Republican or Democrat) to weak loyalty to either party to strong loyalty to the second, opposing party (Federalist, Whig, or Republican). A dimension orthogonal to the first differentiates the members by region within each party. From approximately 1825 to 1861 the second dimension divided northerners from southerners. From approximately 1867 to 1897 the second dimension picked up the divisions in the two political parties over greenbacks, silver, and inflation. In the entire period from the end of Reconstruction to the early New Deal, a second dimension in the Senate also picks up the split between the western and northern Republicans. In contrast, from about 1900 to the mid 1930s, voting in the House was, in effect, one dimensional. The log likelihoods for the one and two dimensional linear models were nearly the same as were the classifications (see Figure 2). Consequently, the second dimension in the House through this period evinced no apparent pattern.

Beginning in the mid to late 1930s, the second dimension once again picks up the conflict between North and South in both Houses of Congress. In fact, after World War II, there were, as an operational matter, three political parties--Southern Democrats, Northern Democrats, and Republicans.

During the brief periods of American history when the two party system was either absent or had broken down, a regional dimension persisted. In the early period, before the Federalist and Jeffersonian Democrat parties solidified, the first dimension divided the northeastern from the southeastern states. During the "Era of Good Feelings"--when the Jeffersonian Democrats were the only major party--the dimension divided the northern and southern states. Finally, when the conflict over slavery tore apart the Whig party in the early 1850s, the dimension once again divided the northern and southern states.

One way of interpreting the dynamics of the space is that the horizontal axis usually picks up the conflict between, roughly speaking, rich and poor. When another issue (slavery, civil rights, easy money for debtors and silver producers) cross cuts this basic conflict and becomes too intense, dimensional alignments break down and a reorganization of the party system results.

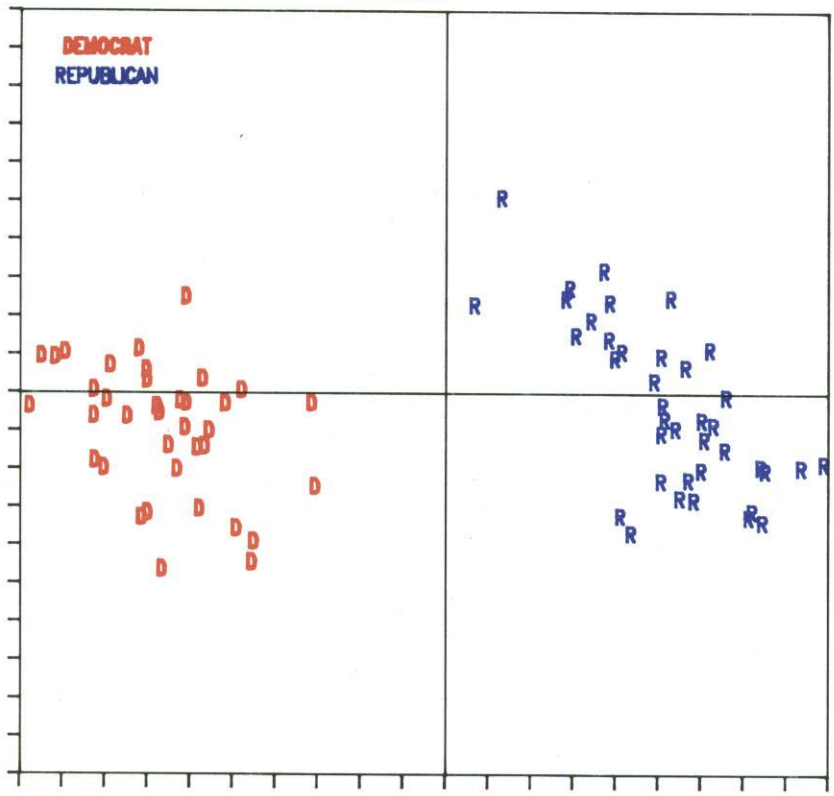
The cover of this paper shows the 30th House (1847-48) which is typical of the period before the collapse of the Whig-Democratic political party system in the 1850s. The tokens represent the political party affiliations. The color scheme for the top panel is based on political party while the color scheme of the bottom panel is based on region--black for South, green for the Border states, and red for North. Although D-NOMINATE has no information about the party and region of representatives, the results sharply distinguish spatial position in terms of these two variables. The cover clearly argues face validity for the algorithm.

Figures 4 and 5 show similar plots for the 50th (1887-88) and 90th (1967-68) Senates respectively; they are organized in the same fashion as the cover. The color scheme of the upper panels is based on political party while the color scheme of the lower panels is based on region--black for South, blue

FIGURE 4

Senate 1887-88

50th Senate



Senate 1887-88

50th Senate

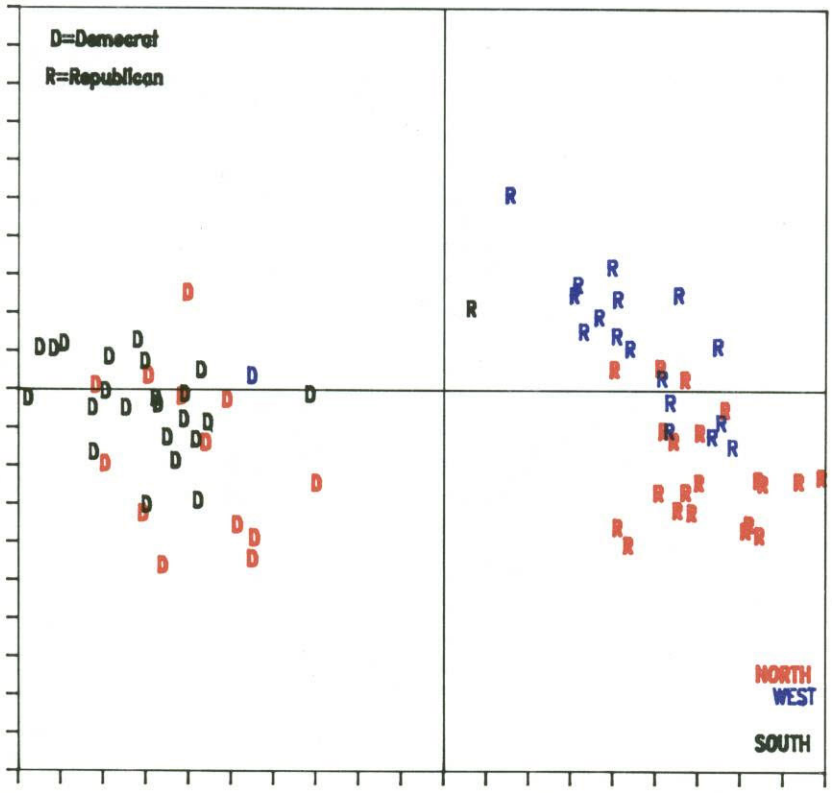
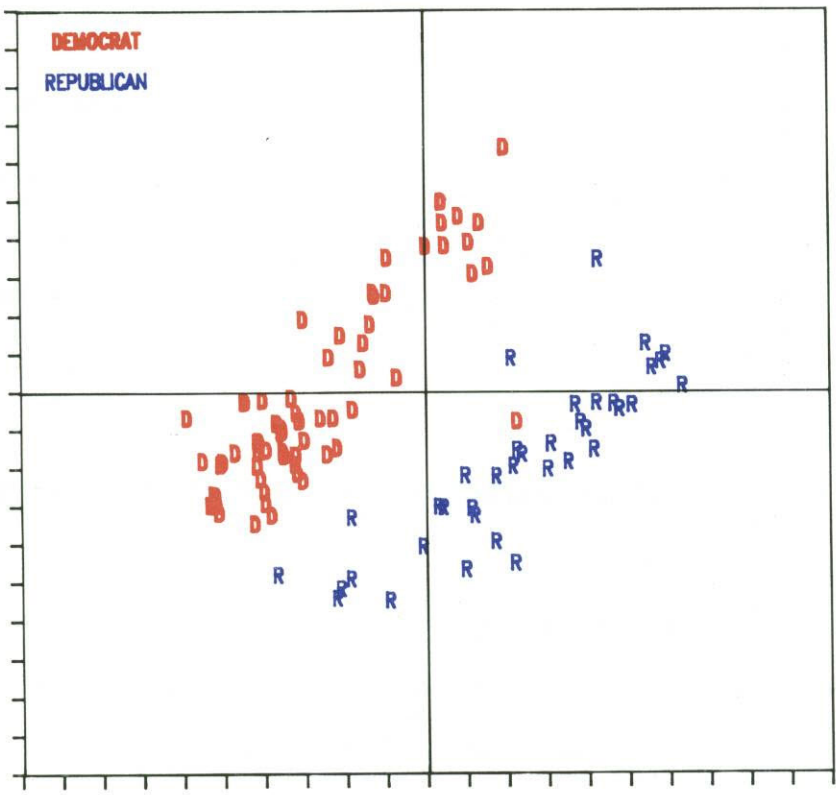


FIGURE 5

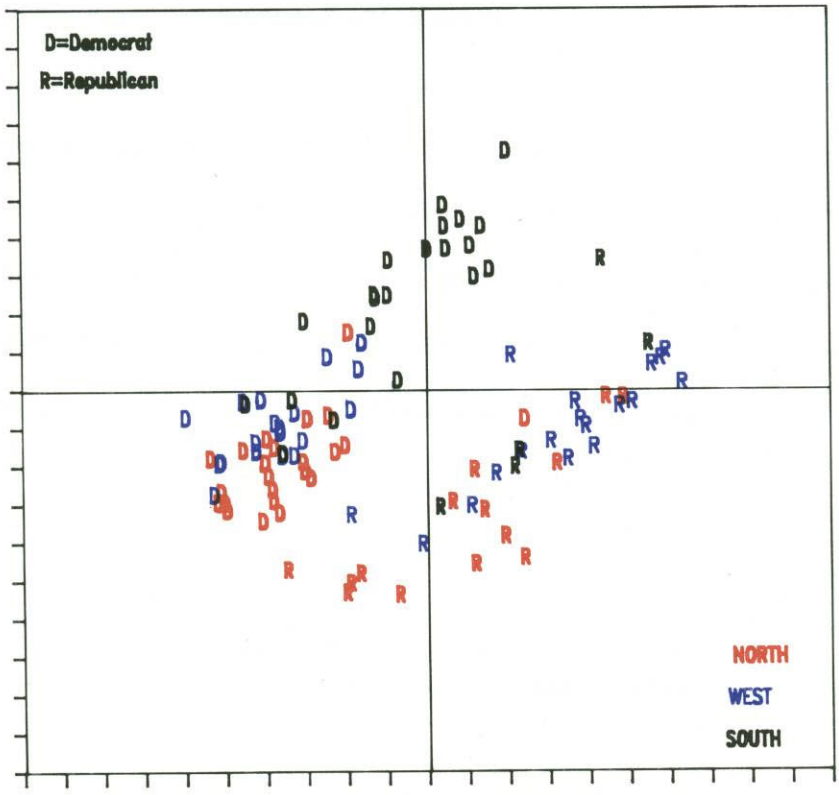
Senate 1967–69

90th Senate



Senate 1967–69

90th Senate



for West, and red for North.[4] Figure 4 shows a clearly organized Democrat versus Republican political party system. Overlaying this system is the division between the North on the one hand, and the West and South on the other, over the issue of cheap money. Figure 5 shows the post World War II three party system. (The aberrant Democrat, on the Republican side of the "channel", is Frank Lausche of Ohio, well-known as a conservative Democrat.) Differences between northern and western Senators remain, but there is more overlap than in Figure 4.

C. Realignment and the Stability of Individual Positions

That distinct eras can be identified means that between these eras basic change occurs in the content of at least one of the dimensions. Three such periods stand out in American history: the 1850s, when the Republican party replaced the Whig party; the 1890s, when the conflict over silver culminated in the sweeping victories of the Republicans; and during the 1930s, when the Great Depression led to even more sweeping victories for the Democrats.

In the 1850s, the realignment consisted of the second dimension of the 1830s and 1840s--which picked up regional differences within the Democratic and Whig parties--becoming the primary dimension. The common thread between the disparate factions which came together to form the Republican party was slavery and the replacement of the Whig party by the Republican party forced the change (Sundquist, 1983). After reconstruction, the Republican party evolved into the party of free enterprise and laissez faire.

The changes in the 1890s and 1930s are not as dramatic. The first

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[4] In these figures, the "South" is the Confederacy plus Oklahoma and Kentucky; the "North", Missouri, Illinois, Indiana, Michigan, and all states to their east that are not "South"; the "West" is all other states.

dimension does not change during either period. In the 1890s, the regional division over silver disappears in the House entirely. In fact, the House is essentially one dimensional until the 1930s. In this regard, the "realignment" of the 1890s really is the disappearance of the regional dimension which does not reappear in any significant way until the conflicts between the North and South over civil rights began during the late 1930s and the 1940s. In the Senate, the pre-1890s regional dimension persists--although it is less important--into the New Deal when it changes into the North versus South dimension.

Our evidence suggests that the standard interpretation of the New Deal realignment of the 1930s is somewhat off the mark. In the standard interpretation (Sinclair, 1977; Brady, 1982; Sundquist, 1983) a party realignment "is the result of the mass electorate's response to a new and highly salient issue which cuts across old party lines" (Sinclair, 1977, p.940). At least at the level of roll call voting, this is not a correct description of what took place in the <u>early</u> 1930s. The change in the <u>content</u> of the legislation passed in the early 1930s (Ginsberg, 1972; Sinclair, 1977) was easily accommodated within the existing spatial structure. We find that the basic nature of the space--the change in the <u>second</u> dimension--did not begin until the very <u>late</u> 1930s and early 1940s. We suggest that the New Deal realignment--at the level of Congressional voting--is the breakup of the overly large Roosevelt Democratic coalition over civil rights issues. Although the Great Depression produced a massive replacement of Republicans by Democrats and a more activist federal government, these events did not change the basic structure of the space. Rather, the revitalization of the Democratic party in the North led to an internal split over civil rights.

Further light can be shed on the relative impact of the realignments by examining the stability of individual positions over time.

To assess the stability of individual positions we computed the annual movement implied by the estimated trend coefficients and computed average trends for each Congress. Only legislators serving at least five Congresses were used to compute the averages. The results are displayed in Figure 6.

D-NOMINATE is normalized so that the span of the estimated space is about two units. In comparison to the span of the space, spatial movement has never been very large. After considerable fluctuation in the early decades, spatial movement has declined considerably over time and has been virtually non-existent in both Houses of Congress during the post World War II period. The three realignments show up as "waves"--each having lower amplitude than the "wave" before it. In this regard, at least at the level of roll call voting, the 1890s realignment had a greater impact on the behavior of individual legislators than the 1930s realignment.[5]

The pattern of the movements in Figure 6 is also of great interest. Note that from the end of the Civil War onwards, the two Houses evinced an almost identical pattern of movements. The point that institutional differences do not matter greatly, made in discussing Figure 2, is confirmed, in terms of spatial stability, by the results contained in Figure 6.

Finally, the remarkable stability of post World War II voting has important implications for public policy; namely, dramatic change can occur only by replacement of legislators--not by conversions that disturb relative voting alignments. Stated in more Darwinian terms, selection is far more important than adaptation.[6]

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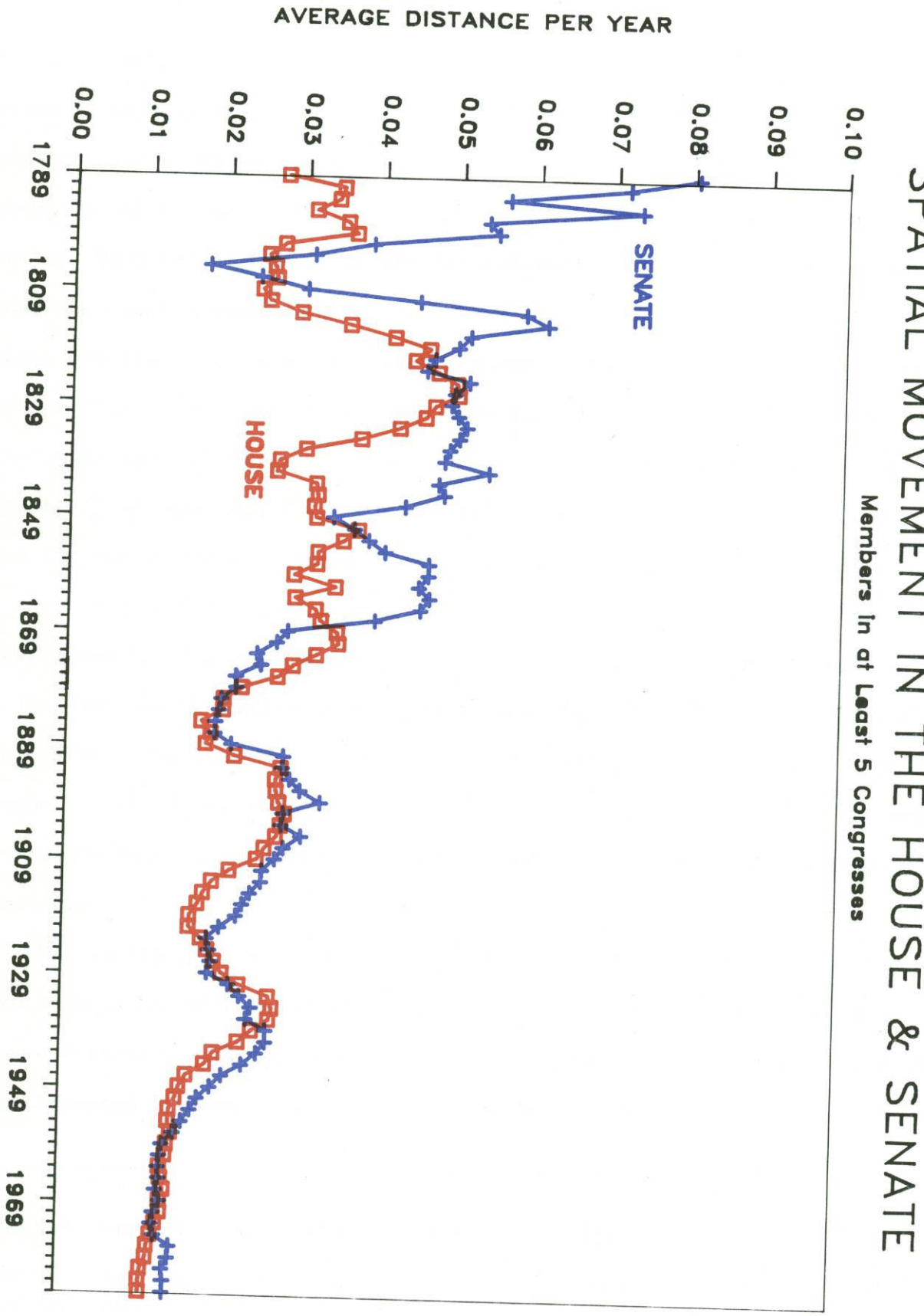
[5] In this regard, these results coincide with David Brady's (1982). Brady found that the 1890s and Civil War realignments were more partisan than the New Deal realignment.

[6] Of course, one important form of adaptation--a shift in cutting lines--is consistent with the model. For example, a mass killing can cause moderates to support forms of gun control they had previously opposed.

FIGURE 6


AVERAGE DISTANCE PER YEAR
SPATIAL MOVEMENT IN THE HOUSE & SENATE
Members in at Least 5 Congresses
SENATE
HOUSE
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
1789
1809
1829
1849
1869
1889
1909
1929
1949
1969

D. The Issue Content of the Dimensions in the Modern Era

The basic structure of the post World War II Congresses is Democrat versus Republican and North versus South. This structure is the result of the conflict over civil rights which began during the late 1930s and early 1940s. Voting on civil rights typically pitted the southern Democrats against the northern Democrats and most of the Republicans. The upper panel of Figure 7 shows the final passage vote on the 1964 civil rights act in the Senate.[7] The tokens are the same as in the other figures. The color scheme indicates how the Senators voted--red is a "Yea" vote in favor of the act and blue is a "Nay" vote against the act. The cutting line is the black line through the figure. There are only 7 voting "errors" (blue on the red side of the cutting line and red on the blue side) on this roll call.

In contrast to the regional voting on the 1964 civil rights act, the lower panel of Figure 7 shows economic liberals pitted against conservatives on the Taft Hartley act--the most important piece of labor legislation since the 1930s. The roll call, taken June 23, 1947, was to override President Truman's veto of the Taft Hartley act.[8] This vote was a coalition of nearly the entire Republican party and many southern Democrats against the northern Democrats.

During the post World War II period, the southern Democrats often voted with a majority of the Republican party on many issues. The upper panel of Figure 8 shows a roll call typical of this "Conservative Coalition". The vote was concerned with the highly devisive issue of school busing. The vote was

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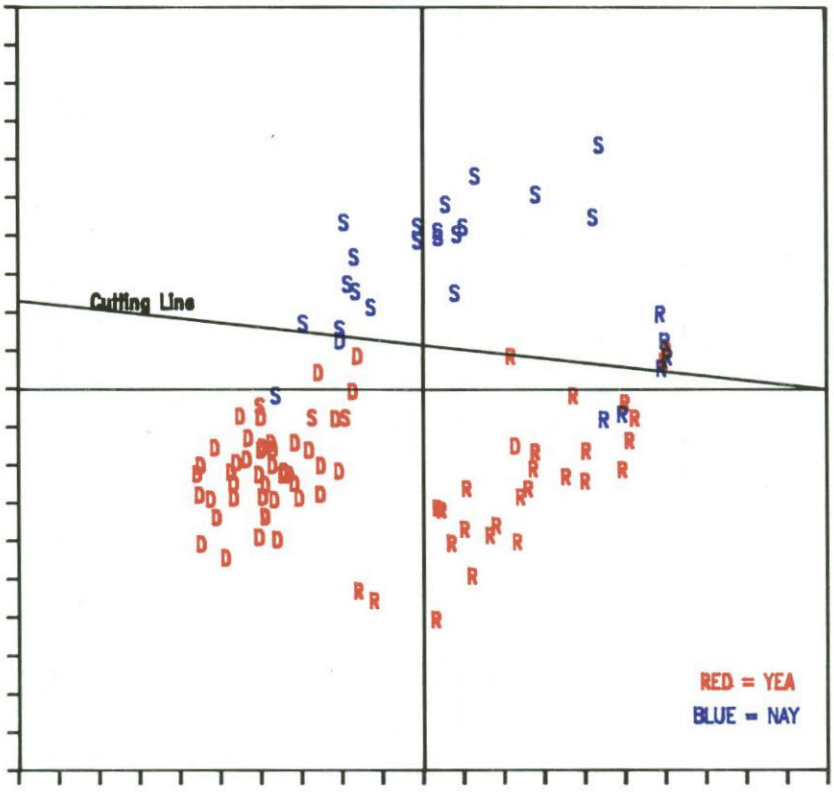
[7]The vote was 73-27 and took place on June 19, 1964.

[8]The veto was overridden by a vote of 68-25. There are 8 voting "errors" on this roll call.

FIGURE 7

1964 Civil Rights Act

Senate, Final Passage, June 19, 1964



Taft Hartley Act

Senate, Veto Override, June 23, 1947

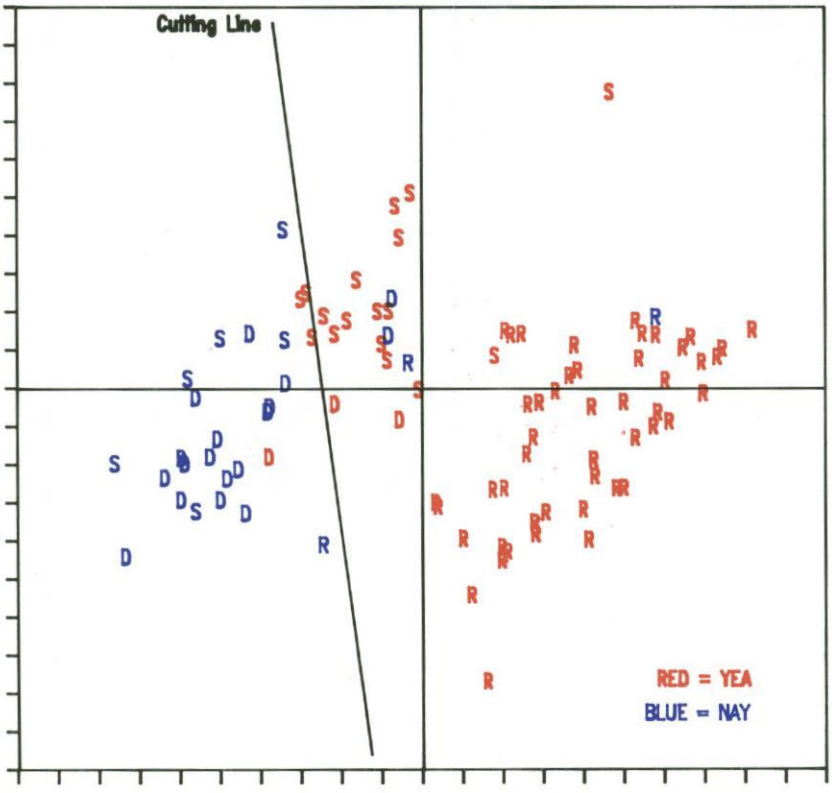
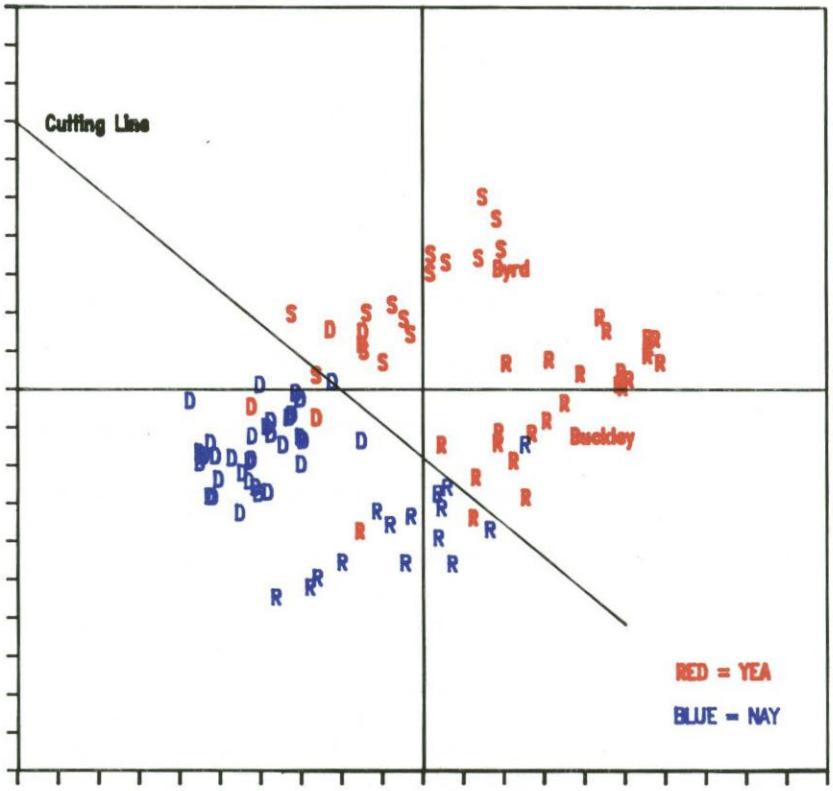


FIGURE 8

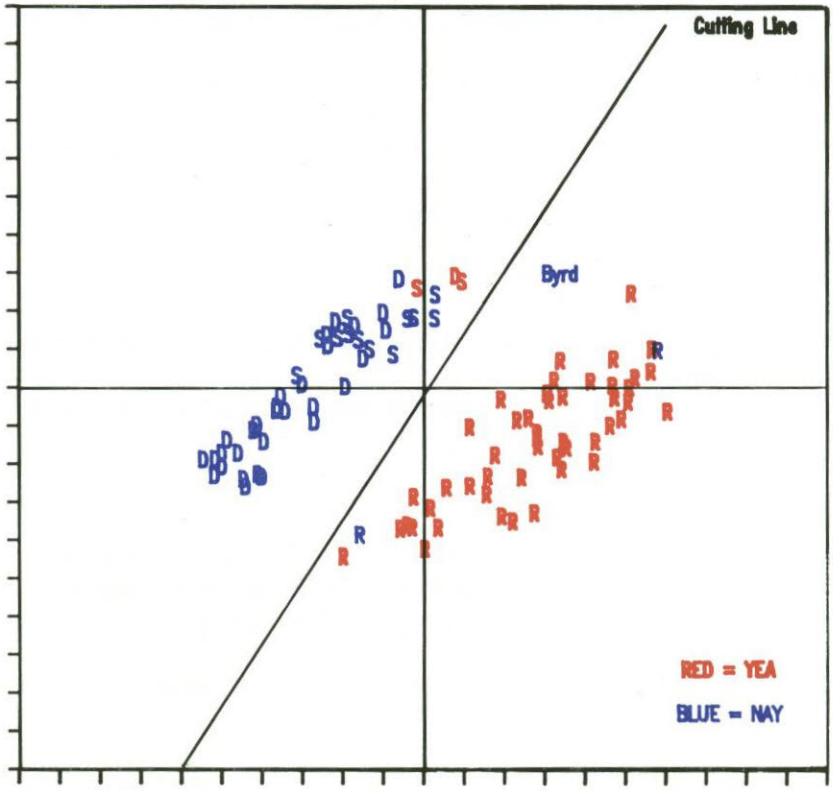
Amendment to Prohibit School Busing

Senate, May 15, 1974



Budget Resolution for Fiscal Year 1983

Senate, May 21, 1982



taken on May 15, 1974 during the 94th Senate.[9]

Note that the cutting line on the school busing roll call is nearly perpendicular to the "channel" between the two parties. Most roll call votes during this period produced cutting lines roughly parallel to the busing and Taft Hartley roll calls. This corresponds to the "liberal" versus "conservative" distinction in contemporary American politics. Republican Senators such as Mathias of Maryland, Percy of Illinois, Brooke of Massachusetts, and Javits of New York were in the lowest southwest portion of the Republican party map. Senators such as Jesse Helms were in the northeasterly portion of the party map. Democratic Senators such as Ted Kennedy and Alan Cranston were in the lowest southwesterly portion of the Democratic party map while southern Democratic Senators such as Stennis of Mississippi were in the northeasterly portion of the party map.

Finally, a pure party line vote is shown in the lower panel of Figure 8. The vote was on the 1983 budget resolution and took place on May 21, 1982 during the 97th Senate.[10]

In sum, the structure of the post World War II space was such that purely regional votes, typically on civil rights, produced cutting lines which were parallel to the first dimension. These roll calls pitted the southern Democrats against the northern Democrats and Republicans. Pure party line votes on organizational matters produced cutting lines through the "channel" dividing the parties. Finally, roll calls on most other issues featured the familiar liberal/conservative divisions with cutting lines perpendicular to the "channel" dividing the Democrats and Republicans.

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[9]The vote, on an amendment to an education bill, was "to prohibit forced busing of students beyond the school closest to his home." The amendment passed 47-46. There are 7 voting "errors" on this roll call.

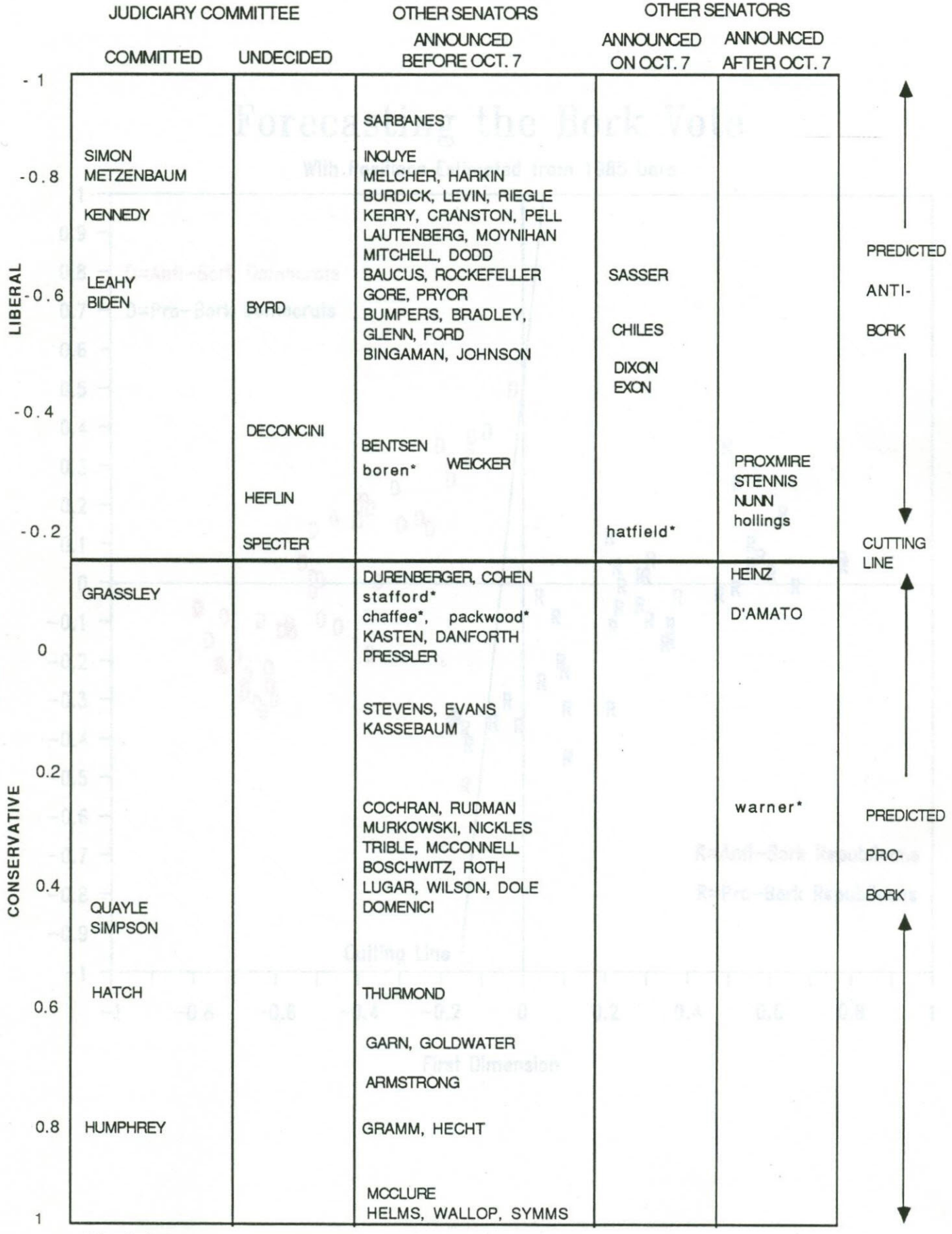
[10]The vote was 49-43 and there were 6 voting "errors" on the roll call.

E. Forecasting Roll Call Votes

As is evident from Figures 7 and 8, the basic spatial structure of Congressional voting has changed only very slowly since 1945. Figure 6 shows that this stability is reflected at the individual level as well. Spatial positions are so stable that hardly any movement over time occurs. Once elected, legislators do not alter their basic beliefs during their careers; and, politically at least, they "die with their ideological boots on".

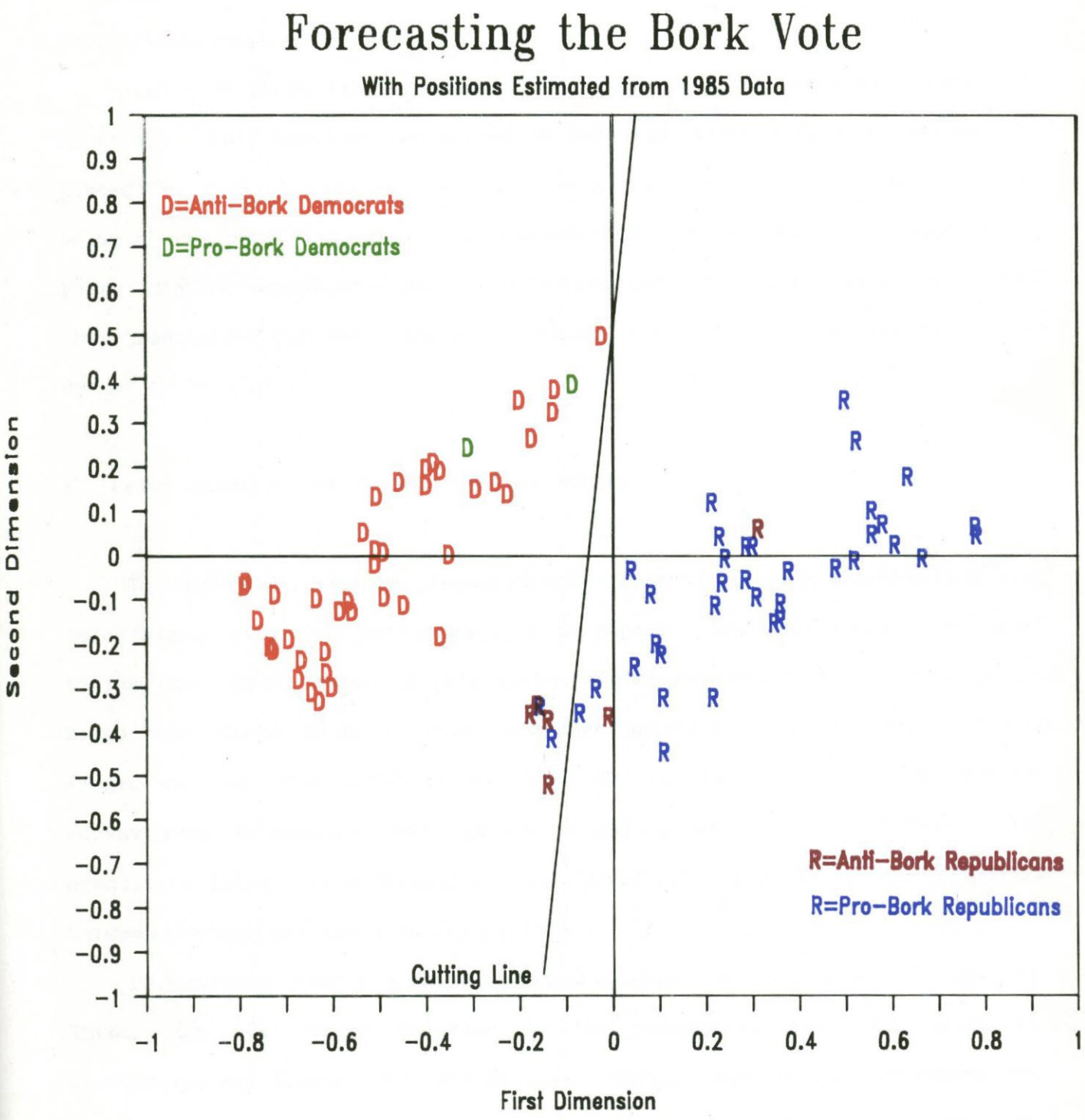
This stability lends itself to forecasting roll call votes in a very simple way. If a random sample of legislators announce their positions prior to a vote, then a cutting line through the spatial map can be estimated and a prediction of the division on the roll call can be made. Figure 9 illustrates this with regard to the vote to confirm Judge Bork in the fall of 1987. Figure 9 shows the positions taken by Senators on the Bork nomination. The spacing of Senators in Figure 9 represents their one dimensional static scaled positions using 1985 data. The Figure is divided into five columns. In the first are the names of the of the Senators on the Judiciary committee who announced early in the confirmation process how they would vote on Judge Bork. When Arlen Specter announced somewhat later in the process that he would oppose Bork it was possible to forecast--accurately as it turned out--that the final committee vote would be 9-5 against because the remaining three undecided members--Byrd, Deconcini, and Heflin--were to the left of Specter. At this time, using the fact that Grassley had announced support for Bork, we could predict a final Senate vote of 59-41 against (the four Senators between Specter and Grassley were predicted to split 2-2 and Senators elected since 1985 were predicted to vote along party lines). The final vote was 58-42. Names in capital letters were correctly forecast. Only 7 of 100 Senators were incorrectly forecast. Of particular interest in Figure 9 is the fact that

FIGURE 9
THE BORK VOTE



*Prediction errors

FIGURE 10


Forecasting the Bork Vote
With Positions Estimated from 1985 Data
D=Anti-Bork Democrats
D=Pro-Bork Democrats
R=Anti-Bork Republicans
R=Pro-Bork Republicans
Cutting Line
Second Dimension
First Dimension
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9
-1
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
1

moderates tended to announce relatively late and the errors tended to be near the predicted cutting point. In other words, the "ideologues" announced their decisions on Bork very early on while more moderate Senators took longer to go public with their positions.

Figure 10 shows the vote to confirm Bork using the 1985 two dimensional positions. Only Senators who served in 1985 and voted on Bork are shown. We placed the cutting line on the map by eye. Although the vote was close to being a pure party line vote, the spatial model was successful in picking out those liberal Republicans and conservative Democrats most likely to desert their respective parties. The one "outlier" very far from the cutting line is Warner of Virginia.

5. Color Animation of Dynamic Spatial Models

To this point, we have presented a traditional academic paper albeit with color plots--rare, but not unheard of in papers. What sets this paper apart is the fact that much of our discussion of Congressional roll call voting is based upon close study of color computer animations of our work. Static images such as those shown on the cover and in Figures 4, 5, 7, 8, and 10, convey much information and aid us in making our points but they cannot adequately illustrate a dynamic model. Quite literally, it is the difference between photographs and a motion picture.

Our dynamic models produce 99 spatial maps for each House of Congress. These maps are linked together by the assumption that the legislator coordinates are linear functions of time. Strung together the two dimensional maps form, quite literally, a "moving" picture. In order to study the dynamics of Congressional voting in detail, we produced computer animations of our two dimensional dynamic estimations. Because only 99 spatial pictures

result from a scaling, we interpolate between Congresses in order to produce a smooth looking animation or "moving" picture.

A more detailed description of the animations and how they were made can be found in the Appendix.

6. Conclusion

Our results suggest that Converse's theory of belief systems has considerable power in capturing the behavior of political elites throughout American history. During most periods voting in Congress is simply structured--a maximum of two basic dimensions account for most individual decisions. A dynamic two dimensional spatial model correctly classifies about 85 percent of all individual decisions on non-unanimous roll calls. The model breaks down when there either is too much consensus amongst the political elite (the "Era of Good Feelings") so that there was insufficient conflict to structure the voting; or it breaks down when individuals are confronted with incompatible choices that lead to voting turmoil (Southern Whigs who wanted to both maintain the traditions of their party and also to protect the system of slavery).

In the modern era the stability in voting coupled with reelection rates of over 95 percent for incumbent members of the House of Representatives has important implications for changes in public policy. Once a member is elected to Congress he or she is essentially a fixed point in terms of basic beliefs over his or her career. If policy is to be changed then either it must be reinterpreted in terms of the basic beliefs (this is possible, the Equal Rights Amendment began its Congressional life as a relatively non-controversial issue) or legislators must be replaced by those of differing views. Neither course is easy and advocates of drastic change in American

politics are likely to be frustrated for the indefinite future.

APPENDIX

THE NOMINATE VIDEOS OF CONGRESSIONAL ROLL CALL VOTING 1789-1985: A GUIDE FOR VIEWERS

KEITH T. POOLE · HOWARD ROSENTHAL
Carnegie Mellon University, Pittsburgh, PA 15213

The videos show two dimensional representations of members of Congress and roll calls. The horizontal dimension can be thought of as dividing economic liberals, near the left end of the screen, from economic conservatives at the bottom. In recent times, social conservatives opposed to civil rights bills and similar measures appear near the top of the screen and social liberals appear near the bottom.

1. CQ Roll Calls: These are all the "significant" roll calls taken in the Senate since the end of World War II as selected by Congressional Quarterly. Each roll call is displayed in two images. The first image shows how the whole Senate voted on the roll-call. A "D" token is always a non-southern democrat, a "S" token is a southern democrat, and a "R" token is a republican. If a token is red the senator voted "Yea" on the roll call and if a token is blue the senator voted "Nay". The black line through the image is the estimated "cutting line" for the roll call. Senators on one side of the line are predicted to vote "Yea" while those on the opposite side are predicted to vote "Nay". An "error" is a senator who is on the "Yea" side of the cutting line and in fact votes "Nay" and vice versa (e.g., a blue token amongst the red). The second image shows only the voting "errors" which are displayed as black tokens.

2. The House of Representatives: This video was constructed using the 2-dimensional linear coordinates from the dynamic NOMINATE model. Technically, only 99 spatial maps or "images" result from a scaling. In order to get a smooth effect, we interpolate between Congresses so as to produce 30 images per Congress. Three frames were recorded on video tape for each image. The speed of the video tape is 30 frames per second. Consequently, this video is approximately 5 minutes long. The title at the top shows the Congress number and the year while the bottom title is a key to the tokens. The insert on the left side of the screen shows the number of major party members in that congress [Federalists (F), Democrats (D), Whigs (W), Republicans (R)] along with our measure of scaling fit, the geometric mean probability. The color of the tokens indicates the political party. For example, red is always used for democrat and blue for republican. However, prior to the emergence of the republican party in the 1850s blue is used for some minor parties.

3. The House of Representatives Regional: This video is the same as #2 only now the token colors indicate regions of the U.S.. The color scheme is always shown in the insert on the left side of the screen. For example,

prior to the civil war black indicates the states of the confederacy, blue the border states, and red the northern states. This video shows that the second dimension is primarily a regional dimension--viz., it picks up conflicts between regions of the U.S..

4. The House of Representatives Replacement: This video is the same as #2 only now the token colors indicate how long the representative has been in the House. Newly elected members are displayed as red, members in the 2nd and 3rd terms in blue, and members in their 4th or greater terms in black. This video is noteworthy for its graphic display of the very large turnover of membership in the 19th century House.

5. The Senate: This video was constructed using the 2-dimensional linear coordinates from the dynamic NOMINATE model. It is identical in format to the House of Representatives video.

6. The Senate Regional: This video is identical in format to the House regional video.

7. The Senate Replacement: This video is identical in format to the House replacement video. Note that, because of the 6 year term of office, the turnover effect is not as dramatic as the House video.

8. Significant Roll Calls 1869 to 1899: This video is identical in format to the CQ roll call video. These roll calls were selected by David J. Rothman as key roll calls in his book Power and Politics in the U.S. Senate: 1869-1900, Harvard University Press, 1966.

9. Political Action Committee Donations: This video displays all those PACs that donated money in at least 100 House races in the 1979-80 election cycle. The "D", "R", and "S" tokens are the same as above but the color scheme is different. If a token is black, that means that the PAC donated money to the Representative. If a token is red, the PAC donated money to the member's opponent; and if a token is pale yellow, the PAC made no donation in the race. Of particular note here is the clear-cut liberal-conservative behavior of the labor PACs. They give money to liberals (black) and spend money against (red) conservatives. In contrast, the corporate PACs spend money on all varieties of Republicans and Democrats except for liberals.

How the Videos Were Made

All of our videos were made at the Pittsburgh National Supercomputer Center. The DEC GKS version of the NCAR graphics package was used to create the images on the Cray XMP/48. The images were then transferred to 3/4 inch video tape and then dubbed to VHS video tape. Joel Welling and Matt Tolbert of the Pittsburgh Supercomputer Center helped us to create the videos. The coordinate estimates that formed the basis for the videos were computed at the John Von Neumann Center at Princeton University. The original data base, which we substantially corrected for coding errors, was furnished by the Interuniversity Consortium for Political Science Research.

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