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Deliberation, single-peakedness, and the possibility of meaningful democracy: evidence from deliberative polls

Working paper

Deliberation, Single-Peakedness, and the Possibility of Meaningful Democracy: Evidence from Deliberative Polls*

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Abstract:

Majority cycling and related social choice paradoxes are often thought to threaten the meaningfulness of democracy. But deliberation can prevent majority cycles – not by inducing unanimity, which is unrealistic, but by bringing preferences closer to single-peakedness. We present the first empirical test of this hypothesis, using data from Deliberative Polls. Comparing preferences before and after deliberation, we find increases in proximity to single-peakedness. The increases are greater for lower versus higher salience issues and for individuals who seem to have deliberated more versus less effectively. They are not merely a byproduct of increased substantive agreement (which in fact does not generally increase). Our results both refine and support the idea that deliberation, by increasing proximity to single-peakedness, provides an escape from the problem of majority cycling.

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Deliberation, Single-Peakedness, and the Possibility of Meaningful Democracy: Evidence from Deliberative Polls

Condorcet's and similar paradoxes of social choice have long been seen as serious problems for democracy. Condorcet showed that pairwise majority voting in decisions involving three or more alternatives can lead to cyclical majority preferences. If a third of a group (electorate, committee, etc.) prefers *x* to *y* to *z*, another third prefers *y* to *z* to *x*, and the remaining third prefers *z* to *x* to *y*, majorities prefer *x* to *y*, *y* to *z*, and yet *z* to *x*, a cyclical majority preference. This paradox famously illustrates at least three problems with majority rule. First, rational individual preferences may lead to irrational majority preferences (*collective irrationality*).[1] Second, pairwise majority voting may fail to produce a stable winning outcome (*instability*). Third, when pairwise majority votes are taken sequentially, the winning outcome may depend on the order in which the votes are taken and may thus be manipulable by agenda setters (*path dependence*, leading to *agenda manipulability*).

Although pairwise majority voting is not the only possible decision procedure, Arrow's theorem (1951/1963) shows that, with three or more alternatives, *any* procedure that guarantees rational collective preferences must violate at least one of four attractive properties satisfied by pairwise majority voting. These are *universal domain* (any possible combination of rational individual preferences is admissible input), *the weak Pareto principle* (the group prefers alternative *x* to alternative *y* if *x* is preferred to *y* by all individuals), *independence of irrelevant alternatives* (the collective preference between *x* and *y* depends only on individual preferences between *x* and *y*, not on individual preferences involving other alternatives), and *non-dictatorship* (there is no individual whose preference always prevails). The consequences of violating these properties may be as problematic as the possibility of cyclical collective preferences under pairwise majority voting. This should be obvious for universal domain, the weak Pareto principle and non-dictatorship. Violations of independence of irrelevant alternatives open the door to agenda manipulation (e.g., Riker 1982) and strategic voting (e.g., Gibbard 1973, Satterthwaite 1975). Riker (1982) has influentially argued that Condorcet's paradox, Arrow's theorem, and their numerous generalizations (e.g., McKelvey 1979, Schofield 1976) undermine the meaningfulness of democracy (cf. Mackie 2004).

What may be said against such counsel of despair? One possibility is to show the existence of realizable conditions under which democratic institutions can achieve robust protection against majority cycles, where "robust protection" means that there will be no cycles for a large class of actual and counterfactual circumstances.

Here we examine the possibility that deliberation can do just this – robustly transforming individual preferences away from combinations leading to cycles. Not, as has sometimes naïvely been claimed, by inducing unanimity (a view described by Elster 1986) but by inducing single-peakedness across individuals, as has been suggested by Miller (1992), Knight and Johnson (1994), and Dryzek and List (2003). A combination of preferences is *single-peaked* across individuals if there exists an ordering of the alternatives from left to right such that each individual has (1) a most preferred alternative and (2) a decreasing preference for other alternatives as they get more distant in either direction from it. Single-peakedness precludes cycling in pairwise majority voting: the median individual's most preferred alternative prevails (Black 1948).

More precisely – and more realistically – we expect deliberation to increase *proximity* to single-peakedness. On the standard definition, single-peakedness is a binary property: a combination of preferences is single-peaked, or it is not. But in sizable groups single-peakedness in this binary sense may be almost as hard to attain as unanimity. Thus Niemi (1969) and List (2001) have suggested measuring *proximity to single-peakedness*, defined formally below.[2] As proximity to single-peakedness increases, the probability of majority cycles decreases (Niemi 1969, Gehrlein 2004).[3]

But does deliberation actually increase proximity to single-peakedness? And, if so, when and how? This paper is the first empirical exploration of these questions. Our data come from *Deliberative Polls* (hereafter *DP*s) designed to examine deliberation's effects on preferences and other variables (see Fishkin 1997, Fishkin and Luskin 1999, Luskin, Fishkin, and Jowell 2002, or Fishkin and Luskin 2005 for overviews). The basic design involves interviewing a good quality random sample; then gathering them for a weekend to deliberate in randomly assigned, moderated small groups and to put questions arising from the small group discussions to panels of competing policy experts and policy makers; and then reinterviewing them at the end.[4]

Our central analysis compares measures of proximity to single-peakedness before and after deliberation. We also advance, and examine the evidence for, some hypotheses about when and for whom proximity to single-peakedness increases most. In particular, we contrast the results for high- versus low- to moderate-salience issues and for participants who seem to have deliberated more versus less effectively, judging from the level of information they emerge with. In all, our results both refine and support the hypothesis that deliberation brings preferences closer to single-peakedness.

THEORETICAL BACKGROUND

Individual and Collective Preferences

Consider a finite set of individuals (voters, committee members, etc.), denoted $N = \{1, 2, \ldots, n\}$, and a finite set of alternatives (policies, candidates, etc.), denoted $X = \{x, y, z, \ldots\}$. Each individual i has a *preference ordering* over the alternatives, denoted R_i, where xR_iy means that individual i weakly prefers x to y. We write xP_iy whenever xR_iy and not yR_ix, meaning that individual i strictly prefers x to y. We assume that each individual's preference ordering R_i is *rational* in the following sense. It is *reflexive* (for every alternative x, xR_ix), *complete* (for every pair of alternatives x and y, xR_iy or yR_ix), and *transitive* (for every triple of alternatives x, y and z, if xR_iy and yR_iz, then xR_iz). A vector of preference orderings across individuals (R_1, R_2, …, R_n), abbreviated as $(R_i)_{i\in N}$, is called a *profile*.

A *decision procedure* is a function that takes a profile $(R_i)_{i\in N}$ as input and produces a corresponding collective preference ordering R as output. We interpret xRy to mean that x is weakly collectively preferred to y. As in the case of individual preferences, we write xPy whenever xRy and not yRx, meaning that x is strictly collectively preferred to y. As noted, our concern here is with the pervasive democratic decision procedure of *pairwise majority voting*, under which, for each profile $(R_i)_{i\in N}$, an alternative x is weakly collectively preferred to another alternative y (xRy) if and only if the number of individuals who weakly prefer x to y (xR_iy) is at least as great as the number of individuals who weakly prefer y to x (yR_ix). The collective preference ordering R is *rational* if it is reflexive, complete and transitive, as defined for the individual case. A *Condorcet winner* is an alternative that is weakly collectively preferred to every other alternative under pairwise majority voting. A rational collective preference ordering guarantees that there is a Condorcet winner.

Condorcet's paradox, in standard form, lies in the existence of profiles of rational individual preference orderings for which there exists no Condorcet winner. A more general form lies in the possibility that pairwise majority voting may generate irrational – specifically, cyclical and thereby intransitive – collective preference orderings, such as xPy, yPz, and zPx.[5] (On the various forms of the paradox, see Gehrlein 1983.)

The Probability of Cycles under an Impartial Culture

How frequently does Condorcet's paradox occur? The answer depends on the distribution of individual preference orderings. One extensively studied assumption is that of an *impartial culture*, under which any logically possible preference ordering is as likely to be held by an individual as any other. Given an impartial culture, the probability that there is no Condorcet winner – a lower bound for the probability of a cycle – increases with both the number of individuals n and the number of alternatives k (Gehrlein 1983). If $k = 3$, for example, the probability that there exists no Condorcet winner converges to 0.08774 as n tends to infinity; if $k = 5$, it converges to 0.25131; if $k = 7$, it converges to 0.36918. For a reasonably large number of alternatives and a reasonably large group, therefore, cycles should be relatively frequent in an impartial culture. But an impartial culture is the distribution that generally maximizes the probability of cycles (Tsetlin, Regenwetter, and Grofman 2003; see also List and Goodin 2001, appendix 3).[6]

Single-Peakedness and Cycling

Consider some ordering (as distinct from preference ordering) of the alternatives from left-most to right-most, taking the terms "left" and "right" in a purely geometric sense. Call it Ω. "Left" could be most liberal, most secular, or most environmentalist; "right" most conservative, most religious, or most anti-environmentalist.[7] The i^{th} individual's preference ordering R_i is *single-peaked with respect to* Ω if he or she has a most preferred alternative and a decreasing preference for other alternatives as they get more distant in either direction from it (relative to Ω).[8] Collectively, a profile of preference orderings $(R_i)_{i \in N}$ is *single-peaked* if there exists a left-right ordering Ω with respect to which *every* individual's preference ordering R_i is single-peaked. An ordering Ω with this property is called a *structuring dimension*.[9]

For example, consider the following profile of individual preference orderings in a four-member group, where, for each individual, the alternatives are listed in strictly decreasing order of preference:

Individual 1: $x\ y\ z$

Individual 2: $z\ y\ x$

Individual 3: $y\ x\ z$

Individual 4: *y z x*

This profile is single-peaked, with structuring dimension (from left to right) [*x*, *y*, *z*]. By contrast, consider the five-member group consisting of individuals 1-4 and 5:

Individual 5: *x z y*

The profile for this five-member group is not single-peaked. Individual 5's preferences are not single-peaked with respect to the left-right ordering [*x*, *y*, *z*], and there is no left-right ordering of *x*, *y*, and *z* with respect to which all five individuals' preference orderings are single-peaked.

Again we note the distinction between the single-peakedness of an individual preference ordering and the single-peakedness of a profile (a vector of individual preference orderings). At the individual level, any strict preference ordering is vacuously single-peaked with respect to *some* left-right ordering of the alternatives.[10] Here single-peakedness becomes non-vacuous only with respect to a *particular* left-right ordering. A profile, by contrast, is single-peaked if and only if every individual's preference ordering is single-peaked with respect to the *same* left-right ordering.

A profile's single-peakedness is important because it is a sufficient condition for avoiding cycles. For any profile $(R_i)_{i \in N}$ satisfying single-peakedness, pairwise majority voting generates a transitive collective preference ordering, and the most preferred alternative of the *median individual*[11] with respect to a structuring dimension Ω is a Condorcet winner. This is a version of Black's classic median voter theorem (Black 1948, Arrow 1951/1963). Single-peakedness thus affords an escape from Condorcet's paradox.

Proximity to Single-Peakedness

But single-peakedness in this standard sense is only a sufficient, not a necessary, condition for avoiding cycles. Sufficient *proximity* to single-peakedness may be enough. In particular, the whole profile of preference orderings across a set of individuals *N* may not be single-peaked, yet the (sub-)profile of preference orderings across some proper subset may be. The existence of a large enough subset with single-peaked preferences may suffice to ensure the existence of a transitive collective preference ordering and a Condorcet winner.

Thus consider the largest (or tied for largest) subset M of N such that there exists some left-right ordering of the alternatives with respect to which the preference orderings of all individuals in M are single-peaked. Call such an ordering (it need not be unique) a *largest structuring dimension*. The larger the subset M, the closer the original profile is to single-peaked. It is in this sense that we speak of *proximity* to single-peakedness.

The idea can be quantified as follows (Niemi 1969, List 2001). Define the *proximity to single-peakedness* for $(R_i)_{i \in N}$ as $S = m/n$, where m is the size of the largest (or tied for largest) subset M of N for which the (sub-)profile $(R_i)_{i \in M}$ (note the subscript M instead of N) is single-peaked.[12] S equals 1 for full single-peakedness ($M = N$) and is typically bounded below by a value strictly greater than 0. If all individual preference orderings are strict, the lower bound is $2^{(k-1)}/k!$, which equals 2/3 for $k = 3$, 1/3 for $k = 4$, 2/15 for $k = 5$, and so on, in decreasing fashion.[13] To illustrate, return to the example of the five-member group above. The largest subset for which the sub-profile $(R_i)_{i \in M}$ is single-peaked is $M = \{1, 2, 3, 4\}$, and the largest structuring dimension is $[x\ y\ z]$. Thus the proximity to single-peakedness S is 4/5 = .8.

By Black's (1948) theorem, $S = 1$ is sufficient for the existence of a Condorcet winner. But what about $S < 1$? In our illustrative five-member group, $S = .8$, but y is a Condorcet winner, defeating both x and z, in pairwise majority voting, by 3 votes to 2.[14] More generally, for any threshold α ($0 < \alpha < 1$), we can determine the conditional probability – call it p – that there exists a Condorcet winner, given $S > \alpha$.[15] Analytical and computational results for a number of cases suggest that the higher the α, the higher the p (Niemi 1969, Gehrlein 2004).[16] In other words, the higher the proximity to single-peakedness, the lower the probability of cycling.[17]

DELIBERATION AND SINGLE-PEAKEDNESS

Deliberation has been variously defined (see, among others, Cohen 1989, Dryzek 1990, 2000, Fishkin 1991, Knight and Johnson 1994, Gutman and Thompson 1996, Bohman and Rehg 1997, Elster 1998). For present purposes, we define it moderately thinly, as discussion that is substantive, balanced, and civil.[18] It focuses on the policy or electoral alternatives and the reasons for preferring some over others; involves the airing of a broad range of perspectives, arguments, and positions; and takes place in an atmosphere of mutual respect. So defined, deliberation can be expected to have a variety of beneficial effects. Most relevantly for present purposes, it can be expected to induce learning and thinking and thus to produce more informed preferences (for evidence of these and other effects, see, e.g., Fishkin and Luskin 1999, Luskin, Fishkin, and Jowell 2002, Luskin and Fishkin 2002, Barabas 2004).

Our present claim is that deliberation helps avoid majority cycles. One common but naïve hypothesis is that it does so by creating perfect *substantive agreement*. Elster (1986, p. 112) describes this line of thought as follows:

> "Rather than aggregating or filtering preferences, the political system should be set up with a view to changing them by public debate and confrontation. The input to the social choice mechanism would then not be the raw, quite possibly selfish or irrational, preferences …, but informed and other-regarding preferences … There would [then] not be any need for an aggregation mechanism, since a rational discussion would tend to produce unanimous preferences."

Unanimity, in populations of any size, is unattainable, but a more realistic version of this argument would claim that deliberation increases substantive agreement. Leaving aside the accuracy of this more modest claim (on which past DPs cast some doubt)[19], substantive agreement is unnecessary for avoiding majority cycles. Single-peakedness, which does not require substantive agreement, precludes them, and proximity to single-peakedness, while not precluding them, makes them less probable, as noted above.

Deliberation, in turn, can be expected to increase proximity to single-peakedness (Miller 1992, Knight and Johnson 1994, Dryzek and List 2003). It may do so by increasing *meta-agreement*, that is, agreement on a common semantic issue dimension (liberal/conservative, secular/religious, etc.) in terms of which to conceptualize the choice at hand (on the distinction between substantive and meta-agreement, see List 2002). As people talk, learn, and think about the alternatives and the criteria for choosing among them, they may come (1) to focus on a common semantic issue dimension and (2) to agree on the left-right ordering of the alternatives with respect to it,[20] which entails relating a geometric left-right ordering to the semantic issue dimension. Each individual may then (3) determine a most preferred alternative and adopt a decreasing preference for other alternatives as they get more distant in either direction from it, with respect to that given left-right ordering. These three steps (suggested in List 2002) may occur either through discussion, with individuals influencing one another, or through excogitation, with individuals independently recognizing some more or less natural left-right ordering of alternatives.

Alternatively, deliberation may increase proximity to single-peakedness without increasing meta-agreement. A profile's single-peakedness is a matter of the aggregate coherence or patterning of preferences across individuals, not necessarily the cognitive organization of any individual's preference ordering. Individuals may simply adopt preference orderings they come to recognize as typical of political elites with whom they identify, and to the extent that elite preference profiles are close to single-peaked (presumably due to meta-agreement at the elite level), the resulting public preference profiles will also be close to single-peaked. This second, cue-taking mechanism is less normatively valuable than the mechanism entailed in meta-agreement, requiring only shallower learning and thought.

We expect deliberation's effect to be nonlinear. Since proximity to single-peakedness (*S*) cannot exceed 1, while deliberation is presumably unbounded above, further increases from high-enough levels of deliberation should bring only small increases in the correspondingly high proximity to single-peakedness, as *S* approaches 1. Thus we expect proximity to single-peakedness to be an increasing, strictly concave function of deliberation, approaching 1 as deliberation increases. A testable implication is that deliberation's effect should vary with the salience of the issue. For sufficiently salient issues, which have usually already received a good deal of deliberation, preference profiles should already be close to single-peaked and deliberation's effect should therefore be small. It is for issues of low to moderate salience that we expect deliberation to make an appreciable difference.

The effect should also be mediated by the learning and reflection deliberation induces. The greater the learning and reflection, the greater the expected increase in proximity to single-peakedness. This hypothesis is normatively important. It suggests that deliberation's effect stems at least partly from meta-agreement produced by learning and reflection, not just from cue-taking.

To sum up, then, our principal hypotheses are:

> **H1**: Deliberation tends to increase proximity to single-peakedness, subject to the constraints in H2 and H3.
>
> **H2**: The rate of increase diminishes, eventually becoming negligible, at high enough levels of deliberation.
>
> **H3**: The increase is greatest among those deliberating most "effectively," in the sense of thinking and learning the most.

We cannot test H2 directly, but a testable corollary is:

> **H2′**: Deliberation's effect is smaller for higher than for lower salience issues.

EMPIRICAL CASES: ISSUES, CONTEXT, AND DATA

We have already described the basic design of Deliberative Polls. Members of a random sample are interviewed, then invited to attend a weekend discussing the issues at a common site. Between the initial interview and the weekend, they are sent carefully balanced briefing materials laying out arguments for and against policy alternatives. During the weekend, they alternate between discussions in randomly assigned small groups led by trained moderators and plenary sessions in which they put questions shaped by the small group discussions to panels of experts, policy makers, or politicians. The moderators are trained to ensure that all the arguments in the briefing materials are considered and that no one dominates and everyone participates in the discussion. At the end, the participants answer the same questions as at the beginning. Some DPs also involve control groups.

Our particular data come from:

- Six regional DPs commissioned by electric utility companies in Texas (SWEPCO, CPL, WTU, Entergy, HL&P, SPS), then regulated monopolies, at the instance of the state's Public Utility Commission about how to meet future electricity needs (see Luskin, Fishkin, and Plane 1999).
- The Australian national DP on the 1999 referendum on making Australia a republic with a parliamentarily appointed president (see Luskin, Fishkin, McAllister, Higley, and Ryan 2000).
- The 1996 British national DP on the future of the Monarchy.
- The 2002 regional New Haven DP about revenue sharing and the future of the local airport (see Farrar et al., 2003).

Each of these studies contained questions eliciting preference orderings over three or more alternatives. The alternatives were:

- Four ways of meeting electricity needs (in three of the six electric utility DPs): in the SWEPCO and CPL DPs, (1) conservation, (2) building new fossil fuel facilities, (3) building new wind or solar facilities, and (4) buying electricity wholesale from elsewhere; in the WTU DP, (1) building new coal facilities, (2) building new wind or solar facilities, (3) conservation, and (4) building new natural gas facilities.
- Four or five goals to consider in deciding how to meet electricity needs (in all six electric utility DPs): in the WTU, Entergy, HL&P, and SPS DPs, (1) minimizing cost, (2) maintaining environmental quality, (3) ensuring adequate present and future supply, (4) making sure that everyone's basic electricity needs are met, and (5) minimizing outages; in the SWEPCO DP, (1) minimizing cost, (2) maintaining environmental quality, (3) avoiding dependence on any one resource, (4) using renewable resources, and (5) maximizing flexibility to increase or reduce production quickly; in the CPL DP, (1) minimizing cost, (2) maintaining environmental quality, (3) creating jobs, and (4) using renewable resources.
- Three constitutional possibilities for the Australian head of state: (1) the status quo with the Queen as head of state, (2) a republic with a parliamentarily appointed president (the referendum proposal), and (3) a republic with a directly elected president.
- Three possible alterations if there were a change to the British monarchy: (1) a continued monarchy with a more ordinary royal family, (2) a republic with a head of state with the same duties as the Queen, and (3) a republic with a head of state with the combined duties of Queen and Prime Minister.
- Three possible levels of service to be provided by the New Haven regional airport: (1) maintaining commercial passenger service to nearby cities; (2) expanding commercial passenger service, providing more flights to more places; and (3) ending commercial passenger service.

- Four possible arrangements for sharing property-tax revenues from new commercial development across the fifteen towns of greater New Haven: (1) complete local control, (2) voluntary agreements with other towns, (3) state-provided incentives to share, and (4) state requirements to share.

In all, then, we have nine datasets, affording thirteen cases (issues). Four of the datasets afford two issues each: electric utility policies and electric utility goals in the SWEPCO, CPL, and WTU DPs and airport expansion and revenue sharing in the New Haven DP.

Conveniently for testing, these issues differ dramatically in salience. Electric utility policies in Texas and revenue sharing in New Haven had received little public attention before the DP. The Monarchy in Britain, the airport in New Haven, and the Constitutional Referendum in Australia had received incomparably more. It would be fair to describe these latter three as highly salient. Since values and goals typically receive some thought, the electric utility goals were presumably in between – more salient than the electric utility policies but less salient than the three high-salience issues.

ANALYSIS

Table 1 describes the preferences on these issues before and after deliberation. The first four rows contain the low salience cases (electric utility policies in Texas and revenue sharing in New Haven), the middle six contain the moderate salience cases (electric utility goals in Texas), and the last three contain the high salience cases (the Australian head of state, the British monarchy, and the New Haven airport). The columns give the number of individuals in the sample (n), the number of alternatives (k), and the largest structuring dimension (D), the Condorcet winner (C), and the proximity to single-peakedness (S) at both T1 (before deliberation) and T2 (after deliberation). The subscripts “1” and “2” distinguish the T1 and T2 values. A final column gives the change in proximity to single-peakedness from T1 to T2 (S_2 - S_1). There need not generally be a Condorcet winner, but in all these cases there happens to be one.

(Table 1 about here)

Consistent with earlier results on non-ranking attitudinal and choice variables (in, e.g., Luskin, Fishkin, and Jowell 2002 and Fishkin and Luskin 1999), deliberation seems to induce considerable preference change. The Condorcet winner changes in eight of the thirteen cases, as does the largest structuring dimension (in not quite the same eight).[21] But our concern here is with proximity to single-peakedness, as reported in the rightmost three columns.

Proximity to Single-Peakedness

A first point to note is that the proximity to single-peakedness at T1 is consistent with the sorting of the issues by salience. Among the four low salience cases, the mean T1 proximity to single-peakedness is .421. Among the six moderate salience cases, it is slightly higher, at .441. Among the three high-salience cases, it is vastly higher, at .751. Granted, the last three cases are also those for which there were only $k = 3$ alternatives, and S's lower bound, given strict preferences, is highest for $k = 3$.[22] Could this be why the last three cases have the highest S at T1? A rough way of addressing this possibility is to calculate how far S exceeds its minimum as a fraction of how far it could do so. Call this adjusted index $S' = (S - S_{min})/(1-S_{min})$, where S_{min} is the lower bound. Clearly, S' ranges from 0 (when $S = S_{min}$) to 1 (when $S = 1$). The adjustment is only rough because the formula for S_{min} assumes strict preferences. As many of our respondents are indifferent between given pairs of alternatives, S is in fact occasionally lower than S_{min}. For what it is worth, however, this rough adjustment leaves the three high salience cases displaying the highest T1 proximity to single-peakedness, the six moderate salience cases the next highest, and the four low salience cases by far the lowest. The mean values of S' are .268, .249, and .131, respectively.[23]

More importantly, Table 1 supports both H1 and H2′. The mean increase across all thirteen rows is .101. But the effect is confined to the ten low and moderate salience cases, for which the mean increase is .134. The mean increase is also larger for the low salience cases (.173) than for the moderate salience cases (.107). For the three high salience cases, the mean increase is -.006. Two of these latter actually show *decreases*. We return to these results below.

Again, this pattern could be an artefact of differences in the number of alternatives. The low salience cases, coincidentally involving more alternatives, could simply have more room to show increase. But *S′*, roughly controlling for the number of alternatives, shows mean increases of -.014 for the high salience cases,[24] .149 for the moderate salience cases, and .259 for the low salience cases – still consistent with H2′. So at least on issues that are not extremely salient, deliberation does seem to increase proximity to single-peakedness.

Proximity to Single-Peakedness and Substantive Agreement

Perfect substantive agreement (unanimity) implies single-peakedness, and high levels of substantive agreement may be expected to produce high proximity to single-peakedness. Perhaps the story of our results is simply that deliberation is producing increased substantive agreement, which is in turn producing increased proximity to single-peakedness as a byproduct. That is what Shapiro (2005), for instance, would suppose. But proximity to single-peakedness, as noted, need not rest on substantive agreement.

To examine this question, we adopt the inverse of the Laakso-Taagepera index of fragmentation (Laakso and Taagepera 1979, Taagepera and Grofman 1981) as a simple measure of substantive agreement. We focus on each individual's most preferred alternative. Let n_1 be the number of individuals most preferring the first alternative, n_2 the number most preferring the second, …, and n_k the number most preferring the k^{th}. Now the index of substantive agreement is $A = (n_1/n)^2 + (n_2/n)^2 + \ldots + (n_k/n)^2$. $A = 1$ when all individuals have the same most preferred alternative (perfect substantive agreement), and $A = 1/k$ when equal numbers of individuals most prefer each of the k alternatives (maximum substantive disagreement).

(Table 2 about here)

Table 2 reports the raw frequencies of most preferred alternatives (n_1, n_2, …, n_k), the index of substantive agreement (A) at T1 and T2 (with the subscripts "1" and "2" again distinguishing the T1 and T2 values) and the change from T1 to T2 (A_2 - A_1). It is clear from these results that the observed increases in proximity to single-peakedness are not just a byproduct of increased substantive agreement. Indeed, substantive agreement does not generally increase. It increases in only four of the thirteen cases, and the average "increase" (actually a decrease) is only -.046. Furthermore, the changes in substantive agreement are only modestly – and negatively – associated with the changes in proximity to single-peakedness. The Pearsonian correlation between the two across the thirteen cases is -.308. At least on these particular issues, increased proximity to single-peakedness tends to be associated with *decreased* substantive agreement; the more those deliberating come to disagree, the more they come to agree about what they are disagreeing about.

The Effect of Information

So far, then, we have established support for H1 and H2′. But the "how" of deliberation's effect is important. The participants could simply have been taking cues, adopting ready-made preference orderings held by their preferred political elites. But if that were all they did, the deliberation behind the increased proximity to single-peakedness would have been quite shallow. Aldred (2004) has recently raised a similar possibility.

This leads us to consider the mediating effect of information. It is difficult to gauge thought, but information is straightforwardly measured with factual items, and the two are highly correlated (Neuman 1981, Luskin 1987, Price 1999). For ten of our thirteen cases (all but the three based on the Entergy, HL&P, and SPS DPs), the questionnaires afford enough factual information items to construct a usable index. The New Haven airport and revenue sharing indices include four general New Haven items, plus two specific to the airport or revenue sharing, respectively, and the Australian constitutional referendum includes four general Australian politics items, plus eight specific to the referendum. The SWEPCO index is confined to the five information items shared with the CPL and WTU questionnaires. The indices range from 0 (no items answered correctly) to 1 (all answered correctly).[25] The Appendix describes the ingredients.

(Table 3 about here)

Table 3 reports the mean T1 and T2 information and the mean information gains from T1 to T2. The table contains only seven rows because three of the electric utility DPs provide six of our original thirteen cases. The first three rows (CPL, WTU, SWEPCO) are a mix of low salience (for policies) and moderate salience (for goals), the fourth (New Haven revenue sharing) is low salience, and the remaining three (the New Haven airport, the Australian head of state, and the British Monarchy) are high salience. The T1 results lend further support to this sorting by salience. While comparisons of different information indices must be taken with some caution, resting as they do on an implicit assumption of equal average difficulty, the pattern is clear. The mean T1 information score is .362 in the low-salience case of New Haven revenue sharing; averages .398 in the three mixed cases of electric utility policies and goals; and averages .502 in the remaining three, high-salience cases.

More importantly, the results show that, in every case, the participants learned a great deal. The magnitudes of these increases are a first indication that more is going on than mere cue-taking. The mean information gain, across all seven rows, is a sizable .212, akin to the mean score on an exam's increasing by 21 points on the familiar 0 to 100 scale. The variation across rows is again consistent with the sorting by salience. With more room for improvement, the mean information gain is .245 in the low-salience case of New Haven revenue sharing; averages .237 in the three mixed cases of electric utility policies and goals; and averages only .176 in the remaining three, high-salience cases.

The next step is to show that the previously observed increases in proximity to single-peakedness are information-driven. Since proximity to single-peakedness is intrinsically aggregate, our strategy is to partition the sample into low and high T2 information subsamples and then to perform the same analysis as above separately within each subsample. Those participants who emerge with high information at T2 have learned a lot, either observably, if they had low information at T1, or unobservably, if they already had high information at T1 (because knowledge facilitates learning).[26] The threshold dividing "high" from "low" information is always drawn so as to divide the sample as equally as possible.[27] Table 3 gives the details. We expect the gain in proximity to single-peakedness to be greater in the high T2 information subsample, in accordance with H3.

(Table 4 about here)

The results, in Table 4, support this hypothesis in spades. Even in the low T2 information subsample, proximity to single-peakedness generally increased. In the high T2 information subsample, it always increased. In every single case, moreover, the increase is greater for the high T2 information subsample than for the low T2 information subsample. The mean increase is .147 among the former, but only .051 among the latter.[28]

Here, too, salience is an important conditioning factor. For the high T2 information subsample, the mean increase in proximity to single-peakedness is .209 in the low-salience cases (electric utility policies and New Haven revenue sharing), .130 in the moderate-salience cases (electric utility goals), and .081 in the high-salience cases (the New Haven airport, the Australian head of state, and the British Monarchy). For the low T2 information subsample, the mean increases in proximity to single-peakedness are similarly consistent with the sorting by salience – but with a twist. While the mean increase is .131 in the low-salience cases and .103 in the moderate-salience cases, it is not merely smaller but negative – a *decrease* – in the high-salience cases, at -.106.

This breakdown sheds further light on the failure of overall proximity to single-peakedness to increase in the three high-salience cases. It *does* increase for the high T2 information participants – for those who emerge knowing relatively much. There is no overall increase because it *decreases* for the low T2 information participants – for those who emerge knowing relatively little. We are unsure of the reason in the British monarchy case, but in the other two high-salience cases, a major reason seems to be that, at least for the low T2 information participants, the largest structuring dimension changes, as Table 5 shows.

(Table 5 about here)

Recall that S registers only the proportion whose preferences are single-peaked with respect to the largest structuring dimension. If many low T2 information participants continue to hold preferences that are single-peaked with respect to the old largest structuring dimension, the T2 proportion whose preferences are single-peaked with respect to the new one can easily be lower than the T1 proportion whose preferences were single-peaked with respect to the old one – in which event S_2 will be lower than S_1.

Thus consider the case of the New Haven airport. Among the high T2 information participants, the largest structuring dimension is [2 1 3] at T1 and remains [2 1 3] at T2, and the proportion whose preferences are single-peaked with respect to that dimension increases from .789 at T1 to .859 at T2. Among the low T2 information participants, the largest structuring dimension changes from [1 2 3] at T1 to [2 1 3] at T2. From T1 to T2, the low T2 information participants acquire the same largest structuring dimension as the high T2 information participants have the whole time. The proportion whose preferences are single-peaked with respect to [1 2 3] at T1 is .787, while the proportion whose preferences are single-peaked with respect to [2 1 3] at T2 is only

.754. Thus *S* declines. But the proportion whose preferences are single-peaked with respect to [2 1 3] at T1 is .754, the same as at T2. The proportion whose preferences are single-peaked with respect to what becomes the largest structuring dimension at T2 does not decline.

In the Australian case, the largest structuring dimension changes from [2 1 3] at T1 to [1 2 3] at T2 for both the high and low T2 information participants. Among the former, the proportion whose preferences are single-peaked with respect to [1 2 3] at T2 (.878) exceeds the proportion whose preferences are single-peaked with respect to [2 1 3] at T1 (.793). Thus *S* increases. Among the latter, however, the proportion whose preferences are single-peaked with respect to [1 2 3] at T2 (.682) is lower than the proportion whose preferences are single-peaked with respect to [2 1 3] at T1 (.860). Here *S* declines. But the proportion whose preferences are single-peaked with respect to [1 2 3] at T1 is only .363, far lower than the .682 at T2. Again, the proportion whose preferences are single-peaked with respect to what becomes the largest structuring dimension at T2 does not decline, indeed in this case increases.

DISCUSSION

We have argued that deliberation increases proximity to single-peakedness – at least on low- to moderate-salience issues, where there has not been too much prior deliberation and where proximity to single-peakedness is not already high. We have also argued that deliberation's effect should be greatest among those who are learning and thinking the most, suggesting that it is not just a matter of thoughtless cue-taking. Our analysis, based on Deliberative Polling data, supports these claims.

We doubt that the issue's salience and the individual's learning are the only conditioning or mediating factors, just two of the most important. We suspect that much also depends on the broader quality of the deliberation itself. The more focused, serious, and reflective the deliberation, the more it should promote proximity to single-peakedness. Much may also depend on the nature of the issue, besides its salience. Some issues, for example, may have more of a natural structuring dimension than others. Deliberation on issues with more natural structuring dimensions should have a greater effect on proximity to single-peakedness. Eventually, as the number of DPs with suitable ranking questions increases, we hope to examine these and other additional hypotheses.

Our results bear some resemblance to those from factor analytic and covariance structure models of responses to non-ranking policy attitude items (as for example in Stimson 1975, Judd and Milburn 1980, Jackson 1983, Peffley and Hurwitz 1993, Rohrschneider 1993). The dimensionality and fit do not directly reflect attitude organization inside the minds of individual respondents (Luskin 1987, 2002) but do register the degree of aggregate patterning of opinion. The fewer the dimensions and the better the fit, the greater the patterning. And, generally speaking, stratifying these analyses by measures of information, sophistication, or the like produces results consistent with those obtained here: the number of dimensions decreases and the fit increases as the level of information increases (Stimson 1975, Delli Carpini and Keeter 1996).

But the specific form of patterning we examine here – the proximity to single-peakedness of preference profiles – is distinctive. The aggregate patterning of opinion is important for understanding democratic politics – it is a matter of "cleavage structures" – but proximity to single-peakedness bears on the meaningfulness of democracy itself. In that light, it is hard to overstate the importance of our present results. Riker's influential claim was that pervasive majority cycling makes democracy meaningless. But here we see that deliberation can protect against majority cycles. Ironically, it was Riker himself who first raised this possibility, writing that

> "If, by reason of discussion, debate, civic education, and political socialization, voters have a common view of the political dimension (as evidenced by single-peakedness), then a transitive outcome is guaranteed." (1982, p. 128)

He immediately added, lest too much hope be drawn from this remark, that he expected this only for "issues of *minor* importance" (emphasis added).

In our results, deliberation has the posited effect only on issues of low to moderate *salience*. But salience and importance are hardly the same. Many issues are important, but only a few, at any moment, are salient.[29] Thus the domain of the effects we have demonstrated is broad. And when unattended but important issues become more salient, the "discussion, debate, civic education, and political socialization" – in short, the deliberation – they then receive provides an avenue of escape from the problem of majority cycling.

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Table 1: Before-After Results: Largest Structuring Dimension, Condorcet Winner, and Proximity to Single-Peakedness

Issue	DP	n	k	D_1	D_2	C_1	C_2	S_1	S_2	$S_2 - S_1$
Electric Utility Policies	**SWEPCO**	232	4	[2314]	[2314]	3	1	.405	.556	.151
	CPL	216	4	[2314]	[3124]	3	1	.389	.519	.130
	WTU	230	4	[2314]	[2134]	3	3	.374	.496	.122
Revenue Sharing	**New Haven**	132	4	[1234]	[1234]	3	2	.515	.803	.288
Electric Utility Goals	**SWEPCO**	232	5	[21435]	[12345]	4	3	.237	.362	.125
	CPL	216	4	[1423]	[3124]	4	2	.444	.579	.135
	WTU	230	5	[12435]	[13425]	4	3	.243	.330	.087
	Entergy	175	4	[3124]	[3214]	1	2	.640	.691	.051
	HL&P	192	4	[3124]	[3124]	1	1	.521	.677	.156
	SPS	222	4	[3214]	[1234]	2	2	.559	.649	.090
Airport Expansion	**New Haven**	132	3	[213]	[213]	2	2	.773	.811	.038
Australian Head of State	**Australian Const. Ref.**	343	3	[213]	[123]	1	2	.828	.776	-.052
Changing the British Monarchy	**British Monarchy**	258	3	[213]	[213]	1	1	.651	.647	-.004

Note: n is the sample size; k the number of alternatives, numbered as in the text; D_1 and D_2 the largest structuring dimensions at T1 and T2; C_1 and C_2 the Condorcet winners at T1 and T2; and S_1 and S_2 the proximity to single-peakedness at T1 and T2.

Table 2: Before-After Substantive Agreement

Issue	DP	$n_1, \ldots, n_k$		A_1	A_2	$A_2 - A_1$
		T1	T2			
Electric Utility Policies	**SWEPCO**	25, 16, 103, 5	115, 29, 65, 15	.519	.369	-.150
	CPL	16, 16, 99, 15	96, 61, 32, 17	.494	.336	-.158
	WTU	11, 18, 112, 15	69, 37, 79, 40	.543	.276	-.267
Revenue Sharing	**New Haven**	43, 14, 48, 15	23, 51, 44, 12	.318	.308	-.010
Electric Utility Goals	**SWEPCO**	53, 31, 34, 83, 22	45, 37, 104, 37, 9	.247	.291	.044
	CPL	45, 29, 41, 94	63, 73, 19, 58	.306	.287	-.019
	WTU	59, 24, 34, 93, 11	46, 36, 76, 60, 11	.286	.246	-.040
	Entergy	99, 29, 18, 13	65, 88, 16, 4	.440	.409	-.031
	HL&P	110, 30, 21, 13	112, 39, 33, 5	.450	.425	-.025
	SPS	40, 107, 52, 16	31, 107, 63, 14	.346	.359	.013
Airport Expansion	**New Haven**	33, 82, 4	30, 83, 13	.553	.501	-.052
Australian Head of State	**Australian Const. Ref.**	170, 69, 91	67, 209, 51	.385	.475	.090
Changing the British Monarchy	**British Monarchy**	136, 41, 33	128, 46, 24	.482	.487	.005

Note: $n_1, \ldots, n_k$ (at T1 and T2) are the numbers of respondents with first preferences for alternatives 1, …, k, numbered as in the text; and A_1 and A_2 the index of substantive agreement at T1 and T2.

Table 3: Before-After Information Measures

Issue	DP	#Items	I_1	I_2	$I_2 - I_1$	Threshold for "High I_2"	"Low I_2" n	"High I_2" n
Electric Utility Policies /Goals	**SWEPCO**	5	.435	.638	$.203^{***}$	≥ .80	122	110
	CPL	5	.360	.580	$.219^{***}$	≥ .80	144	72
	WTU	5	.399	.687	$.288^{***}$	≥ .80	102	128
Revenue Sharing	**New Haven**	6	.362	.607	$.245^{***}$	≥ .66	56	76
Airport Expansion	**New Haven**	6	.407	.588	$.182^{***}$	≥ .66	61	71
Australian Head of State	**Australian Const. Ref.**	9	.452	.651	$.199^{***}$	≥ .83	179	164
Changing the British Monarchy	**British Monarchy**	9	.646	.794	$.148^{***}$	≥ .88	122	136

Note: #Items is the number of information questions in the information index, I_1 and I_2 the information index at T1 and T2, Threshold for "High I_2" the threshold for subdividing the sample into the high and low T2 information subsamples, and "Low I_2" n and "High I_2" n the numbers of respondents in each subsample. *** indicates $p < .01$

Table 4: Before-After Single-Peakedness Conditional on T2 Information

		"Low I_2"		"High I_2"		$S_2 - S_1$	
Issue	**DP**	S_1	S_2	S_1	S_2	"Low I_2"	"High I_2"
Electric Utility Policies	**SWEPCO**	.393	.525	.418	.591	.132	.173
	CPL	.382	.469	.431	.597	.087	.166
	WTU	.382	.490	.367	.508	.108	.141
Revenue Sharing	**New Haven**	.518	.714	.513	.868	.196	.355
Electric Utility Goals	**SWEPCO**	.246	.361	.236	.364	.115	.128
	CPL	.410	.535	.514	.667	.125	.153
	WTU	.235	.304	.281	.391	.069	.110
Airport Expansion	**New Haven**	.787	.754	.789	.859	-.033	.070
Australian Head of State	**Australian Const. Ref.**	.860	.682	.793	.878	-.178	.085
Changing the British Monarchy	**British Monarchy**	.582	.475	.713	.802	-.107	.089

Note: "Low I_2" S_1 and S_2 are the proximity to single-peakedness at T1 and T2 for the low T2 information subsample, "High I_2" S_1 and S_2 the proximity to single-peakedness at T1 and T2 for the high T2 information subsample.

Table 5: The Largest Structuring Dimension in the High-Salience Cases Conditional on T2 Information

		"Low I_2"		"High I_2"	
Issue	**DP**	D_1	D_2	D_1	D_2
Airport Expansion	**New Haven**	[1 2 3]	[2 1 3]	[2 1 3]	[2 1 3]
Australian Head of State	**Australian Const. Ref.**	[2 1 3]	[1 2 3]	[2 1 3]	[1 2 3]
Changing the British Monarchy	**British Monarchy**	[2 1 3]	[2 1 3]	[2 1 3]	[2 1 3]

Note: "Low I_2" D_1 and D_2 are the largest structuring dimension at T1 and T2 for the low T2 information subsample; "High I_2" D_1 and D_2 the largest structuring dimension at T1 and T2 for the high T2 information subsample. The alternatives are numbered as in the text.

APPENDIX: INFORMATION INDICES

SWEPCO, CPL, SPS

The information items ask (1) whether coal, wind, natural gas, fuel oil, nuclear power, or solar power produces the largest share of the service area's electricity, (2) whether residential, commercial, or industrial customers consume the largest share of the service area's electricity, (3) whether the service area's residential, commercial, or industrial customers are charged the highest rates, (4) whether nuclear-, coal-, or natural gas-powered electric facilities produce the most air emissions, and (5) what state agency sets electric rates. The correct answers, varying in some cases according to the service area, are (1) coal for SWEPCO and natural gas for CPL and WTU, (2) residential for WTU and commercial for SWEPCO and CPL, (3) residential for SWEPCO and WTU and commercial for CPL, (4) coal, and (5) the Public Utilities Commission.

New Haven Airport

The four general New Haven information items ask (1) whether the population of the greater New Haven region is closest to 250,000, 350,000, 550,000, or 750,000, (2) whether the rate of job growth in the New Haven region during the 1990's was more, about the same, or less than the rest of the United States, (3) whether the population of the city of New Haven increased, stayed the same, or decreased during the 1990's, (4) whether sales taxes, property taxes, direct state subsidies, or direct federal subsidies are the major source of revenue for most town governments in the region. The airport-specific items ask (5) whether the FAA would describe Tweed New Haven Airport as a major hub, medium hub, minor hub, or a non-hub, and (6) whether maintaining the airport at its current level of service would require any significant investment. The correct answers are (1) 550,000, (2) less, (3) decreased, (4) property taxes, (5) non-hub, and (6) yes.

New Haven Revenue Sharing

The revenue sharing information index contains the same four general New Haven items, plus two revenue sharing-specific items asking (5') whether Connecticut law allows communities to share property tax revenues and (6') whether those communities with the most valuable property tend to have the lowest property tax rates, average property tax rates, or the highest property tax rates. The correct answers are (5') yes and (6') lowest.

Australian Constitutional Referendum

The first four referendum-specific information items ask (1) whether the role of the proposed president would most resemble that of the British Prime Minister, the Australian Prime Minister, the American President, or the Australian Governor General; (2) whether the Prime Minister could remove the president at any time without reporting to the House, at any time with subsequent House approval, after a fair trial in Parliament, or not at all; (3) whether the Queen currently chooses the Governor General, appoints him/her on the recommendation of Parliament, appoints him/her on the advice of the Prime Minister, or plays no role in selecting him/her; (4) whether the Governor General currently controls the government, acts on the Queen's Instructions, performs only ceremonial duties, or can decide to dismiss the government. The remaining four ask whether each of four things would definitely change if the referendum were to pass: (5) the Australian flag, (6) the national anthem, (7) the word "royal" in the names of the "Royal Australian Navy" and the "Royal Australian Air Force," and (8) Australia's participation in the Commonwealth games. The general political information items ask (9) whether the Liberal party is more concerned, the Labour party is more concerned, or the two are equally concerned about social and welfare issues; (10) whether, on the whole, the Liberal party is closer, the Labour party is closer, or the two are equally close to business interests; (11) whether Aden Ridgeway was currently the leader of the Federal opposition, the Leader of the Democrats, a Justice of the High

Court, or an Aboriginal Senator in Parliament; (12) whether Jennie George was currently the Secretary of the Teacher's Federation, a Labour MP, the leader of a worker's union, or the President of the Australian Council of Trade Unions. The correct answers are (1) the Governor General, (2) at any time with subsequent House approval, (3) appoints him/her on the advice of the Prime Minister, (4) can decide to dismiss the government, (5) no, (6) no, (7) yes, (8) no, (9) Labour party more, (10) Liberal party closer, (11) Aboriginal Senator in Parliament, and (12) President of the Australian Council of Trade Unions.

British monarchy

The information items ask (1) whether Princess Anne is next in line to the throne after Prince Charles; (2) whether the Prime Minister rather than the Queen is Britain's Head of State; (3) whether the Queen still heads the Commonwealth; (4) whether it is the Queen's duty to decide the date of all General Elections; (5) whether prime ministers cannot take office without being asked to by the Queen; (6) whether the Queen heads the Church of England; (7) whether the Queen heads the Church of Scotland; (8) whether Britain has an unwritten constitution; and (9) whether the brother or sister, eldest brother, eldest child, eldest son, or eldest daughter is next in line to the throne when a British monarch dies. All but (9) are in true-false format. The correct answers are (1) false, (2) false, (3) true, (4) false, (5) true, (6) true, (7) false, (8) true, and (9) the eldest son.

NOTES

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[1] By "rational," we mean reflexive, complete, and transitive, as defined formally below.

[2] This can also be seen as generalizing single-peakedness as a matter of degree.

[3] This is also supported by unpublished computer simulations we conducted jointly with Susan Holmes.

[4] The use of random samples of the public sets this study apart from most research on the occurrence of cycles, which typically examines narrower and more homogeneous groups like professional associations, clubs, or committees (for a critical overview, see Mackie 2004).

[5] When the cycles in question are "top-cycles," we have an instance of the standard paradox, where there exists no Condorcet winner. This paradox implies the more general one, but not vice-versa when there are more than three alternatives.

[6] There are exceptions. Distributions can be constructed with a highly symmetrical structure so as to reproduce the conditions under which Condorcet's paradox occurs with a high probability. Tsetlin, Regenwetter and Grofman's results specify the precise (large) class of possible distributions among which the impartial culture maximizes the probability of cycles.

[7] Formally, a *left-right ordering* of the alternatives is a one-to-one function $\Omega : X \rightarrow \{1, 2, ..., k\}$ which assigns to each alternative x in X a number between 1 and k, where $\Omega(x) = 1$ means that alternative x is left-most, $\Omega(x) = 2$ means that x is second from left, and so on. An alternative y lies *between* alternatives x and z with respect to Ω if $\Omega(x) < \Omega(y) < \Omega(z)$ or $\Omega(z) < \Omega(y) < \Omega(x)$.

[8] Formally, R_i is *single-peaked with respect to* Ω if, for any triple of alternatives x, y, z in X such that y lies between x and z with respect to Ω, xR_iy implies xP_iz. The clause "xR_iy implies xP_iz" rules out the possibility that both xR_iy and zR_ix hold, in which case there would be a "cave" between x and z, at y.

[9] A profile's structuring dimension is unique at most up to mirror image. For example, a profile is single-peaked with respect to the structuring dimension $[x, y, z]$ if and only if it is single-peaked with respect to the structuring dimension $[z, y, x]$.

[10] We can artificially construct such an ordering by arranging the alternatives from left to right in the individual's decreasing order of preference itself.

[11] When individuals are ordered from left to right according to their most preferred alternatives. To avoid (harmless) ties, we assume that the number of individuals n is odd.

[12] S can also be interpreted simply as "single-peakedness," reconceptualized as a matter of degree. Under this reconceptualization, single-peakedness in the standard sense is the case $S = 1$, and its violation the case $S < 1$.

[13] The formula is stated without proof by Niemi (1969). A proof for $k = 3$ is available on request.

[14] This is no change from the four-member group, where $S = 1$, and *y* is also the Condorcet winner, defeating both *X* and *z* by 3 votes to 1 in pairwise majority voting.

[15] More precisely, the probability is conditional on the conjunction of an impartial culture and $S > \alpha$. So *p* equals the proportion of profiles for which there exists a Condorcet winner among all possible profiles satisfying $S > \alpha$.

[16] The computational results are from unpublished simulations conducted with Susan Holmes.

[17] Under an impartial culture, the probability of *S*'s being high is low. Our computer simulations with Susan Holmes show that the bulk of the probability distribution under an impartial culture is near the minimum value (see also Niemi 1969). If *S* is often discernibly above its minimum, therefore, that can be taken as evidence against the impartial culture assumption.

[18] For a slightly longer but similar list, see Fishkin and Luskin (2005).

[19] See Luskin, Fishkin, and Jowell (2002).

[20] While not necessarily agreeing on the most preferred alternative. This is meta-agreement, not substantive agreement.

[21] The one case for which we have quasi-control groups (the Australian Constitutional Referendum DP) suggests that these observed changes can indeed be attributed to the deliberative treatment. In the treatment group, the Condorcet-winning alternative changes from a popularly elected president (1) to a parliamentarily appointed one (2), and the structuring dimension changes from [2 1 3] to [1 2 3], where 3 is the status quo. Among the original interviewees who did not participate in the

deliberations but were later reinterviewed (n = 227), the Condorcet-winning alternative remains 1 and the structuring dimension remains [2 1 3]. Similarly, among a fresh random sample questioned by the Australian national election study in the period immediately following the referendum (n = 3439), the Condorcet-winning alternative is 1 and the structuring dimension [2 1 3].

[22] Recall that the lower bound for S is 2/15 ≈ .133 for k = 5, 1/3 ≈ .333 for k = 4, and 2/3 ≈ .667 for k = 3.

[23] The .263 figure counts the British monarchy issue, where S fell slightly short of S_{min}, as 0. If instead we count S' as -.047, the .268 falls to .252, still the highest of these figures.

[24] The figure is -0.018 if we do not cut S' off at 0.

[25] We treat "Don't Know" responses as incorrect – the conventional scoring, which would hardly be worth remarking except for Mondak's (2001) suggestion that they randomly be assigned to substantive alternatives. Luskin and Bullock (2004) show the conventional scoring to be superior. See also Bennett (2001).

[26] Observed T2 information can be shown under plausible assumptions to be a better measure of "true" information gain than is observed information gain. The core reasons are that: (a) the information-rich tend to get information-richer, and (b) the information indices are ceilinged at 1.0. Thus those with perfect or near-perfect information scores at T1, who are in fact learning the most, perforce have observed information gains near zero. See Luskin (2002) or the condensed version in Luskin, Fishkin, and Jowell (2002). Our results are not greatly altered if we substitute observed information gain for observed T2 information.

[27] This would be a bad idea at T1, as in ordinary surveys, where the distribution of knowledge is extremely right-skewed, so that dichotomizing at or near the median would yield a "high information" group containing many respondents not much better in formed than the members of the "low information" group. Here, after deliberation, it is reasonable.

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[28] Even in this learning context, to be sure, T1 and T2 information are correlated: those high at T2 are likelier than average already to have been high – and thus already to have had preferences closer to single-peaked – at T1. The low T2 information subsample's mean T1 proximity to single-peakedness was .480, the high T2 information subsample's .505. But this T1 difference is only a small part of the T2 difference. At T2, the low T2 information subsample's mean T2 proximity to single-peakedness was .524, the high T2 information subsample's .653. So the initial .025 difference widened to .129. This widening is exactly the difference between the high and low information subsamples' gains reported above. (The difference between .129 - .025 = .104 and .147 - .045 = .102 is just rounding error.) So it was those who learned the most (operationally, who emerged with the highest T2 information) who contributed most to the increased proximity to single-peakedness.

[29] This is not to say that salient issues are a proper subset of important ones. It is not unknown for relatively frivolous issues to be salient.