Strategic information revelation when experts compete to influence

Sourav Bhattacharya*

and

Arijit Mukherjee**

We consider a persuasion game between a decision-maker and a set of experts. Each expert is identified by two parameters: (i) "quality" or his likelihood of observing the state (i.e., learning what the best decision is) and (ii) "agenda" or the preferred decision that is independent of the state. An informed expert may feign ignorance but cannot misreport. We offer a general characterization of the equilibrium. From the decision-maker's standpoint, (a) higher quality is not necessarily better, (b) extreme agendas are always preferred, and (c) the optimal panel may involve experts with identical (rather than conflicting) agendas.

1. Introduction

■   Decision-makers often rely on the advice of the experts. However, if the experts are themselves interested in the decision, they may attempt to influence the decision-maker by withholding or filtering information. To counteract such manipulation of information, decision-makers often solicit advice from experts with conflicting preference, the premise being that competition between the experts facilitates information revelation. For example, a judge may invite testimony from both the plaintiff and the defendant, a policy maker may listen to advocacy groups representing different interests, and a voter may listen to policy stands of different candidates.

Although several authors have studied the issue of eliciting private information from competing experts (Milgrom and Roberts, 1986; Shin, 1994, 1998; Emons and Fluet, 2009; Kamenica and Gentzkow, 2011; Gentzkow and Kamenica, 2012; Gul and Pesendorfer, 2012), the extant literature has little to say about the link between the *extent of conflict* among the experts and the quality of decision-making. This article attempts to bridge this gap.

We consider an environment where the judge cannot commit to his actions and there is uncertainty over whether or not an expert possesses the relevant information. In this setting, we develop a simple model of competition for persuasion that allows us to explore certain key questions, such as "How does the conflict of interest between experts influence the extent of information revelation? Does the quality of decision-making necessarily improve if the competing experts are more informed? Should policy advisors be chosen from those with moderate or those with extreme policy preferences?"

We find that these questions have nuanced answers with important implications for the optimal design of expert panels. First, employing experts that are more likely to be informed may lead to worse decisions. Second, it is always optimal to use experts with extreme preferences. Moreover, it may be better for the decision-maker to employ experts who have similar interests rather than to promote competition by employing experts with opposing views.

We consider a persuasion game (Milgrom and Roberts, 1986; Glazer and Rubinstein, 2001, 2004, 2006) with the following features. The decision-maker, or the "judge," wants to take an action matching the underlying "state," θ, and each agent A_i, or "expert," *privately* observes the state with a certain probability α_i. We call α_i the "quality" of an expert as it reflects the expert's ability to gather the necessary information. Unlike some of the existing models of persuasion where the judge chooses between just two actions (Shin, 1998; Glazer and Rubinstein, 2001) we assume a richer, continuous action space. An expert A_i's preference is described by his ideal action, or, "agenda," x_i. Irrespective of the underlying state, he prefers that the judge take an action as close to x_i as possible. We assume that the relevant information consists of hard evidence (e.g., legal documents) that can be verified. An informed expert has the choice to either report the state or to feign ignorance and pool with the genuinely uninformed.[1,2] So, an informed expert reveals information if and only if he finds the state favorable.

However, notice that though an expert may feign ignorance when faced with unfavorable information, a state that is unfavorable to one expert may be favorable to another, and thus competition may mitigate the problem of information manipulation. Thus, the main focus of our article is how far and to what extent the conflict of interest between potentially interested experts affects the quality of decision-making. In addition, we assume that not only the judge cannot commit to an action that would maximize the likelihood of truth-telling, but also the judge cannot write contracts to "buy information" from experts. Thus, the experts' incentives are driven only by the judge's action.

As a concrete example of the environment described above, consider a judge listening to the expert reports from both the plaintiff and the defendant to decide on the amount of a monetary damage that the defendant must pay to the plaintiff.[3] The plaintiff's expert prefers a higher damage payment whereas the defendant's expert attempts to lower the damage amount. We assume that both experts have access to the same data or evidence, which is a natural assumption in many judicial systems where both sides of the litigation get equal access to all "discovery documents" of the case. However, the experts vary in terms of their ability to assess the extent of damage by analyzing the available data. The available data and the experts' analyses are verifiable evidence and cannot be fabricated. Thus, if an expert fails to analyze the data effectively, his findings are necessarily uninformative and he cannot produce any assessment of the damage. In contrast, if

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[1] In many judicial settings, feigning ignorance to suppress unfavorable information is indeed a commonly used rhetorical tactic, especially when the cost of perjury is steep. Perhaps an extreme example of such a strategy is the much publicized testimony of former US Attorney General Alberto Gonzales to the Senate Judiciary Committee that subsequently led to his resignation. Facing charges of politicizing his office through wrongful dismissal of several US district attorneys, "Gonzales also repeatedly angered lawmakers by saying that he could not recall key episodes and details related to the US attorneys' dismissals, testifying nearly 70 times at one hearing alone that he could not remember specific events" ("Embattled Gonzales Resigns," by Dan Eggen and Michael A. Fletcher, *Washington Post*, August 28, 2007.)

[2] A similar strategy set for the experts is also assumed by Shavell (1989) in the model of presettlement information sharing between the plaintiff and the defendant. Also see Dziuda (2011) for a model of persuasion where experts may strategically pool across types to obfuscate information revelation.

[3] A similar setting is also considered by Shin (1994).

an expert can successfully analyze the data he has two options: either to reveal his assessment or to withhold it, claiming to have failed to analyze the data. A "better" expert is more likely to be able to analyze the data and reach a definite conclusion about the true extent of the harm caused by the defendant.

In the above scenario, the experts are extreme and opposed in the sense that although one prefers the highest possible action (damages), the other prefers as low an action as possible. Our setting extends to situations where experts may prefer a moderate action. For example, suppose that the government needs to decide on its foreign policy toward a potentially hostile country. The optimal extent of military intervention depends on a complex array of geopolitical issues on which the government lacks the necessary information. The government seeks this information from a panel of defense strategists who may have strong ideological views on the use of armed force—irrespective of the state, a "hawkish" expert may prefer a stronger military action whereas a "dove" may prefer a diplomatic solution. However, it is plausible that a hawkish expert does acknowledge the role for diplomacy in conflict resolution and a "dove" also agrees on the need for occasional use of force. A similar case may arise in the context of policy making on various socioeconomic issues, such as entitlement programs, civil and political rights, gun control, etc. Even though the policy maker may want to design such policies to maximize the well-being of a particular constituency, an expert may not care about the affected constituents per se, and may prefer to align the policy with his own political ideology/moral views (that need not be extreme).

In this setting, when any expert reveals the true state θ, the judge takes the action that matches θ. It turns out that the equilibrium of this game is completely characterized by the "default action" of the judge—the action y^* (say) that the judge takes when all experts fail to report the state. Note that an expert's report matters only when no other expert reveals the state.[4] So, he reports the state if and only if θ is more favorable to him than y^* (in other words, between the default action (y^*) and the true state (θ), the latter is closer to his agenda x_i). Therefore, an (informed) expert's disclosure strategy is represented by a revelation set, that is, the states which he would report truthfully to the judge. In particular, each expert's revelation set is a set of "favorable states" close to his ideal action and the judge's default action y^* is the best response to such disclosure strategies of the experts. This observation leads to a simple characterization of the equilibrium. Also, the equilibrium is robust to whether the experts report simultaneously or in any Prespecified sequence.

In order to explore the implications of our model for the design of expert panels, we confine attention to the case where the state/action space is the unit interval, and there are only two experts, A_0 and A_1, say.[5] The unit interval allows for an unambiguous ordering of the actions and helps capture the extent of conflict between the experts and the quality of decision-making. In this case, the revelation sets of each expert is an interval in the state space with y^* being a boundary point.

An interesting finding of our model is that when experts are moderate, employing a better expert (i.e., an expert who is informed with a higher probability) does not guarantee better decisions—it can lead to *either better or worse* outcomes depending on the underlying parameters. The intuition is as follows. A small change in an expert's quality has two effects: a direct effect where the default action changes, given the experts' revelation sets, and a strategic effect where the revelation sets of the experts change due to the change in the default action. As the judge chooses y^* simply as her best response to the experts' revelation strategy and fails to internalize the impact of her choice on the revelation sets, such a change might leave her worse off. However,

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[4] Several authors (e.g., Wolinsky, 2002; Gerardi, McLean, and Postlewait, 2009) who study the issue of information extraction from experts with divergent agendas from a mechanism design approach also make use of the idea that experts condition their report on the event of being *pivotal*.

[5] Indeed, one-dimensional debates are of special interest. As argued by Spector (2000), multidimensional debates have a tendency to be reduced to single-dimensional ones: when preferences of the debaters are similar but beliefs about the consequences of the various decisions diverge, under certain conditions, public communication either resolves the disagreement between beliefs or the debate becomes one-dimensional at the limit.

when both experts have extreme agendas, the impact of the strategic effect on the decision quality is negligible and the perverse comparative static result does not arise.

As we can vary the divergence of preferences among the experts as a parameter of the model, we can also examine the optimal degree of conflict from the point of view of the judge. If the judge were to choose the configuration of ideal points in the expert panel in order to maximize her ex ante payoff, what would she choose? We make two important points regarding this choice.

First, we show that it is always optimal for the judge to choose extreme (or activist) experts (i.e., $x_i \in \{0, 1\}$) because such experts have the maximum incentive to reveal information. For any given default action, the judge can obtain a larger revelation set by "moving" an expert towards the extreme. This leaves us with the two polar cases—one with extreme and opposed experts (i.e., $x_0 = 0$ and $x_1 = 1$) and the other with extreme but identical experts (i.e., $x_0 = x_1 = 0$ or $x_0 = x_1 = 1$).

A comparison of these two polar cases demonstrates an important trade-off relevant to the design of expert panels. In the case with opposed experts, the equilibrium revelation sets are $[0, y^*]$ for A_0 and $[y^*, 1]$ for A_1. The revelation sets "cover" the state space—conditional on *both* experts having observed the state, it will always be revealed to the judge. On the other hand, in the case with $x_0 = x_1 = 0$, the revelation set for both experts is $[0, y^*]$. In this case, if the state is in $[0, y^*]$, it gets reported if *either* expert observes the state, but states higher than y^* never get revealed. Thus, with similar experts, a high default action offers a strong incentive for information revelation to *both* experts simultaneously (both of them end up with a low payoff in case they fail to reveal the state) even though information is surely lost for a subset of states.

We argue that in the face of this trade-off it may be optimal to use identical but extreme experts.[6] For instance, our result suggests that when deciding on foreign policy, it may be beneficial for the government to employ a panel of antiwar activists and to threaten them with a very hawkish policy unless the activists can present convincing evidence to the contrary, rather than to have a diverse panel with hawks and doves together. This finding is in sharp contrast with the existing literature that by and large supports the use of competing experts.

Related literature. Although we have already mentioned how some of the key assumptions of our model bear resemblance with the frameworks used in the extant literature, in what follows, we relate our work to some of the broad strands of the literature on strategic communication.

In the literature on persuasion games, this article closely relates to Shin (1994), especially for the case of the completely opposed experts. Shin argues that the "burden of proof" should lie more with the expert who is better informed ex ante; that is, the judge's default action (y^*) should favor the expert who has a lower probability of observing the state. However, Shin uses an information structure where the amount of revelation by the experts is independent of the burden of proof. In contrast, we explicitly model the mutual interdependence of experts' and the judge's strategies and highlight how the overall informational content of the debate is affected by the information that each expert has.[7]

The cheap talk literature has also focused on the question of information revelation in the presence of multiple senders of information. Gilligan and Krehbiel (1989) and Austen-Smith (1990, 1993) are some early models analyzing informational properties of "debates" between multiple experts with divergent interests in a cheap talk setting. Among the more recent contributions, Krishna and Morgan (2001) explores the value of competition (i.e., experts with conflicting biases) in improving communication in the unidimensional state/action space. In related work, Battaglini (2002) shows that if the state/action space is multidimensional and unbounded, then there is an equilibrium where the state is always revealed. Whereas the cheap talk

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[6] We later show that in some of the commonly studied environments (e.g., uniform distribution and quadratic loss), the judge's expected payoff is always maximized when experts have identical but extreme agendas.

[7] In recent work, Gentzkow and Kamenica (2011) also explore the role of competition in persuasion games and find that an increase in competition (weakly) increases the amount of information revelation. However, they consider a signal structure that is considerably different from ours where the senders can choose the coarseness of the signal and the senders' reports may be arbitrarily correlated.

literature usually assumes that the experts always know the state, we are interested in a situation where there is uncertainty about what an expert knows.[8] In our model, too, when the experts have completely opposed agendas, information is fully revealed to the judge in the event that both experts know the state. This result is similar to the full revelation result with opposed biases in Krishna and Morgan (2001). However, we point out that the uncertainty about the experts' information opens up new channels of strategic manipulation that the judge has to contend with. Moreover, competition may *limit* the ability of the judge to simultaneously induce all experts to reveal information, and under certain circumstances, the judge may be better off by employing experts with extreme but completely identical preferences.

The above finding is in sharp contrast with an influential article by Dewatripont and Tirole (1999) who argue in favor of using competing experts to address the moral hazard problem involved in costly information acquisition. In the same vein, Shin (1998) shows that even if the judge is as well informed as the experts, on an average it is better to employ completely opposed experts than the judge undertaking his own investigation. Also, in a model where experts engage in costly information acquisition, Gerardi and Yariv (2008) shows that if experts can report in sequence, the optimal mechanism involves using opposing experts.

Finally, there is also a line of work where the judge is assumed to be able to commit to a mechanism to elicit the truth from multiple experts by exploiting the divergence of interests. This literature includes, among others, Wolinsky (2002) and Gerardi, McLean, and Postlewait (2009) that have been mentioned before.[9] Although the mechanism design literature emphasizes how the differences in the experts' preferences may be exploited for eliciting the truth, we show that the judge might optimally want to have experts with similar preferences, even if she could commit to an optimal default action.

The rest of this article is organized as follows. The next section presents the model. In Section 3, we first provide a general characterization of the equilibrium, and then examine the special case of unidimensional state/action space in more detail. Section 4 analyzes how the quality of the experts affects the quality of the decision-making and how this linkage is affected by the diversity of the experts' agendas. Section 5 addresses the question of optimal panel design and some extensions of the model are considered in Section 6. A final section concludes.

2. Model

■ We consider a persuasion game between n experts, $A_0, \ldots, A_{n-1}$, and a judge. The judge needs to choose an action $\mathbf{y} \in Y$ that is most appropriate given the underlying state of the nature $\theta \in \Theta$. We assume that $Y = \Theta$, and it is a compact and convex subset of $\mathbb{R}^k$. The payoff of the judge from taking action y in state θ is $u_J(\mathbf{y}; \theta)$, where u_J is continuous and twice differentiable in both its arguments. Moreover, given θ, $u_J(\mathbf{y}; \theta)$ is strictly concave in $\mathbf{y}$ and is maximized at $\mathbf{y} = \theta$. We normalize the maximal payoff $u_J(\theta; \theta)$ to 0. Effectively then, we assume that the judge wants her action to be as close to the state as possible and interpret u_J as the loss (negative payoff) from taking an action different from the state. An expert A_i, on the other hand, prefers the judge's action to be as close to his ideal action $\mathbf{x}_i \in Y$ as possible, independent of the realized state. The payoff of expert A_i from action $\mathbf{y}$ is given by $u_i(\mathbf{y}; \mathbf{x}_i) = v_i(\|\mathbf{y} - \mathbf{x}_i\|)$ for some strictly decreasing function v_i. Thus, the payoff of expert A_i is assumed to be symmetric and single-peaked around $\mathbf{x}_i$. We refer to the parameter $\mathbf{x}_i$ as the agenda of expert A_i.

The judge cannot observe θ directly but has a (commonly known) prior belief on θ that is given by the probability distribution function $F(\theta)$. We also assume that the density $f(q)$ is continuous and bounded above and below; i.e., there exists some $k > 0$ such that $k < f(q) < 1/k$

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[8] The cheap talk literature also typically assumes that the experts' ideal actions are state -dependent. A notable exception is Chakraborty and Harbaugh (2010) who consider experts with state-independent ideal actions.

[9] A related set of articles relaxes the extent of verifiability of messages and examines the conditions for revelation of truth given the diversity of the experts' preferences (see, e.g., Lipman and Seppi, 1995; Bull and Watson, 2004; Deneckere and Severinov, 2008; Ben-Porath and Lipman, 2012; and Kartik and Tercieux, 2002).

for all q Î Q. Θ. Before choosing her action, the judge receives a report, m_i, from each of the n experts who may or may not have observed the realized value of θ. Expert A_i's type, t_i, can either be "informed" ($t_i = 1$) or "uninformed" ($t_i = 0$), where $\Pr(t_i = 1) = \alpha_i \in [0, 1)$. An informed expert observes the state whereas an uninformed expert does not. As α_i represents expert A_i's prior likelihood of being informed, we can interpret α_i as a measure of the "quality" of the expert. We assume that any report about the state is verifiable. So, upon observing the state θ, an informed expert is left with the choice of whether to disclose the state (i.e., $m_i = \theta$) or conceal it (i.e., $m_i = \emptyset$, say).[10] On the other hand, an uninformed expert is forced to report $m_i = \emptyset$. The reporting is assumed to be costless to the expert and it affects his payoff only through its impact on the judge's action.

The (pure) strategy of an informed expert A_i is $m_i(\theta) \in \{\theta, \emptyset\}$ for all $\theta \in \Theta$ and that of an uninformed expert is $m_i = \emptyset$ (by assumption).[11] Denote a profile of reports from all experts $\{m_0, m_1, \ldots, m_{n-1}\}$ by $\mathbf{m}$. For any state θ, denote by $m_{-i}(\theta)$ the profile of reports of all experts except A_i. Finally, let $\mathbf{y} = y(\mathbf{m})$ be the action taken by the judge upon receiving the report profile $\mathbf{m}$.

We use *perfect* Bayesian equilibrium (PBE) as the solution concept. Let $\mu(\theta \mid \mathbf{m})$ be the posterior belief of the judge upon receiving the experts' reports $\mathbf{m}$. A strategy profile $\langle \mathbf{m}^*, y^*(\mathbf{m}) \rangle$ along with a belief μ^* constitutes a PBE of this game if the following holds:

(i) For all i, if A_i is informed, then for all $\theta \in \Theta$, $m_i(\theta) = \theta$ if and only if,

$$\mathbb{E}u_i\left(y^*(\theta, m^*_{-i}(\theta)); \mathbf{x}_i\right) \geq \mathbb{E}u_i\left(y^*(\emptyset, m^*_{-i}(\theta)); \mathbf{x}_i\right),$$

where the expectation is taken over the types of all other experts. If A_i is uninformed, $m_i = \emptyset$.

(ii) The judge's action

$$y^*(\mathbf{m}) = \arg\max_{\mathbf{y} \in \Theta} \int_{\Theta} u_J(\mathbf{y}; \theta) \, d\mu^*(\theta \mid \mathbf{m})$$

for all $\mathbf{m}$.

(iii) The posterior belief of the judge $\mu^*(\theta \mid \mathbf{m})$ is obtained by using Bayes rule given the prior belief $F(\theta)$ and the strategy profile of the experts, $\mathbf{m}^*$. Also, if an expert takes an out-of-equilibrium action that reveals the state θ, the off-equilibrium belief is only allowed to put weight on θ.

We conclude this section with the following two remarks on our modelling specifications. First, note that our definition of the PBE imposes an off-the-equilibrium path belief restriction that is not a part of the canonical definition. In the canonical definition, the agents' action sets are independent of their types—an assumption that is violated in our setting. Hence, we need to impose the aforementioned restriction in order to be consistent with our modelling assumption of verifiable reporting.

Second, although we have assumed that the experts' preferences are independent of the state, this assumption is not essential for our results. We maintain this assumption as it considerably improves the analytical tractability of our model, and in Section 6 we discuss the robustness of our findings in a scenario where the experts directly care about the state. It is, however, important to note that state-independent preference for the experts is a common assumption in the persuasion game literature (see, e.g., Milgrom, 1981; Fishman and Hagerty, 1990; Shin, 1994, 1998; Glazer

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[10] Our model is robust to a more general specification of the expert's action space where one can report any subset of the state space as long as it contains the true state; (e.g., Milgrom and Roberts, 1986; Shin, 1994). See Section 3 and Appendix B for details.

[11] Our focus on the pure strategy equilibria is without loss of generality. This is due to the fact that u_J is concave and F is atom-less.

and Rubinstein, 2001, 2004, 2006).[12] Finally, as discussed in the Introduction, one may also argue that this assumption is realistic in many persuasion game contexts, such as litigation, expert panels on public policy, etc., where the experts need not care about the "truth" per se, and attempt to manipulate the decision-maker's action toward their own agendas.

3. Equilibrium characterization

■ As we have mentioned in the Introduction, an equilibrium in this game is completely characterized by the "default" action of the judge, that is, the action that the judge would take if all experts fail to reveal the state. In what follows, we first present a general characterization of the equilibrium for a compact and convex, but otherwise arbitrary, state space. We then focus on a special case of unidimensional state space that is of particular relevance for our subsequent analysis.

□ **General characterization.** In order to characterize the equilibrium, first consider the judge's strategy. The best-response of the judge upon receiving the report profile ($\mathbf{m}$) is:

$$y^*(\mathbf{m}) = \begin{cases} \theta & \text{if } m_i(\theta) = \theta \text{ for some } i \\ \mathbf{y} & \text{otherwise} \end{cases} \qquad (1)$$

$$\text{where } \mathbf{y} = \arg\max_{\mathbf{y}' \in \Theta} \int u_J(\mathbf{y}'; \theta) \, d\mu(\theta \mid \mathbf{m} = \emptyset).$$

In other words, if at least one expert reveals the state, the judge trivially takes the action that exactly matches the state. However, when all experts fail to reveal the state, then the judge takes a "default" action $\mathbf{y}$ that maximizes her expected payoff taking into account the experts' reporting strategies.

An informed expert A_i's strategy is characterized by his "revelation set" Θ_i, that is, the set of states over which he reports truthfully. Suppose A_i observes that the state is θ. If he (or any other expert) reveals the state, an action θ will be induced. In contrast, if he conceals the state and no other expert reports, the judge takes the default action ($\mathbf{y}$). Thus, A_i decides to report or not conditioning on the event that he is *pivotal* in determining whether the judge will take the action θ or $\mathbf{y}$. Now, given any state θ, A_i reveals θ if and only if $u_i(\theta; x_i) \geq u_i(\mathbf{y}; x_i)$. As u_i is single-peaked and symmetric around x_i, $u_i(\theta; x_i) \geq u_i(\mathbf{y}; x_i)$ if and only if $\|\theta - \mathbf{x}_i\| \leq \|\mathbf{y} - \mathbf{x}_i\|$. Therefore, A_i reveals the state if and only if A_i's agenda ($\mathbf{x}_i$) is closer to the observed state (θ) than the agenda is to the judge's default action ($\mathbf{y}$). Hence, given the default action $\mathbf{y}$, the "revelation set" for expert A_i is $\Theta_i = \{\theta \in \Theta \mid \|\theta - \mathbf{x}_i\| \leq \|\mathbf{y} - \mathbf{x}_i\|\}$.

The above discussion is summarized in the following proposition that characterizes the equilibrium of the game.

Proposition 1. There always exists a PBE of this game. Moreover, in any PBE of this game an informed expert's strategy is:

$$m_i^*(\theta) = \begin{cases} \theta & \text{if } \theta \in \Theta_i^* = \{\theta \in \Theta \mid \|\theta - \mathbf{x}_i\| \leq \|\mathbf{y}^* - \mathbf{x}_i\|\} \\ \emptyset & \text{otherwise} \end{cases}$$

and the judge's strategy is:

$$y^*(\mathbf{m}) = \begin{cases} \theta & \text{if } m_i(\theta) = \theta \text{ for some } i \\ \mathbf{y}^* & \text{otherwise} \end{cases},$$

where

$$\mathbf{y}^* = \arg\max_{\mathbf{y}' \in \Theta} \int u_J\left(\mathbf{y}'; \theta\right) dF\left(\theta \mid \mathbf{m} = \emptyset\right).$$

In this context, several issues are worth noting. First, the above characterization result tells us that in equilibrium, an (informed) expert A_i's revelation set Θ_i^* is a sphere in $\mathbb{R}^k$ centered around the expert's agenda $\mathbf{x}_i$ (or, more precisely, Θ_i^* is the intersection of Θ and a sphere centered at $\mathbf{x}_i$). Also, in equilibrium, all revelation sets must share a common boundary point $\mathbf{y}^*$, which is the equilibrium default action of the judge.

Second, the equilibrium characterization does not change even if the experts send their messages sequentially. If the experts are asked to speak in some prespecified order, or some subset (possibly all) of them are asked to speak simultaneously, the sequence of reports does not make a difference as each expert's decision is conditioned on the event that he is pivotal. It is also easy to see that the outcome will be the same even if some experts knew the reports of some of the other experts before they spoke. The fact that all informed experts have the same information is important for this feature of our model.[13] This finding is similar in spirit with Dekel and Piccione (2000) who show, in the context of a voting game, that the symmetric equilibria of the simultaneous voting game are also equilibria in any sequential voting structure.

Finally, such an equilibrium characterization continues to hold if one consider a more general strategy space for the experts á la Milgrom and Roberts (1986) where an informed expert reports a subset of states, say S_i, that contains the true state (see, e.g., Milgrom and Roberts, 1986). Under the expanded strategy space, the above equilibrium is supported by an off-the-equilibrium belief that is similar in spirit with the "skeptical posture" discussed by Milgrom and Roberts (1986)—if no expert reports the state and some expert A_i deviates and reports a strict subset S_i of the state space, then the judge believes that the true state is the one in S_i that is least favorable to A_i. See Appendix B for a complete analysis of this case.

☐ **Unidimensional state space.** Given the general characterization of the equilibrium, we now focus our attention to the canonical setting of two experts and a unidimensional state space, $\Theta = [0, 1]$. Such a state/action space has the feature that the preference ordering over the actions for one expert *may* be the complete opposite of the ordering for his rival expert. As we are primarily interested in exploring the link between the extent of conflict between the experts and the quality of decision-making, the case of unidimensional state space is particularly relevant and we will confine our attention to such an environment in the rest of this article.

The specificity of this setting also allows us to analyze the equilibrium characteristic in further detail. In particular, we can highlight how the nature of the debate is influenced by the diversity of the experts' agendas. We first present a corollary to Proposition 1 that characterizes the equilibrium in this environment.

Corollary 1. Suppose that $\theta \in [0, 1]$ and $n = 2$. In equilibrium A_i $(i = 0, 1)$ reveals the truth if and only if $\theta \in \Theta_i^* = [0, 1] \cap [x_i - |y^* - x_i|, \ x_i + |y^* - x_i|]$ where y^* is given by the equation

$$\int \frac{\partial}{\partial y} u_J\left(y^*; \theta\right) dF\left(\theta \mid m_0 = m_1 = \emptyset; m_0(\theta), m_1(\theta)\right) = 0. \tag{2}$$

Moreover, y^* always lies in $(0, 1)$.

Corollary 1 indicates that the experts' equilibrium revelation sets, Θ_i^*, are intervals in $\mathbb{R}$ that share the judge's default action y^* as a common boundary point. Using this simple

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[13] Ottaviani and Sorensen (2001) show that in presence of reputational concerns, the sequencing of experts does matter. In our case, the experts are concerned not with their reputation but only with the final action, and in this setting, the sequence is immaterial.

characterization we can now explore the link between the diversity of agendas and the nature of the persuasion.

To begin with, consider the case where the experts have "extreme" agendas; that is, x_i is either 0 or 1. Note that this setting includes both the canonical model of completely opposed experts where $x_0 = 0$ and $x_1 = 1$, and the case of the "extreme but identical" experts where $x_i = 0$ or 1 for all $i = 0, 1$.

Proposition 2. When the experts have extreme agendas, there exists a unique equilibrium of the game characterized as follows: (i) If $x_0 = 0$ and $x_1 = 1$, then $\Theta_0^* = [0, y_{01}^*]$ and $\Theta_1^* = [y_{01}^*, 1]$, (ii) if $x_0 = x_1 = 0$, then $\Theta_0^* = \Theta_1^* = [0, y_{00}^*]$, and (iii) if $x_0 = x_1 = 1$, then $\Theta_0^* = \Theta_1^* = [y_{11}^*, 1]$, where y_{01}^*, y_{00}^*, and y_{11}^*, all lying in $(0, 1)$, denote the default action of the judge in the respective cases (as derived from equation (2)).

The key features of this equilibrium are intuitive. First, consider the case of completely opposed experts ($x_0 = 0$ and $x_1 = 1$). In equilibrium, the state space is partitioned into two revelation sets, each set containing states deemed favorable by one expert but unfavorable by the other. In this sense, we say that the equilibrium reflects "conflict" between the experts. States less than y_{01}^* are revealed by A_0 and concealed by A_1 and the opposite holds for the states greater than y_{01}^*.[14] Also note that if both experts are informed, then the true state is necessarily revealed in equilibrium.

In contrast, when the experts' agendas are identical (i.e., $x_i = 0$ or 1 for all $i = 0, 1$), so are their revelation sets. As in the case of conflict, the state space is partitioned into two subsets. The judge never learns the state if it is outside the experts' (common) revelation set but if the state lies in the revelation set, the judge learns it if *at least one* of the two experts are informed. In this case, we say that the equilibrium reflects "congruence" between the experts—both experts agree on the set of states that they prefer to reveal.

Now, consider a more general environment where the experts may be moderate in the sense that $0 < x_0 \leq x_1 < 1$. It turns out that while the equilibrium is unique with extreme experts, with moderate experts, the game may have multiple equilibria. As we let the experts' agendas vary, much like the extreme expert case we can have two classes of equilibria: one with conflict where the revelation sets are disjoint (but always adjacent) and another with (partial) congruence where one expert's revelation set is a weak subset of the other's. However, with the same primitives, some equilibria may exhibit conflict (i.e., $x_0 < y^* < x_1$) and some may exhibit partial congruence (i.e., $y^* < x_0 \leq x_1$ or $x_0 \leq x_1 < y^*$). The following example illustrates this point.

Example 1. Assume that θ is distributed uniformly on $[0, 1]$ and $u_J(y; \theta) = -(y - \theta)^2$. Let $x_0 = 0.45$, $x_1 = 0.65$. Suppose that both experts are of the same quality, and $\alpha_0 = \alpha_1 = 0.5$. In this case, there are three equilibria and both conflict and (partial) congruence in revelation sets can emerge in equilibrium. In the conflict equilibrium, $y^* = 0.4667$, $\Theta_0^* = [0.4333, 0.4667]$ and $\Theta_1^* = [0.4667, 0.8333]$. There are two other partially congruent equilibria (in both cases, $y^* < x_0 < x_1$): (i) $y^* = 0.2403$, $\Theta_1^* = [0.2403, 0.4597]$, and $\Theta_2^* = [0.2403, 0.9797]$; (ii) $y^* = 0.1826$, $\Theta_1^* = [0.1826, 0.5174]$, and $\Theta_2^* = [0.1826, 1]$.

The above example also highlights the fact that the degree of opposition between the experts' agendas need not indicate whether the experts' interests in equilibrium are in conflict or in (partial) congruence. For the same underlying parameters there can be multiple equilibria depending on the coordination between the players.

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[14] This observation is in contrast with the so-called unraveling argument (see Milgrom, 1981; Milgrom and Roberts, 1986) that suggests that nondisclosure of information is never useful in equilibrium as they signal an unfavorable state for the sender with certainty. However, in our framework, such messages are useful as the judge cannot tell whether the expert is indeed informed or not (a similar argument is also presented in Shin, 1998).

At this stage, we introduce an important distinction between equilibria that will prove to be useful in the next section when discussing the comparative static properties. Consider a small change in x_i, the agenda of expert A_i. If the equilibrium revelation sets are already $[0, y^*]$ or $[y^*, 1]$ (as always the case with extreme experts), such a change in an expert's agenda will not change the equilibrium outcome. On the other hand, if the experts are moderate, it may be the case that even a small change in expert agendas may alter equilibrium outcomes, depending on the particular equilibrium being played. For example, while every equilibrium in example 1 is sensitive to a change in x_0, the outcome of the partially congruent equilibrium with $y^* = 0.1826$ is not sensitive to a small change in x_1. The following definition distinguishes equilibria that are sensitive to local changes in expert agendas from those that are not.

Definition 1. Consider an equilibrium of the persuasion game where the judge's default action is y^*. The equilibrium is said to be "locally insensitive" to the experts' agendas if for each expert A_i, either $x_i < y^*/2$ or $x_i > (1 + y^*)/2$, $i = 0, 1$.

It is easy to see that if both experts have extreme agendas, the unique equilibrium is locally insensitive to experts' agendas. This feature leads to special comparative static properties that hold true when the agendas are extreme, but are not guaranteed when they are moderate.

4. Diversity of agendas and the value of information

■   We now focus on relationship between the quality of experts (as measured by α_i, the ex ante likelihood of the expert being informed) and the quality of decision-making (as measured by the ex ante equilibrium payoff of the judge). The model suggests that the effect of expert quality on the quality of decisions depends crucially on whether the experts have extreme or moderate agendas.

Consider how a marginal change in α_0, (i.e., the quality of A_0) will affect the equilibrium payoff of the judge. First, it will lead to a positive direct effect: given A_0's revelation set Θ_0^*, an increase in A_0's likelihood of observing the true state reduces the judge's loss when the state is in Θ_0^*. However, there is also a strategic effect: a change in α_0 will lead the equilibrium default action to shift and this will lead both experts to adjust their revelation sets accordingly. Each expert will reveal some states not being revealed earlier and conceal some states that were being disclosed before, and the aggregate impact on the judge's payoff cannot be signed *a priori*. Thus the sign of the strategic effect is ambiguous and if this effect is strong and negative, we may end up with a situation where an improvement in expert quality makes the judge worse off ex ante.

However, note that if the particular equilibrium is locally insensitive (i.e., the revelation sets are either $[0, y^*]$ or $[y^*, 1]$), then a small change in y^* will change the revelation sets only close to y^*. Given our assumption that $u'_J(y^*, \theta) = 0$ at $\theta = y^*$, a change in the revelation strategy over states very close to y^* has no first order effect. Therefore, if the equilibrium is locally insensitive to the expert's agendas, the strategic effect vanishes and an increase in expert quality is guaranteed to improve the judge's payoff.

Now, recall that if both experts have extreme agendas, the unique equilibrium is locally insensitive. So, our discussion above implies that with extreme agendas, an increase in the quality of either expert is always beneficial for the judge but when at least one expert is moderate, higher expert quality does not necessarily mean larger ex ante payoff for the judge. The following proposition and its corollary formalize this point.

Proposition 3. Consider the persuasion game with $0 \leq x_0 \leq x_1 \leq 1$. The judge's ex ante equilibrium payoff, $\mathbb{E}_\theta [u_J (y^*; \theta) \mid \mathbf{m}^*]$, is increasing in an expert's quality α_i if the equilibrium is locally insensitive to the expert agendas. Otherwise, the sign of $\frac{\partial}{\partial \alpha_i} \mathbb{E}_\theta [u_J (y^*; \theta) \mid \mathbf{m}^*]$ is ambiguous. Moreover, there exist parameters for which the judge's ex ante equilibrium payoff decreases in an expert's quality.

Corollary 2. When the experts have extreme agendas (i.e., $x_i \in \{0, 1\}$ for $i = 0, 1$), the judge's ex ante equilibrium payoff is increasing in an expert's quality; i.e., $\frac{\partial}{\partial \alpha_i} \mathbb{E}_\theta [u_J(y^*; \theta) \mid \mathbf{m}^*] > 0$.

To see the intuition behind the proposition, consider a conflict equilibrium.[15] Suppose that the judge's default action is $y^* \in (x_0, x_1)$ and the revelation sets are $\Theta_0^* = [l_0, y^*]$ and $\Theta_1^* = [y^*, h_1]$, where $l_0 = \max\{2x_0 - y^*, 0\}$ and $h_1 = \min\{2x_1 - y^*, 1\}$. Suppose that α_0 increases. Using equation (2), one obtains

$$\frac{\partial}{\partial \alpha_0} \mathbb{E}[u_J(y^*; \theta) \mid \mathbf{m}^*] = \left[\alpha_0 u_J(y^*; l_0) f(l_0) \frac{\partial l_0}{\partial \alpha_0} - \alpha_1 u_J(y^*; h_1) f(h_1) \frac{\partial h_1}{\partial \alpha_0} \right] \\ - \int_{l_0}^{y^*} u_J(y^*; \theta) \, dF. \tag{3}$$

The term $-\int_{l_0}^{y^*} u_J(y^*; \theta) \, dF > 0$ is the direct effect, and the expression in square brackets is the strategic effect. In general, the strategic effect cannot be signed. However, if the equilibrium is locally insensitive, that is, if $l_0 = 0$ and $h_1 = 1$, then the strategic effect reduces to zero, and the overall effect is equal to the positive direct effect.

In the environment of example 1, we show that an increase in expert quality may indeed make the judge worse off.[16]

Example 2. Consider the conflict equilibrium presented earlier in example 1 where $y^* = 0.4667$, $\Theta_0^* = [0.4333, 0.4667]$, and $\Theta_1^* = [0.4667, 0.8333]$. The associated payoff to the judge is -0.07622. Now suppose that the quality of A_0 improves from $\alpha_0 = 0.5$ to $\alpha_0 = 0.75$. The unique conflict equilibrium is $y^* = 0.4669$, $\Theta_0^* = [0.4331, 0.4669]$, and $\Theta_1^* = [0.4669, 0.8331]$. The corresponding payoff of the judge reduces to -0.07624.

The following remarks are in order. First, note that an increase in α_i can be reinterpreted as the arrival of an additional expert who shares the same agenda with expert A_i. One interpretation of Proposition 3 is the following: when experts have extreme agendas, bringing in additional experts always benefits the judge. However when at least one expert has moderate agenda, the marginal value of an additional expert may be negative.

Another important observation in the context of Proposition 3 is that in the extreme expert case, an increase in the quality of an expert induces the default action to move away from the expert's agenda and expand the expert's revelation set (see the proof of Proposition 3). This implies that when the experts are opposed, an improvement in an expert's quality leads the default action to be more favorable to the other expert.[17] This result is similar in spirit with the findings in Shin (1994) who argues that the burden of proof should lie with the more informed expert, that is, the default action favors the less informed expert. It is also reminiscent of Che and Kartik (2009) who derive a similar result in a single expert model.

Finally, it is worth mentioning that if the judge could commit to a default action, then she could internalize the experts' response to changes in her own action. One can argue that in this case, an increase in expert quality would always make the judge better off.[18] Therefore, we can attribute the "perverse" comparative static result in Proposition 3 to the lack of commitment power of the judge.

Also recall that if the experts have extreme agendas, then, too, the strategic effect is of the second order. Because of this fact, when the agendas are extreme, the outcome (and hence the

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[15] A similar argument applies for the case of partially congruent equilibrium.

[16] Although example 2 presents the "perverse" comparative static for a conflict equilibrium, see Section 6 for an example where the comparative static arises for an equilibrium with congruence.

[17] Formally, if $x_0 = 0$ and $x_1 = 1$, then $\partial y^*/\partial \alpha_0 > 0$ and $\partial y^*/\partial \alpha_1 < 0$. We skip the proof as its derivation is straightforward.

[18] When the judge commits to y^*, routine application of the envelope theorem implies that the strategic effect in equation (3) is zero.

payoff to the respective players) is the same irrespective of whether the judge can commit to a default action or not. As this fact proves to be very useful for studying the issue of optimal panel design in the next section, we summarize it below as a formal proposition.

Proposition 4. If both experts have extreme agendas (i.e., $x_i \in \{0, 1\}$ for $i = 0, 1$) then the judge's ability to commit to a default action does not affect the equilibrium outcome: the equilibrium default action and the associated expected payoff of the judge remains the same as in the case where she does not have such commitment power.

5. Optimal panel design

■   As discussed in the Introduction, in many real-world environments the decision-maker has discretion over the selection of the members in the expert panel. What type of panel is most conducive to information revelation? That is, if the judge can select (or "commission") two experts from a continuum of experts with their ideal points distributed over state space $[0, 1]$, what should she choose to maximize her ex ante payoff?

Our first result is that, when forming the optimal panel, without loss of generality the judge can restrict attention to the panels with extreme experts. This result crucially depends on the insight offered by Proposition 4.

Proposition 5. If the judge could select the agenda profile $\{x_0, x_1\}$ of the experts (given the other parameters) then irrespective of whether the judge can commit to a default action or not, one of the following agenda profiles is always optimal: $\{0, 1\}$, $\{0, 0\}$, and $\{1, 1\}$.

The proof proceeds by showing that in the class of conflict equilibria ($x_0 < y^* < x_1$), the highest payoff is obtained in the case with extreme and opposed experts ($x_0 = 0$ and $x_1 = 1$); in the class of (partially) congruent equilibria with $x_0 \leq x_1 < y^*$, the highest payoff is obtained in the case with extreme and identical experts ($x_0 = x_1 = 0$); and in the class of (partially) congruent equilibria with $y^* < x_0 \leq x_1$, the highest payoff is obtained in the case with extreme and identical experts ($x_0 = x_1 = 0$). We demonstrate the intuition for the case with conflict equilibria.

Consider a conflict equilibrium with agenda profile $\{x_0, x_1\}$ and default action y^*. It is straightforward to note that if the judge could commit to a default action, replacing the agenda profile $\{x_0, x_1\}$ by $\{0, 1\}$ would make her better off.[19] However, according to Proposition 4, when the agenda profile is $\{0, 1\}$, commitment power has no value to the judge—without any commitment power she earns the same payoff that she would get if she could commit to her default action. Thus, even when the judge has no commitment power, her payoff increases when she chooses the agenda profile $\{0, 1\}$ over $\{x_0, x_1\}$.

Now, observe that Proposition 5 indicates a possibility that a panel of completely opposed experts *may* be dominated by a panel of identical but extreme experts. When the experts stand at opposite extremes, an expansion of A_0's revelation set (i.e., $\Theta_0^* = [0, y^*]$) necessarily dampens A_1's incentives for disclosure (i.e., $\Theta_1^* = [y^*, 1]$ shrinks). Such a countervailing effect disappears when both experts stand at the same extreme, say at 0. In this case, a default action sufficiently away from 0 gives both experts strong incentives to reveal the state (if they are indeed informed) but the judge is guaranteed to lose information if the state is in $[y^*, 1]$. In contrast, with opposed experts, all states are necessarily revealed when both experts are informed.

Thus, the judge faces the following trade-off: a panel with identical (extreme) experts increases the likelihood of learning the states in $[0, y^*]$ but information is necessarily lost if the state is in $[y^*, 1]$. The judge would prefer identical experts if the gain from additional information on low states (i.e., when $\theta \leq y^*$) outweighs the loss from the absence of information on high

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[19] The argument is as follows: even when the judge can commit to her action, the default action y^* remains a feasible choice, and under this choice, the revelation sets (weakly) expand from $[\max\{2x_0 - y^*, 0\}, y^*]$ to $[0, y^*]$ for A_0 and from $[y^*, \min\{2x_1 - y^*, 1\}]$ to $[y^*, 1]$ for A_1.

states (i.e., when $\theta > y^*$). Which one of these two effects dominates depends on the judge's loss function and the underlying distribution of the states. Interestingly, as the following proposition suggests, a panel with identical and extreme experts is indeed optimal in some of the most commonly studied environments in the strategic communication literature.

Proposition 6. Suppose that θ is uniformly distributed over $[0, 1]$ and the judge's payoff is $u_J(y, \theta) = -(y - \theta)^2$. Then for all values of α_0 and α_1, it is optimal to form a panel with identical extreme experts.

We conclude this section with the following remarks. First, the optimality of choosing identical experts runs contrary to the received wisdom that experts with opposing agendas facilitate information revelation as their competing interests mitigate each other's attempt to conceal unfavorable information.[20] A similar intuition is also suggested in the mechanism design literature (Wolinsky, 2002; Gerardi, McLean, and Postlewait, 2009) that emphasizes how the differences in the experts' preferences may be exploited to elicit the truth.

Second, our finding is also in contrast with the some of the existing models of persuasion games such as Dewatripont and Tirole (1999) that argue for the optimality of advocacy of opposed viewpoints. Dewatripont and Tirole consider a different information structure where each expert can only look for an evidence that is favorable to his agenda and an expert needs to (privately) exert effort to find the evidence. Consequently, the judge faces a moral hazard problem that can be resolved through the competition between the opposing expert. The moral hazard problem is absent in our environment as the observation on the state is assumed to be costless for an informed expert.[21]

Finally, an alternative interpretation of this finding is that a single expert with extreme preferences (i.e., an "activist," say), if sufficiently able, may be better for the judge than any panel with two experts. Thus, our finding offers a novel justification for decision-making based on the information provided by a single expert, rather than through competitive advocacy.

6. Discussion

■ In this section, we further elaborate on the issue of equilibrium characterization by considering specific functional forms. We also highlight a few extensions of our model to explore the robustness of our key findings in environments where the expert may care about the true state of the world.

□ **Equilibrium characterization with parametric restrictions.** Our discussion so far suggests that the set of equilibria is highly dependent on the particular parameters under consideration. For a given set of parameters, would all equilibria exhibit similar comparative static properties? Also, can the equilibria be Pareto ranked? To address these issues we characterize the complete set of equilibria in the canonical environment where the judge's loss function is quadratic and the prior distribution of the state is uniform. Moreover, we focus on the case where the experts have

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[20] This argument is also common in public debates. For example, the current governor of Florida, Rick Scott, was criticized for his choice of an "unbalanced panel" of experts for reviewing the controversial "Stand Your Ground" law on the use of firearms in self-defense, as several panelists were known to support the existing version of the law (see "Stand Your Ground task force to hold public hearings," by Toluse Olorunnipa, *Miami Herald*, May 1, 2012). Our finding suggests that an "unbalanced" panel may indeed lead to better decision-making.

[21] Note that by the virtue of the continuity of the payoff functions, even if we assume that information acquisition is costly for the experts, it would still be the case that the judge has higher payoff from congruent experts as compared to competing experts as long as the cost of information acquisition is sufficiently small.

identical agendas: $x_0 = x_1 = x \in (0, 1)$.[22] We show that the answer to both of the above questions is negative.

Note that without loss of generality, we can restrict attention to the case where $x \leq 1/2$. Proposition 7 describes the set of equilibria and their comparative statics properties. In the proposition, we use the following notation for the sake of brevity: let $\alpha = 1 - (1 - \alpha_0)(1 - \alpha_1)$. Denote by $\mathcal{P}$ the set of parameters (x, α) where $\alpha \geq 3/4$ and $x \in [1/2 - 1/8\alpha, \; y_{00}^*/2]$. As before, y_{00}^* denotes the equilibrium default action when $x_0 = x_1 = 0$ and is given by $y_{00}^* = 1/(1 + \sqrt{1 - \alpha})$.

Proposition 7. Suppose that $u_J(y; \theta) = -(y - \theta)^2$ and F is uniform. Moreover, consider the case where $x_0 = x_1 = x \; (\leq 1/2)$. The set of equilibria of the persuasion game is as follows.

(i) If $x \in [y_{00}^*/2, \; 1/2]$, then there exists a unique equilibrium of the game where $y^* = x + t_-$ and both experts' revelation set is $[x - t_-, y^*]$ where $t_- = \frac{1}{4\alpha}(1 - \sqrt{1 - 8\alpha(1/2 - x)})$.

(ii) If $x \in [0, \; y_{00}^*/2)$, then there always exists an equilibrium where $y^* = y_{00}^*$ and both experts' revelation set is $[0, y_{00}^*]$. Moreover, this equilibrium is also unique when $(x, \alpha) \notin \mathcal{P}$. If $(x, \alpha) \in \mathcal{P}$, then there exists another equilibrium where $y^* = x + t_+$ and both experts' revelation set is $[x - t_+, y^*]$ where $t_+ = \frac{1}{4\alpha}(1 + \sqrt{1 - 8\alpha(1/2 - x)})$.

Finally, in the equilibrium where $y^* = x + t_+$, the judge's ex ante payoff (i.e., $\mathbb{E}[u_J(y^*; \theta) \mid \mathbf{m}^*]$) decreases in the experts' quality α_i. In all other equilibria, $\mathbb{E}[u_J(y^*; \theta) \mid \mathbf{m}^*]$ is increasing in α_i ($i = 0, 1$).

Proposition 7 implies that for the same set of parameters, the comparative statics properties of different equilibria might be different. Consider the two equilibria for any $(x, \alpha) \in \mathcal{P}$ and recall that one is locally insensitive (with revelation sets $[0, y_{00}^*]$) whereas the other is not (with revelation sets $[x - t_+, y^*]$). We know from Proposition 3 that in the locally insensitive equilibrium an increase in expert quality always increases the judge's ex ante payoff. However, Proposition 7 indicates that in the locally *sensitive* equilibrium the judge's payoff *decreases* in the quality of either expert.

It is also instructive to note that the equilibria cannot be Pareto ranked. For any $(x, \alpha) \in \mathcal{P}$, the judge and the experts have exactly opposite (and strict) preference over the two equilibria: both experts prefer the equilibrium with a smaller revelation set—which, in this case, is the locally sensitive one—whereas the judge gets a larger payoff in the locally insensitive equilibrium.

Finally, as an increase in α can be conceived as the judge recruiting another expert who has the same agenda (x), the proposition above lays out a scenario arising in a canonical environment where the judge may be better off with fewer experts; the sufficient condition being $(x, \alpha) \in \mathcal{P}$ and the equilibrium chosen is the one preferred by experts.

☐ **Experts with state-dependent preferences.** So far, we have assumed that the experts do not directly care about the underlying state, and irrespective of the state, an expert's payoff increases as the judge's action becomes closer to the expert's agenda. However, one may argue that in some settings, an expert's agenda may be correlated with the underlying state of the world or the expert may directly care about the quality of decision-making (e.g., the expert's reputation may be damaged if his report leads to an egregiously "wrong" decision by the judge). One can easily extend our model by directly incorporating the state in the expert's payoff. Suppose that $\Theta = [0, 1]$ and the payoff of expert A_i is

$$u_i(y, \theta; x_i) = -\left[\beta(x_i - y)^2 + (1 - \beta)(y - \theta)^2\right],$$

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[22] Even though this case trivially rules out the existence of conflict equilibria, it allows for both locally sensitive and locally insensitive equilibria. Thus, we can still explore the variation in the comparative statics properties across equilibria.

where $\beta \in (1/2, 1]$. That is, A_i's payoff is a convex combination of the proximity of the decision to his agenda (i.e., $|x_i - y|$) and the error in decision-making (i.e., $|y - \theta|$). However, the expert is assumed to care more about a former than the latter (i.e., $\beta > 1/2$). Under the utility function specified above, the most preferred action for the expert is given by $\tilde{x}_i(\theta) = \beta x_i + (1 - \beta)\theta$, and for any given default action of the judge, y^*, the revelation set is given as

$$\Theta_i^* = \begin{cases} [\max\{0, \ x_i + (x_i - y^*)/(2\beta - 1)\}, \ y^*] & if \ y^* > x_i \\ [y^*, \min\{1, \ x_i + (x_i - y^*)/(2\beta - 1)\}] & if \ y^* \leq x_i. \end{cases}$$

Observe that the qualitative nature of the revelation sets is the same as in the case of our previous model: for any given y^*, an expert A_i's revelation set is locally insensitive only if his agenda x_i is sufficiently extreme. Hence, all our results remain qualitatively unchanged in this altered setting.

□ **Paying for information revelation.** A potentially alternative method to induce the expert to reveal the state is to offer monetary payments for the information. We argue that the salient themes of our analysis continue to hold even if we allow for such a payment. Suppose that $\Theta = [0, 1]$ and the decision-maker offers a price p to an expert if he reveals the state. For a given payment p and a default action y^* the revelation set of expert A_i becomes $\Theta_i^* = \{\theta \mid |x_i - \theta| - p \leq |x_i - y^*|\}$, or

$$\Theta_i^* = \begin{cases} [\max\{0, \ 2x_i - y^* - p\}, \ y^* + p] & if \ y^* > x_i \\ [y^* - p, \ \min\{1, \ 2x_i - y^* + p\}] & if \ y^* \leq x_i \end{cases}. \tag{4}$$

Note that for a given y^*, the revelation set expands with p. This observation is quite intuitive as the payment increases the expert's incentive for information revelation. However, the default action y^* now lies in the *interior* of the set. This feature implies that even if the experts have extreme agendas, an increase in an expert's quality may decrease the judge's ex ante payoff; that is, Corollary 2 need not hold, as this argument relies on the fact that the expert's revelation set is locally insensitive and y^* is at its boundary. However, as the experts' payment p becomes arbitrarily small, the outcome converges to the outcome without payments. Therefore, the qualitative features of the equilibrium in our initial model continues to hold even if a sufficiently small yet positive payment is offered for information revelation.

7. Conclusion

■ Reliance on expert advice is a common practice in a variety of decision-making processes. The decision-maker herself may lack the expertise to find or analyze the relevant information needed for effective decision-making and may rely on experts' opinions to reach a conclusion. However, experts can be biased. They may have their personal agendas and may manipulate the information they provide to the decision-maker so as to induce her to take an action that better serves their own self-interests rather than facilitating efficient decision-making. However, in many such environments there are also constraints on an expert's ability to manipulate his report. Once revealed, often the expert's report can be verified, and concerns for reputation or threat of penalty for fabrication of evidence (or both) may act as a deterrent for information manipulation. Moreover, the presence of competing experts with potentially opposed self-interests may undo each others' attempt to conceal unfavorable information.

We consider such a "persuasion game" where two experts with potentially conflicting agendas attempt to persuade a decision-maker, or a "judge," to take a favorable action and ask the following question: how does the *extent of conflict* between the experts affect the quality of decision-making (as reflected by the payoff of the judge)? We focus on two different measures of conflict: (i) how diverse the agendas of the two experts are and (ii) the quality of the opposing experts as reflected by their (prior) likelihood of being informed.

We highlight three key results. First, we argue that employing experts of better quality need not result in better decision-making. When the experts have moderate agendas, an increase in an

expert's quality can reduce the judge's payoff *ex ante*. This finding runs contrary to the intuitive argument that having better quality experts should *always* lead to better decision-making. Second, if the judge could choose the two experts based on their own agendas, it is always optimal to engage experts whose agendas are either completely opposed or completely aligned but extreme. Third, it may be optimal to employ two experts with the same extreme agenda rather than two experts with completely opposed agendas. This finding, again, runs contrary to the common intuition that conflicting experts always reveal more information.

Note that our findings are based on two key assumptions: (i) both experts, if informed, observe the same information about the state, and (ii) conditional on being the "informed" type, the information acquisition by an expert is automatic—that is, the expert does not have to incur any cost or exert any effort to observe the state. The latter assumption rules out any moral hazard issue in the persuasion game. To what extent our key findings are robust to these assumptions remains an interesting area for future research.

Appendix A
Proofs omitted in the text.

As most of our proofs rely on nature of the equation (2), it is instructive to further expand this equation as

$$
\int_0^{l_0} u'_J(y^*; \Theta)\, dF(\Theta) + \int_{h_1}^{1} u'_J(y^*; \Theta)\, dF(\Theta) + (1-\alpha_0)\int_{l_0}^{l_1} u'_J(y^*; \Theta)\, dF(\Theta)
$$
$$
+ (1-\alpha_1)\int_{h_0}^{h_1} u'_J(y^*; \Theta)\, dF(\Theta) + (1-\alpha_0)(1-\alpha_1)\int_{l_1}^{h_0} u'_J(y^*; \Theta)\, dF(\Theta) = 0,
\tag{A1}
$$

where l_i and h_i are the lower and upper bounds of the revelation interval for expert A_i. That is, $l_0 = \max\{0, x_0 - |y^* - x_0|\}$, $l_1 = \max\{0, x_1 - |y^* - x_1|\}$, $h_0 = \min\{x_0 + |y^* - x_0|, 1\}$, and $h_1 = \min\{x_1 + |y^* - x_1|, 1\}$. We now present the proofs below.

Proof of Proposition 1. That the proposed strategies constitutes an equilibrium is already argued in Section 3. So the only need is to prove existence of the equilibrium. Consider some $y \in \Theta$, which is the judge's action consequent of receiving an all-null report. Each expert's best response (strategy) is only a function of y, given by $m_i(\cdot, y) : \Theta \to \Theta \cup \{\emptyset\}$. For every A_i, the function is unique and well-defined, given by the above proposition. Call the experts' best response profile of strategies $m(y) = \{m_i(\cdot, y), i = 0, 1, \ldots, n-1\}$. Note again that y^*, the best response of the judge, is simply a function of $m(y)$, and not of the actual profile of reports. That it is well-defined and unique follows from concavity of u_J in y. We write y^* as $G(m(y))$. Therefore, we have a function $G : \Theta \to \Theta$, that is, from the space of y to itself. Notice that Θ is compact and convex. Also, $m_i(\cdot, y)$ is continuous in y for all i. As f is a continuous pdf, by the theorem of maximum, $G(m(y))$ is continuous in the distribution induced by $m(y)$, and as the induced distribution is continuous in y, $G(m(y))$ is continuous in y. Thus, by Brouwer's fixed point theorem, there exists a fixed point for the function G. It is easy to see that the fixed point y^* is a Nash equilibrium of the game.   *Q.E.D.*

Proof of Corollary 1. The revelation sets Θ_i^* follows directly from its characterization as given in Proposition 1. Also, equation (2) is simply the first-order condition associated with the maximization problem given in Proposition 1 that y^* is a solution to. The first-order condition is both necessary and sufficient to characterize y^* since the assumption that $u'' < 0$ implies that the second-order condition is always satisfied. Thus, it only remains to show that in equilibrium, $y^* \in (0, 1)$.

Suppose that the revelation sets of the two experts are Θ_0 and Θ_1, respectively. Now, the judge's payoff from any default action y is

$$
U_J(y) := \Pr(\Theta \in \Theta \backslash \Theta_0 \cup \Theta_1)\int_{\Theta\backslash\Theta_0\cup\Theta_1} u_J(y, \Theta) f(\Theta | \Theta \in \Theta\backslash\Theta_0 \cup \Theta_1) d\Theta
$$
$$
+ (1-\alpha_0)\Pr(\Theta \in \Theta_0\backslash\Theta_1)\int_{\Theta_0\backslash\Theta_1} u_J(y, \Theta) f(\Theta | \Theta \in \Theta_0\backslash\Theta_1) d\Theta
$$
$$
+ (1-\alpha_1)\Pr(\Theta \in \Theta_1\backslash\Theta_0)\int_{\Theta_1\backslash\Theta_0} u_J(y, \Theta) f(\Theta | \Theta \in \Theta_1\backslash\Theta_0) d\Theta
$$
$$
+ (1-\alpha_0)(1-\alpha_1)\Pr(\Theta \in \Theta_0 \cap \Theta_1)\int_{\Theta_0\cap\Theta_1} u_J(y, \Theta) f(\Theta | \Theta \in \Theta_0 \cap \Theta_1) d\Theta
$$
$$
= \int_{\Theta\backslash\Theta_0\cup\Theta_1} u_J(y, \Theta) f(\Theta) d\Theta + (1-\alpha_0)\int_{\Theta_0\backslash\Theta_1} u_J(y, \Theta) f(\Theta) d\Theta
$$
$$
+ (1-\alpha_1)\int_{\Theta_1\backslash\Theta_0} u_J(y, \Theta) f(\Theta) d\Theta + (1-\alpha_0)(1-\alpha_1)\int_{\Theta_0\cap\Theta_1} u_J(y, \Theta) f(\Theta) d\Theta.
$$

(Here we use the fact that for any set $E \subset \Theta$, $f(\Theta|E) = f(\Theta) / \Pr(E)$.) Taking derivative with respect to y and setting $y = 0$, we have

$$U'_J(0) = \int_{\Theta \setminus \Theta_0 \cup \Theta_1} u'_J(0, \Theta) f(\Theta) d\Theta + (1 - \alpha_0) \int_{\Theta_0 \setminus \Theta_1} u'_J(0, \Theta) f(\Theta) d\Theta$$
$$+ (1 - \alpha_1) \int_{\Theta_1 \setminus \Theta_0} u'_J(0, \Theta) f(\Theta) d\Theta + (1 - \alpha_0)(1 - \alpha_1) \int_{\Theta_0 \cap \Theta_1} u'_J(0, \Theta) f(\Theta) d\Theta.$$

Due to strict single-peakedness, $u'_J(0, 0) = 0$ and $u'_J(0, \Theta) < 0$ for $\Theta > 0$. As, by assumption, $k < f(\Theta) < 1/k$ for some finite $k > 0$, we can write

$$U'_J(0) = \int_{\Theta \setminus \Theta_0 \cup \Theta_1 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta + (1 - \alpha_0) \int_{\Theta_0 \setminus \Theta_1 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta$$
$$+ (1 - \alpha_1) \int_{\Theta_1 \setminus \Theta_0 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta + (1 - \alpha_0)(1 - \alpha_1) \int_{\Theta_0 \cap \Theta_1 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta.$$

Now, $\alpha_i \in [0, 1)$ implies $(1 - \alpha_0)(1 - \alpha_1) \in (0, 1]$. Also, $(1 - \alpha_0)(1 - \alpha_1) \leq \max\{1 - \alpha_0, 1 - \alpha_1\}$. Therefore,

$$U'_J(0) < (1 - \alpha_0)(1 - \alpha_1) \left[\int_{\Theta \setminus \Theta_0 \cup \Theta_1 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta + \int_{\Theta_0 \setminus \Theta_1 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta \right.$$
$$\left. + \int_{\Theta_1 \setminus \Theta_0 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta + \int_{\Theta_0 \cap \Theta_1 \cup \{0\}} u'_J(0, \Theta) f(\Theta) d\Theta \right]$$
$$\leq (1 - \alpha_0)(1 - \alpha_1)k \left[\int_{\Theta \setminus \Theta_0 \cup \Theta_1 \cup \{0\}} u'_J(0, \Theta) d\Theta + \int_{\Theta_0 \setminus \Theta_1 \cup \{0\}} u'_J(0, \Theta) d\Theta \right.$$
$$\left. + \int_{\Theta_1 \setminus \Theta_0 \cup \{0\}} u'_J(0, \Theta) d\Theta + \int_{\Theta_0 \cap \Theta_1 \cup \{0\}} u'_J(0, \Theta) d\Theta \right]$$
$$\leq (1 - \alpha_0)(1 - \alpha_1)k \int_{\Theta \setminus \{0\}} u'_J(0, \Theta) d\Theta < 0.$$

Similarly, we can show that $U'_J(1)$ is strictly greater than a positive number. Therefore, the best response of the judge is always an interior action. *Q.E.D.*

Proof of Proposition 2. The proof follows directly from the proof of Proposition 1 and Corollary 1 by plugging $n = 2$, $\Theta \in [0, 1]$ and the respective values of x_0 and x_1. It is instructive to write down the equations solving for the default action for the three cases separately.

(i) If $x_0 = 0$ and $x_1 = 1$, then $\Theta_0^* = [0, y^*]$ and $\Theta_1^* = [y^*, 1]$; the default action $y^* = y_{01}^*$ solves

$$(1 - \alpha_0) \int_0^{y^*} u'_J(y^*; \Theta) dF(\Theta) + (1 - \alpha_1) \int_{y^*}^1 u'_J(y^*; \Theta) dF(\Theta) = 0. \tag{A2}$$

(ii) If $x_0 = x_1 = 0$, then $\Theta_0^* = \Theta_1^* = [0, y^*]$; the default action $y^* = y_{00}^*$ solves

$$(1 - \alpha_0)(1 - \alpha_1) \int_0^{y^*} u'_J(y^*, \Theta) dF(\Theta) + \int_{y^*}^1 u'_J(y^*, \Theta) dF(\Theta) = 0. \tag{A3}$$

(iii) Finally, if $x_0 = x_1 = 1$, then $\Theta_0^* = \Theta_1^* = [y^*, 1]$; the default action $y^* = y_{11}^*$ solves

$$\int_0^{y^*} u'_J(y^*, \Theta) dF(\Theta) + (1 - \alpha_0)(1 - \alpha_1) \int_{y^*}^1 u'_J(y^*, \Theta) dF(\Theta) = 0. \tag{A4}$$

The only additional claim that needs to be proved is that the equilibrium is unique. We present the proof for the case of opposed experts ($x_0 = 0$ and $x_1 = 1$). To see this, denote

$$Z(y) := (1 - \alpha_0) \int_0^y u'_J(y; \Theta) dF(\Theta) + (1 - \alpha_1) \int_y^1 u'_J(y; \Theta) dF(\Theta).$$

Note that Z is continuous, $Z(0) = (1 - \alpha_1) \int_0^1 u'_J(0; \Theta) dF(\Theta) > 0$, $Z(1) = (1 - \alpha_0) \int_0^1 u'_J(1; \Theta) dF(\Theta) < 0$, and

$$Z'(y) = (1 - \alpha_0) \int_0^y u''_J(y; \Theta) dF(\Theta) + (1 - \alpha_1) \int_y^1 u''_J(y; \Theta) dF(\Theta) < 0.$$

So, by Mean Value Theorem, there exists a value of $y \in (0, 1)$ such that $Z(y) = 0$. Moreover, this value must be unique as $Z'(y) < 0$. This observation completes the proof. The cases for similar experts are analogous. *Q.E.D.*

Proof of Proposition 3 and Corollary 2. We first prove the proposition and its corollary for conflict equilibria and then the same for (partially) congruent equilibria.

Step 1. Consider a conflict equilibrium, that is, $x_0 < y^* < x_1$. The revelation set for A_0 is $[l_0, y^*]$ where $l_0 = \max\{2x_0 - y^*, 0\}$. Similarly, the revelation set for A_1 is $[y^*, h_1]$ where $h_1 = \min\{2x_1 - y^*, 1\}$. Now, we have

$$\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] =$$
$$\int_0^{l_0} u_J\left(y^*; \theta\right) dF + (1-\alpha_0)\int_{l_0}^{y^*} u_J\left(y^*; \theta\right) dF + (1-\alpha_1)\int_{y^*}^{h_1} u_J\left(y^*; \theta\right) dF + \int_{h_1}^1 u_J\left(y^*; \theta\right) dF.$$

Taking derivative with respect to α_0, we obtain

$$\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] = -\int_{l_0}^{y^*} u_J\left(y^*; \theta\right) dF +$$
$$\left[\int_0^{l_0} u_J'\left(y^*; \theta\right) dF + (1-\alpha_0)\int_{l_0}^{y^*} u_J'\left(y^*; \theta\right) dF + (1-\alpha_1)\int_{y^*}^{h_1} u_J'\left(y^*; \theta\right) dF + \int_{h_1}^1 u_J'\left(y^*; \theta\right) dF\right]\frac{dy^*}{d\alpha_0}$$
$$+u_J\left(y^*; l_0\right) f(l_0)\frac{dl_0}{d\alpha_0} + (1-\alpha_0)\left[u_J\left(y^*; y^*\right) f(y^*)\frac{dy^*}{d\alpha_0} - u_J\left(y^*; l_0\right) f(l_0)\frac{dl_0}{d\alpha_0}\right]$$
$$+(1-\alpha_1)\left[u_J\left(y^*; h_1\right) f(h_1)\frac{dh_1}{d\alpha_0} - u_J\left(y^*; y^*\right) f(y^*)\frac{dy^*}{d\alpha_0}\right] - u_J\left(y^*; h_1\right) f(h_1)\frac{dh_1}{d\alpha_0}.$$

Using the first-order condition and the fact that $u_J(x; x) = 0$, we have

$$\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] = \left[\alpha_0 u_J\left(y^*; l_0\right) f(l_0)\frac{dl_0}{d\alpha_0} - \alpha_1 u_J\left(y^*; h_1\right) f(h_1)\frac{dh_1}{d\alpha_0}\right] - \int_{l_0}^{y^*} u_J\left(y^*; \theta\right) dF.$$

Step 2. If a conflict equilibrium is locally insensitive, that is, if $x_0 < y^*/2$ and $x_1 > (1+y^*)/2$, then $l_0 = 0$ and $h_1 = 1$. In that case, $\frac{dl_0}{d\alpha_0} = \frac{dh_1}{d\alpha_0} = 0$. Therefore,

$$\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] = -\int_0^{y^*} u_J\left(y^*; \theta\right) dF > 0.$$

This proves Proposition 3 for the case of conflict equilibrium. If $x_0 = 0$ and $x_1 = 1$, the equilibrium is unique by Proposition 2, and as $y^* \in (0, 1)$, we must have $x_0 < y^*/2$ and $x_1 > (1+y^*)/2$. Thus, the unique equilibrium is locally insensitive, and we must have $\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] = -\int_0^{y^*} u_J\left(y^*; \theta\right) dF > 0$. This proves Corollary 2 for the case of $x_0 = 0$ and $x_1 = 1$.

Step 3. Next, consider a (partially) congruent equilibrium. We consider only the case where $x_0 \leq x_1 \leq y^*$. (The other case, where $y^* \leq x_0$ is similar.) The revelation set for A_i is $[l_0, y^*]$ where $l_i = \max\{2x_i - y^*, 0\}, i = 1, 2$. Moreover, since $x_0 \leq x_1$, we must have $l_0 \leq l_1$. Now, we have

$$\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] =$$
$$\int_0^{l_0} u_J\left(y^*; \theta\right) dF + (1-\alpha_0)\int_{l_0}^{l_1} u_J\left(y^*; \theta\right) dF + (1-\alpha_1)(1-\alpha_0)\int_{l_1}^{y^*} u_J\left(y^*; \theta\right) dF + \int_{y^*}^1 u_J\left(y^*; \theta\right) dF.$$

Taking derivative with respect to α_0, we obtain

$$\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] = -\int_{l_0}^{l_1} u_J\left(y^*; \theta\right) dF - (1-\alpha_1)\int_{l_1}^{y^*} u_J\left(y^*; \theta\right) dF +$$
$$\left[\int_0^{l_0} u_J'\left(y^*; \theta\right) dF + (1-\alpha_0)\int_{l_0}^{l_1} u_J'\left(y^*; \theta\right) dF + \right.$$
$$\left. (1-\alpha_1)(1-\alpha_0)\int_{l_1}^{y^*} u_J'\left(y^*; \theta\right) dF + \int_{y^*}^1 u_J'\left(y^*; \theta\right) dF\right]\frac{dy^*}{d\alpha_0}$$
$$+u_J\left(y^*; l_0\right) f(l_0)\frac{dl_0}{d\alpha_0} + (1-\alpha_0)\left[u_J\left(y^*; l_1\right) f(l_1)\frac{dl_1}{d\alpha_0} - u_J\left(y^*; l_0\right) f(l_0)\frac{dl_0}{d\alpha_0}\right]$$
$$+(1-\alpha_1)(1-\alpha_0)\left[u_J\left(y^*; y^*\right) f(y^*)\frac{dy^*}{d\alpha_0} - u_J\left(y^*; l_1\right) f(l_1)\frac{dl_1}{d\alpha_0}\right] - u_J\left(y^*; y^*\right) f(h_1)\frac{dy^*}{d\alpha_0}.$$

Again, by using the first-order condition and the fact that $u_J(x; x) = 0$, we have

$$\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*; \theta\right) \mid \mathbf{m}^*\right] = -\int_{l_0}^{l_1} u_J\left(y^*; \theta\right) dF - (1-\alpha_1)\int_{l_1}^{y^*} u_J\left(y^*; \theta\right) dF$$
$$+\alpha_0 u_J\left(y^*; l_0\right) f(l_0)\frac{dl_0}{d\alpha_0} + \alpha_1(1-\alpha_0) u_J\left(y^*; l_1\right) f(l_1)\frac{dl_1}{d\alpha_0}.$$

Step 4. If such a partially congruent equilibrium is locally insensitive, that is, if $x_1 < y^*/2$, then $l_0 = l_1 = 0$. In that case, $\frac{dl_0}{d\alpha_0} = \frac{dl_1}{d\alpha_0} = 0$. Therefore, for locally insensitive congruent equilibria, we have

$$\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*;\theta\right)\mid \mathbf{m}^*\right] = -\int_{l_0}^{l_1} u_J\left(y^*;\theta\right)dF - (1-\alpha_1)\int_{l_1}^{y^*} u_J\left(y^*;\theta\right)dF$$

$$= -(1-\alpha_1)\int_0^{y^*} u_J\left(y^*;\theta\right)dF > 0.$$

This proves Proposition 3 for the case of congruent equilibrium. If $x_0 = x_1 = 0$, the equilibrium is unique by Proposition 2, and as $y^* \in (0, 1)$, the unique equilibrium is locally insensitive, implying that $\frac{d}{d\alpha_0}\mathbb{E}\left[u_J\left(y^*;\theta\right)\mid \mathbf{m}^*\right] > 0$. This proves Corollary 2 for the case of identical extreme experts. *Q.E.D.*

Proof of Proposition 4. If $x_0 = 0$ and $x_1 = 1$, then by definition, $y^* \in [x_0, x_1]$. So, $\Theta_0 = \{\theta \mid \theta \le y^*\} = [0, y^*]$ and $\Theta_1 = \{\theta \mid \theta \ge y^*\} = [y^*, 1]$. Hence, $\Theta_0\backslash\Theta_1 = \Theta_0$, $\Theta_1\backslash\Theta_0 = \Theta_1$, $\Theta_0 \cap \Theta_1 = y^*$, and $(\Theta_1 \cup \Theta_0)^c = \varnothing$. So, (A1) boils down to:

$$(1-\alpha_0)\int_0^{y^*} u'_J\left(y^*;\theta\right)dF\left(\theta\right) + (1-\alpha_1)\int_{y^*}^1 u'_J\left(y^*;\theta\right)dF\left(\theta\right) = 0.$$

Suppose the judge commits to a default action $\hat{y}$. So $\hat{y}$ must solve

$$\max_y\ (1-\alpha_0)\int_0^y u_J\left(y;\theta\right)dF\left(\theta\right) + (1-\alpha_1)\int_y^1 u_J\left(y;\theta\right)dF\left(\theta\right).$$

The first-order condition is

$$(1-\alpha_0)\left[u_J\left(\hat{y};\hat{y}\right) - u_J\left(\hat{y};0\right).0 + \int_0^{\hat{y}} u'_J\left(\hat{y};\theta\right)dF\left(\theta\right)\right]$$

$$+ (1-\alpha_0)\left[u_J\left(\hat{y};1\right).0 - u_J\left(\hat{y};\hat{y}\right) + \int_{\hat{y}}^1 u'_J\left(\hat{y};\theta\right)dF\left(\theta\right)\right] = 0,$$

or

$$(1-\alpha_0)\int_0^{\hat{y}} u'_J\left(\hat{y};\theta\right)dF\left(\theta\right) + (1-\alpha_1)\int_{\hat{y}}^1 u'_J\left(\hat{y};\theta\right)dF\left(\theta\right) = 0.$$

However, this is the same condition as in equation (A2). Hence, the judge's choice of the default action (under commitment power) coincides with her default action in the original game. Hence, the payoffs are also identical in the two case. In other words, commitment power has no value to the judge in this case. We can similarly prove the cases for extreme and identical experts, that is, $x_0 = x_1 = 0$ and $x_0 = x_1 = 1$. *Q.E.D.*

Proof of Proposition 5. Fix F, α_0, α_1. Now, consider any (x_0, x_1), and suppose the expected utility in equilibrium of the judge is $u^*_J(x_0, x_1)$. We show that

$$\max_{\{x_0,x_1\}\in[0,1]^2} u^*_J(x_0, x_1) \le \max\{u^*_J(0, 0),\ u^*_J(1, 1),\ u^*_J(0, 1)\}.$$

By Proposition 4, $u^*_J(0, 0)$, $u^*_J(1, 1)$, and $u^*_J(0, 1)$ are the same under commitment or in absence of commitment. To prove the above inequality, we proceed along the following steps.

Step 1. We argue that for any equilibrium with $x_0 \le y^* \le x_1$, $u^*_J(x_0, x_1) \le u^*_J(0, 1)$. Suppose $x_0 \le y^* \le x_1$. Now, the revelation sets of the two experts are $[l_0, y^*]$ and $[y^*, u_2]$, respectively, where $l_0 \in [0, y^*]$ and $u_2 \in [y^*, 1]$. Now,

$$u^*_J(x_0, x_1) = \int_0^{l_0} u_J(y^*, \theta)dF + (1-\alpha_0)\int_{l_0}^{y^*} u_J(y^*, \theta)dF + (1-\alpha_1)\int_{y^*}^{h_1} u_J(y^*, \theta)dF$$
$$+ \int_{h_1}^1 u_J(y^*, \theta)dF.$$

We have already noted in the proof of Proposition 4, $u^*_J(0, 1) = \max_y (1-\alpha_0)\int_0^y u_J(y, \theta)dF + (1-\alpha_1)\int_y^1 u_J(y, \theta)dF$. Therefore,

$$u^*_J(0, 1) \ge (1-\alpha_0)\int_0^{y^*} u_J(y^*, \theta)dF + (1-\alpha_1)\int_{y^*}^1 u_J(y^*, \theta)dF$$

$$= (1-\alpha_0)\left[\int_0^{l_0} u_J(y^*, \theta)dF + \int_{l_0}^{y^*} u_J(y^*, \theta)dF\right] + (1-\alpha_1)\left[\int_{y^*}^{h_1} u_J(y^*, \theta)dF + \int_{h_1}^1 u_J(y^*, \theta)dF\right]$$

$$\ge \int_0^{l_0} u_J(y^*, \theta)dF + (1-\alpha_0)\int_{l_0}^{y^*} u_J(y^*, \theta)dF + (1-\alpha_1)\int_{y^*}^{h_1} u_J(y^*, \theta)dF + \int_{h_1}^1 u_J(y^*, \theta)dF$$

$$= u^*_J(x_0, x_1),$$

where the last inequality follows from the fact that the utilities are all non-positive, and $(1 - \alpha_i) \in (0, 1]$ for $i = 1, 2$.

Step 2. Next, we argue that for any equilibrium with $x_0 \leq x_1 < y^*$, $u_J^*(x_0, x_1) \leq u_J^*(0, 0)$ (and similarly, for any equilibrium with $x_1 \geq x_0 > y^*$, we have $u_J^*(x_0, x_1) \leq u_J^*(1, 1)$). Suppose $x_0 \leq x_1 < y^*$. Now, the revelation sets of the two experts are $[l_0, y^*]$ and $[l_1, y^*]$, respectively, where $l_0 \in [0, y^*]$ and $l_1 \in [l_0, y^*]$. Now,

$$u_J^*(x_0, x_1) = \int_0^{l_0} u_J(y^*, \Theta) dF + (1 - \alpha_0) \int_{l_0}^{l_1} u_J(y^*, \Theta) dF + (1 - \alpha_1)(1 - \alpha_0) \int_{l_1}^{y^*} u_J(y^*, \Theta) dF$$
$$+ \int_{y^*}^1 u_J(y^*, \Theta) dF.$$

We have already noted in the proof of Proposition 4 that $u_J^*(0, 0) = \max_y (1 - \alpha_0)(1 - \alpha_1) \times \int_0^y u_J(y, \Theta) dF + \int_y^1 u_J(y, \Theta) dF$. Therefore,

$$u_J^*(0, 0) \geq (1 - \alpha_0)(1 - \alpha_1) \int_0^{y^*} u_J(y^*, \Theta) dF + \int_{y^*}^1 u_J(y^*, \Theta) dF$$
$$= (1 - \alpha_0)(1 - \alpha_1) \left[\int_0^{l_0} u_J(y^*, \Theta) dF + \int_{l_0}^{l_1} u_J(y^*, \Theta) dF + \int_{l_1}^{y^*} u_J(y^*, \Theta) dF \right] + \int_{y^*}^1 u_J(y^*, \Theta) dF$$
$$\geq \int_0^{l_0} u_J(y^*, \Theta) dF + (1 - \alpha_0) \int_{l_0}^{l_1} u_J(y^*, \Theta) dF + (1 - \alpha_0)(1 - \alpha_1) \int_{l_1}^{y^*} u_J(y^*, \Theta) dF + \int_{y^*}^1 u_J(y^*, \Theta) dF$$
$$= u_J^*(x_0, x_1),$$

where the last inequality follows from the fact that the utilities are all nonpositive, and $(1 - \alpha_i) \in (0, 1]$ for $i = 1, 2$.

By the same logic, we can show that if $y^* < x_0 \leq x_1$, then $u_J^*(1, 1) \geq u_J^*(x_0, x_1)$. Finally, if we have $x_0 = x_1 = y*$ it must be true that $x_0 = x_1$ XX $(0,1)$. In this equilibrium, the judge never learns the state and it is easy to check that each of the profiles with extreme experts makes the judge better off. Therefore, we obtain that

$$\max_{x_i \in [0,1]} u_J^*(x_0, x_1) \leq \max\{u_J^*(0, 0), u_J^*(1, 1), u_J^*(0, 1)\}.$$

Last, note that whenever experts are sufficiently opposed, there is an equilibrium where the outcome is the same as that of the profile {0, 1} independent of whether commitment is allowed or not. Similarly, for sufficiently similar but extreme experts, we have an equilibrium where the outcome is the same as that of completely identical but extreme experts. Hence the proof.   *Q.E.D.*

Proof of Proposition 6. When the experts are opposed, by equation (A2), the judge's default action is $y^* = \sqrt{1 - \alpha_1}/(\sqrt{1 - \alpha_0} + \sqrt{1 - \alpha_1})$. The associated payoff is

$$u_J^{01} := \mathbb{E}_\Theta [u_J(y^*; \Theta) \mid x_0 = 0, x_1 = 1] = -(1 - \alpha_0)(1 - \alpha_1)/3(\sqrt{1 - \alpha_0} + \sqrt{1 - \alpha_1})^2,$$

Similarly, if $x_0 = x_1 = 0$, by equation (A3), judge's default action $y^* = 1/(\sqrt{(1 - \alpha_0)(1 - \alpha_1)} + 1)$, and the judge's payoff is

$$u_J^{00} := \mathbb{E}_\Theta [u_J(y^*; \Theta) \mid x_0 = x_1 = 0] = -(1 - \alpha_0)(1 - \alpha_1)/3(\sqrt{(1 - \alpha_0)(1 - \alpha_1)} + 1)^2.$$

It is routine the check that the judge's payoff is the same as u_J^{00} even if $x_0 = x_1 = 1$. Now, as for any α_0 and α_1, $\sqrt{1 - \alpha_0} + \sqrt{1 - \alpha_1} < \sqrt{(1 - \alpha_0)(1 - \alpha_1)} + 1$, we have $u_J^{00} > u_J^{01}$.   *Q.E.D.*

Proof of Proposition 7. Suppose that in an equilibrium, the revelation set of the experts is $[a, b]$ with $0 \leq a \leq b \leq 1$, and the best response of the judge is y^* (trivially, both experts have identical revelation sets). Using Corollary 1, one obtains that in any equilibrium, y^* must satisfy the following condition:

$$y^* = \frac{\mathbb{E}(\Theta) - \alpha \mathbb{E}(\Theta | \Theta \in [a, b]) \Pr(\Theta \in [a, b])}{1 - \alpha \Pr(\Theta \in [a, b])} = \frac{1 - \alpha(b^2 - a^2)}{2 - 2\alpha(b - a)}. \tag{A5}$$

Now, in any equilibrium of this game (i) either $a = y^*$ and $b = \min\{1, 2x - y^*\}$ or (ii) $b = y^*$ and $a = \max\{0, 2x - y^*\}$. Thus, in order to obtain the complete characterization of the set of equilibria, we need to check under what conditions (if any), each of the above types of equilibrium is consistent with equation (A5).

Case 1. $a = 0$, $b = y^*$. This equilibrium exists whenever $x \leq y^*/2$. Equation (A5) would imply $\alpha y^2 - 2y + 1 = 0$. The only solution to this equation that is less than 1 is

$$y_{00}^* = \frac{1}{1 + \sqrt{1 - \alpha}}.$$

Therefore, whenever $x \leq 1/2(1 + \sqrt{1 - \alpha})$, there is an equilibrium where the judge's decision is $1/(1 + \sqrt{1 - \alpha})$.

Case 2. $a = y^*$, $b = 1$. This does not apply here, as we have $x \leq 1/2$.

Case 3. $a = y^* < b = 2x - y^*$. Equation (A5) would imply $y + 2\alpha(x - y)^2 = 1/2$. Let $y = x - u$. Then, we can rewrite this as a quadratic in u: $2\alpha u^2 - u + (x - 1/2) = 0$. Notice that because $0 < y < x$, we must have the solution $u^* \in (0, x)$. The only positive solution to the above equation is

$$u_+ = \frac{1}{4\alpha}(1 + \sqrt{1 + 8\alpha(1/2 - x)}).$$

The constraint $u_+ < x$ implies $\sqrt{1 + 8\alpha(1/2 - x)} < 4\alpha x - 1$, which requires $4\alpha x - 1 > 1$, that is, $x > \frac{1}{2\alpha} > \frac{1}{2}$, which is a contradiction. Therefore, there cannot be any equilibrium in case 3.

Case 4. $a = 2x - y \le b = y$. Equation (A5) would imply $y - 2\alpha(y - x)^2 = 1/2$. Let $y - x = t$. Then, we can rewrite this as the following quadratic in t: $2\alpha t^2 - t + (1/2 - x) = 0$ which gives two solutions t_+ and t_-, where

$$t_+ = \frac{1}{4\alpha}(1 + \sqrt{1 - 8\alpha(1/2 - x)}) \text{ and } t_- = \frac{1}{4\alpha}(1 - \sqrt{1 - 8\alpha(1/2 - x)}). \tag{A6}$$

For feasibility, we need $y \ge 0$, that is, $t \le x$ and $2x - y \le 1$, that is, $t \le 1 - x$. As $x \le \frac{1}{2}$, $t \le x \Rightarrow t \le 1 - x$. We also need $t \ge 0$. First, for t to be real, we need $x \ge \frac{1}{2} - \frac{1}{8\alpha}$. Notice that as long as this condition is true we have $0 \le \sqrt{1 - 8\alpha(1/2 - x)} \le 1$, and thus both t_+ and t_- are weakly positive.

Case 4.1. We first look into the root t_+. We need $t_+ \le x$, that is,

$$\sqrt{1 - 8\alpha(1/2 - x)} \le 4\alpha x - 1,$$

for which, a necessary condition is $x \ge \frac{1}{4\alpha}$. If that holds, we have

$$1 - 8\alpha(1/2 - x) \le (4\alpha x - 1)^2 \Leftrightarrow 4\alpha x^2 - 4x + 1 \ge 0.$$

Thus, we must have either $x \le \frac{1}{2\alpha}(1 - \sqrt{1 - \alpha})$ or $x \ge \frac{1}{2\alpha}(1 + \sqrt{1 - \alpha})$. As $\frac{1}{2\alpha}(1 + \sqrt{1 - \alpha}) > \frac{1}{2}$, we need $x \le \frac{1}{2\alpha}(1 - \sqrt{1 - \alpha}) = 1/2(1 + \sqrt{1 - \alpha})$. Therefore, if $x \in (\max\{1/2 - 1/8\alpha, 1/4\alpha\}, 1/2(1 + \sqrt{1 - \alpha}))$, then there is an equilibrium with $y^* = x + t_+$, and the revelation set is $[x - t_+, x + t_+]$.

When is the above a valid interval? First, we notice that $\max\{1/2 - 1/8\alpha, 1/4\alpha\} = 1/2 - 1/8\alpha$, if $\alpha \ge \frac{3}{4}$, and $\max\{1/2 - 1/8\alpha, 1/4\alpha\} = 1/4\alpha$ when $\alpha \le 3/4$. Also, if $\alpha < 3/4$, $1/4\alpha > 1/2(1 + \sqrt{1 - \alpha})$. Therefore, there can be no equilibrium with root t_+ for $\alpha < 3/4$. For $\alpha = 3/4$, the interval reduces to a point $x = 1/3$. On the other hand, for all α, we have $\max\{1/2 - 1/8\alpha, 1/4\alpha\} = 1/2 - 1/8\alpha < 1/2(1 + \sqrt{1 - \alpha})$. This tells us that when $\alpha \ge 3/4$, if $x \in (1/2 - 1/8\alpha, 1/2(1 + \sqrt{1 - \alpha}))$, then there is an equilibrium with $y^* = x + t_+$, and the revelation set is $[x - t_+, x + t_+]$.

Case 4.2. Now, we look into the root t_-. We need $t_- \le x$, that is,

$$\frac{1}{4\alpha}\left(1 - \sqrt{1 - 8\alpha(1/2 - x)}\right) \le x \Leftrightarrow 4\alpha x^2 - 4x + 1 \le 0.$$

As $x \le \frac{1}{2}$, the above condition is satisfied iff. $x \in \left[1/2(1 + \sqrt{1 - \alpha}), 1/2\right]$. Moreover, notice that $1/2 - 1/8\alpha < 1/2(1 + \sqrt{1 - \alpha})$ for all α. Therefore, when $x \in \left[1/2(1 + \sqrt{1 - \alpha}), 1/2\right]$, we also have $x \ge 1/2 - 1/8\alpha$. Therefore, whenever $x \in \left[1/2(1 + \sqrt{1 - \alpha}), 1/2\right]$, then there is an equilibrium with $y^* = x + t_-$, and the revelation set is $[x - t_-, x + t_-]$.

To summarize, the equilibrium in case 4 exists when $x \in \left[1/2(1 + \sqrt{1 - \alpha}), 1/2\right]$ or when $x \in (1/2 - 1/8\alpha, 1/2(1 + \sqrt{1 - \alpha}))$. The second interval is a valid one if and only if $\alpha > 3/4$ and collapses to a point if $\alpha = 3/4$.

Next, consider the impact of α on the judge's expected payoff (u_J^*). By Proposition 3, we know that in an equilibrium falling under case 1 or 2, u_J^* increases in α (as such a equilibrium is locally insensitive to the experts' agendas). So, we only need to consider the equilibrium that may emerge in case 4, that is, the class of equilibria where $a = 2x - y^*$ and $b = y^*$. The rest of the proof is given by the following steps:

Step 1. Under case 4, $\frac{du_J^*}{d\alpha} = -\int_{2x-y^*}^{y^*}(y^* - \Theta)^2 dF - \alpha \frac{d}{dy}[\int_{2x-y}^{y}(y^* - \Theta)^2 dF]_{y=y^*} \times \frac{dy^*}{d\alpha}$ where (A5) can be used to obtain $\frac{dy^*}{d\alpha} = \frac{2(y-x)^2}{1 - 4\alpha(y-x)}$. Simplifying, we have

$$\frac{du_J^*}{d\alpha} = -8t^3\left[\frac{1}{3} + \frac{\alpha t}{1 - 4\alpha t}\right],$$

where $t = y^* - x$. So, $du_J^*/d\alpha > 0$ if and only if $\frac{1}{3} + \frac{\alpha t}{1 - 4\alpha t} < 0 \Leftrightarrow \frac{1}{4\alpha} < t < \frac{1}{\alpha}$. We need to check whether this condition is satisfied at any of the two equilibria that emerges in this case.

Step 2. Recall that the two equilibria are given by the default actions $y^* = x + t_+$ and $y^* = x + t_-$ where t_+ and t_- are as given in (A6). Clearly, $t_- < 1/4\alpha$. So, at the equilibrium with $y^* = x + t_-$, $du_J^*/d\alpha < 0$.

Step 3. Finally, consider the equilibrium with default action $y^* = x + t_+$, which exists only when $x \in (1/2 - 1/8\alpha, 1/2(1 + \sqrt{1 - \alpha}))$. Note that $t_+ > 1/4\alpha$ and it is increasing in x; so if $t_+ \le 1/\alpha$ at $x = 1/2(1 + \sqrt{1 - \alpha})$, then it must be the case that whenever such an equilibrium exists, $t_+ \in (1/4\alpha, 1/\alpha)$. Take any $x = 1/2 - 1/8\alpha + \varepsilon$ where $\varepsilon > 0$. The corresponding value of $t_+ = 1/4\alpha + \sqrt{\varepsilon/4\alpha}$. Now, $t_+ \le 1/4\alpha \Leftrightarrow \varepsilon \le 9/4\varepsilon$. However, at $\varepsilon = 9/4\varepsilon$, $x = 1/2 - 1/8\alpha + 9/4\varepsilon > 1/2$. As $1/2(1 + \sqrt{1 - \alpha}) < 1/2$, we can claim that if $x \in (1/2 - 1/8\alpha, 1/2(1 + \sqrt{1 - \alpha}))$, we have $t_+ \in (1/4\alpha, 1/\alpha)$. Hence, in the equilibrium with $y^* = x + t_+$, $du_J^*/d\alpha > 0$.   *Q.E.D.*

Appendix B
Robustness to general reporting strategy space.

In this Appendix, we elaborate on the claim that our equilibrium characterization continues to hold if one considers a more general strategy space for the experts à la Milgrom and Roberts (1986): Suppose that for all $_i$, expert A_i is the experts are allowed to make (correct) statements of the following form: "the true state lies in the set $S_i \subseteq \Theta$", that is, the strategy space of an informed expert is the collection of all correspondences $m_i : \Theta \twoheadrightarrow \Theta$ such that for all θ, $\theta \in M_i := m_i(\theta)$. Suppose $\mathcal{M}_i$ be the set of all such strategies. On the contrary, let $\mathcal{R}_i$ be the set of reporting strategies, that is, the set of strategies available to each expert A_i in our baseline game considered in the previous proposition. Trivially, any strategy in $\mathcal{R}_i$ is also available to expert A_i when the strategy space is expanded to $\mathcal{M}_i$. The following proposition shows that for any equilibrium in the model with the restricted strategy space $\mathcal{R}_i$ (i.e., the game we have considered in our model), there exists an equilibrium in the one with the expanded strategy space $\mathcal{M}_i$ where the behavior of the experts and the judge is exactly the same, that is, (i) the judge takes the same default action y^* and (ii) the equilibrium behavior for each informed expert A_i is characterized by the same revelation set Θ_i^* such that he reports the state exactly if $\theta \in \Theta_i$ and reports the whole state space if $\theta \notin \Theta_i^*$. To formalize this result, we first need to present a few definitions.

Suppose $\mathbf{M} = \{M_0, M_1, \ldots M_{n-1}\}$ is the profile of messages sent to the judge in the game with the expanded message space. The judge infers that $\theta \in S(\mathbf{M}) = \cap_k M_k$. The state is revealed if $S(\mathbf{M})$ is a singleton. If, on the other hand, $S(\mathbf{M})$ is a strict subset of Θ, the judge knows for sure that at least one expert knows the state. We assume that the judge then takes a skeptical posture in the sense of Milgrom and Roberts (1986), adapted to the case of multiple experts.

Definition 2. For any message profile $\mathbf{M}$, let $S(\mathbf{M}) = \cap_k M_k \subset \Theta$ and $I = \{i : M_i \subset \Theta\}$ be the set of experts who report a strict subset of the state space. Then the judge is said to assume a skeptical posture if for a message profile $\mathbf{M}$, her belief $\mu(\theta \mid \mathbf{M})$ is defined as follows: there exists some $i \in I$ such that

$$\mu(\theta \mid \mathbf{M}) = \begin{cases} 1 & \text{if } \theta = \hat{\theta}_i \in \arg\min_{\theta \in S(\mathbf{M})} u_i(\theta; \mathbf{x}_i) \\ 0 & \text{otherwise} \end{cases}.$$

Proposition 8. Suppose that the strategy profile $\langle y^*(\mathbf{m}), m_i^*(\theta) \rangle$ as defined in Proposition 1 constitutes a PBE of the game where the strategy space for each expert A_i is $\mathcal{R}_i$. Then $\langle y^*(\mathbf{m}), m_i^*(\theta) \rangle$ also constitutes a PBE of the game where the strategy space available to each expert is expanded to $\mathcal{M}_i$, where the judge assumes a skeptical posture off the equilibrium path.

Proof. The proof is given in the following two steps: **Step 1**: First, note that given the strategies specified in Proposition 1, the specified beliefs are trivially consistent on the equilibrium path. If at least one expert reports the true θ, say θ^*, $\mu^* = 1$ for $\theta = \theta^*$ and 0 otherwise.

Step 2. Next, we need to show that the proposed strategies are mutual best responses given the belief μ^*. Consider the strategy of an expert A_i. Given the strategies of the judge and all rival experts, expert A_i's action affects his payoff only if all other experts fail to reveal the state (i.e., $A_j = \Theta$ for all $j \neq i$). However, if $A_j = \Theta$ and A_i reports a set $S_i \subset \Theta$ such that $\theta^* \in S_i$, then given the belief of the judge, her action is $\hat{\theta} = \arg\min_{\theta \in S_i} u_i(\theta, \mathbf{x}_i)$. So, $u_i(\hat{\theta}, \mathbf{x}_i) \leq u_i(\theta^*, \mathbf{x}_i)$. Hence, it is never a (strictly) best response for A_i to report $S_i \subset \Theta$. Thus, without loss of generality, the game boils down to the persuasion game with restricted strategy space for the experts where $m_i \in \{\theta, \emptyset\}$. Now, the proof follows directly from Proposition 1. *Q.E.D.*

Note that under the strategy profile $\langle y^*(\mathbf{m}), m_i^*(\theta) \rangle$, $S(\mathbf{M})$ is either θ (fully informative report profile) or Θ (fully uninformative report profile) and any partially informative report profile may arise only off the equilibrium path. The PBE given in Proposition 1 is supported by the following off-equilibrium belief of the judge: if she observes only one expert, say A_i, reporting a set M_i that contains multiple states but not the entire state space, she believes that the state is actually the one in $S(\mathbf{M})$ which is worst from the point of view of the expert A_i. Under such a belief, conditional on being pivotal (when all other experts send uninformative reports), *partial* obfuscation through reporting a subset of the state space is always weakly worse than reporting the state itself. Thus, Proposition 8 shows that there is limited loss of generality in considering a restricted strategy space, and we maintain this simpler formulation as it considerably improves the analytical tractability of our model.

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