How Many Dimensions Has the Supreme Court?
Analysis of "Natural Courts" 1953-1991

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January 1, 2000

* We are indebted to Dorothy Green and Clover Behrend for library assistance and to A. Kimball Romney, Professor of Anthropology, University of California, Irvine and J. Douglas Carroll, Bell Laboratories, for helpful bibliographic citations to the literatures on MDS and related approaches in anthropology and psychology, respectively. The first author's interest in roll-call voting analysis was stimulated many years ago when he took a course on that topic from Duncan MacRae. We are also indebted to the helpful suggestions of three anonymous referees on another paper by the present authors. Our analyses make use of the invaluable database created by Harold Spaeth, "United States Supreme Court Judicial Database: 1953-1991 Terms," ICPSR 9422 (4th Release, May 1993). We are indebted to the ICPSR, University of Michigan, for making this data set available to us. The completion of this research was supported by National Science Foundation Grant # SBR 446740-21167, Program in Methodology, Measurement, and Statistics (to Bernard Grofman and Anthony Marley).

ABSTRACT

Paralleling the Poole and Rosenthal (1984,1991a,1991b, 1997) analysis of the U.S. Congress, we apply both metric and non-metric multidimensional scaling to voting patterns in the U.S. Supreme Court over the period l953-l991 to determine the number of dimensions needed to characterize judicial voting patterns . We show that voting in the Supreme Court on each of the 15 nine member "natural courts" during this time period in which a substantial number of cases were heard by the full court has been largely unidimensional (with a two-dimensional solution explaining virtually all of the variance). This result is virtually identical to the Poole and Rosenthal findings about the dimensionality of congressional voting. We also find that the fit of a purely unidimensional model has never been higher than in the Rehnquist Courts. We consider alternative reasons for the striking degree of unidimensionality we observe.

We offer a dimensional scaling of votes in the U.S. Supreme Court, 1953-1991.[1] Our work is in the Poole-Rosenthal tradition of longitudinal dimensional analysis of congressional roll call voting.[2] While there is a parallel body of work in the judicial literature, drawing on the Schubert-Spaeth "attitudinal" tradition,[3] our work differs in two important ways from most earlier work on Supreme Court voting patterns.

First, we perform our analyses on the entire range of cases considered by the Supreme Court rather than looking separately at cases within some particular more narrow issue domain such as First Amendment freedoms, Fourth Amendment search and

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[1]The literature on Supreme Court decision-making is too voluminous to review in capsule form, but carious articles and books focusing on the Supreme Court are cited in the text below and a useful, although now dated, review is found in Ryan and Tate (1980); important general treatments of judicial behavior and public law include Murphy and Tanenhaus (1972), Gibson (1983), Shapiro (1993), and Baum (1997). Reviews of the judicial behavior literature on trial and lower appellate courts, respectively, are found in Jacob (1991) and Gibson (1991).

[2]The classic early works on congressional roll-call voting analysis are Turner (1951) and MacRae (1958). The methodological underpinnings of this early behavioral work are laid out in MacRae (1970). Similar methods have been applied to legislatures outside the U.S. (see e.g., MacRae, 1967). What is unquestionably the most important recent scholarship in this area has been by Keith Poole and Howard Rosenthal (see Poole and Daniels, 1985; Poole and Rosenthal, 1984, 1991a,b, 1997). The Poole and Rosenthal work reflects major technical advances over the work of the 60s and 70s on roll-call voting.

[3] While "legal realism" got its start among lawyers (see e.g., Frank, 1949), it has largely been political scientists such as Glendon Schubert (1959, 1964, 1965, 1974), and Harold Spaeth (1963a,b, 1979), and their students and successors (e.g., Spaeth and Peterson, 1971; Rohde and Spaeth, 1976; Spaeth and Brenner, 1990; Hagle and Spaeth, 1992; Segal and Spaeth, 1993), who, beginning in the late 1950s, have provided the empirical evidence to buttress a claim that the policy attitudes of Supreme Court justices serves as the principal determinant of their voting behavior. The locus classicus for the modern empirical study of the Supreme Court, however, is Pritchett (1948) which viewed the Court as a political institution, looked at the social values of justices, and introduced bloc analysis as a tool for analysis of court decisions. Other important early work was done by Sidney Ulmer (1960, 1970, 1973a, 1973b, 1974), some of it arguing for the importance of judge's social background.

seizure cases, judicial power, federalism, etc. (see e.g., Rohde and Spaeth, 1976; Segal, 1984, 1988; Segal and Spaeth, 1993) While there are unquestionable gains in both statistical fit and in subtlety of analysis to be obtained by looking at cases pre-grouped according to the similarity of their issue content, a broad-brush pattern captures a very substantial portion of the variance.

Second, rather than using Guttman scaling or factor analysis, like Poole and Rosenthal (1997), we use a form of multidimensional scaling (MDS) to estimate the policy preferences of the justices.[4] When the structure of the data can be thought of in terms of voters who have ideal points in some n-dimensional space and who are choosing among alternatives that can also be represented as points in that same n-dimensional space, MDS is the most appropriate technique to recover voter ideal points and specify the dimensionality of the issue space, i.e., MDS is appropriate for representing data generated by an underlying Coombsian unfolding model (Coombs, 1964)[5] that, in the

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[4] Multidimensional scaling (hereafter MDS) is a class of techniques designed to reduce a matrix of proximities to a geometrical configuration of points lying in some number of dimensions in such a way that the distances d_{ij} between the points are related in some fashion to the proximities δ_{ij}.. MDS is based on capturing underlying dimensions in terms of what is called Coombsian unfolding (Coombs, 1964). There are both metric and non-metric versions of MDS (see e.g., Torgerson, 1958; Shepherd, 1962a, l962b; 1974; Kruskal, 1964a, l964b; Shepherd, Romney and Nerlove, 1972a; Coxon, 1982; Kruskal and Wish, 1991). The latter may be used where proximity between stimuli is not specified in metric terms and only ordinal information about relative closeness is known.

[5] The unfolding model has been independently discovered by scholars in different disciplines, who often write in ignorance of each other's work. Coombs (1964) distinguished between I scales and J scales. Coombsian J scales posit that we can locate both individuals and stimuli in the same metric space. An I scale is an individual's preference ordering of the stimuli and may be thought of as the J scale unfolded on the ideal point of the individual, with only the rank order of the stimuli given in increasing distance from the ideal point (Coombs, 1964). In one dimension, the set of Coombsian I scales that are consistent with a given Coombsian J scale gives a form of what economists (Black, 1958; Arrow, 1961) call a "single-peaked" ordering. However, there may be some single-peaked orderings that do not coincide with any Coombsian J scale because, although the ordinality conditions required for a set of individual orderings to be single-peaked are satisfied, any proposed metric on the alternatives gives rise to logical inconsistencies.

legislative roll call voting context, can be thought of as giving rise to a spatially embedded "ideological" structure.[6] In particular, when properly used, MDS does not normally create artifactual additional dimensions (e.g., an extremism dimension) the way that factor analysis inevitably does when applied to attitudinal data or to data on voter choices or preferences that has been generated by spatial proximity in unfolding terms.[7]

In political science and economics, while the recent seminal work of Keith Poole and Howard Rosenthal (l984, l991a,1991b,1997) on historical patterns of roll-call voting in the U.S. Congress brought MDS ideas to the attention of political scientists and economists, MDS had been relatively little used, at least as compared to factor analysis.[8] MDS techniques have, as far as we are aware, only rarely been applied to multi-judge voting patterns, twice in the form of "smallest-space analysis," used by Schubert (1974) and Spaeth and Peterson (1971) to analyze Supreme Court decision-making, and once in the form of metric factor analysis (Rohde and Spaeth, 1976).

We use MDS techniques to model that aspect of Supreme Court decision-making that is most directly comparable to roll call voting in legislatures. Roll call data may consist of yes/no votes by a set of legislators on some set of bills or amendments, or reverse/affirm votes by members of a multi-judge (appellate) court on some set of cases (on appeal) before it. Drawing on the computerized data base on Supreme Court decisions that has been created by Harold J. Spaeth, we examine the voting patterns of justices from the fifteen of the twenty-three "natural courts" found during the period 1953-1991 in which a full nine justices served and in which there were a substantial number of full-opinion cases heard by the full court.

We are interested in how many dimensions are needed to account for Supreme Court decision-making. Here we show that voting in the Supreme Court has been largely

[6] Cf. Feld and Grofman (l988).

[7] See references cited later in the paper.

[8] In contrast, there is a long tradition of MDS use in disciplines such as mathematical anthropology and mathematical psychology (see e.g., Shepherd, Romney and Nerlove, 1972b; Carroll and Wish, 1974; Kruskal and Wish, 1991).

unidimensional and never more than effectively two-dimensional. We also show that the fit of a purely unidimensional model has never been higher than in several of the recent Rehnquist Courts. Thus, while the particular issues confronted by the Court changes considerably over time, our ability to fit judicial choices into what can essentially be described in left-right terms does not. In the concluding section of the paper we consider alternative reasons for why we might observe such a high degree of overall unidimensionality in Supreme Court voting patterns.

II. Data and Empirical Results

Data

We make use of the invaluable computerized database on Supreme Court decisions that has been created by Harold Spaeth.[9] For most purposes, we group data for analysis according to "natural courts"[10] Our analyses cover only those nine member

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[9]This data set, "United States Supreme Court Judicial Database: 1953-1991 Terms," was made available to us through ICPSR (ICPSR 9422 4th Release, May 1993).

[10] There were 23 natural courts during the period 1953-1991. Of these, seventeen were nine member courts. We report as the first number below the number of cases actually used for analyses of that natural court after we have performed our screening; the second number is total number of cases in the data set for that court before screening. Warren Court 1 (N = 48/65), consists of Justices Black, Burton, Clark, Douglas, Frankfurter, Jackson, Minton, Reed, and Warren. In Warren Court 2 (N = 36/39, omitted), Justice Jackson leaves the court but is not yet replaced (this court has only eight members). In Warren Court 3 (N = 75/121), Justice Jackson is replaced with Justice Harlan. In Warren Court 4 (N = 26/43, omitted), Justice Minton is replaced with Justice Brennan. In Warren Court 5 (N = 116/161), Justice Reed is replaced with Justice Whittaker. In Warren Court 6 (N = 291/342), Justice Burton is replaced with Justice Stewart. In Warren Court 7 (N = 0/49, omitted), Justice Whittaker is replaced with Justice White, but Frankfurter fails to serve on any of the decisions in our reduced data set. In Warren Court 8 (N = 270/312), Justice Frankfurter is replaced with Justice Goldberg. In Warren Court 9 (N = 161/197), Justice Goldberg is replaced with Justice Fortas. In Warren Court 10 (N = 98/175), Justice Clark is replaced with Justice Marshall. In Warren Court 11 (N = 29/34, omitted), Justice Fortas steps down but is not yet replaced (this court has only eight members). In Burger Court 1 (N = 56/70, omitted), Justice Warren is replaced with Justice Burger (this court has only eight members). In Burger Court 2 (N = 95/128), Justice Fortas is replaced with Justice Blackmun. In Burger Court 3 (N = 18/18, omitted), Justices Black and Harlan leave but are not yet replaced. In Burger Court 4 (N = 394/514), Justice Black and Harlan are replaced with Justices Rehnquist and Powell . In Burger Court 5 (N = 6/6, omitted), Justice Douglas leaves the court but is not yet replaced (this court has only eight members). In Burger Court 6 (N = 569/772), Justice Douglas is replaced with Justice Stevens. In Burger Court 7 (N = 624/728), Justice Stewart is replaced with Justice O'Connor. In Rehnquist Court 1 (N = 132/145), Justice Burger is replaced with Justice Scalia. In Rehnquist Court 2 (N = 21/22, omitted), Justice Powell departs but is not yet replaced. In Rehnquist Court 3 (N = 303/378), Justice Powell is replaced with Justice Kennedy. In Rehnquist Court 4 (N =

courts with a substantial number of cases[11] heard by all nine justices during the period 1953-1991.[12] Including cases with less than a full court might reduce the dimensionality of our solution; thus the decision to exclude them is a conservative choice in making a solution with low dimensionality less likely.[13] We also analyze only those cases from this data set uniquely identified by case citation number, in which the Court heard oral argument and gave a formally decided full opinion.[14] Where it is used below, the term "case" refers to just these types of cases. Note that all cases involving certiorari or cases with only memorandum opinions are excluded by the coding decisions we have made.[15]

Because we are focusing on affirmance or denial of the lower court decision, we do not require that cases have a majority opinion, as long as the directionality of a decision is clear. Spaeth's categorizations of justice's voting behavior were binarized by recoding "voted with majority," "regular concurrence," "special concurrence," and "judgment of the court" as concurrences and "dissent" as dissent. Cases where one or

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100/112), Justice Brennan is replaced with Justice Souter. In Rehnquist Court 5 (N = 87/106), Justice Marshall is replaced with Justice Thomas.

[11] Courts with too few cases reduce the reliability of the MDS spatial estimates.

[12] Following Spaeth's (1993) codebook accompanying the ICPSR dataset, this set was initially screened by selecting dataset "cases" where his level of analysis variable ANALU = " " and his decision type variable DEC_TYPE = 1.

[13] Also, we did not wish to artificially inflate the similarity between those justices who may have simply failed to participate in some number of particular cases.

[14] It should be noted that cases decided "on the merits" are rare, and cases with full signed written opinions are rarer, still In the 1994-95 term, the Court had 2526 cases on its dockets [excluding the 5,574 *in forma pauperis* petitions from indigents seeking reversals of their convictions] and disposed of the vast bulk of them. But of the many cases handled by the Court, "it decided only 160 on the merits, with full signed, written opinions handed down in 91 cases ... . the remainder being disposed of either *per curiam*, or by memorandum orders (e.g.., "affirmed," "reversed," "dismissed," or "vacated.")" (Abraham, 1998: 197). However, the relatively small set of cases decided on the merits with signed written opinions are the precedent setting cases which are the lifeblood of jurisprudential analysis.

[15] It might be argued that the decision coalitions in such cases might differ in substantially significant ways from other cases before the Court.

more Justice's votes were categorized as "jurisdictional dissent," "dissent from a denial or dismissal of cert.," and "non-participation," (namely those for which full roll call data is not available) were also deleted from the data set. Spaeth identified some decisions that he viewed as not being codeable in left-right terms.[16] However, although our interest is in ideological scaling, we have not eliminated those decisions from the data set. Including cases that Spaeth did not see as codeable in left-right terms is another conservative choice because it makes it less likely that a unidimensional model will satisfactorily fit the data.

Our coding choices restrict us to fifteen of the seventeen nine-member natural courts found during the period 1953-1991.[17] In our fifteen-court data set we have 4256 cases before data reduction and 3363 cases after data reduction. Because we have deliberately restricted the set of decisions we would analyze in a number of ways, it is natural to ask how much of the data set has been excluded and would our results have been different if we had chosen a more inclusive strategy.[18] First, we would emphasize that, even though we only look at 15 of the 23 natural courts, those courts include 93.8% (4256/4537) of the cases before reduction and 94.6% (3363/3555) of the cases after reduction during the time period under study. Second, a more inclusive strategy would not have significantly altered our results. For example, comparisons between the one-dimensional MDS scalings reported below and additional analyses where both cases with less than full participation and cases involving certiorari decisions were included show

[16] In the fifteen-court data set there are 3,363 cases (after reduction) , but of these there were only a relatively small number (28) that Spaeth viewed as not being codeable in left-right terms.

[17] Of the 17 nine-member courts, we omitted Warren Court 4, with only 26 cases after data reduction, and Warren Court 7, with no cases after data reduction. We should note that Warren 7, though technically a nine-member court, was not a nine member court in practice, since Frankfurter, although formally still on the court, only participated in 8 of the 93 decisions. The minimum number of cases in any of the natural courts we analyze is 48, in Warren 1.

[18] Several of our decisions as to which cases to exclude (e.g., the decision to exclude cases involving certiorari and the decision to exclude multiple decisions arising from a single case) were based in large part on suggestions of an anonymous referee.

almost no difference in average fit.[19] Moreover, our choice of which types of cases to include and which to exclude has minimal consequences for analysis of the identity of the median justice.[20]

Data Analyses

Estimating the Dimensionality of Supreme Court Voting: 1953-1991

The MDS calculations we report here were carried out using SYSTAT 5.0.[21] We report results from both metric and non-metric MDS.[22] Following Poole and Rosenthal

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[19] The average absolute difference between fit scores (squared multiple r) for the unidimensional solution to the larger as compared to the reduced data set was .045 (standard deviation = .053) for non-metric MDS and .031 (standard deviation = .041) for the metric MDS scalings. Neither data set fits significantly better than does the other. The average difference between fit scores (squared multiple r) for the unidimensional solution to the larger as compared to the reduced data set was a minuscule .004 (standard deviation = .07) for non-metric MDS and .006 (standard deviation = .052) for the metric MDS scalings.

[20] In none of the comparisons with alternative data sets we performed, did the identity of more than one of the fifteen median justices change, although in some instances we also got additional ties.

[21] We make no effort in this paper to provide a general mathematical descriptions of MDS techniques since these are available elsewhere (e.g., Kruskal and Wish, 1991), and MDS algorithms are now being included in most advanced statistics program. Generally, MDS techniques seek to optimize some objective function of goodness (or badness) of fit between the observed proximities and the distances between the points in the geometric configuration. The most commonly used objective functions, STRESS 1 and STRESS 2 (Kruskal 1964a, 1964b) are actually badness of fit measures, as is Young's S-STRESS. While the results we report were done using SYSTAT 5.0, a program which minimizes the value of Kruskal's STRESS 1, as an added precaution, the results were replicated using SPSS for Windows, which minimizes Young's S-STRESS. Ordinal results from the two programs were virtually identical, with only a few pairwise reversals of the location of proximate justices in some of the natural courts. Moreover, differences found in ordinal rankings invariably involved justices whose metric locations were virtually indistinguishable from one another. The correlations between the one dimensional solutions of the two programs were .99 for both the metric and the non-metric solutions, and the same was true for the two dimensional solutions. Because the results of the two methods were so close, we have only reported results from the SYSTAT runs.

(1991a, b) we answer the question of how many dimensions are needed to account for Supreme Court decision-making by looking at total explained variance[23] and at the gain in proportion of variance explained as we increase the number of dimensions used to fit the data.[24] Of course, when we look at only nine justices, then the maximum feasible dimensionality of any solution space is eight.

We focus on analysis in terms of the natural courts. For each of the 15 nine-member natural courts with a substantial number of cases, Table 1 shows variance explained for one dimensional, two dimensional, and three-dimensional fits for non-metric MDS, and Table 2 shows the corresponding values for the metric MDS calculations.

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[22] The choice of metric scaling instead of non-metric scaling has only limited effect on the general configuration of points in most cases. As we shall see, the differences between metric and non-metric MDS results proved unimportant for our analyses of Supreme Court data. For more detailed discussion of differences between metric and non-metric MDS see Kruskal and Wish (1991).

[23]The explained variance is the square of correlation between the raw data (i.e., for each pair of justices on a given natural court, the proportion of cases in which those two justices vote the same) and the MDS-recovered inter-justice (paired) distances. In the MDS literature, so-called "Shepard diagrams " are commonly used to display the scattergram between the raw data and the MDS distance estimates (Kruskal and Wish, 1991). We are reporting the square of the correlation that would be found for the data in such scattergrams. This value is, we believe, directly comparable to the explained variance reported in the work of Poole and Rosenthal (1991a, b). We have not reported values for the various stress measures common in the MDS literature (see e.g. Kruskal and Wish, 1991) because the explained variance measures are more readily interpretable.

[24] The heuristic generally employed is to examine the scree plot, a graph of the mean variance explained level for solutions of various dimensionalities (m = 1,2,3...). In theory, there should be an elbow in the plot marking the "true" underlying dimensionality. That is, variance explained should increase rapidly until the appropriate dimensionality is reached and then the plot should gradually flatten out, as the "additional" dimensions reflect mainly noise. (Sometimes “stress reduction” rather than “variance explained” is used as the basis for a decision about dimensionality.)

<< Tables 1 and 2 about here >>

Our expectation that solutions of low dimensions would well describe the various natural courts is generally satisfied. On average, over the 15 courts, the mean r^2 values are .86 for a one-dimensional metric MDS solution, and .97 for a two dimensional metric MDS solution. The corresponding mean r^2 values are .80 and .95 for the non-metric solutions. For the one-dimensional solution, we have r^2 values above .85 for 5 of the 15 courts, and r^2 values above .80 for 10 of the 15 courts when we consider non-metric MDS solutions; and r^2 values above .85 for 9 of the 15 courts and r^2 values above .80 for 11 of the 15 courts when we consider metric MDS solutions. For metric MDS, for which the fits are generally slightly better, only Warren 1, Warren 3, Warren 9 and Warren 10 show any real evidence of requiring even a two-dimensional solution, and no court requires a solution in more than two dimensions.

Clearly a one-dimensional solution is a very good one, but we can almost perfectly explain the data with two dimensions. The issue is very simple: which should we use? For this paper we have chosen to go with the one-dimensional solution, for ease of interpretation and because it explains so much of the variance in the data.[25] This choice is consistent with Poole and Rosenthal's (1997) measure of roll-call voting, D-Nominate scores. For scholars who wish a more fine-tuned analysis, concern for the second dimension as well would be desirable, but we shall not attempt such analysis here.

For comparison purposes, we present the results from a pooled analysis of the complete data sets. We would expect the fit of the MDS model to be greater on average for the disaggregated than for the pooled data. One likely source of multidimensionality in the pooled data is the introduction of new issues confronting the court such that the

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[25] We would emphasize that we would never expect to get a perfect scale pattern. As Poole and Rosenthal (1997:7) observe for congressional roll-voting analyses: "Allowance must be made for errors." We can make such an allowance via "a probabilistic model of voting. " Errors, however, should not be randomly distributed. In particular, errors should be most common among legislators who are located near the "cut-point" between any proposal and the status quo reversion point that obtains if that proposal fails to pass. MDS finds the dimensional structure that best fits the data, and allows for mistakes.

issue positions of justices with respect to these issues are not the same as for the issues that had been previously been central. By focusing on single natural courts, we minimize this problem. Another likely source of error (and thus potential imputed higher dimensions) is changes over time in the issue locations of justices, i.e., even if the issues don't change, the views of particular justices might. *Ceteris paribus*, the longer the time period over which we examine decisions of a sitting justice, the more likely is it that there will be some ideological drift in that justice's position.

For our analysis we initially pooled together the 15 data sets (yielding 3363 cases), computed simple matching coefficients between each pair of the 27 justices that served over this time period, and analyzed the resulting matrix as before with metric and non-metric MDS. The results were as expected. The r^2 value was .79 for the one dimensional metric MDS solution, and .79 for the non-metric solution as well. For the two-dimensional solutions we found r^2 values of .91 for metric MDS and .90 for non-metric MDS. This is a drop of .05 to .06 in total r^2 from the average values for the individual natural courts of one dimensional and two-dimensional fit.

Finally, we examined what might be considered the "worst case" scenario, where the pooled data set subject to MDS was expanded in ways that might be expected to introduce still further sources of error. We selected the formally decided full opinion cases uniquely identified by case citation number (as before), but now included cases from all 23 courts (including the eight member courts), and left in those cases where there were less than nine justices participating.[26] This left an aggregated dataset of 4537 cases, which we then analyzed as above. Here the fit is slightly worse, but not remarkably so. The r^2 value was .75 for the one dimensional metric MDS solution, and .75 for the non-metric solution as well. For the two-dimensional solutions we recovered r^2 values of .88 for metric MDS and .87 for non-metric MDS.

Even though the MDS fit for the pooled data is not that bad, our interest in tracking justices over time lead us to prefer dealing with analyses of each of the 15

[26] These are the cases where Spaeth coded the Justice's vote as 5 (non-participation), 7 (dissent from a denial or dismissal of certiorari or dissent from summary affirmation), or 8 (jurisdictional dissent).

natural courts, separately.[27] Let us now turn to some of the more fine-grained features of our results (see Tables 1 and 2 above). Of our fifteen courts, Warren 1, Warren 3 and Burger 2 are courts taking place soon after there has been a change in Chief Justice that occurred when a non-sitting justice is chosen as Chief Justice. With the advantage of hindsight we may hypothesize that such changes in the court are particularly disturbing of existing coalitions on the court, and that it may take a while for the dust to settle and new alliances to coalesce. If so, then the dimensionality of the MDS solutions can be expected to be increased when we have such critical changes in the court's leadership that take the court in a new direction. This interpretation is reinforced when we look at data from Burger 1, which, although not a nine-member court, votes on sufficiently many decisions to allow us to calculate an MDS solution. The metric MDS solution in one-dimension for Burger 1 has an r^2 value of only .36 but the two-dimensional metric solution has an r^2 value of .96.[28] In contrast, when we look at the early Rehnquist courts, we see very high explained variances for the one dimensional solutions, suggesting that Rehnquist's promotion to Chief Justice did not have a major impact on existing coalition patterns on the court.[29]

Another important result that can be derived from the data in Tables 1 and 2 is that the degree of unidimensionality has, generally speaking, been on the increase. For example, the mean r^2 values for the Warren courts are .74 for the one dimensional non-metric MDS solution and .80 for the one dimensional metric MDS solution. The corresponding mean values for the Burger courts are .87 and .88; while the mean values

[27] Another reason for not using the pooled data except for clues as to dimensionality is that the locations of justices who served on only a handful of courts may not be reliably estimated from the pooled data.

[28] The corresponding non-metric values are .37 (in one dimension) and .95 (in two dimensions). For a three dimensional solution, however, we get r^2 values of .99 (metric) and .99 (non-metric).

[29] Alternatively, of course, it may simply be that there were particular important changes in the natures of the issues confronting the court that happened to be taking place at the same time as we had these two changes in Chief Justice (e.g. civil rights issues in the 1950s; perhaps anti-Vietnam war protest issues in the 1970s). Choosing between these two explanations is not possible with the sorts of data we are looking at.

for the Rehnquist courts are .85 and .93. Thus, by the time we get to the Rehnquist courts the finding of nearly perfect unidimensionality is indisputable.

III. Discussion: Why So Few Dimensions?

We have shown that, using properly specified MDS analyses, a single dimension of conflict is a useful metaphor to conceptualize Supreme Court decisions, explaining on average some 80% or more of the variance in judicial agreements, with two dimensions sufficient to capture virtually all of the variation in decisional coalitions. Our results directly parallel those of Poole and Rosenthal (1984,1991a,19991b,1997) for the U.S. Congress. Poole and Rosenthal find strong evidence that a single dimension explains 80 percent or more of the variance in historical patterns of congressional roll-call voting, and that a two-dimensional representation accounts for most of the remaining variance. Moreover, their finding that, since the 1980s, the dimensionality of congressional voting has more and most closely approximated unidimensionality, parallels our results for the more recent natural courts in our data set.[30]

If we accept our finding of low dimensionality/near unidimensionality of Supreme Court decisions, our work, like that of Poole and Rosenthal (1997) for Congress, raises the important question of how so few dimensions could be found given the variety of issues confronting legislatures and courts, and given the fact that other scholars who have studied the Supreme Court have found evidence for higher dimensionality. First we turn to comparisons of our findings with those of other authors who have looked at the court; then we consider whether the evidence for low dimensionality reported above ought to be suspect, and if not, how the voting patterns we observe might have arisen.

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[30] However, the fit of their two-dimensional solution is not as good as the fit of our two-dimensional solution. We believe that this can be explained, at least in part, by the difference in degrees of freedom between a 435 member House and a 9 member Supreme Court. For the latter, as noted earlier, the maximum possible dimensionality is only 8.

Comparison of MDS and Factor Analysis

One reason for a difference in the dimensionality we estimate for the Supreme Court and the findings of other scholars is that those other authors did not use MDS but used factor analysis instead (Schubert, 1965, 1974[31]; Dudley and Ducat, 1986; Ducat and Dudley, 1987).[32] This same reason helps explain why Poole and Rosenthal (1997) get lower dimensionality for congress than some other scholars (e.g., Wilcox and Clausen , 1991) who rely on factor analysis. When roll-call votes are generated by a process that can be characterized as Coombsian unfolding, factor analysis will invariably overestimate the number of dimensions. This point is well known in the mathematical psychology literature (see e.g., van Schuur and Kiers, 1994) but does not appear to have widely diffused to other social science disciplines.

For comparison to our metric and non-metric MDS analyses we have produced comparable analyses of each of the natural courts using the standard principal components factor analysis (PCFA)[33]. We find, as expected, that factor analyses of Supreme Court data invariably "recover" more dimensions than does either metric or non-metric MDS when we use the standard eigenvalue tests to determine the dimensionality of the factor analytic solution. The mean eigenvalues over all 15 courts, in descending order of magnitude, are 2.979, 1.763, 1.204, 0.893, 0.695, 0.529, 0.434, 0.315, and 0.188. The Kaiser criterion, perhaps the most commonly used criterion for addressing the

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[31] Schubert's (1974) use of smallest space analysis is a kind of "after thought" to the bulk of his work (six of the seven chapters) using factor analysis.

[32] Much of the earliest work on scaling analyses of the Supreme Court used bloc analysis -- a form of cluster analysis -- see e.g., Pritchett 1948; Schubert, 1959; Snyder, 1959; Sprague, 1968. Intended for use by students, Ryan and Tate (1980) offer a synthesis of the early judicial behavior literature that revolves around computer exercises for students to do using Supreme Court data (of various sorts) for the period 1946-1978; one of their exercises (Chapter 5) involves bloc voting analysis.

[33] A crucial point here is that the original binarized roll-call data was reduced to a symmetric matrix of inter-justice Pearson Product Moment Correlation Coefficients before submission to PCFA, as is standard practice for factor analyses. Note that this differs from our earlier treatment of the data, which involved computing simple matching coefficients for each pair of justices, before submission to MDS. Again analyses were carried out with SYSTAT 5.0.

number of factors question, advocates retaining those factors with eigenvalues greater than one. Under this criterion, all 15 of our natural courts would seem to require three factors, and three of the courts seem to require four. . Furthermore, if we wished to use a decision procedure to decide when to retain factors that is directly analogous to the one we used for MDS above, we would examine the percentage of variance explained by each factor. On average over the 15 courts these percentages are 33.099, 19.593, 13.381, 9.919, 7.724, 5.879, 4.818, 3.505, and 2.084, for the first through ninth factors. Clearly, it takes many factors to reach the average level of explained variance in our one-dimensional metric MDS solutions ($r^2 = .86$). Indeed, on average it takes at least five PCFA factors to reach this level of explained variance.

When we reexamine the analyses in Schubert (1974) and Rhode and Spaeth (1976) which use both factor analysis and a form of MDS, we se that Schubert consistently finds one additional substantively interpretable dimension when he reports factor analysis results than he gets from smallest space analysis,[34] however Rohde and Spaeth (1976: 137-138) find both factor analysis and MDS to yield three dimensions in the Warren Court and Burger Court data they analyze.[35] Ducat and Dudley (1987), who

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[34] While the statistical measures of fit Schubert (1974) uses are not directly comparable to the one we use, they serve much the same function. The average "coefficient of alienation" reported by Schubert (1974) for his smallest space analyses are .212 for the 1D solution, .076 for the 2D solution, .032 for the 3D solution and .013 for the 4D solution. Schubert (1974) himself prefers a three-dimensional MDS solution for the courts in his 20+ year data Supreme Court set, but even he characterizes the two-dimensional solution as "vastly easier both to construct and appraise (1974: 135) involving what he regards as two particularly well-demarcated dimensions, one tied to civil liberties/political liberalism and one tied to economic liberalism (see also Schubert, 1974: 146-147). (He regards his one-dimensional smallest space solution as a mixture of the locations on these two dimensions (1974:134).) We might also note that Schubert (1965, Chap. 8, "The Circumflex of Liberalism", esp. pp. 248-249) finds curvilinear patterns in the factor analyses of Supreme Court data that he, following Guttman (1954), attributes to complex patterns of inter-correlation among factors. In our view, however, such curvilinearities better be viewed simply as statistical artifacts do to an inappropriate choice of factor analysis to model data with an unfolding structure (See IDENTIFYING REFERENCE REMOVED)

[35] However, we believe that differences between their results and ours can be attributed to differences in the nature of the input matrix used for the MDS analyses. This quite technical issue is discussed in IDENTIFYING REFERENCE REMOVED.

use factor analysis, even though they are looking only at economic cases during the Burger Court, also find three distinct dimensions in their factor analysis of Supreme Court data, as does perhaps the first factor analytic study of the Court (Thurstone and Degan, 1951), analyzing cases in the 1943-44 and 1044-45 terms..[36]

Reasons for Unidensionality in a Complex World

There are six types of answers that have been given to the puzzle of why we may find considerable unidimensionality (or low dimensionality) in a complex world, although some of these answers seem more relevant for partisan conflict and legislative choices than for judicial ones.

Taagepera and Shugart (1989) suggest that party conflict is linked to the dimensionality of the issue space; in particular, they hypothesize that the number of issue dimensions equals the (effective) number of parties minus one.[37] But they also note that the causal arrows can go in the reverse direction. Thus, with two-party politics in a legislature, we might expect that politics would be essentially unidimensional -- because two points determine a line. Because political competition in the U.S. is effectively two-party competition, the Taagepera and Shugart analysis would lead us to expect a strong tendency toward unidimensional issue conflict in legislatures, as diverse issues are

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[36] Moreover, they offer plausible substantive explanations of the three factors they identify; yet we would regard as least one of their dimensions as completely artifactual.

[37] Looking at the countries that were continuously democratic in the post W. W. II period, and using estimates of issue dimensionality from Lijphart (1984) and Lijphart's calculations of the Laakso-Taagepera (Laakso and Taagepera, 1979) measure of the effective number of parties, they provide rather strong evidence in support of the hypothesis that the (effective) number of parties is linearly related to the number of issue dimensions, with a slope of (roughly) one and a constant of (roughly) plus one. To account for this pattern, they propose a model in which initially competition is unidimensional and new dimensions are added when a new party locates itself at a relatively central position with respect to the existing dimension(s) but with a more extreme policy stance on the new dimension, a stance designed to attract voters who attach high importance to that issue. (See also Taagepera and Grofman, 1985).

projected onto the line defined by the contestation between the two major parties. [38] To the extent that the same kinds of conflicts often show up in courts as in legislatures given the tendency in U.S. politics to "judicialize/constitutionalize" virtually all conflicts, and because justices can be identified in terms of the party of the president that appointed them, this model might also be applicable to the judicial context.[39]

Another attempt to account for the high prevalence of unidimensionality in partisan politics in the U.S. is that of Glazer and Grofman (1989), Glazer and Grofman suggest that asserting a position that can be characterized in left-right terms is like a clip-on tie; it's easy to put-on. To the extent that they describe their positions to voters in terms of conflict over a single dimension, politicians find it easy to explain their views to ordinary voters. Politicians do not need to try to acquaint voters with a host of subtle distinctions about where they stand across different issue domains. One simple ideological label then becomes cost-effective shorthand for positions on a whole host of issues. This explanation, however, seems more useful for party competition than for judicial decision-making.[40]

However, Glazer and Grofman also offer a somewhat different argument about the determinants of the dimensions over which conflict is carried out. They suggest that

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[38]To the extent that party and ideology have a strong overlap so that levels of party loyalty vary as a function of ideological location, legislative conflicts will be translated into what appears to be near unidimensionality in roll-call voting patterns (Krehbiel, 1999; IDENTIFYING CITE REMOVED).

[39]Indeed, one of the anonymous referees of another paper by the present authors proposed a similar partisan-appointment based model of judicial behavior as a possible baseline model. Here, justices appointed by Democratic presidents could generally be expected to line up together (on the liberal side) while justices appointed by Republican presidents could generally be expected to line up together (taking more conservative positions), with justices appointed by the same President presumably expected to vote together almost entirely as a bloc. A number of judicial scholars have pursued closely related approaches, some incorporating other variables such as social background as additional predictors (see esp. Adamany, 1969; Tate, 1981; Tate and Handberg, 1991; Ulmer, 1970, 1973b, 1986).

[40]Rather different arguments for why party competition might reduce the dimensionality of issue conflict are developed in Glazer and Lohmann (1999), who suggest that parties seek to take certain issues "off the table."

coalition patterns and vote-trading may account for unidimensionality, i.e., if a certain groups of legislators forms an alliance over some particular set of questions, the alliance may spill over into other domains, as enemies (friends) on one issue become defined as enemies (friends), period.[41] For example, if most liberals are strong environmentalists, then it becomes hard for a liberal who is not a strong environmentalist to vote his convictions without antagonizing his closest allies. This argument about alliance structure may be generalized beyond the legislative domain to any group, including judges. It is consistent with our earlier finding that dimensionality appears to increase when we get a new Chief Justice who had not previously served on the Supreme Court, since the insertion of such an outsider into a leadership role, when coupled with the loss of the leadership of the previous Chief Justice, has the potential to disrupt the group dynamics and existing (polarized) coalitional alignments.

A fourth model of how high multidimensionality may become transformed into unidimensionality (or at least a space of only two or three dimensions) is offered by Hinich and Munger (1994). They propose that there may be many potential issues but only a limited number of dimensions, which come to define potential policy conflicts. The former are related to the latter by projections from higher dimensional to lower dimensional space. Again, this model, too, can be adapted to be applicable to the judicial context, and we believe it to provide very important insights about how many dimensions get compressed into one or at most a few dimensions.

A fifth (and closely related) explanation of low dimensionality involves the idea that any actual vote reflects a packaging of issues – thus reducing the overall dimensionality (Poole and Rosenthal, 1997: 6)[42]

A sixth explanation for unidimensionality in the legislative and court data is that it is, at least in part a statistical artifact. This would be the view taken by some judicial scholars.

Feld and Grofman (l986) suggest that, in most decision contexts, there may indeed be many issue dimensions, but that most of these are relevant only for a handful of

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[41] A somewhat similar argument is found in Poole and Rosenthal (1984).

[42] Poole and Rosenthal (1997: 6) suggest that vote trading may occur over the items in this package.

decisions. In effect, these issue dimensions function like noise in the data.[43] Even if there are lots of issue dimensions, if most are relevant only for a handful of cases, then only the "main" dimensions will be visible in the MDS analyses, i.e., the modal dimension(s) of conflict will be the "signal" produced by analysis of voting data. Thus, it would be possible to find more dimensions than we do if we were to restrict ourselves to subsets of the data.

Spaeth (1963a, 1963b, 1979) and other judicial scholars who have looked at specific domains such as civil rights or economic issues, or federalism (Spaeth and Peterson, 1971; Segal, 1984, 1986; Dudley and Ducat, 1986; Ducat and Dudley, 1987; Hagle and Spaeth, 1992; Segal and Spaeth, 1993) customarily find strong evidence for distinguishing such issue dimensions from one another, and thus claim that Supreme Court decision-making is not at all well fit by a simple unidimensional model. But, analogously, analysts such as Wilcox and Clausen (1991), who look at limited sets of roll calls defined by subject domain, find a greater number of dimensions in congressional voting than do Poole and Rosenthal (1984). If we look only at small subsets of voting decisions carefully selected with respect to the type of issue/jurisprudential concerns they are likely to elicit, then it is quite possible that particular types of issues may give rise to distinctive coalitional alignments that can only be explained in terms of some new and distinct dimension of conflict. But, even if they do, this does not imply the invalidity of lower-dimensional solutions to the data, since the additional dimensions may account for only a small portion of the variance.[44] Thus, we do not regard the Wilcox and Clausen (1991) findings on Congress as incompatible with the Poole and Rosenthal findings for that body, nor do we regard the findings of multiple policy-arena specific/jurisprudential dimensions in Supreme Court decision-making (Rohde and Spaeth, 1976; Spaeth, 1979;

[43] In looking at mass electorates, Feld and Grofman (1988) suggest that most voters need not have clear left-right views for the group-decision process to exhibit what looks like unidimensionality. They show that non-ideological voters add noise in a form that is very likely to cancel out when we look at majority preferences in the society.

[44] Also, since restrictions to specific policy domains limits the number of cases we have to examine, some imputed differences across different issue domains may be due to sampling error.

Spaeth and Brenner, 1990; Segal and Spaeth, 1993) as incompatible with our own findings.

A related statistical issue has to do with the possibility that MDS techniques understates the true number of dimensions. The Poole and Rosenthal analyses of the U.S. House have been challenged by Koford (1989) as overstating the degree of unidimensionality because, even if there were, say, two equally weighted and orthogonal dimensions, a single dimensional MDS model will account for three fourths of the variance (here the single dimension would be a line at 45 degrees to the two orthogonal axes). Moreover, Koford also notes that, if there are two underlying dimensions that are correlated with one another (i.e., non-orthogonal), the explained variance of the single-dimensional solution rises above 75% as the correlations between the two dimensions increase (see also Koford, 1990, 1994).

Koford's ideas have been further extended by Snyder (1992a) based on the idea of a committee gate-keeping role in which the only bills that committees allow to the floor are those that might pass. Snyder (1992a) shows that this restriction in the space of feasible bills further reduces MDS estimates of dimensionality, such that we may get very high proportions of variance explained from a unidimensional model even if the process generating the roll-call involves 2-4 dimensions. While this idea has never been developed, it is possible that lower courts might serve the same gate-keeping function as committees do for Congress.[45] In related work, Heckman and Snyder (1997) further criticize the Poole and Rosenthal approach on statistical grounds.[46]

While Rosenthal (1992:31-32) is correct that the benchlines developed by both Koford and Snyder assume "errorless voting" and thus underestimate the likelihood that MDS applied to real multidimensional data will produce one or at most a few dimensions, and he provides reasons to be suspicious that a committee gate-keeping role affects the dimensionality of congressional voting, Koford and Snyder are nonetheless correct that MDS can produce estimates that understate the true dimensionality of the data. Thus, we wish to issue a slight note of caution about how best to interpret our results.

We take our results as indicating that a single-dimensional explanation works well, and, because our results show that a two-dimensional solution explains virtually everything, we would conclude that the true dimensionality of Court decision-making is no greater that two. Moreover, Koford's caveats about the "true" dimensionality of data whose dimensionality is estimated via MDS do not significantly affect our estimates of who were the median justices in the various natural courts or our claims about the leftward and then rightward shifts in the court, because the one-dimensional solution and

[45] A variant of the Snyder (1992a) model has been suggested by one of the anonymous referees of another paper by the present authors. That referee observed that there may be gatekeeping effects due to the ability of the Court (or at least four members of it) to determine which cases will and which will not come before it, that affect dimensionality. If, for example, most of the cases that come before the court are ones where there is a bloc of at least four justices who put forward a case only in anticipation of being on the winning side, then we would expect that this bloc would vote together when the case is before the Court. Still, if this phenomenon is to affect dimensionality it must be the case that this bloc of votes for certiorari is ideologically connected, which begs the question of there being an underlying dimensional structure to the Court.

[46] For further discussion about these issues see response to Rosenthal (1992) by Snyder (1992b); Heckman and Snyder (1997); Poole and Rosenthal (1990, 1994); and Poole, Sowell and Spear (1992).

the first dimension of the two dimensional solution provide such very similar orderings of justices in each of these courts.[47]

[47] Because the second dimension may be more important that it seems from looking simply at the gain in r^2 values in our analyses, it would be desirable to examine this dimension in more detail to see what cases load on it. However, as noted earlier, doing so takes us beyond the scope of this paper. (Extensive analysis of the meaning of subsidiary dimensions in their MDS analyses of congressional roll-call voting is found in Poole and Rosenthal (1997), and this is a central concern in Schubert's (1965, 1974) studies of the Supreme Court as it is in the work of many other scholars .)

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Table 1

Variance Explained
on Fifteen Nine Member "Natural Courts" 1953-1991
(Non-Metric MDS)

Court	**One Dimensional Solution**	**Two Dimensional Solution**	**Three Dimensional Solution**
WAR 1	.68	.90	.97
WAR3	.55	.97	.99
WAR5	.77	.94	.99
WAR6	.80	.97	.98
WAR8	.92	.97	.98
WAR9	.76	.97	.97
WAR10	.67	.94	.99
BURG2	.80	.86	.98
BURG4	.95	.99	.99
BURG6	.83	.94	.96
BURG7	.90	.98	.99
RENQ1	.83	.96	.99
RENQ3	.87	.97	.99
RENQ4	.87	.96	.99
RENQ5	.84	.86	.90

Table 2

Variance Explained
on Fifteen Nine Member "Natural Courts" 1953-1991
(Metric MDS)

Court	One Dimensional Solution	Two Dimensional Solution	Three Dimensional Solution
WAR 1	.70	.91	.98
WAR3	.63	.98	.99
WAR5	.94	.98	.99
WAR6	.95	.99	.99
WAR8	.92	.98	.99
WAR9	.77	.99	.99
WAR10	.71	.97	.99
BURG2	.82	.96	.99
BURG4	.96	.99	.99
BURG6	.84	.95	.98
BURG7	.91	.99	.99
RENQ1	.94	.98	.99
RENQ3	.96	.99	.99
RENQ4	.96	.98	.99
RENQ5	.85	.94	.95