Political Analysis Advance Access published November 22, 2006

doi:10.1093/pan/mpl009

UK OC OK? Interpreting Optimal Classification Scores for the U.K. House of Commons

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Poole's (2000, Non-parametric unfolding of binary choice data. *Political Analysis* 8:211–37) nonparametric Optimal Classification procedure for binary data produces misleading rank orderings when applied to the modern House of Commons. With simulations and qualitative evidence, we show that the problem arises from the government-versus-opposition nature of British (Westminster) parliamentary politics and the strategic voting that is entailed therein. We suggest that political scientists think seriously about strategic voting in legislatures when interpreting results from such techniques.

1 Introduction

Party cohesion and whipping in the U.K. House of Commons suggests that the errors across legislators and roll calls are not independent and identically distributed. As a result, parametric scaling techniques, which rely on this assumption, are inappropriate. In such circumstances, one possible solution is to use Poole's (2000) Optimal Classification (OC) procedure (e.g., Rosenthal and Voeten 2004).

A sample of the rank ordering that the Poole (2000) OC procedure yields for the period of the first Blair government (1997–2001) in the U.K. House of Commons is given in Appendix A.[1] If the technique has worked as expected, Appendix A ought to be an edited list of Members of Parliament (MPs) from the most liberal parliamentarian in the Commons to the least liberal, from the least conservative to the most conservative. In terms of parties, the ranking is as expected: the Labour party, which has socialist origins, occurs to the "left" (lower) than the right-wing Conservative party and the placement of the Liberal Democrats toward the center is quite plausible.

Authors' note: Financial and technical support from The Star Lab is gratefully acknowledged. We are very grateful to three anonymous referees for insightful comments on both content and structure. All errors and omissions remain ours and ours alone.

[1]The full list is available on application from the authors. Appendix C gives some replication information that readers may find helpful.

Problematically, the last 30 scaled positions for Labour include MPs such as Tam Dalyell (position 409), Robert Marshall-Andrews (411), Dennis Skinner (412), Jeremy Corbyn (420), Diane Abbott (415), Tony Benn (417), Ken Livingstone (422), and Bernie Grant (426). To be clear, OC classifies these MPs as some of the most right wing of the Labour party. Ideologically then, they are the closest to the Conservatives. This seems odd. Commentators—for example, Cowley (2002)—have not been slow to cite some or all of these individuals as Labour rebels, but not for the reason suggested by the attendant analysis. Rather, these members are widely accepted as ideologically left wing. Yet, here we observe them being placed right of their Prime Minister and, in fact, the entire Cabinet.

Appendix B gives the iterations report from the OC rank order for 1997–2001. From the first iteration there are practically no classification errors (just 1% by the 10th iteration): the proportion of those correctly classified by the simple OC rearrangement of cut points and then legislators is some 99.1%. By contrast, for the U.S. 107th Senate, the comparable figure was 91.9%. Voting at Westminster seems "perfect" in one dimension.

This note argues that strategic, "government versus opposition," voting at Westminster leads to OC rank orderings that cannot be interpreted as ideological continua. We explain our "possibility result" formally and informally in Section 2. In Section 3, we marshal numerical, simulation evidence for our contention. In Section 4, we discuss some qualitative evidence and simulate a (we think) compelling counterfactual scenario based on imputed sincere Conservative preferences that yield results consistent with our hypothesis that strategic voting drives the misordering. In Section 5, we conclude and suggest future avenues of research.

2 "Government versus Opposition" and OC

OC consists of two sequentially repeated algorithms: a *cutting plane procedure* and a *legislative procedure*. More formally, and drawing heavily on Poole (2000; 2005, 49–59), for one dimension the OC procedure consists of four stages:

1. There are p legislators and $s = 1$ dimensions of voting. The $p \times s = p \times 1$ matrix that contains the ideal points of the legislators is denoted $\mathbf{x}$. First, generate starting values for $\mathbf{x}$, which will be iteratively improved (below). To do so, calculate the $p \times p$ agreement score matrix where the "agreement score" between two members (voters, legislators) is the proportion of the divisions (roll calls) in which they vote the same way. This agreement matrix is converted to a matrix of squared distances, then double centered. Extracting the first eigenvector of this transformed matrix gives the starting values, which in this case are a rank ordering (Poole 2005, 49).
2. Fix the legislative rank ordering, use the Janice algorithm to find the optimal cutting point ordering. For p legislators, on any particular roll call, there are a total of $p + 1$ rank positions for a cut point, which will divide those who are predicted to vote "aye" from those who are predicted to vote "no." If the number of bills is n, then there are n total cut points. The cut points are picked such that they maximize the number of correct classifications. This means that, on any particular bill, the number of misclassified legislators—i.e., those for whom the cutting line predicts they voted "aye" but they actually voted "no" or the cutting line predicts they voted "no" but they actually voted "aye"—is minimized. When there are two or more cut points that would maximize correct classification, the algorithm picks the one closer to the center of the legislator rank order (Poole 2005, 55). Notice that for two (or more)

separate bills, there is no problem in having two (or more) cut points equal to one another. We now have a joint ordering of legislators and cut points interspersed. As an example, for $p = 5$ members with ideal points x_1 through x_5, and $n = 4$ bills, with cut points b_1 through b_4, we might now have:

$$x_2 < b_2 < x_1 = x_3 < b_1 < x_5 < b_3 = b_4 < x_4.$$

3. Holding the cutting point ordering fixed, use the Janice algorithm to find the optimal legislator ordering. Because we have a (one-dimensional) joint ordering—from step 2—we have the polarity for each bill. That is, we are predicting one voting side, "aye" or "no," to be the "left" or "right" on any particular roll call. For example, above we are predicting that legislators 2, 1 and 3 vote "left" on bill number 1, whereas legislators 5 and 4 vote "right" on that roll call. Clearly, for n roll calls there are $n + 1$ possible legislator positions. For any particular legislator, the algorithm places him "left" or "right" relative to each roll call such that the number of errors—in terms of his predicted "aye" or "no" votes on the bills—is minimized. This is done for all of the p legislators. When two or more rank positions produce the same (maximum) correct classification, the algorithm picks the rank position for the member that is closest to the median of the roll call cutting point rank ordering (Poole 2005, 57).
4. Return to step 2 and repeat.

OC assumes that legislators' preferences are single peaked and symmetric and the choice space is Euclidean (Poole 2005, 46–48). Crucially, legislators are assumed to "vote sincerely for the alternative that is closest to their ideal point" (Poole 2000, 212). The resulting rank order is, in theory, that of the legislators' ideal points. Conventionally, analysts would interpret this ranking as an ideological spectrum.

The central problem is that not all MPs in the modern House of Commons vote sincerely and proximally. Notice first that the governing party proposes almost all legislation voted upon at Westminster and controls the legislative agenda. Usually, the official opposition will vote against a government bill in favor of the status quo, even when the status quo is further from their ideal point than the proposed policy. In this sense, Westminster systems are government versus opposition, and *strategic* voting by opposition MPs simply to defeat the government, regardless of the issue, is common. By contrast, government party dissident MPs "rebel" when they vote their sincere preference against the explicit wishes of the government and with—in terms of "aye" or "no"—the opposition parties. Rebelling is costly for dissidents because it can lead to punishment: these MPs will be passed over for ministerial promotion and may be deselected for future elections (i.e., the central party can decide not to allow them to compete for a seat). Hence, there is an observational equivalence between the behaviors of rebel MPs from the governing party and MPs from the opposition party that belie important differences in their true (sincere, ideological) preferences. Scaling techniques like OC will fail to distinguish between these quite different motivations and place the two groups together in ranking terms.

More formally, suppose there are two types of parliaments demarcated by their legislators' preferences. Actors in a type I parliament have preferences over policy x, which are Euclidean with a quadratic loss function, represented as follows:

$$u_i(x) = -| \, x - x_i \, |^2,$$

where, of course, x_i is MP i's ideal point.

These actors vote sincerely and will be properly ranked by OC. By contrast, actors in the type II parliament—of which type I is a special case—have single-peaked, symmetric preferences over policy represented as

$$u_i(x) = -|\ x - x_i\ |^2 + (I \times \xi_i).$$

Here, I is an indicator function taking the value 1 when the bill under consideration is proposed by the government, and $\xi_i \geq 0$ if the MP is a member of the governing party and $\xi_i \leq 0$ otherwise. So, ξ_i represents the "strategic incentive" that MPs have to either support or oppose the government regardless of their sincere preference over policy. In particular, we expect that rebels with $\xi_i = 0$ vote sincerely. To elucidate our informal logic about why OC will struggle to produce an ideological continuum in such cases, consider Example 1 and Example 2.

Example 1. *Suppose there are three players, Far Left (*FL*), Left (*L*) and Right (*R*) with ideal points satisfying $x_i \in \mathbb{R}^1$, in particular, $x_{\text{FL}} < x_{\text{L}} < x_{\text{R}}$. Suppose there are $n = 2$ bills, with cut points $b_j \in \mathbb{R}^1$, $j \in \{1, 2\}$, which relative to the status quo (*SQ*) and the ideal points satisfy $x_{\text{FL}} < \text{SQ} < x_{\text{L}} = b_1 < b_2 < x_{\text{R}}$ and $|b_2 - x_{\text{L}}| > |\text{SQ} - x_{\text{L}}|$. Heuristically, we could suppose b_1 is proposed by the government (*L*), and b_2 is not.*

Then, when voting is of type I (sincere), OC will recover the correct rank ordering, $x_{\text{FL}} < x_{\text{L}} < x_{\text{R}}$.[2]

Explanation: Under sincere, type I, voting the matrix of votes will appear as

Bill	FL	L	R
1	0	1	1
2	0	0	1

where "1" is an "aye" vote and "0" is a "no" vote. Here OC will recover the correct rank order, with no classification errors: no matter what the starting estimate of the legislators' order is, the cutting vector will be estimated as (c_1^I, c_2^I), where $c_1^I \in [x_{\text{FL}}, x_{\text{L}}]$ and $c_2^I \in [x_{\text{L}}, x_{\text{R}}]$. But then, only the correct order $x_{\text{FL}} < x_{\text{L}} < x_{\text{R}}$ can result from the procedure.

Example 2. *Ceteris paribus, consider a type II parliament in which $\xi_{\text{L}} = \xi_{\text{FL}} = 0$ but ξ_{R} is sufficiently large (and negative) such that $u_{\text{R}}(b_1) = -|b_1 - x_{\text{R}}|^2 + I \times \xi_{\text{R}} < u_{\text{R}}(\text{SQ})$ even though $x_{\text{FL}} < \text{SQ} < x_{\text{L}} = b_1 < b_2 < x_{\text{R}}$. That is,* R *votes strategically in opposition to the government on b_1, even if the bill is an improvement for* R *relative to the status quo.*

Then, OC will recover an incorrect rank ordering $x_{\text{L}} < x_{\text{FL}} < x_{\text{R}}$.[3]

[2]Notice that the ordering $x_{\text{FL}} < x_{\text{L}} < x_{\text{R}}$ is, in practice, equivalent in one dimension to $x_{\text{R}} < x_{\text{L}} < x_{\text{FL}}$ since the technique is "blind" in terms of which "end" is left or right. For simplicity, and with no loss of generality, we only deal with the former case here.

[3]We are assuming that *Left* proposes a bill at its own ideal point, though this is not necessary to make the example work: all that is required is that $\text{SQ} < x_{\text{L}} < b_1 < x_{\text{R}}$ and that *Right* votes strategically for SQ.

Explanation: Now, the voting matrix will appear as

Bill	FL	L	R
1	0	1	0
2	0	0	1

The cutting vector will be estimated as (c_1^{II}, c_2^{II}), where $c_1^{II} \in [x_{\mathrm{L}}, x_{\mathrm{FL}}]$ and $c_2^{II} \in [x_{\mathrm{FL}}, x_{\mathrm{R}}]$, in which case L can be placed left of FL—reducing errors to zero—to give

Bill	L	FL	R
1	1	0	0
2	0	0	1

Once again, voting is perfect, but the conclusion that $x_{\mathrm{L}} < x_{\mathrm{FL}} < x_{\mathrm{R}}$ is incorrect.

This is exactly what we saw when we applied OC to the U.K. House of Commons: far left rebels appear between the moderate left government and the right opposition. In the next section we test and extend our hypothesis with some simulations.

3 Experiments

We simulated a Westminster style parliament with 700 members organized in three groups according to our examples above with ideal points relative to the status quo at zero: a *Far Left* (100 members, ideal point at -4), a *Left* (300,-2) and a *Right* (300, 2) group. Initially, we assumed that 1000 policies (roll call votes) are proposed by the *Left* (in government) group and that they are distributed along the ideological spectrum, but clustered around the government's ideal point, as $\mathcal{N}(\mu = -2,\ \sigma^2 = 4)$. Members behave as modeled above with the indicator taking the value 1 for all policy proposals and ξ_i varying as described below. Members cast an "aye" vote if $u_i(x) > u_i(\mathrm{SQ})$ and vote "no" otherwise. We analyzed the resulting vote matrix with OC.

We claim that the opposition (*Right*) drives the result we observe because it votes strategically. But the quantity of strategic voting can vary in two senses. First, we can directly manipulate the magnitude of ξ_{R} to capture the extent to which the *Right* is being whipped across all the bills. We began by setting a large value of $|\xi_i|$ for both *Left* and *Right* such that the former would always vote for the government's proposals and the *Right* would vote against. This placed the *Far Left* in the center of the OC ranking (position 301–400), exactly as expected. Next we held ξ_{L} constant and allowed the *Right*'s degree of strategic voting to vary. Interestingly, we found a threshold effect: below a certain level of ξ_{R} voting was sufficiently sincere to ensure a "correct" ranking (with *Far Left* placed positions 1–100); above the threshold, the Westminster result held, and the *Far Left* is misplaced. So, once a (threshold) degree of strategic voting is introduced to the opposition party, our claimed dynamic holds.

A second way in which strategic voting may vary pertains to the number of "free" votes in the Commons. That is, we could assume that there is some proportion of bills on which the party leaderships simply impose no order at all, but rather allow their members to vote their conscience. On the other bills, ξ_{R} is constant. Here, we supposed again that the *Left* bloc always backs their own (government) policy, the *Far Left* always votes sincerely, but that the *Right* votes strategically q percent of the time

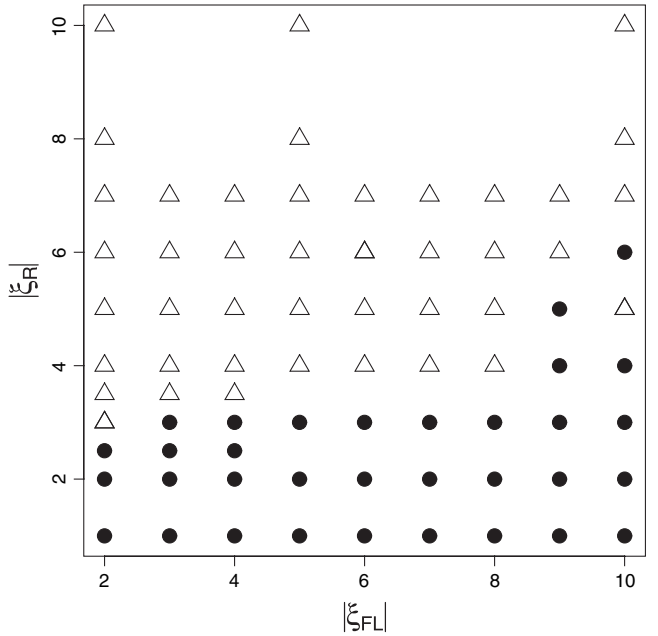

Fig. 1 Effect of altering $|\xi_R|$ and $|\xi_{FL}|$. Filled circles correspond to a correct OC ranking, and open triangles correspond to incorrect OC ranking.

(i.e., on q percent of the roll calls). Interestingly, OC recovers the correct rank order until $q = 60$: i.e., the *Right* bloc is voting strategically well over half of the time. Hence, it seems that part of the problem is the sheer number of strategic voting roll calls at Westminster.

Next, we allowed the *Right* and *Far Left* to vary in their response to government (*Left*) policy. In Fig. 1 we summarize these results. For some 75 combinations of ξ_R and ξ_{FL} we judged the OC ranking to be correct if it returned $\xi_{FL} < \xi_L < \xi_R$ and incorrect otherwise. The former classifications are denoted by filled points, whereas the incorrect classifications are open triangles. Notice that when $|\xi_i|$ for the blocs is large—such that both groups are voting strategically for all votes ($\xi_{FL} \geq 9$; $\xi_R \geq 7$)—the *Far Left* is placed incorrectly in the middle of the rank order. We also found that once $|\xi_R|$ became sufficiently small ($\xi_R \leq 3$) such that not all voting was strategic, for even large values of $|\xi_{FL}|$, so long as $|\xi_{FL}| \geq |\xi_R|$, the correct rank ordering emerged. However, if $|\xi_{FL}| < |\xi_R|$, the *Far Left* group was once again placed to the right of the *Left* bloc. In general, this implies that when the incentive to vote strategically—in absolute terms—is stronger for the opposition than the left-wing rebels, the rebels will be misplaced. Notice that the few correct recoveries of the ordering for high levels of ξ_{FL} ($\xi_{FL} \geq 9$) correspond to a counterfactual scenario where the *Far Left* has a very high strategic incentive such that the *Far Left* essentially always votes for the government. In this situation, the occasional deviation by *Left* members (due to an error term) will pull them toward the *Right* and the correct order may emerge.

Finally, we investigated an alternative governing circumstance where the *Far Left* was able to propose its own policy (i.e., it was in government). In particular, policy was distributed $\mathcal{N}(\mu = -4,\ \sigma^2 = 4)$. We now allowed the *Left* group to vote sincerely on all bills while employing a sufficiently high $|\xi_{FL}|$, $|\xi_R|$ to ensure strategic voting on all bills by the extremes of the parliament. We found that the OC ranking was now correct: it placed the *Far Left* $<$ *Left* $<$ *Right* in terms of rank ordering.

In short, the problem of the OC rank ordering for our simulated Westminster is exactly a function of a moderate government (occasionally) proposing policy that a more radical wing sincerely opposes and an opposition strategically opposes. In the next section we move to some more qualitative evidence in favor of our claims.

4 Qualitative Evidence

The essence of the critique offered above is that, on any one division, either Labour rebels voted against the government on matters of principle, whereas the Conservative opposition did so strategically, or vice versa. One way to show this is to consider some of the specific bills over which the rebels dissented, and contrast their public statements—which hopefully reveal their preferences—with those of the opposition. Cowley (2002, 22–93) gives a thorough discussion of the issues that divided left-wingers from their more conformist colleagues in the 1997–2001 parliament. In particular, three of the largest rebellions (in terms of numbers of MPs) were on the Welfare Reform and Pensions Bill of 1999 (74), the Transport Bill of the same year (65), and the Criminal Justice Bill of 2000 (37) (Cowley 2002, 92). Briefly, and drawing on Cowley, we consider each in turn here.

The Welfare Reform and Pensions Bill dealt inter alia with reforms to the way that the state paid incapacity benefit to the disabled. In particular, it proposed means tested benefits and reduced payments for those who had made private provisions for health care[4] or pensions. Some 68 MPs signed an Early Day Motion,[5] penned by Roger Berry (a Labour backbencher), which called

> . . . upon Her Majesty's Government to give more consideration to a more generous set of arrangements for those recipients of incapacity benefit who draw upon occupational pensions. [EDM 375, 1999]

Commensurate with this principled rhetoric, several MPs who would later rebel made seemingly ideological statements in Commons' debates on the subject. The Conservative opposition is by both reputation and ideological commitment generally critical of broad-based state benefits funded by taxation. So, in response to Berry's proposed amendment to the government bill—an amendment that would drop means testing—we might therefore expect the Conservatives to join Labour and overwhelmingly reject it precisely because means testing disability benefit is presumably an improvement for the Conservatives relative to the status quo. In practice, the Conservatives supported the amendment, and voted with the rebels.[6] This support included the then shadow (opposition) Secretary of State for Social Security, Iain Duncan Smith. In this case, the Labour rebels appear to have voted sincerely and the Conservatives strategically.

There is a similar story for the Transport Bill in which the privatization of the National Air Traffic Control System was opposed by the rebels for ideological reasons, whereas the Conservatives voted against the government and, contrary to their key industrial policy of the 1980s and 1990s, strategically. Similarly the Conservatives backed the rebel amendments that opposed the government on its proposals to reform the trial-by-jury process: from the party that had prided itself for its toughness on crime and criminals, this was surely a strategic act.

[4]The United Kingdom has a "National Health Service" that funds medical services from general taxation, free at the point of delivery.
[5]A public statement by MPs that will not be debated in the legislature but that draws attention and support to a particular (policy) position.
[6]Division 191, May 20, 1999.

As a further check on our hypothesis, we conducted a counterfactual experiment. We considered the five largest rebellions of the years 1997–2001 in terms of the expected (but counterfactual) Conservative preference on each of the votes. We supposed that, instead of abstaining or voting with the rebels, all the Conservative MPs voted with the government on the following bills in their various stages, whenever 10 or more Labour rebels voted against the government (actual number of roll calls pertaining to this bill): the Welfare Reform and Pensions Bill (10), the Transport Bill (8), the Social Security Bill (3), the Child Support, Pensions and Social Security Bill (3), the Criminal Justice (Terrorism and Conspiracy) Bill (4), and the Criminal Justice (Mode of Trial) Bill (5).[7] We removed the original division votes for these bills from the roll call matrix and replaced them with the counterfactual ones. Now, the first dozen or so MPs in the rank order produced by OC—from left to right—include Jeremy Corbyn (position 2), Robert Marshall-Andrews (6), Tony Benn (7), Tam Dalyell (8), Dennis Skinner (9), Ken Livingstone (11), Bernie Grant (12), and Diane Abbott (13). That is, when these few votes are removed and the Conservatives are entered with their imputed sincere—rather than strategic—preferences, OC correctly recovers the left-wing Labour rebels that were misplaced in the ways described in Section 1.

5 Discussion

Rosenthal and Voeten (2004, 620) argue that OC "is preferable to parametric methods for studying many legislatures ... because the nature of party discipline, near-perfect spatial voting, and parliamentary institutions that provides [*sic*] incentives for strategic behavior lead to severe violations of the error assumptions underlying parametric methods." They show that OC works well in analyzing spatial voting in the National Assembly of the French Fourth Republic (1946–1958), which featured not only perfect spatial voting but differential party discipline—rigid in some parties and "more freewheeling" (Rosenthal and Voeten 2004, 361) in others. They suggest that the method will work for other legislatures, citing inter alia Schonhardt-Bailey's (2003) analysis of roll calls relating to Repeal of the Corn Laws in the U.K. Parliament of 1841–1847. They conclude that non-parametric methods should in future be used for legislatures with stronger party systems than the U.S. Congress, with strategic voting and with "both-ends-against-the-middle voting." They show that their method works for the legislature they study. We have shown that it does not work for the modern House of Commons, and this is due to the sheer preponderance of government-versus-opposition strategic voting; emphatically, this is not "both ends-against-the-middle": the opposition votes strategically to defeat the government, the rebels vote sincerely.

As an aside, we note that the dynamic and problem we discuss has plagued techniques closely related to OC, like Guttman scaling (Poole 2005, 19, 45). For example, Aydelotte's (1967, 1970, 1972) massive studies of the 1841–1847 parliament generated 21 Guttman scales, one of them (the Miles motions scale) puzzlingly failing to integrate with the main (big scale) dimensional measure, although Miles's motions were about sugar duty, an issue that fitted along the main dimension of the day. The reason is that Miles's motions were deliberately crafted in order to induce strategic voting and embarrass the government (Gash 1972, 447).

As a result of our experiments in Section 3, we can be a little more specific about when OC will return a correct rank ordering: (1) when strategic voting is infrequent (occurring

[7] In fact, the fifth largest rebellion occurred on the Freedom of Information Bill, but it is less obvious what the Conservative preference on this issue was.

on less than half of all votes, in terms of the opposition's incentives); (2) when strategic voting is not symmetric (i.e., when the opposition does not vote strategically, even if the government loyalists do); (3) when rebels are less extreme than the government; (4) when the incentive to vote strategically is stronger for rebels than it is for the opposition; and (5) when some legislation is not proposed (or, rather, whipped) by the government. We suspect that condition (1) is generally satisfied in the Rosenthal and Voeten (2004) case.

With these caveats in mind, OC could well be helpful to researchers who were specifically interested in party discipline as a feature of legislatures. One option may be to compare the same individuals' ranks—like our rebels above—over time, since actors' movements up and down the rankings could be either a product of ideological change or, more likely, a product of their varying responses to the whip.

A claimed strength of OC—as opposed to the parametric approaches proposed by Poole and Rosenthal (1997) and Clinton, Jackman, and Rivers (2004)—is that it does not rely on distributional assumptions about errors in voting. A consequence is that the technique is not model-based and hence does not permit probability statements over quantities of interest (e.g., we cannot know if we are more certain about MP *A*'s or MP *B*'s position in the rank order). Moreover, missing data—abstentions in this case—are essentially ignored in the fitting procedure (Poole 2005, 83). A model-based technique with a systematic treatment of missingness, which does not rely on parametric error assumptions, would be an improvement. A different tack might be to "cluster" MPs who vote similarly into qualitatively different groups. More particularly, we would like to make probability statements over both the number of clusters and their membership (in terms of MPs). This is a concern at Westminster precisely because different members attend roll calls in varying proportions: the fact that missingness is not constant across legislators should influence our measures. We suspect that a Bayesian clustering approach that has these features is both feasible and helpful, especially in combination with OC. For example, we could perform a cluster analysis in which MPs are probabilistically grouped around certain issue areas according to their votes in particular roll calls. Comparing the clusters with the OC rank order should elucidate patterns of rebellion—in terms of issues and MPs—that would otherwise be hidden. A Bayesian algorithm that solicits expert opinion—perhaps informed in part by OC—to generate priors would be ideal. We leave this for future work.

Appendix A: Rank-Ordered Sample of MPs from "Left" to "Right" 1997–2001

Position	*Name*	*Party*[a]	*Score*
1	Radice, Giles	Labour	1
2	Galbraith, Sam	Labour	2
3	Davies, Ron	Labour	3
4	Turner, Neil	Labour	3
5	Gibson, Ian	Labour	5
6	Iddon, Brian	Labour	9
81	Blair, Tony	Labour	80
211	Prescott, John	Labour	208
409	Dalyell, Tam	Labour	409
411	Marshall-Andrews, Robert	Labour	411

Continued

Appendix A: (continued)

Position	*Name*	*Party*[a]	*Score*
412	Skinner, Dennis	Labour	412
415	Abbott, Diane	Labour	415
417	Benn, Tony	Labour	417
420	Corbyn, Jeremy	Labour	420
422	Livingstone, Ken	Independent[b]	422
425	Hume, John	SDLP	425
426	Grant, Bernie	Labour	426
428	McGrady, Eddie	SDLP	428
429	Mallon, Seamus	SDLP	429
431	Jones, Ieuan Wyn	Plaid Cymru	431
432	Bell, Martin Tat	Independent	432
435	Salmond, Alex	SDLP	435
458	Ashdown, Paddy	LD	458
459	Kennedy, Charles	LD	458
490	Woodward, Shaun	Labour[b]	490
492	Trimble, David	UUP	492
509	Heath, Edward	Conservative	508
606	Hague, William	Conservative	605
634	Widdecombe Ann	Conservative	634
666	McCartney, Robert	UKUP	667
667	Ross, William	UUP	667
668	Paisley, Ian	DUP	667

Note. Rank order based on 1279 roll calls. Note that MPs are classified according to their party affiliation at the end of the parliament, before the general election of 2001. Thus, Ken Livingstone is classed as an Independent after being expelled from Labour in April 2001.

[a]DUP, Democratic Unionist Party; LD, Liberal Democrat; SDLP, Social Democratic and Labour Party; UKUP, United Kingdom Unionist Party; UUP, Ulster Unionist Party.

[b]Livingstone began the parliament as a labour member but was subsequently expelled from the party.

Appendix B: Goodness-of-Fit Statistics for OC Analysis of 1997–2001 Parliament

Iteration	*A*	*B*	*C*	*D*	*E*	*F*
1	Roll calls	1	5895	515,966	0.01143	0.98857
2	Legislators	1	4896	515,966	0.00949	0.99051
3	Roll calls	1	4575	515,966	0.00887	0.99113
4	Legislators	1	4449	515,966	0.00862	0.99138
5	Roll calls	1	4409	515,966	0.00855	0.99145
6	Legislators	1	4381	515,966	0.00849	0.99151
7	Roll calls	1	4362	515,966	0.00845	0.99155
8	Legislators	1	4350	515,966	0.00843	0.99157
9	Roll calls	1	4346	515,966	0.00842	0.99158
10	Legislators	1	4341	515,966	0.00841	0.99159

Note. In the table, the columns are demarcated by letters. To wit, column *A* gives the subject of movement in the iteration, column *B* gives the number of dimensions of the analysis, column *C* gives the number of classification errors, column *D* gives the number of choices, column *E* gives the error proportion, and column *F* gives the correct classification proportion after the respective iteration of the OC procedure is complete.

Appendix C: Some Replication Information

The Poole (2000) technique is distributed as both a Microsoft Windows (with Intel processor) executable file and a *Fortran* program (which is compatible with Lahey compilers). We assume most users will be using the Windows version.

Users should first download PERFL.EXE from http://voteview.com/Optimal_Classification.htm. Then, they should obtain the data for the parliament (1997–2001) either from the current authors or from http://www2.warwick.ac.uk/fac/sci/statistics/staff/academic/firth/software/tapir/ were it is held in a (zipped) comma delimited form (further description of the data can be found in Firth and Spirling [forthcoming]). If the latter, the data need to be recoded such that a "yes" vote is coded "1," a "no" vote is coded "6" and a missing value is coded "9." The data need to be in a flat file format (like ASCII), which looks something like the following:

AbbottDianeLab	6661611166616161191...
AdamsIrenePaiLab	9661699999999999999...
AingerNickLab	6661611166616161111...
AinsworthPeterESCon	1196166699999616699...
AinsworthRobertCovLab	6661611166616161111...
AlexanderDouglasLab	9999999999999999999...
AllanRichardSheLD	9611699161669999999...
AllenGrahamNotLab	6661611166616161111...
AmessDavidCon	1196166699999619996...
AncramMichaelCon	1196166699999619999...
...	
...	

On the left are the names of the MPs (in alphabetical order) with a party indicator (LD, Lab, Con) etc. simply added at the end. On the right are the voting records for each bill.

The control card file, PERFSTRT.DAT should look as follows:

```
9701matrixformat.txt
NON-PARAMETRIC MULTIDIMENSIONAL UNFOLDING OF 9701 COMMONS
1 1279 20 34 39 18 10 0.005
(34A1,3900I1) (I5,1X,34A1,2I5,50F8.3)
```

where 9701matrixformat.txt is saved to the same (working) directory as PERFL.EXE and PERFSTRT.

We use exactly the same defaults that Poole suggests on his Web site, except that the number 1279 in the third row of PERFSTRT.DAT refers to the number of votes in our data, 39 refers to a (presumed) left member from our data set (Tony Benn). The classification procedure was complete after approximately 1 min and 20 s on a 3.5 GHz PC.

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