EXPERT ADVICE TO A VOTING BODY

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Abstract

I provide a theory of information transmission in collective choice settings. In the model, an expert has private information on the effect of a policy proposal and communicates to a set of voters prior to a vote over whether or not to implement the proposal. In contrast to previous game-theoretic models of political communication, the results apply to situations involving multiple voters, multidimensional policy spaces and a broad class of voting rules. The results highlight how experts can use information to manipulate collective choices in a way that reduces the ex ante expected utilities of all voters. Opportunities for expert manipulation are the result of collective choice instability: all voting rules that allow collective preference cycles also allow welfare-reducing manipulative persuasion by an expert. The results challenge prevailing theories of institutions in which procedures are designed to maximize information transmission.

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Expertise is at least as important as formal decision-making authority as a source of political power in many institutions. As a result, formal models of communication under asymmetric information have improved our understanding of legislative committees (Gilligan and Krehbiel, 1987, 1989, 1990), lobbying (Austen-Smith and Wright, 1992; Grossman and Helpman, 2001), and information acquisition by voters (Lupia and McCubbins, 1998). These models feature a key insight from the seminal Crawford and Sobel (1982) model: though more communication would lead to better policies, the expert wants to obfuscate when her preferences diverge from the policy-maker's. Institutions, therefore, are posed as mechanisms for extracting the maximum amount of information from the expert. As Hirsch and Shotts (2012) noted, "uncertainty reduction, expertise, and the common good have become essentially synonymous, regardless of whether the empirical domain is institutional design, lobbying, or delegation."

The prevailing wisdom about communication in political institutions is built on models in which policies are one-dimensional. One-dimensional models reduce the problem of communicating with a voting body to one of communicating with a single representative voter or legislator. This parsimony comes at the cost of generality because representative voters are unlikely to exist in multidimensional policy domains. In two or more dimensions, majority rule is known to be unstable in the sense that all policies can be beaten by some other policy (McKelvey, 1979; Schofield, 1983). Furthermore, this instability property extends beyond majority rule to a wide variety of voting rules (Nakamura, 1979). Though it is known that instability makes voting bodies subject to manipulation in other contexts (McKelvey, 1976; Riker, 1986), the implications of collective choice instability for information transmission are not well established.

In this paper I show that information transmission by an expert can reduce the ex ante expected utilities of all voters in many collective choice environments. I refer to this outcome as manipulative persuasion. The possibility of manipulative persuasion is equivalent to collective choice instability: information transmission that reduces the expected welfare of all voters is possible at some prior belief if and only if the voting rule allows collective preference cycles over lotteries.

The fact that information transmission may lead to welfare losses in voting environments implies that standard theoretical accounts of lobbying and legislative organization may not extend well to applications with multidimensional policy outcomes. Classic models in political economy depict strategic information transmission as a mutually beneficial exchange, where the legislative committee member (Gilligan and Krehbiel, 1987, 1989, 1990) or lobbyist (Grossman and Helpman, 2001; Austen-Smith and Wright, 1992) offers helpful policy expertise in exchange for some influence over the outcome. As I demonstrate, information transmission in voting environments could instead appear as a malevolent form of political manipulation. In settings where this manipulation is possible, voters or legislators may prefer institutions that provide checks on expertise rather than, as is generally assumed in the legislative organization literature, choosing institutions in order to maximize information acquisition and transmission.

Example 1. To illustrate the logic of manipulative persuasion, consider the following example. A lobbyist wants to persuade a majority of a three-member legislative committee to approve a public project. The legislators' districts are labeled A, B, and C. The legislators know that they will receive zero utility from rejecting the project, but the benefits of approving the project are uncertain. There are four possible effects of the project. The project is *efficient* with probability $\frac{1}{10}$ which means that all legislators receive a one unit benefit if the project is approved. Alternatively, the policy may have a *provincial* effect, in which case approval of the project provides a benefit of one unit to one of the three legislators and imposes a cost of one unit on the other two legislators. The probability for each of the three provincial effects is $\frac{3}{10}$. The four possible distributions of benefits and their prior probabilities are below:

Policy state	Benefit to A	Benefit to B	Benefit to C	Probability
Efficient	1	1	1	$\frac{1}{10}$
Provincial A	1	-1	-1	$\frac{3}{10}$
Provincial B	-1	1	-1	$\frac{3}{10}$
Provincial C	-1	-1	1	$\frac{3}{10}$

The lobbyist receives a payoff of zero if the proposal fails and one if the proposal passes. The lobbyist, who knows the effect of the policy, can advise the legislators in the form of a public

Policy state	Message	Probability
Efficient	$\{A,B\}$	1/3
	$\{A,C\}$	1/3
	$\{B,C\}$	1/3
Provincial A	$\{A,B\}$	1/2
	$\{A,C\}$	1/2
Provincial B	$\{A,B\}$	1/2
	$\{B,C\}$	1/2
Provincial C	$\{A,C\}$	1/2
	$\{B,C\}$	1/2

Table 1: An equilibrium communication strategy for the game in Example 1.

speech revealing some information about the policy.

What type of speech should the lobbyist make in this situation? If the lobbyist revealed no information, the project would be unanimously rejected since each legislators' ex ante benefit from approving the project is $-\frac{1}{5}$. For the sake of argument, suppose that the lobbyist instead revealed all information to the legislators. Then the proposal would pass unanimously in the efficient state and fail in a 2-1 vote the rest of the time. However, if the legislators are persuaded to pass the proposal when the lobbyist makes a speech implying that the policy is efficient, then the lobbyist has an incentive to make the same speech in the provincial states. Thus, the lobbyist cannot credibly reveal all information.

Instead, suppose that the lobbyist gives a partially informative speech. Let the set of possible speeches be represented by subsets of $\{A,B,C\}$ so that a message of $\{A\}$ is interpreted as a recommendation that only legislator A votes in favor of approving the project, a message of $\{A,B\}$ is interpreted as a recommendation that legislators A and B vote in favor of approving the project, and so on.[1] Here, the lobbyist randomizes only among minimal winning coalitions. In the efficient state, the lobbyist randomizes among all minimal winning coalitions. In a provincial state, the lobbyist randomizes only among minimal winning coalitions that include the true beneficiary of the project.

[1] In the main model, the set of possible messages will be equal to the state space instead of all subsets of voters. However, this representation is equivalent and aids interpretation of the example.

To see why this is an equilibrium, consider what happens after the legislators see the message $\{A, B\}$. Following this message, the posterior probability of the efficient state remains $\frac{1}{10}$, the probability of "Provincial C" is zero, and the "Provincial A" and "Provincial B" states are each assigned probabilities of $\frac{9}{20}$. Thus, the expected benefit of approving the project for both A and B is $\frac{1}{10} + \frac{9}{20} - \frac{9}{20} = \frac{1}{10}$ and the expected benefit to C is $\frac{1}{10} - \frac{9}{10} = -\frac{4}{5}$. Thus, the proposal will pass with both A and B voting in favor and C voting against. Because of the symmetry of this example, the calculations for the other two messages are comparable, which means that the project is approved with probability one in this equilibrium.

Though the information provided by the lobbyist is persuasive and accurate, the legislators are ex ante worse off in this equilibrium than if the lobbyist had not provided any information. Since the project is approve with probability one, each legislator's expected payoff from this equilibrium is $-\frac{1}{5}$, compared to a payoff of zero from automatically rejecting the project with no information transmission. ■

In what follows, I demonstrate that the insights from Example 1 are applicable to a significant set of voting games using a broad class of voting rules. I also show that manipulative (ex ante welfare-reducing) persuasion is tied to collective preference instability; when considering characteristics of voting rules, the possibility of collective choice cycles is equivalent to the possibility of manipulative persuasion. The results challenge the prevailing theories of institutions in which procedures are chosen in order to maximize information transmission. Instead, voters may unanimously prefer institutions that reduce opportunities for persuasion.

1 The model

Let $N = \{1, \ldots, n\}$ denote the set of voters and let E denote a single Expert. The voters must decide whether to implement a proposed policy ($x = 1$) or reject the proposal in favor of the status quo ($x = 0$). The utility to each voter from implementing the proposed policy depends on the state of the world, denoted $\omega = (\omega_1, \ldots, \omega_n)$. Specifically, the preferences of each voter $i \in N$ are represented by the utility function $u_i(x, \omega) = \omega_i x$. Let $\Omega = \{-1, 1\}^n$ denote the feasible states of the world, so that each voter experiences a one-unit loss or gain if the proposal passes and receives utility of zero if the proposal fails. The Expert's utility is $u_E(x) = x$ meaning that the Expert seeks to maximize the probability that the proposal passes regardless of the state of the world.[2]

The sequence of the game is as follows. First, Nature determines the value of ω and reveals it to the Expert. Second, the Expert sends a payoff-irrelevant message $s \in \Omega$ to the voters. Finally, all voters observe the Expert's message and make a vote choice $v_i \in \{\text{No, Yes}\}$. Let $\mathcal{D} \subset 2^N \backslash \{\emptyset\}$ denote a set of decisive coalitions. If $\{i \in N : v_i = \text{Yes}\} \in \mathcal{D}$ then the proposed policy is implemented ($x = 1$), otherwise the proposal is rejected ($x = 0$). Assume that $\mathcal{D}$ is monotonic ($C \in \mathcal{D}$ and $C \subseteq C'$ imply $C' \in \mathcal{D}$) and proper ($C \in \mathcal{D}$ implies $N \backslash C \notin \mathcal{D}$). The class of voting rules permitted by these assumptions is similar to that in Banks and Duggan (2000) and Kalandrakis (2006) and subsumes all supermajority rules, weighted supermajority rules, certain bicameral voting rules, and many others.

The value of ω is private information for the Expert. The distribution of ω is represented by a common prior $\mu_0 \in \Delta(\Omega)$, where $\Delta(\Omega)$ is the set of probability measures on Ω. After observing a message $s \in \Omega$, the voters form a posterior belief $\mu_s \in \Delta(\Omega)$. For any beliefs $\mu \in \Delta(\Omega)$, let $p_i(\mu) = \sum_{\{\omega' \in \Omega : \omega'_i = 1\}} \mu(\omega')$ be the probability that $\omega_i = 1$ given those beliefs.

A strategy profile consists of a messaging strategy for the Expert and a voting strategy for each voter. The Expert's strategy is a function $\sigma : \Omega \to \Delta(\Omega)$ mapping the states of the world into probability distributions over messages. Thus, $\sigma(s|\omega)$ is the probability that the Expert sends the message s when the state of the world is ω. A voting strategy is a function $v_i^* : \Omega \to \{\text{No, Yes}\}$ mapping messages into voting decisions.[3] Let $v^* = (v_1^*, \ldots, v_n^*)$ be the profile of all voting strategies.

Let x^* be the function mapping messages into voting outcomes given a profile of strategies.

[2] Allowing the Expert's preferences to depend on the state of the world would be straightforward but the case of state-independent expert preferences is used for simplicity. This assumption is realistic for certain applications. For instance, a lobbyist who has contracted with a client to advocate the proposal would behave as if her preferences were independent of her information about the proposal. A judicial nominee would communicate to Congress about her judicial philosophy but would wish to be confirmed regardless of this philosophy.

[3] The restriction to pure voting strategies does not alter communications outcomes in this model. Voters would only use non-degenerate mixed strategies when they were indifferent between outcomes. Thus, any equilibrium in mixed strategies can be replaced by one with the same messaging strategy in which indifferent voters always voted Yes.

Thus, $x^*(s, v^*) = 1$ if $\{i \in N : v_i^*(s) = \text{Yes}\} \in \mathcal{D}$ and 0 otherwise.

I characterize perfect Bayesian equilibria in weakly undominated strategies. Thus, an equilibrium is a profile of strategies and beliefs $(\sigma, v^*, \{\mu_s\}_{s\in\Omega})$ such that:

1. For any $\omega, s \in \Omega$, $\sigma(s|\omega) > 0$ implies that $s \in \arg\max_{s'\in\Omega} u_E(x^*(s', v^*))$; and
2. For all $i \in N$ and all $s \in \Omega$, $v_i^*(s) = \text{Yes}$ if $p_i(\mu_s) > \frac{1}{2}$ and $v_i^*(s) = \text{No}$ if $p_i(\mu_s) < \frac{1}{2}$, where μ_s is consistent with Bayes' rule for all s such that $\sigma(s|\omega) > 0$.

The focus on weakly undominated strategies shows in the second condition because voters vote in favor of their preferred outcome whether or not their votes are pivotal in determining the outcome.

2 Existence of manipulative equilibria

The analysis identifies conditions under which persuasion makes the voters unanimously worse off from an ex ante perspective. A persuasive equilibrium is one in which the proposal passes following some message and would not have passed absent any information transmission: $x^*(s, v^*) = 1$ for some $s \in \Omega$ and $\{i \in N : p_i(\mu_0) \geq 1/2\} \notin \mathcal{D}$. A manipulative equilibrium is a persuasive equilibrium that gives negative ex ante expected utility to all voters: $\sum_{\omega\in\Omega}\sum_{s\in\Omega}\mu_0(\omega)\sigma(s|\omega)x^*(s, v^*)\omega_i < 0$. Usually we will focus on the case in which all voters are opposed to the proposal ex ante ($p_i(\mu_0) < \frac{1}{2}$ for all $i \in N$). In that case, as Lemma 1 establishes, persuasive and manipulative equilibria are equivalent.

Lemma 1 establishes two facts that follow easily from the definition of persuasive equilibria. First, in any persuasive equilibrium the proposal passes with probability one. Second, if the voters were each opposed to the proposal prior to communication, this implies that all voters have negative ex ante expected utility in a persuasive equilibrium. Since all voters would get an expected utility of zero from automatically rejecting the proposal without consulting the Expert, this implies that the expected value of the Expert's advice is negative for all voters.

Lemma 1. *Let $(\sigma, v^*, \{\mu_s\}_{s\in\Omega})$ be a persuasive equilibrium. The following hold:*

1. *For all $s \in \Omega$, if $\sigma(s|\omega) > 0$ for some $\omega \in \Omega$ then $x^*(s, v^*) = 1$.*

2. *If $p_i(\mu_0) < \frac{1}{2}$ for all $i \in N$ then all voters' equilibrium ex ante expected utilities are negative*

Proof. To prove part (1), assume that $(\sigma, v^*, \{\mu_s\}_{s\in\Omega})$ is a persuasive equilibrium and $\sigma(s|\omega) > 0$ for some $\omega \in \Omega$. The definition of persuasive equilibrium implies that there exists some $s' \in \Omega$ with $x^*(s', v^*) = 1$. Since σ is an equilibrium strategy we must have $u_E(x^*(s, v^*)) \geq u_E(x^*(s', v^*))$ which implies that $x^*(s, v^*) = 1$. To prove part (2), note that (1) implies that $x = 1$ with probability one in any persuasive equilibrium. Thus, i's ex ante expected utility is $\mathbb{E}[\omega_i \cdot x] = \mathbb{E}[\omega_i \cdot 1] = p_i(\mu_0) - (1 - p_i(\mu_0)) = 2p_i(\mu_0) - 1$. Since it is assumed that $p_i(\mu_0) < \frac{1}{2}$, this shows that i's ex ante expected utility is less than zero in this equilibrium. ■

Lemma 1 establishes that the expected value of persuasion by the Expert is negative for all voters if the voters are initially opposed to the proposal.[4] Next, we need to characterize the requirements for existence of persuasive equilibria.

Let

$$W_{\mathcal{D}} = \left\{\mu \in \Delta(\Omega) : \left\{i \in N : p_i(\mu) \geq \frac{1}{2}\right\} \in \mathcal{D}\right\} \tag{1}$$

denote the set of beliefs under which the voters may pass the proposal. Lemma 1 implies that if $(\sigma, v^*, \{\mu_s\}_{s\in\Omega})$ is a persuasive equilibrium then $\mu_s \in W_{\mathcal{D}}$ for all s in the support of σ. The following result, which follows from arguments similar to Kamenica and Gentzkow (2011) as well as concurrent work by Alonzo and Câmara (2015), establishes that such a signaling strategy is possible if and only if the prior distribution is in the convex hull of $W_{\mathcal{D}}$. Throughout the proof, $\text{Co}(\cdot)$ refers to the convex hull of a set.

Lemma 2. *Assume that the proposal would fail absent any information transmission. There exists a persuasive equilibrium if and only if μ_0 is in the convex hull of $W_{\mathcal{D}}$.*

[4] This result depends on the fact that voters do not have private information about their utilities for passing the proposal. If voters did have private information about their preferences, persuasion from an expert with state-independent preferences may still have a positive ex ante expected value to voters. The starker assumptions used here help illuminate the impact of voting rules more clearly.

Proof. I will first prove that $\mu_0 \in \mathrm{Co}(W_{\mathcal{D}})$ implies the existence of a persuasive equilibrium. By Carathéodory's theorem, if $\mu_0 \in \mathrm{Co}(W_{\mathcal{D}})$ then there is a finite subset $\{\mu^1, \dots, \mu^K\} \subset W_{\mathcal{D}}$ (where $K \leq n+1 \leq 2^n$) and a vector $q \in \mathbb{R}^K$ such that $\sum_{k=1}^K q^k = 1$ and $\mu_0 = \sum_{k=1}^K q^k \mu^k$. Define a strategy σ and a set of K signals $\{s^1, \dots s^K\} \subseteq \Omega$ such that $\sigma(s^k|\omega) = \frac{\mu^k(\omega) q^k}{\mu_0(\omega)}$ and $\sigma(\hat{s}|\omega) = 0$ for $\hat{s} \notin \{s^1, \dots s^K\}$ for any ω such that $\mu_0(\omega) > 0$. Bayesian updating shows that, for any such ω:

$$\Pr[\omega|s^k] = \frac{\frac{\mu^k(\omega)q^k}{\mu_0(\omega)}\mu_0(\omega)}{\sum_{\omega' \in \Omega} \frac{\mu^k(\omega')q^k}{\mu_0(\omega')}\mu_0(\omega')} = \frac{\mu^k(\omega)q^k}{q^k} = \mu^k(\omega), \tag{2}$$

which shows that σ induces the posteriors $\{\mu^1, \dots, \mu^K\} \subset W_{\mathcal{D}}$. Since the proposal passes following each s^k by $\mu^k \in W_{\mathcal{D}}$, this shows that there is a persuasive equilibrium.

Finally, I prove that the existence of a persuasive equilibrium implies that $\mu_0 \in \mathrm{Co}(W_{\mathcal{D}})$. Let $(\sigma, v^*, \{\mu_s\}_{s \in \Omega})$ be a persuasive equilibrium. By Lemma 1, $\mu_s \in W_{\mathcal{D}}$ for all s such that $\sigma(s|\omega) > 0$ for some $\omega \in \Omega$. Let $\Pr[s] = \sum_{\omega \in \Omega} \mu_0(\omega)\sigma(s|\omega)$ denote the total probability that E sends the message $s \in \Omega$. We have $\sum_{s \in \Omega} \Pr[s] = 1$ and, by the law of total probability, $\mu_0(\omega) = \sum_{s \in \Omega} \Pr[s]\mu_s(\omega)$ for all $\omega \in \Omega$, which shows that $\mu_0 \in \mathrm{Co}(W_{\mathcal{D}})$. ■

The conditions for existence of manipulative equilibria follows easily from Lemmas 1 and 2. Existence of a persuasive equilibrium requires that the prior beliefs are in the convex hull of $W_{\mathcal{D}}$ and such an equilibrium is manipulative when all players are opposed to the proposal ex ante. Corollary 1 states the result.

Corollary 1. *There exists a manipulative equilibrium if and only if $\mu_0 \in Co(W_{\mathcal{D}})$ and $p_i(\mu_0) < \frac{1}{2}$.*

3 Voting rules and manipulative persuasion

Though Corollary 1 establishes necessary and sufficient conditions for the existence of manipulative equilibria, two factors limit the applicability of the result. First, for a given voting rule, there may not exist any prior beliefs that simultaneously satisfy both conditions of Corollary 1. In other words, some political institutions may not permit manipulation by an Expert. Second, applied political economists are more interested in making comparisons across institutions than across prior beliefs. Therefore, determining whether manipulative persuasion would occur given a particular set of beliefs is less useful than understanding whether such an outcome is *permitted* by a particular rule.[5] For instance, knowing which rules permit manipulative persuasion may help explain why voting bodies select mechanisms that discourage information acquisition[6] or limit debate or lobbying on certain bills. These observations lead us back to the main research question of this article: Which voting institutions are susceptible to manipulation by an expert?

Collegiality and cycling provide two potential ways to categorize voting rules. The *collegium* of a voting rule is the intersection of all decisive coalitions: $\cap_{C \in \mathcal{D}} C$. A voting rule is *collegial* if the collegium is non-empty and *non-collegial* otherwise (Austen-Smith and Banks, 2000). To illustrate the concept of collegial and non-collegial rules, consider the following examples:

- Three-person majority rule. The set of decisive coalitions is $\mathcal{D} = \{\{1,2\},\{1,3\},\{2,3\},\{1,2,3\}\}$. Since $\{1,2\} \cap \{1,3\} \cap \{2,3\} = \emptyset$, majority rule is non-collegial.

- Majority rule modified to give player 1 a veto. The set of decisive coalitions is $\mathcal{D} = \{C \subset N : |C| \geq \frac{n}{2}$ and $1 \in C\}$. Since $\cap_{C \in D} = \{1\}$, this rule is collegial.

- Unanimity rule: The set of decisive coalitions is $\mathcal{D} = \{N\}$. Since the entire set of voters is in every decisive coalition, this rule is collegial.

In other words, the collegium of a voting rule is the set of voters whose approval is always required to pass a proposal.

We also consider whether a rule allows cycles over lotteries. Define a binary relation $\succeq_{\mathcal{D}}$ over the elements of $\Delta(\Omega)$ such that for any $\mu, \mu' \in \Delta(\Omega)$, $\mu \succeq_{\mathcal{D}} \mu'$ if and only if $\{i \in N : p_i(\mu) \geq p_i(\mu')\} \in$

[5] Since the role of prior distributions in this model is analogous to the role of preference profiles in social choice theory, my focus in this section on the *possibility* of manipulative persuasion given different rules is similar to the setup for many results in social choice theory (Arrow, 1950, 1951; Gibbard, 1973; Satterthwaite, 1975), which focus on whether aggregation or choice functions violate deirable axioms for some preference profile rather than on predicting outcomes for a particular profile.

[6] For instance, closed amendment rules are thought to encourage committee chairs to acquire private information on policies (Gilligan and Krehbiel, 1987), so announcing an open rule on a bill may discourage such information acquisition.

$\mathcal{D}$. Let $\succ_{\mathcal{D}}$ denote the strict part of $\succeq_{\mathcal{D}}$.[7] $\mathcal{D}$ allows collective preference cycles over lotteries if there exist $\mu,\mu',\mu'' \in \Delta(\Omega)$ such that $\mu \succeq_{\mathcal{D}} \mu'$, $\mu' \succeq_{\mathcal{D}} \mu''$, but not $\mu \succeq_{\mathcal{D}} \mu''$. Rules allowing collective preference cycles over lotteries are unstable in the following way: given an arbitrary set of probability distributions over outcomes, we cannot guarantee that one is maximal with respect to the rule.

The relationship between collegiality, cycling, and manipulative persuasion is given by Theorem 1.

Theorem 1. *The following statements are equivalent:*

1. *$\mathcal{D}$ is non-collegial.*
2. *$\mathcal{D}$ allows collective preference cycles over lotteries.*
3. *There exists a manipulative equilibrium at some $\mu^* \in \Delta(\Omega)$.*

Proof. To prove this result, I will prove the equivalence of (1) and (2) and then of (1) and (3).

The proof that (1) implies (2) is related to the proof of Theorem 2.4 in Austen-Smith and Banks (2000). Assume $\mathcal{D}$ is non-collegial. There exists a set $\{\mu^1,\dots,\mu^n\} \subseteq \Delta(\Omega)$ such that:

$$\begin{aligned} p_1(\mu^1) > p_1(\mu^2) > \cdots > p_1(\mu^n) \\ p_2(\mu^2) > p_2(\mu^3) > \cdots > p_2(\mu^n) > p_2(\mu^1) \\ p_3(\mu^3) > p_3(\mu^4) > \cdots > p_3(\mu^n) > p_3(\mu^1) > p_3(\mu^2) \\ \vdots \\ p_n(\mu^n) > p_n(\mu^1) > p_n(\mu^2) > \cdots > p_n(\mu^{n-2}) > p_n(\mu^{n-1}). \end{aligned}$$

Since $\mathcal{D}$ is non-collegial, for all $i \in N$ there exists $C \in \mathcal{D}$ such that $i \notin C$. For each element of $\{\mu^1,\dots,\mu^n\}$, we have $\{i \in N : p_i(\mu^{j-1}) > p_i(\mu^j)\} = N\backslash\{j\}$ if $j \neq 1$ and $\{i \in N : p_i(\mu^n) > p_j(\mu^1)\} = N\backslash\{1\}$. Since $\mathcal{D}$ is monotonic as well as non-collegial, we have $N\backslash\{j\} \in \mathcal{D}$ for all $j \in N$, which implies that

[7] That is, $\mu \succ_{\mathcal{D}} \mu'$ if and only if $\mu \succeq_{\mathcal{D}} \mu'$ and not $\mu' \succeq_{\mathcal{D}} \mu$.

$\mu^n \succ_{\mathcal{D}} \mu^1 \succ_{\mathcal{D}} \mu^2 \succ_{\mathcal{D}} \cdots \succ_{\mathcal{D}} \mu^{n-1}$ and $\mu^{n-1} \succ_{\mathcal{D}} \mu^n$. Thus, $\mathcal{D}$ allows collective preference cycles over lotteries.

To see that (2) implies (1), suppose by way of contrapositive that $\mathcal{D}$ is collegial. Then there is some $i \in N$ such that $i \in \cap_{C \in \mathcal{D}}$. Transitivity of i's expected utility implies that there are no collective preference cycles over lotteries. Therefore, if $\mathcal{D}$ is collegial then there are no collective preference cycles over lotteries, proving that the existence of cycles over lotteries implies non-collegiality of $\mathcal{D}$. This proves the equivalence of (1) and (2).

Finally, I must show that (1) and (3) are equivalent. It is clear that (3) implies (1): since a collegium voter must always vote Yes in a persuasive equilibrium, such a voter's ex ante expected utility cannot be negative.

To see that (1) implies (3), suppose that $\mathcal{D}$ is non-collegial. Then there exists a set $\{C^1, C^2, \ldots, C^K\} \subseteq \mathcal{D}$ of K decisive coalitions (with $K \geq 3$ by properness of $\mathcal{D}$) such that $\cap_{k=1}^K C^k = \emptyset$. Define a set of K probability distributions $\{\mu^1, \ldots, \mu^K\} \subset \Delta(\Omega)$ such that for all $k \in \{1, 2, \ldots, K\}$ we have

$$p_i(\mu^k) \in \left[\frac{1}{2}, \frac{K}{2(K-1)}\right) \text{ for all } i \in C^k \text{, and} \tag{3}$$

$$p_i(\mu^k) = 0 \text{ for all } i \notin C^k. \tag{4}$$

Let $\mu^* = \frac{1}{K}\sum_{k=1}^K \mu^k$ be a simple average of these distributions. Since $\cap_{k=1}^K C^k = \emptyset$, each voter is left out of at least one coalition. Therefore, we have

$$p_i(\mu^*) < \frac{K-1}{K}\frac{K}{2(K-1)} = \frac{1}{2} \tag{5}$$

for all $i \in N$, which shows that $p_i(\mu^*) < \frac{1}{2}$ for all voters. Furthermore, since $p_i(\mu^k) \geq \frac{1}{2}$ for all i in the decisive coalition C^k, we have $\{\mu^1, \ldots, \mu^K\} \subset W_{\mathcal{D}}$. Since μ^* is formed by a convex combination of elements of $\{\mu^1, \ldots, \mu^K\}$, Lemma 2 implies that there is a persuasive equilibrium at $\mu_0 = \mu^*$. By part 2 of Lemma 1, this implies that there is a manipulative equilibrium at $\mu_0 = \mu^*$. ■

The proof of Theorem 1 also suggests that many manipulative equilibria are stable with respect to small changes in the prior distribution. If μ_0 is a combination of distributions that satisfy Equation 3 (on the interior of the interval) and Equation 4, then small changes in the prior will not eliminate the existence of manipulative equilibria: for all priors in some open neighborhood of μ_0, we will have $p_i(\mu_0) < 0$ for all $i \in N$ and $p_i(\mu^k) \geq 1/2$ for all $i \in C^k$, with C^k defined as in the proof above.

4 Discussion and Conclusions

I have analyzed a model of communication from an expert to a voting body in a multidimensional state space. In contrast to existing models of communication in political institutions, I show that persuasion by an expert can reduce the ex ante expected utilities of all voters. In fact, the possibility of expert manipulation is a feature of all cyclic voting rules. This result challenges prevailing informational theories of legislative and electoral institutions, in which uncertainty reduction inevitably leads to better policy decisions. For instance, the informational approach to legislative organization views legislative institutions as chosen for the purpose of providing "incentives for individuals to develop policy expertise and share policy-relevant information with fellow legislators" (Krehbiel, 1991). My argument implies that this theoretical approach requires revision in situations where policies are not unidimensional. In many situations, legislators would unanimously prefer institutions that reduce information transmission.

Uncertainty about the distribution of benefits from a proposal is known to generate inefficient outcomes in voting environments. For example, Fernandez and Rodrik (1991) showed that when there is ex ante uncertainty about who gains or loses from reforms and policies are chosen through a majority vote, reforms may be rejected ex ante even though a majority of voters benefit from the reform ex post. Similarly, Messner and Polborn (2012) showed that voting bodies, in contrast to individual investors, may be made worse off by having the option to postpone a decision to wait for more information. I build upon these insights about collective decision-making by showing that inefficiencies due to voting under uncertainty can work to the advantage of an outside expert, and the presence of an expert may exacerbate these inefficiencies for the voters.

This study also relates to recent work on communication to voters. Most notably, Chakraborty and Harbaugh (2010) show by example that communication from an expert can reduce voter welfare. Their example features a jury operating by unanimity rule. Jurors are privately informed about their preferences and a defense attorney is privately informed about the case facts. Communication by the defense attorney lowers expected voter welfare by increasing the probability of acquital to suboptimal levels.[8] Outside of the cheap talk setting, Jackson and Tan (2012) analyze a model in which a set of voters consult one or more experts before choosing between two alternatives. Their model differs from cheap talk settings in that experts' signals are verifiable and the experts simply choose whether to reveal their signal or act as if they did not observe a signal. Preferences are unidimensional and single-peaked in their model, which rules out manipulative persuasion by inducing a representative voter, and voters may prefer to adopt a supermajority rule in order to maximize information disclosure.

The model in this study also relates to recent work on information control, starting with Kamenica and Gentzkow (2011). In these models, a sender chooses a public signal that will be revealed to the receiver. The signal is chosen before the state of the world is known, so the sender does not possess private information when she makes this decision. Kamenica and Gentzkow derive conditions under which there exists a signal that benefits the sender and discuss optimal signals from the perspective of the sender. Alonzo and Câmara (2015) extend this framework to a setting in which multiple receivers make decisions by voting. These public signals, like the expert communication in my model, can make a majority of voters strictly worse off. Furthermore, Alonzo and Câmara show that stricter supermajority rules reduce the harm from informational manipulation. A critical difference between my model and these information control models is that I allow the expert to obfuscate information after she learns the state of the world rather than assuming the sender can commit to full revelation.[9] As a result of removing this commitment assumption,

[8] The voting example in Chakraborty and Harbaugh (2010) differs from this study because welfare effects depend on random components of voter preferences rather than on instability of collective preferences. In fact, welfare-reducing persuasion is not possible for unanimity rule in my model.

[9] The work of Aumann et al. (1995) is also related to the literature on information control. This work considers

the conditions for manipulative persuasion in my model are more stringent than those required for manipulation by an information controller. The manipulative persuasion set to the cheap talk game is therefore smaller than the set of prior distributions enabling manipulation by an information controller.

The current model assumes that experts are not voters. A natural extension is to model situations in which voters themselves have private information, which introduces the additional complication that the expert's vote conveys some information and voters can condition on being pivotal (Austen-Smith and Feddersen, 2006). The question of whether deliberation among voters with private information is subject to welfare-reducing manipulation is still open. Extending the model to incorporate voting experts would be a first step toward a multidimensional model of deliberation and debate in the spirit of the one-dimensional models by Austen-Smith and Riker (1987) or Austen-Smith (1990).

The model also assumes that policy proposals are generated exogenously and cannot be altered once introduced. The exogenous proposal distinguishes this paper from models of legislative bargaining, which have been extended to incomplete information environments by Meirowitz (2007). The fact that proposals cannot be altered amounts to an assumption that the voting body operates under a closed rule. Though this assumption is appropriate in popular elections and some legislatures, it contrasts with some models of the United States Congress in which bills can be considered under open or closed rules. Unfortunately, though one-dimensional models rely on the assumption that bills are amended to reflect the preferences of the chamber median under open rules, there is no similarly justifiable assumption in the absense of a median. However, the fact that information transmission can be problematic under closed rules is significant in light of the common theoretical finding that closed amendment rules can be preferable on informational grounds (Gilligan and Krehbiel, 1987).

This paper provides novel results regarding information transmission by experts and its sub-

the value of asymmetric information about the game being played when the other player lacks that information. As Kamenica and Gentzkow (2011) note, the focus on Nash equilibria in Aumann et al. (1995) implicitly mirrors the commitment assumption in models of information control that I eliminate by focusing on cheap talk.

stantive impact on voting. It also provides a general, flexible formal framework that can be easily extended to study a number of legislative and electoral institutions. Exploring the connections between signaling models and social choice theoretic concepts is a fruitful path for future research.

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