DISCUSSION PAPER SERIES

No. 6168

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ISSN 0265-8003

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Discussion Paper No. 6168
March 2007

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CEPR Discussion Paper No. 6168

March 2007

ABSTRACT

Why a Group Needs a Leader: Decision-making and Debate in Committees.*

I develop a model of group decision-making, in which a committee generates proposals and holds open discussions, but the ultimate decision is either taken by a leader (decision by authority) or by majority vote. Optimal communication processes are studied that combine both cheap talk statements (proposals) and costly state verification (discussions). I show that by favouring one particular agent — the leader — authoritative decision-making reduces rent-seeking discussions and often results in a higher decision-quality relative to majority decision-making. Institutions which guarantee a "right to voice" by separating the roles of decision maker and discussion leader may further improve efficiency.

JEL Classification: D71, D72, D82 and D83
Keywords: authority, committees, debate, group decision-making, leadership and majority rule

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* I have benefited from discussions with Luis Garicano, Canice Prendergast, Larry B. Mohr, Eric Van den Steen and seminar participants at the 1st MIT-NBER Organizational Economics Conference, the University of Pensylvania and the University of Chicago, and research assistance by Karen F. Bernhardt-Walther and Jessica Pan. A previous version of this paper was circulated under the title: “Hierarchies versus Committees." Email:
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Submitted 15 February 2007

"Rudi's brilliant. He's a tyrant; no, not a tyrant, a dictator. He has to be. You don't have a leader if you don't have a dictator. If you don't have a dictator, you won't be successful. Show me a company run by democracy, and I'll show you a loser. There's always got to be one chief and plenty of Indians"[1]

(First violinist:) "I am a bit of dictator. It just seems logical that I decide. [...] I don't think a democratic quartet can work. I think everybody recognizes that." His cellist concurred: "You must go with the first".[2]

1 Introduction

Freedom of speech and democracy are core values of modern societies. Most organizations operating in these societies, however, are far from democratic. While firms tend to encourage open discussions and debate – and set-up numerous committees and task-forces for this purpose – final decision authority often lies with a task leader, a chairman or the chief executive. In many firms, therefore, the term group decision-making simply refers to the ability of group members to generate proposals and voice their opinion on matters, not to a democratic process. Even in the political arena, democratic decision-making is not always a panacea. In April 2005, citing his "near imperial power", Time Magazine selected Chicago's Richard W. Daley as one of America's *five best big city mayors*. "Daley's unchecked power sometimes short-circuits public debate," but "most of Chicago would have it no other way". Similarly, in many Asian countries, a strong leader is often preferred over a democracy.

Why are most modern firms not run by democracy? When is decision authority best allocated to a leader, even if this leader has his own agenda? To address these questions, I consider decision-making by a small team of equally knowledgeable and equally motivated agents. I ask whether, despite this apparent symmetry, there is any reason for decision-making to be *asymmetric*. Is there any benefit to create a first-among-equals, to give one agent a bigger weight in the decision-making process?

In the proposed model, a group of agents faces a problem or opportunity and needs to agree on a course of action (choice of restaurant, a new hire, a project, a policy or procedure). Information is dispersed in the sense that each group member may come up with an idea

[1] Senior executive quoted in "Rudi Gassner and the Executive Committee of BMG International", HBS Case 494-055, p12.

[2] String quartet members quoted in "The Dynamics of Intense Work Groups: A Study of Britisch Spring Quartets", Murninghan and Conlon (1991), p 174.

whose merits are only known to themselves.[3] Members must decide whether or not to propose their idea and the group must decide how much resources to spend on discussions which may reveal the merits of proposals. Conflicts of interests arise as members are biased towards their own idea. At first sight, democratic decision-making is very attractive in this setting: A majority rule results in unbiased decision-making whereas potential leaders are self-interested and favor their own ideas. Yet, as I show, decision-making by authority is typically preferred over decision-making by majority. Not only does authoritative decision-making result in lower communication costs (that is, fewer discussions), the quality of decisions is often better. The intuition for this result is simple. A leader is pre-disposed towards his own idea and has the final authority to implement this idea. The leader's proposal, therefore, constitutes a default decision that can only be overturned by proposals which are clear improvements. As a result, only group members who are convinced of the merits of their alternative proposal are willing to challenge the leader. Similarly, as the leader has final decision authority, he has limited incentives to distort information about his own proposal. Under majority rule, in contrast, there is no such default decision and all group members have strong incentives to lobby in favor of their idea, regardless of its merits. Relative to a democracy, a dictator therefore short-circuits debate, but this comes mainly at the expense of rent-seeking discussions that do not improve the quality of decisions.[4]

A key feature of the model is that communication occurs through a combination of soft information (Crawford and Sobel (1982)) and hard information ((Milgrom (1981), Milgrom and Roberts (1986)). Agents *propose* their idea by issuing a 'cheap talk' statement about its quality. An agent, for example, can claim: " I know a terrific restaurant." Following a proposal, the group can engage in a *discussion* about the proposal. Discussions are modeled as a costly state verification of a proposed idea: the group can launch a time-consuming investigation in order to assess the true value of a proposal. Whereas proposing an idea involves negligible communication costs, discussions are costly since they delay the implementation of a solution and waste the time of group members. The model endogenizes the number and average quality

[3] Group members are equally knowlegeable, however, since each possesses the same amount of private information.

[4] Our rationale in favor of decision-making therefore draws upon the literature on *influence costs* (Milgrom (1988), Milgrom and Roberts (1988,1990), Meyer, Milgrom and Roberts (1992)). This literature argues that members in organizations often spend considerable time and effort in attempting to influence decision-makers, time which could be otherwise used in more productive activities. Optimal decision processes should therefore try to limit these influence activities. Whereas most of this literature assumes that influence activities are a pure waste, in our model they take the form of agents proposing ideas and subjecting them to group discussion.

of proposed ideas, and how much discussion a proposal tends to generate. In doing so, the model *endogenizes communication costs* in organizations*:* the only reason why communication is costly is because agents may have an incentive to misrepresent the value of their idea, inducing the group - or the leader - to investigate the proposal in greater detail.[5]

Since there are, a priori, many ways in which the communication process could be structured, I adopt a mechanism design approach where the extensive form of the decision process, combining cheap talk and costly state verification, is designed by either the leader (under authoritative decision-maker) or the median voter (under majority decision-making). The only constraint imposed is that this extensive form must be time consistent. The median voter/leader, for example, cannot commit ex ante to engage in a discussion whose costs outweigh the informational benefits ex post.[6]a

As a key insight, I show that favoring a particular group member – the leader – tends to improve decision-making both in terms of communication costs and decision quality. Under authoritative decision-making, the leader's solution is chosen unless an alternative proposal is shown to be clearly better. Whereas this discourages other group members from proposing mediocre ideas, it does not refrain them from advocating high quality ones. Authoritative decision-making thus avoids discussions whose main purpose is to move rents from one agent (the leader) to another agent, but have little impact on the quality of the decision. In contrast, the absence of a clear default under majority decision-making implies that agents lobby in favor of their idea regardless of its merits. Since proposals (cheap talk) contain little or no information, the group then must rely on time-consuming discussions (hard information) in order to select a proposal. Majority decision-making not only results in more discussions, the decision quality also tends to be lower. Intuitively, since the average quality of proposed ideas is lower and discussions are often non-conclusive, the final decision often ends up being of a lower quality too.

Figure 1, which summarizes our main results and is discussed in more detail in section 6, shows the optimal decision process as a function of the incentive conflict between members

[5]The notion that soft information can be made "hard" at a cost is also present in Dewatripont and Tirole (2005), which emphasizes moral hazard problems in communication as well as different modes (issue-relevant and issue-irrelevant) of communication and in Caillaud and Tirole (2006), who study the strategies that the sponsor of a proposal may employ to convince a group to approve the proposal. Unlike our paper, the above papers do not provide normative results regarding decision processes such as majority decision-making or dictatorship. They take the authority structure as given and focus on the type of communication strategies used in equilibrium.

[6]By adopting a mechanims design approach to structuring the communication process, we follow Caillaud and Tirole (2006). Cheap talk plays no role in the latter paper though.

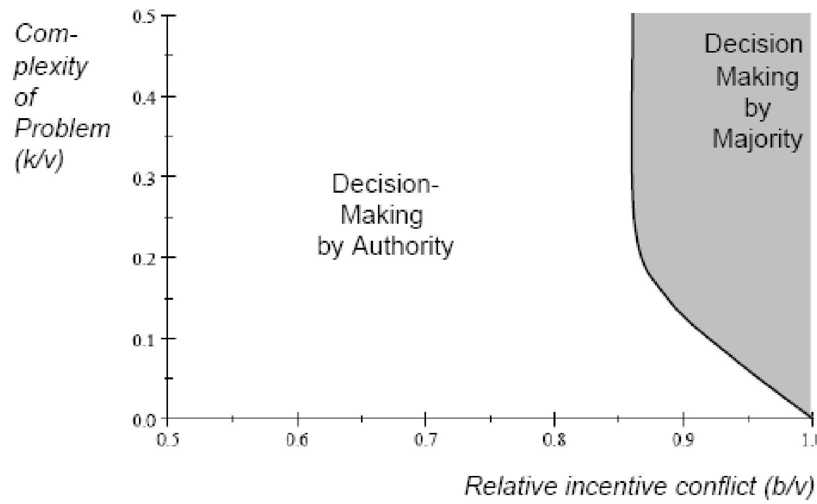

Figure 1: Optimal decision process when mediocre and high-quality ideas are equally likely.

and the complexity of the problem, both of which will be defined in Section 2. When incentive conflicts are moderate, authoritative decision-making is always preferred. If incentive conflicts are sufficiently large and problems sufficiently complex, however, the leader becomes *dismissive* of alternative proposals: she combines a suboptimal low level of discussion with a tendency to stick to her own mediocre ideas whenever a discussion is non-conclusive. Majority decision-making is then preferred unless one can ensure that alternative ideas receive sufficient attention. In particular, if it is feasible to appoint an independent moderator who ensures sufficient debate prior to any decision, then majority decision-making is never be optimal in Figure 1. Separating discussion authority from decision authority, however, is not always recommended. If problems are sufficiently simple and the incentive conflict is moderate, the leader actually engages in a more discussion than an independent moderator would. The leader then optimally controls the discussion as this provides the necessary commitment that prevents other group members from proposing mediocre ideas.

Related Literature: In addition to the papers mentioned above, this paper is related to and draws upon a number of literatures. The idea that decision-making by authority saves on communication costs has been put forward informally by Arrow (1974), Williamson (1975) and Chandler (1977). Williamson's argument is exemplary and goes as follows:

"Consider the problem of devising access rules for an indivisible physical asset which can be utilized by only one or a few members of the group at a time. (...) While a full group discussion may permit one of the efficient rules eventually to be selected, how much simpler if instrumental rules were to be "imposed" authoritatively. (...) Assigning the responsibility to specify access rules to whichever member occupies the position at the center avoids the need for full group discussion with little or no sacrifice in the quality of the decision. Economies of communication are thereby realized."[7]

Williamson's reasoning, however, fails to explain why a group would engage in long and costly discussions whose informational benefits do not outweigh the costs. I consider a set-up similar to the one proposed by Williamson, but endogenize the communication costs that each decision process generates. I find that decision-making by authority not only saves on communication costs, as assumed by Williamson, but also may result in decisions of higher quality. Williamson, in contrast, implicitly assumes a trade-off between communication savings and decision quality. One of the few papers to formalize the benefits of a central authority in terms of speedy decision-making is Bolton and Farrell (1990).[8] In their model, two firms contemplate sinking costs to enter a natural monopoly market. Under decentralization, firms with a high cost structure postpone entry in order to avoid duplication. Under centralization, a central planner picks an entrant at random. Centralized decision-making therefore avoids delays, but makes no use of private information. Unlike this paper, Bolton and Farrell do not allow for communication. Decentralization is also not feasible in the present model as group members must agree on a particular solution.

A fast growing literature on decision-making in committees has analyzed, among other things, incentives for information acquisition in committees (Persico (2004)) the impact of career concerns on strategic voting (Levy (2007), Swank and Visser (2007)) and the impact of communication prior to voting (Gerardi and Yariv (2007), Swank, Swank and Visser (2006)). Whereas considerable attention has been devoted to the impact of voting rules on voting behavior, this debate is often focussed on the comparison between majority and unanimity rule (see, e.g., Austan-Smith and Feddersen (2002)).[9] To my best knowledge, no paper has demonstrated the optimality of a dictator in committee decision-making.

[7] Williamson (1975), Chapter 3: Peer Groups and Simple Hierarchies, pp 46-47.

[8] Also Segal (2007) formalizes the idea that authority saves on communication costs, but incentives conflicts play no role. Communication problems arise because agents do not share a common labelling and need to describe potential actions, which is costly. Wernerfelt (2007) argues that a group of peers may delegate authority to a small committee of managers in order to economize on decision-making time.

[9] Unanimity biases the decision towards the status quo. My model differs from most of the literature on

Communication in committees, if allowed, is typically modeled as cheap talk. Interestingly, Li, Rosen and Suen (2000) analyze the optimal structure of collective decision-processes when communication takes the form of cheap talk, and show that voting procedures arise endogenously as the equilibrium method of aggregating dispersed information. Besides decision-making in committees, the classic cheap talk model by Crawford and Sobel (1982) has recently been applied to analyze the value of consulting multiple experts (Krishna and Morgan (2000), Ottaviani and Sorensen (2001), Battaglini (2002)), the value of delegation to an expert (Dessein 2002), the relative efficiency of vertical and horizontal communication (Alonso, Dessein, Matouschek (2006)), and most closely related to this paper, the optimal structure of collective decision-processes (Li, Rosen and Suen (2000)).[10] Relative to this literature, the present paper enriches communication by adding a discussion stage in which the decision-maker(s) have the option to verify cheap talk statements at a cost. As I show, the prospect of such a discussion stage makes the initial cheap talk stage more informative under authoritative decision-making.

Finally, this paper contributes to a nascent literature which argues that firms may benefit from employing a CEO whose vision biases him in favor of certain projects (a strong leader), as opposed to a purely profit-maximizing CEO (a weak leader). In particular, a strong vision may improve incentives for employees or partners of the firm to undertake strategy-specific investments (Rotemberg and Saloner (2000)) and will attract, through sorting in the labor market, employees with similar beliefs (Van den Steen (2005)).[11] Unlike this paper, the above papers do not study alternative decision processes and group-decision making and communication play no role in their analysis.

Outline: The remainder of the paper proceeds as follows. Section 2 presents the basic model. Section 3 analyzes a benchmark case in which cheap talk is the only means of communication. Sections 4 and 5 characterize the equilibrium under majority decision-making and under authoritative decision-making respectively. Section 6 compares these two decision processes. Section 7 analyzes when it may be optimal to separate discussion authority from decision authority. Section 7 concludes. Most proofs are relegated to the Appendix.

committees in that the status quo is never a viable option: group members prefer any alternative over the status quo. Unanimity, therefore, is ill-defined.

[10] Farrell and Rabin (1997) provide an overview of other cheap talk applications.

[11] See also Ferreira and Rezende (2005), who endogenize commitment to a publicly announced strategy as the result of carreer concerns rather than some exogenous bias or belief.

2 The Model

2.1 Basic Structure

A committee consisting of N members must formulate a response to a problem or an opportunity. Two group members, denoted by L and R, have an idea as to how to solve the problem or exploit the opportunity, but only one of these ideas can be implemented. A decision process, consisting of a communication stage and a vote on L or $R's$ idea, determines which idea is selected.

Payoffs– With an independent probability α, an idea by L or R is 'high quality' and yields benefits v_H to all group members. With a probability $1-\alpha$, it is 'mediocre' and yields benefits $v_L < v_H$. To reduce notation, I normalize $v_L = 0$ and denote $v = v_H$. The status quo (that is choosing no idea at all) yields a strictly negative pay-off. In addition to v, the 'sponsor' of the idea – the group member who conceived the idea – also derives a private benefit $b > 0$ from his idea being implemented. This assumption is realistic: In developing ideas, group members will tend to focus on solutions which are self-serving or, in case of inter-divisional committees, have positive distributional consequences for their division.[12] For example, group members may come up with solutions who exploit their human capital, skills or specific knowledge. Therefore, if adopted, they will probably play a leading role in the implementation of this solution or idea, resulting in additional opportunities for rent extraction, skill development, organizational influence or benefits of control. The ratio b/v is a measure of the *incentive conflict* in the organization. When b/v is larger than α, for example, agent L prefers his own mediocre idea over a random idea by R. Agent L may then have an incentive to falsely claim that his mediocre idea is high quality.

Communication— The quality of an idea is privately known by its sponsor, L or R, but can be revealed in two ways: First, both L and R can *propose* their idea, that is, describe it and make a statement about its quality. This communication of *soft information* is 'free': Committee members do not incur any costs by listening to these statements. Second, in order to assess the true value of the proposals — make the soft information *hard* — the group may decide to engage in a *discussion* (debate the problem or opportunity at hand, read numerous reports, order expert advice). In particular, the group can learn the true value of all proposals with

[12] The latter assumes that an agent is subject to an (implicit or explict) incentive scheme which rewards positive performance by the division.

probability d by incurring a cost $g(d)$ per group member.[13] I will refer to d as the *discussion intensity* and for tractability, I assume that

$$g(d) \equiv kd^2/2$$

The discussion costs $g(d)$ reflect the delay in the implementation of a solution and the opportunity cost of time of the group (as long as a particular problem is not solved, other problems or opportunities lack attention). The parameter k is best interpreted as a measure of the complexity or urgency of the problem. Since all members loose valuable time or suffer from a delay in the resolution of a problem, I assume that $g(d)$ is incurred by each committee member.[14]

Decision processes.— I assume that the organization has no commitment power except for the allocation of voting rights. A decision process then consists of (i) an extensive form of the communication game and (ii) a voting rule. I will focus on two voting rules:[15]

- Authoritative decision-making: The discussion intensity, d, and the final decision are decided by group member L.[16]

- Majority decision-making: The discussion intensity, d, and the final decision are decided by majority vote.

In section 7, I will consider authoritative decision-making with voice, where the final decision is still taken by the leader L, but the discussion intensity, d, is decided upon by an independent moderator: one of the neutral members of the committee.

[13] Alternatively, one could assume that ideas must be investigated sequentially, where $g(d)$ must be incurred for each new idea under discussion. Since two ideas need to be discussed under majority decision-making but only one under authoritative decision-making, the discussion technology assumed in this paper favors majority decision-making (and, hence, works against our main result).

[14] An alternative modeling assumption would be that $g(d)$ is only incurred by the sponsor of an idea, reflecting the time and effort put into preparing an argument, a presentation or collecting supporting evidence. As in the current set-up, an agent then only proposes an idea if he believes there is a reasonable chance that this idea will be effectively implemented. Similar qualitative results are therefore likely; authoritative decision-making may even be more attractive as then only one agent needs to incur the cost $g(d)$ compared with two agents under majority decision-making.

[15] Provided that the status quo yields a sufficiently negative outcome, all other voting rules are either equivalent to majority decision-making or plagued by multiple equilibria. Under decision-making by unanimity, for example, two possible equilibria are majority decision-making and authoritative decision-making.

[16] Our result would be equivalent if R were to be the dictator. As we will show later, giving control to one of the uninformed members is equivalent to majority decision-making as an uninformed member is always the median voter.

I will say that a decision is compatible with majority vote if and only if this decision is weakly preferred by a majority of the group over any other decision. In order to simplify the analysis, I assume that in addition to L and R there are at least 3 other members in the committee, that is $N \geq 5$. This implies that (i) the group always chooses the idea of the highest expected quality and (ii) communication costs $g(d)$ are only incurred if the latter are justified by the expected informational benefits.[17] Majority decision-making is then equivalent with giving authority to one of the neutral members (or put differently, one of the neutral members is always the median voter).

I adopt a mechanism design approach to decision-making in that the extensive form of the communication game is designed either by one of the neutral members (under majority decision-making) or by the leader L (under authoritative decision-making). The only restriction I impose is that the extensive for must be incentive compatible: the neutral members (under majority decision-making) or the leader L (under authoritative decision-making) must not want to change the extensive form ex post. Similarly, I allow the designer to instruct group members how to vote as long as this is incentive compatible.

3 Cheap Talk Benchmark

A key feature of communication in my model is that it consists of both soft information (cheap talk statements about the value of ideas) and hard information (costly discussions which may reveal the true value of ideas). To set the stage for the analysis, however, I first analyze decision-making when communication consists only of soft information. That is, communication consists of L and R simply making a cheap talk statement about the quality of their idea. As I show, whether or not decision-making is by majority or by authority is then irrelevant from an efficiency point of view. In particular, when incentive conflicts as measured by b/v are limited, group members can be trusted to truthfully reveal the quality of their idea, and both majority decision-making and authoritative decision-making implement the first-best. When the incentive conflict b/v exceeds a threshold, cheap talk is pure noise. Again, both decision-processes are then equally (in)efficient: the group selects a random idea, whereas a dictator always selects his own idea.

[17] Observation (i) would still hold if there was only one neutral committee member, as both L and R either vote for their own idea or for the idea with the highest expected quality. L and R, however, may advocate an inefficiently high discussion intensity d in order to signal the quality of their idea. By assuming at least three neutral committee members, I avoid having to deal with such spurious signalling equilibria.

Majority decision-making Consider the following decision-process which implements majority rule:

- Communication strategy: L and R propose their idea (e.g. raise their hand) if and only if their idea is high-quality idea.
- Decision rule: If only one idea is proposed, this idea is selected. If no idea or two ideas are proposed, the group randomly selects an idea.

Obviously, this decision-process implements the first best if it is incentive compatible and agent L and R never propose a mediocre idea. Now, consider the case where L has a mediocre idea and is deciding whether or not to propose it. Regardless of $R's$ communication strategy, by proposing a mediocre idea, L increases the probability of adoption of this mediocre idea by 1/2. If $R's$ idea is mediocre as well (probability $1-\alpha$), this adoption increases $L's$ pay-off with b. If instead $R's$ idea is high-quality (probability α), adoption decreases $L's$ pay-off by $v - b$. It follows that the communication structure is incentive compatible if and only if

$$(1-\alpha)\frac{1}{2}b - \alpha\frac{1}{2}[v-b] \quad \leq \quad 0 \tag{1}$$

$$\iff \quad b \leq \alpha v \tag{2}$$

Thus, if $b \leq \alpha v$, each group member can be trusted to truthfully reveal the quality of his idea and majority decision-making implements the first best. If, in contrast, the incentive conflict is pronounced, that is $b > \alpha v$, then given the above decision rule, cheap talk is not credible anymore: both L and R always propose their idea and the group always selects an idea at random. I will refer to $b \leq \alpha v$ as the *cheap talk constraint*. In the Appendix, I show that for $b > \alpha v$, any other extensive form of the communication game (communication could be sequential, for example) and any other decision-rule compatible with majority vote (one could always select $R's$ idea in case of a tie, for example) yields an equilibrium outcome which is economically equivalent to randomly selecting an idea.

Authoritative decision-making. Consider now authoritative decision-making where L is the decision-maker. It is easy to see that whenever $b \leq \alpha v$, the following decision-process is incentive compatible and achieves first best:

- Communication strategy: R always proposes his idea.

- Decision rule: L accepts $R's$ proposal if and only if his own idea is mediocre.

When $b > \alpha v$ the above decision-process is not incentive compatible anymore as L then strictly prefers to implement his own idea, knowing that the average quality of a proposed idea is given by αv. More generally one can show that for $b > \alpha v$, there exists a unique equilibrium in which L always implements his own idea.[18]

I conclude as follows

Proposition 1 *If cheap talk is the only means of communication, then authoritative decision-making and majority decision-making are equally efficient: Both yield first best for $b \leq \alpha v$, whereas decisions reflect no information when $b > \alpha v$.*

The above proposition shows that authoritative decision-making has no inherent advantage in information processing when communication occurs through cheap talk. In what follows, I enrich communication by allowing the group to engage in costly and time-consuming discussions which may verify the true quality of proposals. Since discussions add no value unless $b > \alpha v$, I will make the following assumption for the main analysis:

A1: The cheap talk constraint is violated: $b > \alpha v$.

In section 7.3, I briefly return to the case where the cheap constraint is satisfied.

4 Decision-making by Majority

Under majority decision-making, decisions are effectively made by the neutral members in the committee. I adopt a mechanism design approach to communication by letting the neutral members design the extensive form of the communication game. This process will also be (constraint) efficient since the neutral members are unbiased and internalize communication costs. The only restriction on the extensive form is that it must be time consistent: the neutral members must not want to change the extensive form ex post. Similarly, the neutral members may instruct L and R which messages to send, but these instructions must be incentive compatible.

[18] Indeed, if there were a message that R could send which would induce L to accept $R's$ idea with positive probability, then R would always send this message. But given that $b > \alpha v$, L would have no incentive to accept such a proposal, even if his own idea were to be mediocre.

4.1 Communication design

The following observations will help us identify an incentive-compatible extensive form that maximizes efficiency:

1. There is no loss in efficiency in restricting the message space to $M = \{propose, not\ propose\}$ and instruct group members with a high-quality idea to send the message $m_i = propose$.[19] An agent $i \in \{L, R\}$ is said to propose his idea if $m_i = propose$.

2. Efficiency cannot be improved by having more than one round of cheap talk.[20]

3. It is weakly optimal to let L and R send a cheap talk message before engaging the group in a discussion.[21]

4. In an incentive-compatible decision process, if agent $i \in \{L, R\}$ proposes an idea, but agent $j \neq i$ not, then agent $i's$ idea is always selected and the group does not engage in a discussion ($d = 0$). Similarly, the group does not engage in a discussion ($d = 0$) if neither L nor R propose their idea.[22]

4. A decision-process which has an informative cheap talk stage following an uninformative discussion cannot be incentive compatible.[23]

Observations 1 to 5 imply the following:

Lemma 1 (communication design by majority) *Under majority decision-making, efficiency is maximized by adopting a decision-process which has the following extensive form:*
(1) Cheap talk stage: Agent i, $i = L, R$*, sends a message* $m_i \in \{propose, not\ propose\}$*.*
(2) Discussion stage: If and only if $\{m_L, m_R\} = \{propose, propose\}$ *, the group chooses a discussion intensity* $d > 0$ *and engages in a discussion.*
(3) Decision stage: The group selects an idea.

[19] The argument is straightforward and is omitted.

[20] If there are n rounds of cheap talk and one of these rounds is fully or partially informative, then all the previous rounds must be non-informative. A proof is provided in Appendix B.

[21] If this cheap talk is non-informative, it does not matter. If this cheap talk is informative, however, it will always improve the average pay-off.

[22] Since an agent with a high-quality idea always proposes this idea, an agent who does not propose his idea must have a mediocre idea. Obviously, a discussion never has value if at least one idea is know to be mediocre.

[23] If partially revealing cheap talk is incentive compatible after a non-informative discussion, then fully revealing cheap talk must be incentive compatible as well. Indeed, L's incentives to propose a mediocre idea are decreasing in the probability that R proposes a mediocre idea. Postponing such fully revealing cheap talk untill after a costly discussion, however, is never incentive compatible.

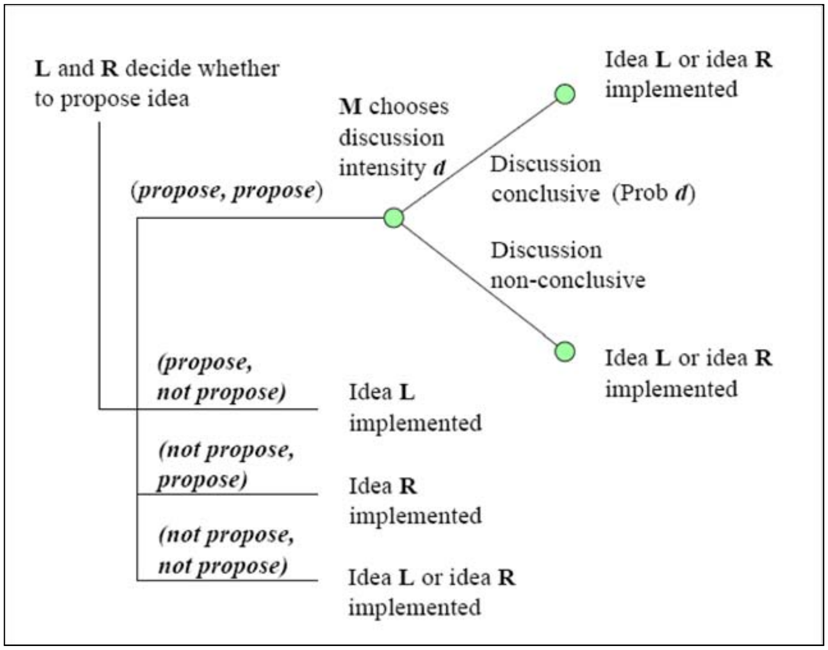

Figure 2: Optimal communication design under majority decision-making.

Lemma 1 does not put any restriction on the sequence of messages in the cheap talk stage (sequential versus simultaneous). In the main text, I will assume that L and R communicate simultaneously. In Appendix, I show that efficiency cannot be improved by letting one agent report first. Figure 2 summarizes the extensive form of the communication game under majority decision-making, where M refers to the median voter (one of the neutral committee members):

4.2 Equilibrium

I now show that the prospect of adding a discussion stage following the cheap talk stage never renders this cheap talk stage informative. Obviously, adding a discussion stage can never result in fully revealing cheap talk communication. Indeed, if cheap talk were fully informative, the group would have no incentive to engage in a costly discussion. Consider, therefore, equilibria that involve partial truthtelling where agent $i \in \{L, R\}$ proposes a mediocre idea with probability $p_i \in [0, 1]$. Denoting by $\mu(p_i)$ the probability that an idea *proposed* by agent $i \in \{L, R\}$ is high quality, then

$$\mu(p_i) \equiv \frac{\alpha}{\alpha + (1-\alpha)p_i} \in [\alpha, 1]\,. \tag{3}$$

where α is the ex ante probability that an idea is high quality.

In Appendix B, I show that asymmetric equilibria where $p_L < p_R$ can be ruled out if one assumes that whenever a discussion reveals both L and R to be mediocre, then the group selects the idea of the agent who is more credible, that is for whom $\mu(p_i)$ is highest. This assumption arises endogenously if one relaxes the all-or-nothing nature of discussions. In particular, consider the equilibria of the game where with a probability ε the discussion produces a signal which is pure noise but cannot be distinguished from an informative signal. The informative signal occurs with probability $d - \varepsilon$:

Equilibrium Refinement (ER): I restrict attention to equilibria which are consistent with $\varepsilon > 0$ but arbitrarily small..[24]

In Appendix B, I show that (ER) implies the following:

Lemma 2 (asymmetric proposal equilibria) *Given (ER), no asymmetric equilibria exist where $p_L > p_R$ or $p_R > p_L$.*

Let us therefore denote $p = p_R = p_L$. Conditional on two proposals being made, a discussion has value only if one proposal is high-quality and the other one is mediocre, which occurs with probability $2(1 - \mu(p))\mu(p)$. With probability d the group then finds out which proposal is high-quality, whereas with probability $(1-d)$, it simply selects a proposal at random. It follows that following two proposals, the surplus maximizing discussion intensity d is given by

$$d^* = \arg\max_d \left\{ 2(1 - \mu(p))\mu(p)d \left[v - \frac{v}{2} \right] - kd^2/2 \right\},$$

or still

$$d^* = \min \{1, (1 - \mu(p))\mu(p)v/k\}$$

Only d^* is consistent with majority decision-making as d^* is strictly preferred over any other $d \neq d^*$ by a majority of the group members.

In Appendix B, I further show that unless $p_L = p_R = 1$, no equilibrium exists in which the group 'favors' agent L or agent R. For example, one could conceive of a candidate equilibrium in which the group always picks the idea of R, except when R does no propose his idea or a discussion reveals $L's$ idea to be high-quality. I show, however, that favoring agent R results in R being more eager to propose a mediocre idea than agent L. But then either $p_R = p_L = 1$

[24] More formally, consider an equilibrium where $a(x)$ is the probability of action x being played. This equilibrium is consistent with the equilibrium refinement (ER) if for any $\delta > 0$, there exists an $\varepsilon > 0$ and a corresponding equilibrium characterized by probabilities $a(x, \varepsilon)$, such that for any action x with $a(x) > 0$, $|a(x) - a(x, \varepsilon)| < \delta$.

or $p_L < p_R$, in which case the group strictly prefers to favor $L's$ idea since L is more credible! Hence, no 'favoring' equilibrium exist in which cheap talk is informative. Without loss of generality, I can therefore focus on 'equal treatment' equilibria where the group randomizes between $L's$ and $R's$ idea whenever there is a 'tie': a discussion is uninformative, a discussion reveals both ideas to be mediocre or neither L nor R proses their idea.

Given such 'equal treatment', if both L and R have a mediocre idea, then regardless of p and d, a proposal by L raises the probability of adoption of $L's$ idea by $1/2$.[25] If R has a high-quality idea, then a proposal by L reduces the probability of adoption of $R's$ high-quality idea by $(1-d)/2$. Finally, if R also proposes his idea, a proposal by L results in communication costs $kd^2/2$ for all group members. Thus, the expected value to L of proposing a mediocre idea is given by

$$V_p \equiv \frac{1}{2}(1-\alpha)b - \frac{1}{2}\alpha\left[1-d\right](v-b) - \left[\alpha + (1-\alpha)p\right]kd^2/2. \tag{4}$$

Substituting d^*, this yields

$$V_p \equiv \frac{1}{2}(1-\alpha)b - \left[\alpha + (1-\alpha)p\right]k/2.$$

if $d^* = 1$, and

$$\begin{aligned} V_p \quad &\equiv \quad \frac{1}{2}(1-\alpha)b - \frac{1}{2k}\alpha\left[k - (1-\mu(p))\mu(p)v\right](v-b) \\ &\quad -\frac{1}{2k}\left[\alpha + (1-\alpha)p\right](1-\mu(p))^2\mu(p)^2v^2 \end{aligned}$$

if $d^* < 1$. In Appendix, I show that whenever cheap talk is non-informative in the absence of discussions, that is the cheap talk constraint $b \leq \alpha v$ is violated, then cheap talk is also non-informative when discussion are feasible: $V_p > 0$ for any p.

Lemma 3 (Proposals are non-informative under majority) *If the cheap talk constraint is violated, no equilibrium exists where $p < 1$.*

Lemma 3 highlights the inefficiency of majority decision-making: Agents always propose their own idea regardless of its quality ($p = 1$). In order to select an idea, the group then always needs to engage in time-consuming discussion whose intensity is given by

$$d^* = \min\left\{1, (1-\alpha)\alpha v/k\right\}$$

[25] If R proposes his idea, then $R's$ idea is definitely implemented if L does not propose. In contrast, proposing give L a $1/2$ chance of adoption. Similarly, if R does not propose his idea, then by proposing, L is guaranteed of adoption. Not proposing only yields a $1/2$ chance.

since $\mu(p) = \alpha$ if $p = 1$. The fact that agents always lobby in favor of their own idea not only results in wasteful discussions, the group may also fail to implement an available high-quality idea. Indeed, whenever the problem at hand is sufficiently complex, that is $k > k^m$ with

$$k^m \equiv \alpha(1-\alpha)v \tag{5}$$

then discussions are often inconclusive ($d < 1$) and with probability $(1-\alpha)\alpha(1-d)$ the group selects a mediocre idea even though a high-quality one is available. The following proposition summarizes the equilibrium under majority decision-making:

Proposition 2 (Majority decision-making) *There exists a unique equilibrium in which L and R always propose their idea ($p = 1$). If $k < k^m = \alpha(1-\alpha)v$, then $d = 1$ and the best idea is always selected. In contrast, if $k > k^m$ then $d < 1$ and with probability $1 - d > 0$, a project is selected at random.*

5 Decision-making by Authority

Consider now the decision process where L selects a solution after consulting R. I will refer to L as '*leader*' and R as the '*advisor*'. A mechanism design approach to communication is again adopted. The leader L designs the extensive form of the communication game subject to the restriction that the latter is time consistent: L may not want to change the extensive form ex post. Similarly, L may instruct R which messages to send, but these instructions must be incentive compatible.

5.1 Communication design

The following observations will be useful in identifying an incentive-compatible extensive form that maximizes expected payoffs of the leader:

1. The leader always implements her idea if it is high quality. Since the advisor knows that his advice only matters if L has a mediocre idea, the leader cannot improve her pay-off by sending a cheap talk message to the advisor.

2. There is no loss to the leader in restricting the message space to $M = \{propose, not\ propose\}$ and instruct R to send the message $m = propose$ when he has a high-quality idea.[26]

[26] That is, any other cheap talk design will be at best economically equivalent. The argument is straightforward and is omitted.

3. The leader cannot improve her pay-off by having more than one round of cheap talk.[27]

4. It is weakly optimal for the leader to let R send a cheap talk statement before engaging in a discussion.[28]

5. If agent R does not propose his idea, then L always implements her own idea and $d = 0$.

6. A decision-process which has an informative cheap talk stage following an uninformative discussion cannot be incentive compatible.[29]

Observations 1 to 6 imply the following:

Lemma 4 (communication design authority) *Under authoritative decision-making, the leader L cannot do better than adopting a decision-process which has the following extensive form:*
a. If the leader has a high-quality idea, she implements this idea
b. If the leader has a mediocre idea, she consults her advisor, and
(b.1) Cheap talk stage: Agent R sends a message $m \in \{propose, not\ propose\}$.
(b.2) Discussion stage: If and only if $m = propose$, the leader chooses a discussion intensity $d > 0$ and engages in a discussion.
(b.3) Decision stage: the leader selects an idea.

Figure 3 summarize the extensive form under authoritative decision-making:

5.2 Equilibrium

I now analyze whether the prospect of a discussion stage may induce more truthful communication in the cheap talk stage. Recall that if discussions are not feasible, cheap talk is uninformative whenever $b > \alpha v$. Again, adding a discussion stage can never result in fully revealing cheap talk communication. Indeed, if cheap talk were fully informative, the leader would have no incentive to engage in a costly discussion. Consider therefore equilibria that involve partial truthtelling where R proposes a mediocre idea with probability $p \in [0, 1]$. Similar

[27] The proof is straightforward and is omitted.

[28] If this cheap talk is non-informative, it does not matter. If this cheap talk is informative, however, it will alway improve the average pay-off.

[29] If partially revealing cheap talk is incentive compatible after a non-informative discussion, then fully revealing cheap must be incentive compatible as well. Postponing such fully revealing cheap talk untill after a costly discussion, however, is never incentive compatible.

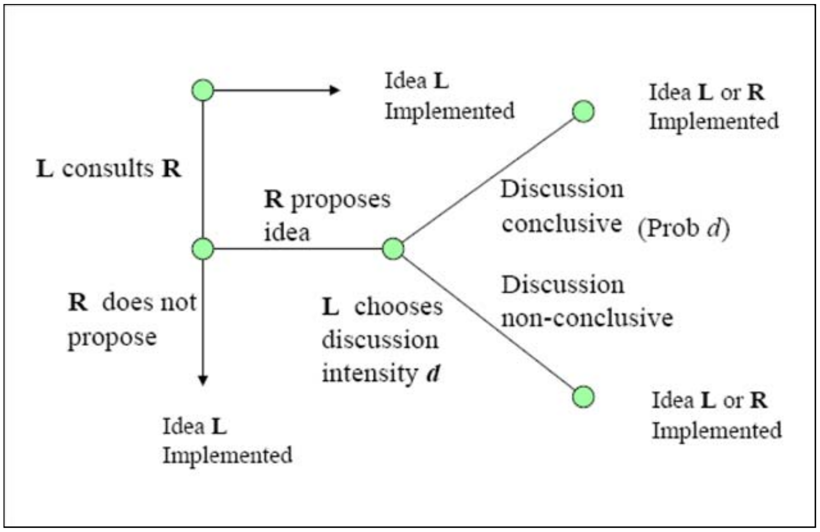

Figure 3: Optimal communication design under authoritative decision-making.

to before, I denote by $\mu(p)$ the probability that an idea proposed by R is high quality, then

$$\mu(p) \equiv \frac{\alpha}{\alpha + (1-\alpha)p} \in [\alpha, 1]\,. \tag{6}$$

where α is the ex ante probability that $R's$ idea is high quality. If $b > v$, then the leader always prefers his own idea. Hence, cheap talk is irrelevant and the leader never engages in a discussion ($d = 0$). In contrast, if $b < v$ and $p > 0$, the leader L will find it optimal to engage in a discussion of intensity $d > 0$ whenever R proposes an idea. Following an informative discussion, the leader then adopts a high quality proposal by R, but rejects a mediocre one, preferring instead to adopt her own mediocre idea. If a discussion is uninformative, the leader adopts a proposal by R only if

$$\mu(p)v \geq b \tag{7}$$

It follows that p must be such that $\mu(p)v \geq b$ implying that $p < 1$ in equilibrium. Indeed, if the advisor were always to propose an idea ($p = 1$), then $\mu(p)v = \alpha v < b$ and the leader would only accept ideas which were proven to be high quality. By proposing a mediocre idea, the advisor then only generates wasteful discussions, but never gets his proposal implemented. The following result follows:

Lemma 5 (Proposals are informative under authority) *If the cheap talk constraint is violated, then as long as $b < v$ no equilibrium exists where the advisor always proposes his idea ($p = 1$).*

Since $\mu(p)v \geq b$ in equilibrium, the leader weakly prefers to accept a proposal following a non-conclusive discussion. It follows that the leader optimally chooses a discussion intensity d given by

$$d^* = \arg\max_d \left\{ d(1 - \mu(p)b - \frac{k}{2}d^2 \right\} \tag{8}$$

where b is the opportunity cost of not identifying a mediocre proposal and $1 - \mu(p)$ is the likelihood of a mediocre proposal. No equilibrium exists where $d = 1$. Indeed, if discussions were always informative ($d = 1$), the leader would never select a mediocre idea and, hence, the advisor would never propose mediocre ideas ($p = 0$). But if the advisor only proposes high-quality ideas, there is no need for discussions ($d = 0$). It follows that d is given by

$$d = (1 - \mu(p))b/k \tag{9}$$

and $0 < d < 1$ implies

$$1 - b/k < \mu(p) < 1 \tag{10}$$

I can now write down the value to the advisor of proposing a mediocre idea. Let r be the probability that the leader accepts a proposal if a discussion is uninformative. The value of proposing a mediocre idea is then given by

$$V_p(d, r) \equiv [1 - d]\, rb - kd^2/2 \tag{11}$$

where $[1 - d]\, r$ is the probability of a mediocre proposal being accepted and $kd^2/2$ the discussion costs resulting from proposing an idea. The advisor always proposes a mediocre idea ($p = 1$) if $V_p(d, r) > 0$. From lemma 5, no equilibrium exists where $p = 1$, that is it must be that $V_p(d, r) \leq 0$. Since also $p = 0$ cannot be an equilibrium, we must have that $V_p(d, r) = 0$.

Consider potential equilibria where $r = 1$, that is, the leader never rejects a proposal unless it is proven to be mediocre. Note that if $r = 1$, authoritative decision-making never fails to implement an available high-quality idea: decision-quality is first-best. Since $r > 0$ only if $\mu(p)v \geq b$, the discussion intensity d is bounded above by

$$d \leq \bar{d} = \min\left\{ (1 - \frac{b}{v})\frac{b}{k}, 1 \right\}$$

and the the value of proposing a mediocre idea is bounded below by

$$V_p(d, 1) \geq V_p(\bar{d}, 1) = \left[1 - \bar{d}\right] b - k(\bar{d})^2/2$$

One can easily verify that $V_p(\bar{d}, 1)$ is increasing in k. Intuitively, when problems become more complex, the probability that a discussion is uninformative increases as well, making proposing a mediocre idea more attractive.

If problems are sufficiently simple (k sufficiently small), then $V_p(\bar{d}, 1) < 0$ and a unique equilibrium exists where $r = 1$, $d < \bar{d}$ is given by $V_p(d, 1) = 0$ and p is given by (9). The leader then never rejects a high-quality idea. In contrast, whenever problems are sufficiently complex (k is sufficiently large) then $V_p(\bar{d}, 1) > 0$ and $r = 1$ cannot be an equilibrium. In equilibrium, $r < 1$ and the leader rejects a high-quality proposals with positive probability. The advisor then proposes mediocre ideas with probability p given by $b = \mu(p)v$ such that the leader is indifferent between accepting or rejecting a proposal when a discussion is non-conclusive. The discussion intensity is then maximal and given by $d = \bar{d}$ whereas $r < 1$ is such that $V_p(d, r) = 0$.

The following proposition characterizes the unique equilibrium under authoritative decision-making:

Proposition 3 (Authoritative decision-making) *If $b > \alpha v$, there exists a unique equilibrium where*

- The leader consults the advisor whenever his own idea is mediocre.

- An advisor with a mediocre idea proposes this idea with probability $0 < p < 1$, where p is weakly increasing in k with $\lim_{k \to 0} p = 0$

- A discussion is conclusive with probability $0 < d < 1$ where d is decreasing in k

- There exists a k^{au} such that whenever $k < k^{au}$ the best idea is always selected: The leader accepts any proposal unless proven to be mediocre. In contrast, if $k > k^{au}$, the leader implements her own mediocre idea with probability $1 - r > 0$ if a discussion is uninformative, where $1 - r$ is increasing in k and b.

A direct implication from proposition 3 is that decision-making by authority is more efficient at processing information than majority decision-making. Under majority rule, agents always claim to have a great idea ($p = 1$). Information processing then necessarily relies on 'hard information': discussions or investigations. In contrast, in a dictatorship, an advisor often shows restraint in advocating a mediocre idea ($p < 1$). The reason is that it is more difficult to get a mediocre idea 'approved' by a leader who is biased in favor of her own ideas than by a committee deciding in all objectivity. Advocating a mediocre idea then primarily results in wasteful discussions, but only rarely is this idea actually being adopted. Since many mediocre ideas are not brought forward for discussion, this yields considerable communication savings. In addition, a dictatorship has the obvious advantage that the leader can implement his own high quality ideas without any need for discussion. Communication savings are again obtained.

While authoritative decision-making often avoids wasteful discussions, it is a priori ambiguous whether or not authoritative decision-making results in better or worse decisions. On the one hand, it is easy to verify that the leader's bias results in his own idea being much more likely to be implemented than the advisor's idea. On the other hand, at least for k small, this does not affect efficiency as the leader never selects a sub-optimal decision. When problems are complex (k is large), the leader's bias does result in inefficient decisions, but then also majority decision-making often selects the 'wrong' idea. In the next section I show that authoritative decision-making not only saves on communication costs, it also tends to result in better decisions, on average, than majority decision-making.

6 Authority versus Majority

From the above analysis, as long as proposals are relatively easy to evaluate (k is small), both authoritative and majority decision-making always select the best available idea. As problems become more complex, however, both decision-processes sacrifice some decision quality in order to save on the cost of information acquisition (costly discussions). Even when a high-quality alternative is available, a mediocre idea is then selected with positive probability. Formally, relative to first best, majority decision-making results in an efficiency loss of

$$L_m = \alpha(1-\alpha)(1-d)v + \frac{kd^2}{2} \tag{12}$$

where $2\alpha(1-\alpha)$ is the probability that the ideas of L and R vary in quality and $(1-d)$ is the probability that a discussion is non-conclusive. Similarly, decision-making by authority yields an efficiency loss given by

$$L_{au} = \alpha(1-\alpha)(1-d)(1-r)v + (1-\alpha)[\alpha + (1-\alpha)p]\frac{kd^2}{2} \tag{13}$$

where $1-r$ is the probability that a leader chooses his own mediocre project following a non-conclusive discussion and p is the probability with which the advisor proposes his idea if it is mediocre. I discuss two cases:

k small Consider first the case where k is small, that is $k < \min\{k^m, k^{au}\}$. Under majority decision-making, a discussion then always reveals the best available idea ($d = 1$). Under authoritative decision-making, discussions are often non-conclusive ($d < 1$), but a leader only implements his own mediocre idea if a discussion reveals that his advisor's idea is mediocre as well ($r = 1$). It follows that for k small, both decision-processes always select the best available idea. Authoritative decision-making, however, achieves this first best decision quality at a much lower communication cost. Indeed, whereas the group always engages in a full scale discussion under majority decision-making ($d = 1, p = 1$), discussions are often avoided under authoritative decision-making because

- the advisor refrains from proposing a mediocre idea ($p < 1$), or
- the leader can implement a high-quality idea without any group discussion,

and when discussions occur, they are less intense ($d < 1$). Concretely, for k small, $d = 1$ under majority decision-making and efficiency losses equal $L_m = k/2$, whereas under authoritative decision-making they amount to

$$L_{au} = (1-\alpha)[\alpha + (1-\alpha)p]\frac{kd^2}{2}$$

Since $p < 1$ and $d < 1$, then $L_{au} < L_m$ and decision-making by authority is strictly preferred.

Authoritative decision-making not only saves on discussion costs, it may also result in a higher average decision quality than majority decision-making. Indeed, from proposition 2, majority decision-making fails to implement an available high-quality idea with positive probability whenever $k > k^m$ with

$$k^m = \alpha(1-\alpha)v \tag{14}$$

In contrast, from proposition 3, the leader always chooses the best available idea under authoritative decision-making as long as $k < k^{au}$, where I show in Appendix that

$$k^{au} \equiv (1 - \frac{b}{v})\frac{b}{v}(3 - \frac{b}{v})v \tag{15}$$

We have that $k^{au} < k^m$ if either the probability of having a high-quality idea α is small or incentive distortions, as measured by b, are small. For $k \in (k^m, k^{au})$, authoritative decision-making then results in a strictly higher decision quality than majority decision-making. More generally, the following result holds:

Proposition 4 (decision quality: authority versus majority) *Whenever $k < k^{au}$, given by (15), authoritative decision-making is strictly preferred over majority decision-making and results in a weakly higher decision quality.*

k large Recall that the advisor is more likely to propose a mediocre idea as problems become more complex, that is, p is increasing in k. Intuitively, a discussion is more likely to be non-conclusive if problems are complex, making it easier for mediocre proposals to be adopted. It follows that the average quality of proposals, $\mu(p)v$, is decreasing in k. The leader never reject a high-quality proposal as long as $\mu(p)v > b$, where $\mu(p)v > b$ if and only if $k < k^{au}$ given by (15). In contrast, if $k > k^{au}$, then $\mu(p)v = b$ and the leader implements his own mediocre idea with strictly positive probability $r > 1$ even if a discussion about the advisor's proposal is non-conclusive. I now show that for $k > k^{au}$, wether or not authoritative decision-making is preferred over majority decision-making for a given k, crucially depends on the relative incentive conflict b/v.

To see this, fix the complexity of a problem at a level $k < k^m$, given by (14), such that the group always selects the best available idea under majority decision-making ($d = 1$). If the relative incentive conflict as measured by b/v is sufficiently large, then $k > k^{au}$ under authoritative decision-making and the leader fails to select the best available idea with probability

$$(1-r)(1-d)\alpha(1-\alpha) \tag{16}$$

where both $r < 1$ and $d < 1$, and where $\alpha(1-\alpha)$ is the likelihood that the advisor's idea is of a higher quality than the leader's idea. Authoritative decision-making then results in a lower decision quality than majority decision-making. Whereas from lemma 4 decision-making by authority is then still strictly preferred for k small, for b/v sufficiently large, there exists a threshold value $\kappa \in (k^{au}/v, k^m/v)$ which solves

$$L_{au} = k/2, \tag{17}$$

where L_{au} is given by (13), such that majority decision-making is preferred if and only if $k/v > \kappa$. For $k/v > \kappa$, the savings in communication costs under authoritative decision-making are then outweighed by a better decision quality under majority decision-making. The following proposition characterizes the optimal decision process as a function of the relative incentive conflict (b/v) and the the relative complexity of the problem at hand (k/v).

Proposition 5 (optimal decision process: authority versus majority) *There exists a cut-off value $\beta(\alpha) \geq \alpha$ given by $\beta(1-\beta) = \alpha(1-\alpha)/2$ such that*
(i) Whenever $b/v \leq \beta$ decision-making by authority is optimal for any k.
(ii) Whenever $b/v \geq \beta$, there exists a cut-off $\kappa \in (k^{au}/v, k^m/v)$, solving (17), such that decision-making by majority is optimal if and only if $k/v > \kappa$. This cut-off κ is decreasing in b/v and $\alpha(1-\alpha)$.

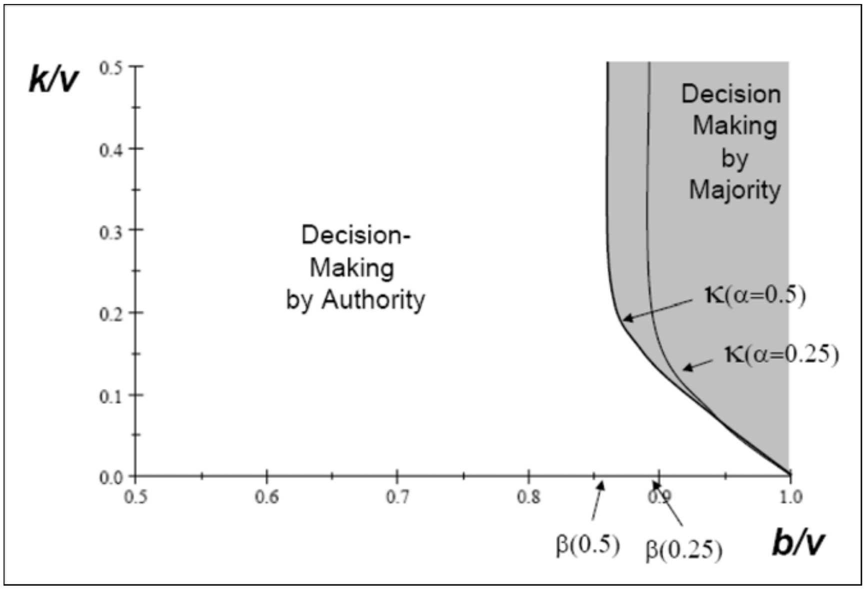

Figure 4: Optimal decision process as a function of the relative complexity (k/v) and the relative incentive conflict (b/v), and this for $\alpha = 0.5$ and $\alpha = 0.25$.

Figure 4 illustrates Proposition 5 for the parameter value $\alpha = 0.5$, which is the value for which both cutoffs β and κ are minimized, and hence majority decision-making is most attractive, and for $\alpha = 0.25$:

Proposition 5 is the central result of this paper. If the incentive conflicts as measured by b/v are only moderate, authoritative decision-making is always preferred for reasons highlighted in sections 4 and 5:

- A leader never accepts proposals which a discussion has revealed to be mediocre. In contrast, such ideas are accepted with probability $(1 - \alpha)/2$ under majority decision-making. Authoritative decision-making, therefore, discourages agents from proposing mediocre ideas *but not* high-quality ones. This saves communication costs and increases the average quality of proposed and selected ideas.

- For more complex problems (k large), discussions are often non-conclusive (d is small). Since the average quality of proposals is low under majority decision-making, mediocre ideas are then often selected even though a high-quality one is available.

If incentive conflicts (as measured by b/v) are sufficiently large and problems are sufficiently complex (k sufficiently large), however, decision-making by majority may be preferred. The reason is the leader under authoritative decision-making then becomes *dismissive* of alternative proposals. In particular, decision-making is then characterized by a destructive combination of

- a leader who allows for only limited discussion of proposals (d is small)
- a leader who tends to stick to his own mediocre idea whenever a discussion is non-conclusive (r is small).

To conclude, I discuss how the likelihood of high-quality ideas affects the optimal decision process. From proposition 5, majority decision is optimal for the widest parameter range when the variance in the quality of ideas, as given by $\alpha(1-\alpha)v$ is maximized. Indeed, both β, the cut-off on the relative incentive conflict b/v and κ, the cut-off on the relative complexity of the problem k/v, are decreasing in $\alpha(1-\alpha)$. Intuitively, the efficiency loss of not selecting the best available idea is proportional to the variance in the quality of ideas. Since for b/v large, the optimal decision-process involves a trade-off between better decision-making (under majority decision-making) and lower communication costs (under authoritative decision-making), it is then not surprising that κ is minimized when $\alpha(1-\alpha)v$ is maximized

The following proposition shows that $b < v$ and for any k, authoritative decision-making is preferred whenever the probability α of having a high-quality idea is sufficiently small:

Proposition 6 (optimal decision process when ideas are scarce) *.*
Given $b < v$, one can always find an α sufficiently small such that decision-making by authority is preferred for any k : $\partial\beta(\alpha)/\partial\alpha < 0$ for $\alpha < 1/2$ and $\lim_{\alpha\to 0}\beta(\alpha) = 1$.

Intuitively, the value of constraining agents from proposing mediocre ideas is largest when high-quality ideas are scarce. Indeed, under majority decision-making, high-quality ideas then very often go undiscovered as the group is not willing to spend much time discussing ideas which are most likely to be of little value (d is very small). Instead, the group simply picks an idea at random after a short discussion. Under authoritative decision-making, in contrast, the average quality of a proposal is bounded from below by b/v. Few ideas are then put forward, and when they are put forward, they are put to much more scrutiny (d is larger) than under majority decision-making. The smaller α the large the gap between the quality of proposals under majority decision-making and a dictatorship.

7 The Right to Voice: Decision versus Discussion Authority

A key flaw of authoritative decision-making is that the leader becomes dismissive when incentive conflicts grow large. She chooses a discussion intensity which is suboptimal low and then often sticks to her own mediocre project when the discussion is non-conclusive. A potential institutional response to a dismissive leader is to separate the control over the communication process from the control over the final decision. Bureaucrats or elected officials, for example, often need to organize "hearings" before they can make a decision. Similarly, in Congress, detailed procedures regulate how much discussion or debate must take place before there can be a vote. In this section, I consider the same game as in Section 5, but rather than the discussion intensity being selected by the leader, I assume that d is chosen by a welfare maximizing moderator (e.g. one of the neutral committee members).[30] I will refer to this decision process as authoritative decision-making with voice. In section 7.1, I first show that if such a neutral moderator is appointed, authoritative decision-making is always preferred over majority decision-making as long as $b < v$. In Section 7.2, however, I show that having a separate moderator is not always valuable. In particular, if k/v and/or b/v are small, it is typically preferred to let the final decision-maker also control the discussion. Finally, in section 7.3, I return to the case where the cheap talk constraint $\alpha v \leq b$ is non-binding and show that a moderator is then required to refrain the leader from discussing proposals.

7.1 Authority with voice versus majority

Since d is now chosen by an independent decision-maker, the optimal communication process allows for an additional cheap talk stage in which the leader communicates the quality of her idea before the moderator selects d.[31] In a separating equilibrium, this cheap talk stage is informative and the moderator only engages in a discussion if the leader confesses to have a mediocre idea. In a pooling idea, the cheap talk by the leader is pure noise, and the moderator always engages in a discussion if the advisor also proposes an idea. Such a pooling equilibrium exists when a leader with a mediocre idea wants to avoid a time consuming discussion.[32]

In Appendix A, I fully characterizes the above pooling and separating equilibria. Regard-

[30] Note that this is equivalent with the discussion intensity d being chosen by majority.

[31] Whether or not this cheap talk by the the leader occurs before, after or simulatenously with the cheap talk communication by the advisor does not matter. The advisor knows that his message only matters if the leader's idea is mediocre.

[32] In appendix, we show that semi-separating equilibria in which a leader with a mediocre idea claims to have a high-quality idea with probability $0 < p < 1$ do not exist.

less of which equilibrium prevails, however, it will be characterized by a probability $r > 1$ that the decision-maker accepts a proposal following a non-conclusive discussion and a probability $p < 1$ that an advisor with a mediocre idea proposes his idea. The argument is identical to the case of authoritative decision-making where the leader selects both the discussion intensity d and the final project. The observations that, in equilibrium, $r > 0$ and $p < 1$ are sufficient to prove the following result:

Proposition 7 (Authority with voice versus majority) *Whenever $b < v$, authoritative decision-making with voice is more efficient than majority decision-making.*

The proof is instructive and is therefore provided here. Consider first the case where informative communication between the moderator and the leader is not feasible and, hence, the moderator always engages in a discussion. In such a pooling equilibrium, expected payoffs per committee member, excluding private benefits, are given by

$$U_{voice}^{pool} = \max_{d} \left\{ \alpha v + (1-\alpha)\alpha \left[d + (1-d) r^* \right] v - (\alpha + (1-\alpha)p)\, kd^2/2 \right\}$$

Indeed, with a probability α, the leader L has a high-quality idea and always implements this idea. With a probability $(1-\alpha)\alpha$, L has a mediocre idea but R has a high-quality idea. $R's$ idea is then implemented if either a discussion is informative, or if the L accepts $R's$ idea following a non-conclusive discussion. Discussion costs, finally, will be incurred whenever R proposes an idea, which occurs with probability $\alpha + (1-\alpha)p$.

Similarly, expected payoffs per committee member under majority decision-making, excluding private benefits, are given by[33]

$$U_{majority} = \max_{d} \left\{ \alpha v + (1-\alpha)\alpha dv - kd^2/2 \right\}$$

Indeed, assume that $i's$ idea is chosen if a discussion is non-informative, with $i \in \{L, R\}$. With probability α, $i's$ idea is high-quality and regardless of d, majority decision-making will select an idea of quality v. With probability $1-\alpha$, however, $i's$ project is mediocre, in which case majority decision-making will select a project of value v with probability αd. Discussion costs, finally, are always incurred.

Since $p < 1$ and $r > 0$, we have that

$$U_{voice}^{pool} > U_{majority}.$$

[33] Note that $U_{majority} = (\alpha + \alpha(1-\alpha))\, v - L_{majority}$, where $L_{majority}$ is given by (12)

Hence, even if the leader cannot reveal the quality of his idea, authoritative decision-making with voice is more efficient than majority decision-making.

Next, if credibly communication about the leader's idea is feasible, then authoritative decision-making with voice is even more efficient as wasteful discussion are avoided when the leader's idea is high-quality. In such a separating equilibrium, expected payoffs per committee member, excluding private benefits, are then[34]

$$U_{voice}^{sep} = \max_{d} \left\{ \alpha v + (1-\alpha)\alpha \left[d + (1-d) r^{*} \right] v - (1-\alpha) \left(\alpha + (1-\alpha) p \right) k d^{2}/2 \right\}$$

In particular,

$$U_{voice}^{sep} > U_{voice}^{pool} > U_{majority}.$$

This concludes the formal proof.

The above proof is instructive in that is shows that authoritative decision-making with voice is more efficient than majority decision-making because

- There are less discussions ($p < 1$) than under majority decision-making, and
- If a discussion is non-informative, a high-quality project is selected with a larger probability: Under majority decision-making, it is selected with probability α, whereas under authoritative decision-making, it is selected with probability $\alpha + (1-\alpha)r > \alpha$

A direct implication is that the only reason why majority decision-making may be more efficient than authoritative decision-making is

- because $b > v$ and the leader always selects his own idea, or
- the discussion intensity d chosen by the leader is inefficiently low – which can be avoided by having an impartial moderator.

7.2 When is voice optimal?

Appointing an independent moderator increases the parameter range for which authoritative decision-making is optimal. Yet, as I show next, an independent moderator may also reduce efficiency. In particular, when problems are relatively simple a leader will typically engage in more discussion than an independent moderator would do. Obviously, this cannot be optimal from an ex post point of view. The prospect of a high discussion intensity, however, reduces

[34] Note that $U_{voice}^{sep} = (\alpha + (1-\alpha)\alpha) v - L_{au}$, where L_{au} is given by (13).

the probability that an advisor proposes a mediocre idea. As I show, the aggressiveness of the leader in discussing ideas then makes her a better moderator than an independent committee members would be. I now develop this insight in more detail.

Formally, let us denote by d^{au} the discussion intensity when the leader controls the communication process and by d^M the discussion intensity when an independent moderator chooses the discussion intensity. The value of d^M is characterized in Appendix A and depends on whether or not the leader can credibly reveal the quality of her own idea. In particular, d^M will be smaller if no separating equilibrium exists and the moderator engages in a discussion regardless of the quality of the leader's idea. Regardless of whether or not a separating equilibrium exists, however, the next proposition states that an independent moderator is optimal if and only if the moderator chooses a higher equilibrium discussion intensity than the leader would choose.

Proposition 8 *The leader is optimally also the moderator if and only if $d^{au} > d^M$.*

In Appendix A, I show that $d^{au} > d^M$ whenever $k < k^{au}$, that is whenever $r = 1$ and authoritative decision-making always selects the best available idea. Substituting the values of d^M in case of a separating equilibrium, Proposition *8* implies the following:

Proposition 9 *A necessary condition for an independent moderator to be optimal is that*

$$k/v \geq \chi \equiv \frac{1}{2}\left(1-\left(\frac{b}{v}\right)^2\right) \tag{18}$$

If $\alpha < 1/2$, this condition is also sufficient.

Assuming $\alpha < 1/2$, Figure 5 replicates Figure 4, but now indicates when a moderator is optimal. As one can see, there is a unique cut-off for communication complexity k above which an independent moderator is optimal. Note that this cut-off for k is decreasing in incentive conflict b/v.

Condition (18) in Proposition is a necessary and sufficient condition for a moderator to be optimal only if $\alpha < 1/2$. If $\alpha > 1/2$, the optimality of a moderator may be non-monotonic in k. The reason is that as problems become more complex (k larger), we may move from a separating equilibrium to a pooling equilibrium in which communication breaks down between the leader and the moderator. The leader then cannot be trusted to truthfully reveal the quality of his own idea. In order to avoid this strategic response by the leader, it may then be optimal to let the leader control the communication process. As I proof in Appendix A, this is case whenever the leader is very likely to have a high-quality idea:

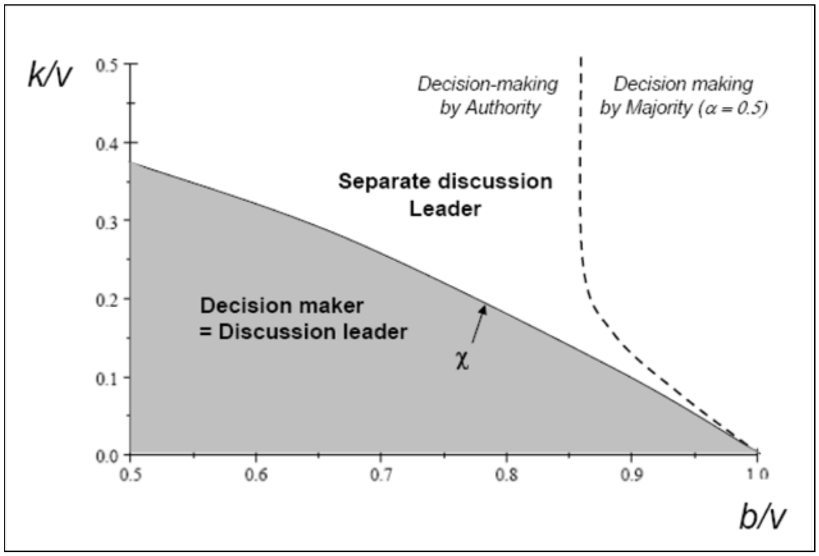

Figure 5: Optimality of an independent moderator when α, the likelihood of a good idea, is smaller or equal than 0.5. The y-axis denotes the complexity of the problem (k/v), the x-axis denotes the size of the incentive conflict (b/v).

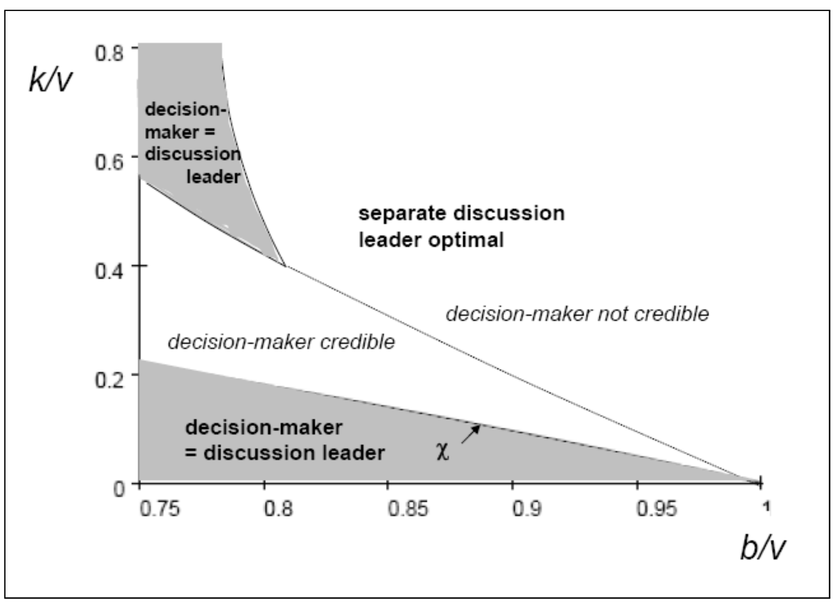

Figure 6: Optimality of an independent moderator when α, the likelihood of a good idea, equals 0.75. The y-axis denotes the complexity of the problem (k/v), the x-axis denotes the size of the incentive conflict (b/v).

Proposition 10 For any $k > 1$ and any $b < v$, there exists an $\alpha\prime < b/v$ such that for $\alpha > \alpha\prime$, the leader optimally controls the discussion if no truthful communication is feasible between leader and moderator.

Intuitively, if α is large, the efficiency loss of the breakdown in communication is very large. With a probability α, the group then engages in a discussion which could have been avoided by letting the leader be the moderator.

Figure 6 shows when a moderator is optimal for $\alpha = 0.75$, and indicates when the leader can credibly communicate the quality of his idea. The Figure shows how an independent moderator ceases to be efficient when the communication breaks down between the leader and the moderator.

7.3 Authoritative decision-making and bureaucracy

In the above analysis, an independent moderator is preferred whenever his presence results in an increased discussion intensity. There is, however, one instance where the leader engages in too much discussion. Recall from section 3 that both decision-processes implement the first best when cheap talk is the only means of communication and the cheap talk constraint, $b < \alpha v$, is satisfied. If decision-making is by majority, discussions play no role then, as communication is truthful. The option of engaging in a time-consuming discussion, however, reduces efficiency under authoritative decision-making when the cheap talk constraint, $b < \alpha v$, is satisfied. Whereas a leader with a mediocre idea then would have rubberstamped her advisor in section 3, now she will choose a strictly positive level of discussion intensity, d. For $b < \alpha v$, a dictatorship thus becomes an inefficient bureaucracy: the leader insists that her advisor supports her proposal with hard information, inefficiently slowing down the decision process. Again, a moderator may restore efficiency but rather than stimulating discussion, the moderator's role is to refrain the leader from subjecting proposals to too much scrutiny.

The superiority of majority decision-making for $b < \alpha v$ crucially depends on cheap talk being fully revealing. Truthful communication, however, is an artifact of the discrete nature of the asymmetric information. If the quality of ideas were to be continuous on some interval $[0, v]$, then communication would be strategic and noisy for any $b > 0$, not just for $b > \alpha v$. The results obtained for $b \leq \alpha v$ are therefore unlikely to hold in a more general framework.[35]

[35] A parallel can be made with the delegation literature. Dessein (2002), building on the cheap talk model proposed by Crawford and Sobel (1982), has shown that an uninformed principal optimally delegates decision authority to a privately informed sender whenever the latter's bias b is sufficiently small. In the version of this

8 Concluding remarks

This paper has studied group decision-making, where a committee must select one of two available solutions. The value of a solution is privately known to its sponsor but can be revealed through gratuitous claims (cheap talk) and/or through time-consuming group discussions. Incentive conflicts arise as the sponsors are biased towards their own solution.

I have argued that favoring a particular group member – by choosing his solution unless the alternative proposal is shown to be clearly better – tends to improve group decision-making both in terms of communication costs and decision quality. Intuitively, the disadvantaged group member then has little incentives to engage the group in a time-consuming discussion unless his proposal has substantial merits. Favoring one agent, therefore, reduces rent seeking discussions which do not improve the quality of the decision.

The paper focusses on one particular mechanism that implements such an (optimal) asymmetry in an otherwise symmetric world: authoritative decision-making. As far as I am aware, this paper is the first to show that a dictatorship may be optimal in a world in which a group must choose between two alternatives. I further show that it may be optimal to separate decision-making authority from discussion authority. An independent moderator then ensures that alternative proposals receive sufficient attention before a decision is made. Such mechanisms which ensure "voice" are widely observed in practice.

The reader may wonder whether the desired asymmetry can be obtained without resorting to a dictatorship. A leader could be defined as an agent whose proposals are chosen by the group unless a clearly better alternative is identified. A priori, there is no need to allocate the latter formal authority. In the symmetric, one-shot world studied in this paper this is not feasible. As I show in Appendix C, keeping majority rule, but favoring one particular group member would make this member more eager to propose mediocre ideas. As this makes this group member less credible, favoring his proposal is then not incentive compatible. A promising avenue for future research, however, would be to consider a dynamic model where the rents associated with becoming a leader induces agents to build up a reputation for integrity. Asymmetries in ability between group members may play an important role as well. As many agents vie for leadership, a natural choice would be to coordinate on the most capable member of the group. In the absence of a such a "natural" leader, no one may be willing or able to

model where information is discrete, however, the opposite result holds. The principal then optimally retains control for b sufficiently small as cheap talk is then fully revealing. The discrete version of the delegation model thus gives the counterintuitive result that centralization is optimal for either small or large biases. This counterintuitive result disappears when the agent's private information has a continuous support.

build up the reputational capital needed to gain leadership of the group.

One fascinating study in this regard, is Murninghan et al. (1991) who study the role of leadership in 20 professional British String Quartets (all professional quartets at the time of the study). String quartets are a democracy by nature: everyone in the quartet has the power to stop repetitions, members feel strongly about equality, there are no distinctions in formal authority and fees are typically split evenly. Conflict in quartets is also omnipresent as there are unlimited ways to play a given piece. During rehearsals, quartets often spend as much time on playing a piece as on discussions about how to play it. While formally a democracy, the study argues that successful quartets tend to give de facto authority to the first violinist.[36] Less successful quartets tend to be more democratic in their decision process, with members having a more equal say. Interestingly, many of the less successful quartets seem to be keenly aware of the need for more leadership. As the authors note (p 175):

> In several of the least successful quartets, other players thought that the first violinist did not have the personal power to lead them effectively: "Enthusiasm, yes, but he doesn't lead . . . . He's a weak leader, no flair, not extroverted enough.

Obviously, the problems encountered by string quartets are not unique, but present in any intense work group: a small task force, a team of researchers, a group of artists, creative team, an executive committee, a quality circle or a hiring committee. As this paper has argued, the above workgroups typically benefit from the presence of an agent whose voice carries more weight: a leader. Whereas I have considered a leader who is endowed with formal authority, the current paper is hopefully a first step towards a theory of endogenous leadership.

[36] Credible measures of success are established based on fees for performance, record sales, etc.

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APPENDIX A

Proposition 1. *If cheap talk is the only means of communication, then authoritative decision-making and majority decision-making are equally efficient: Both yield first best for $b \leq \alpha v$, whereas decisions reflect no information when $b > \alpha v$.*

Proof. I only need to show that decisions reflect no information when $b > \alpha v$.
A) Majority decision-making. As I discuss in Section 4, under majority decision-making, there is no loss to the committee members in restricting the message space to $M = \{propose, not\ propose\}$ and instruct group members with a high-quality idea to send the message $m_i = propose$. An agent $i \in \{L, R\}$ is said to propose his idea if $m_i = propose$. I further limit communication to one round of cheap talk. One can show that multiple rounds of cheap talk cannot improve the outcome following a similar logic as in Lemma B.3.

Let q_1 be the probability with which the group selects $L's$ idea when no agent proposes an idea and q_2 the probability with which the group selects $L's$ idea when both propose their idea. (1) I consider first the case where communication is simultaneous. The value of proposing an idea to L is then given by

$$V_p^L = (1-\alpha)b\left[(1-q_1)(1-p_R) + q_2 p_R\right] - \alpha q_2 \left[v - b\right] \leq 0$$

and to R

$$V_p^R = (1-\alpha)b\left[q_1(1-p_L) + (1-q_2)p_L\right] - \alpha(1-q_2)\left[v - b\right] \leq 0$$

Assume first that $p_R = 1$, then

$$\begin{aligned} V_p^L &= (1-\alpha)bq_2 - \alpha q_2 \left[v-b\right] \\ &= q_2\left(b - \alpha v\right) > 0, \end{aligned}$$

and, hence, $p_L = 1$. Similarly, $p_L = 1$ implies that $V_p^R > 0$ and, hence, $p_R = 1$. Note further that $V_p^L > 0$ for any p_R whenever $1 - q_1 \geq q_2$ as then V_p^L is decreasing in p_R. Similarly, $V_p^R > 0$ for any p_L whenever $q_1 \geq 1 - q_2$ as then V_p^R is decreasing in p_L. It follows that either $1 - q_1 \geq q_2$ and then $p_L = 1$ regardless of p_R, or $1 - q_1 \leq q_2$ and then $p_R = 1$ regardless of $p_L = 1$. Since $p_L = p_R = 1$ whenever either $p_R = 1$ or $p_L = 1$, it follows that $p_L = p_R = 1$ is the only possible equilibrium.
(2) Consider next the case where L communicates first. If L does not propose his idea, then R makes a proposal and $R's$ is always adopted. I denote by p_R the probability with which R proposes his idea conditional on L having proposed his idea as well. The value to L of proposing an idea is then given by

$$\begin{aligned} V_p^L &= (1-\alpha)b\left[(1-p_R) + q_2 p_R\right] - \alpha q_2 \left[v-b\right] \\ &\geq q_2\left(b - \alpha v\right) > 0 \end{aligned}$$

Hence, under sequential communication, $p_L = 1$. Given $p_L = 1$, the incentives of R to propose an idea then equal

$$\begin{aligned} V_p^R &= (1-\alpha)b(1-q_2) - \alpha(1-q_2)\left[v-b\right] \\ &= (1-q_2)\left(b - \alpha v\right) > 0 \end{aligned}$$

from which $p_L = p_R = 1$ is the unique equilibrium under sequential communication.

B) Authoritative Decision-making. Under authoritative decision-making, there is no loss to the leader in restricting the message space to $M = \{propose, not\ propose\}$ and instruct R to send the message $m = propose$ when he has a high-quality idea. Let r be the probability with which a leader selects an idea whenever R proposes an idea and his own idea is mediocre. The leader always implements her idea if the latter is high quality. Since the advisor knows that his advice only matters if L has a mediocre idea, the leader cannot improve her pay-off by sending a cheap talk message to the advisor. I need to show that no equilibrium exists in which $r > 0$ exists. Since R knows that his idea will only be selected if the leader's idea is mediocre, he has a strict incentive to propose his idea whenever $r > 0$. But if R always proposes his idea, the average quality of a proposal is $\alpha v < b$ in which case L strictly prefers his own mediocre idea, that is $r = 0$. It follows that no equilibrium exists in which $r > 0$. QED.

Lemma 2. *Given equilibrium refinement (ER), no asymmetric equilibria exist where $p_L > p_R$.*

Proof: The Proof is given in Appendix B.

Lemma 3. *Under majority decision-making, no equilibrium exists where $p < 1$.*

Proof. (1) Assume first that $d^* = (1 - \mu(p))\mu(p)v/k \leq 1$, then

$$\begin{aligned} V_p &\equiv \frac{1}{2}(1-\alpha)b - \frac{1}{2k}\alpha\left[k - (1-\mu(p))\mu(p)v\right](v-b) \\ &\quad -\frac{1}{2k}\left[\alpha + (1-\alpha)p\right](1-\mu(p))^2\mu(p)^2 v^2 \end{aligned}$$

It follows that an equilibrium with $p < 1$ exists only if $V_p \leq 0$, which is equivalent to

$$k\left[b - \alpha v\right] + (1-\mu(p))\mu(p)v\left[\alpha\left(v-b\right) - (1-\mu(p))\alpha v\right] \leq 0$$

Moreover, since d^* is an interior solution, it must be that

$$(1-\mu(p))\mu(p)v \leq k$$

Hence a necessary condition for $p < 1$ is that

$$k\left[b - \alpha v\right] + k\left[\alpha\left(v-b\right) - (1-\mu(p))\alpha v\right] \leq 0$$

implying

$$k\left[b - \alpha v\right] + k\left[\alpha\left(v-b\right) - (1-\alpha)\alpha v\right] \leq 0$$

or still

$$k\left[b - \alpha v\right](1-\alpha) \leq 0$$

which is impossible given $A1$. It follows that no equilibrium exists where $p < 1$ and $d < 1$.
(2) Next, consider a corner equilibrium where $(1-\mu(p))\mu(p)v/k > 1$ and $d = 1$. Then $V_p \leq 0$ only if

$$V_p \equiv \frac{1}{2}(1-\alpha)b - \left[\alpha + (1-\alpha)p\right]\frac{k}{2} \leq 0$$

or still

$$(1-\alpha)\frac{b}{[\alpha+(1-\alpha)p]} \leq k$$

which implies that

$$(1-\alpha)\frac{\alpha}{[\alpha+(1-\alpha)p]}v = (1-\alpha)\mu(p)v \leq k$$

which, in turn, implies

$$(1-\mu(p)\mu(p)v \leq k,$$

a contradiction. It follows that no equilibrium exists where $p < 1$.QED.

Proof of Proposition 3 (Equilibrium under authoritative decision-making).

To proof proposition (**3**), I first show that $p \in (0,1)$. I subsequently show that an equilibrium with $r = 1$ and $p \in (0,1)$ exists if and only if $k \leq k^{au}$. Moreover, at most one equilibrium with $r = 1$ exists. Finally, I show that an equilibrium with $r < 1$ and $p \in (0,1)$ exists if and only if $k > k^{au}$. Moreover, at most equilibrium with $r < 1$ exists. Taken together, this implies that for any k, there exists a unique equilibrium, where $p \in (0,1)$ and either $r = 1$ or $r < 1$.

(1) To R, the value of proposing a mediocre idea is given by

$$V_p \equiv [1-d(p)]\, rb - kd^2/2 \tag{19}$$

Note that $V_p > 0$ implies $p = 1$. As argued in the text, no equilibrium exists where $p = 1$. Similarly, no equilibrium exists where $p = 0$, as then $d = 0$ and $r = 1$, from which $V_p > 0$, a contradiction. Hence, in equilibrium, $p \in (0,1)$ and thus $V_p = 0$. Substituting d, given by (9), it follows that in any equilibrium, p must be a solution to

$$V_p \equiv [1-(1-\mu(p))b/k]\, rb - (1-\mu(p))^2 b^2/2k = 0 \tag{20}$$

(2) Consider first candidate equilibria where $p \in (0,1)$ and $r = 1$. Then $V_p = 0$ implies

$$[1-(1-\mu(p))b/k]\, b - (1-\mu(p))^2 b^2/2k = 0 \tag{21}$$

or still

$$2kb - 2(1-\mu(p))b^2 - (1-\mu(p))^2 b^2 = 0 \tag{22}$$

from which p is given by

$$2k = (1-\mu(p))(3-\mu(p))b \tag{23}$$

Moreover, $r = 1$ implies that $\mu(p) \geq b/v$. Since (23) implies that $\mu(p)$ is decreasing in k, it follows that if an equilibrium with $r = 1$ exists then $k \leq k^{au}$ where

$$k^{au} \equiv (1-\frac{b}{v})(3-\frac{b}{v})b/2$$

Indeed, for $k > k^{au}$, equality (23) implies that $\mu(p) < b/v$ in which case $r = 0$. It follows that for $k > k^{au}$, no equilibrium exists where $r = 1$.

Conversely, if $k \leq k^{au}$, then condition (23) defines a unique p which is such that $\mu(p) \geq b/v$ and, hence, $r = 1$ and d given by (9) are best responses by the leader. It follows that for $k \leq k^{au}$, p given by (23), $r = 1$, and d given by (9) is indeed an equilibrium and no other equilibrium exists with $r = 1$. Moreover, from (23), $\lim_{k \to 0} \mu(p) = 1$ and thus $\lim_{k \to 0} p = 1$.

(3) Next, consider candidate equilibria where $p \in (0,1)$ and $r < 1$. If $r = 0$, then $d > 0$ implies that $p = 0$, which cannot be an equilibrium. Hence, whenever $r < 1$, it must be that $r \in (0,1)$ and the leader is indifferent between accepting or rejecting a proposal following an uninformative discussion. Thus, if $r < 1$, then p is given by

$$\mu(p)v = b$$

Since also $p \in (0,1)$ and thus $V(p) = 0$, $r < 1$ is given as a solution to

$$\left[1 - (1 - \frac{b}{v})b/k\right] rb - (1 - \frac{b}{v})^2 b^2/2k = 0$$

or still

$$2\left[k - (1 - \frac{b}{v})b\right] r^* - (1 - \frac{b}{v})^2 b = 0 \tag{24}$$

or still

$$r = \frac{(1 - \frac{b}{v})^2 b}{2\left[k - (1 - \frac{b}{v})b\right]} \tag{25}$$

Thus, if an equilibrium with $r < 1$ exists, it is characterized by a unique p given by $\mu(p)v = b$, a unique r given by (25) and a unique d given by (9). From (25), a necessary condition for $r < 1$ is that

$$(1 - \frac{b}{v})^2 b < 2\left[k - (1 - \frac{b}{v})b\right]$$

or still

$$\begin{aligned} 2k &> (1 - \frac{b}{v})^2 b + 2(1 - \frac{b}{v})b \\ &= (1 - \frac{b}{v})(3 - \frac{b}{v})b \\ &= 2k^{au} \end{aligned}$$

Hence, no equilibrium with $r < 1$ exists if $k \leq k^{au}$. For $k \leq k^{au}$, the equilibrium characterized above where $r = 1$ is thus the unique equilibrium.

Conversely, if $k > k^{au}$, then $r < 1$ given by (25), p given by $\mu(p)v = b$, and d given by (9) are best responses and are thus indeed an equilibrium. Moreover $r < 1$ and no other equilibrium exists with $r < 1$. Since for $k > k^{au}$ no equilibrium exists for which $r = 1$, it follows this is the unique equilibrium for $k > k^{au}$. Finally, from (25), if follows that $1 - r$ is increasing in k and decreasing in b. QED.

Proposition 4 *Whenever $k < k^{au}$, given by (15), authoritative decision-making is strictly preferred over majority decision-making and results in a weakly higher decision quality.*

Proof. Proposition 4 follows directly from Proposition **7**, proven in the text, which states that authoritative decision-making with an independent moderator is more efficient than majority decision-making for $b < v$, and the first part of the proof of Proposition 9, which shows that, under authoritative decision-making, it is optimal not to have an independent moderator whenever $k < k^{au}$.[37] QED

Proof of propositions 5 and 6.

Preliminaries: I first calculate the expected efficiency losses under each decision process when $k > k^{au}$ and $k \lesseqgtr k^m$.

(1) Under majority decision-making, the expected loss relative to first best decision-making is given by

$$L_m = (1-\alpha)\alpha(1-d^*)v + \frac{kd^{*2}}{2}$$

Whenever $k < k^m$, then $d^* = 1$ and $L_m = k/2$. If $k > k^m$, then $d^* < 1$ is given by

$$(1-\alpha)\alpha v/k$$

and L_m can be rewritten as

$$L_m = \alpha(1-\alpha)(1-\frac{\alpha(1-\alpha)v}{k})v + \frac{\alpha^2(1-\alpha)^2v^2}{2k}$$

or still

$$L_m = \alpha(1-\alpha)v\left[1-\frac{\alpha(1-\alpha)v}{2k}\right] \tag{26}$$

(2) Under decision-making by authority, the expected efficiency losses relative to first best is given by

$$L_{au} = \alpha(1-\alpha)v(1-d^*)(1-r^*) + (1-\alpha)\left[\alpha+(1-\alpha)p\right]\frac{kd^2}{2} \tag{27}$$

Whenever $k > k^{au}$, $r^* < 1$ is the solution to

$$(1-d)rb = kd^2/2$$

and $\mu(q) = b/v$. Substituting $kd^2/2$ and $(\alpha + (1-\alpha)p)$, we have

$$\begin{aligned} L_{au} &= \alpha(1-\alpha)v(1-d^*)(1-r^*) + (1-\alpha)\alpha\frac{v}{b}(1-d)rb & (28)\\ &= \alpha(1-\alpha)v(1-d^*) & (29)\end{aligned}$$

Finally, substituting d^* we have

$$L_{au} = \alpha(1-\alpha)v\left[1-(1-\frac{b}{v})\frac{b}{k}\right] \tag{30}$$

[37]The proofs of propositions 7 and 9 do not make use of propositions 4 or 5.

Proposition 5

There exists a cut-off value $\beta(\alpha) \geq \alpha$ given by $\beta(1-\beta) = \alpha(1-\alpha)/2$ such that
(i) Whenever $b/v \leq \beta$ decision-making by authority is preferred for any k.
(ii) Whenever $b/v \geq \beta$, there exists a cut-off $\kappa \in (k^{au}/v, k^m/v)$, solving (17), such that decision-making by majority is strictly preferred if and only if $k/v > \kappa$. This cut-off κ is decreasing in b/v and $\alpha(1-\alpha)$.

Proof. From Proposition 4, decision-making by authority is always preferred whenever $k < k^{au}$. Assume therefore that $k > k^{au}$. I distinguish two cases:
(1) Consider first the case where $k > \max\{k^m, k^{au}\}$, such that efficiency losses under majority decision-making are given by (26) and efficiency losses in a dictatorship are given by (30). Authority will be more efficient than majority whenever $L_m > L_{au}$ or still

$$(1-\frac{b}{v})\frac{b}{v} > \frac{1}{2}\alpha(1-\alpha) \tag{31}$$

It follows that if $k > \max\{k^m, k^{au}\}$, then there exists a unique $\beta(\alpha)$ given by the conditions

$$\begin{aligned}(1-\beta)\beta &= \frac{1}{2}\alpha(1-\alpha) \\ \alpha &< \beta\end{aligned} \tag{32}$$

such that $L_m > L_{au}$ if and only if $b/v \in (\alpha, \beta(\alpha))$. Indeed, if $\alpha > 1/2$, then $(1-b/v)b/v$ is decreasing in b/v and equals $\alpha(1-\alpha)/2$ if $b/v = \beta(\alpha)$. If $\alpha < 1/2$, then $(1-b/v)b/v > \alpha(1-\alpha)$ when $b/v \in (\alpha, 1-\alpha)$ and $(1-b/v)b/v$ is decreasing in b/v when $b/v \in [1-\alpha, \beta(\alpha)]$.

(2) Consider next the case where $k^{au} < k^m$ and $k \in (k^{au}, k^m)$, such that efficiency losses under majority decision-making equal $k/2$ and efficiency losses in a dictatorship are given by (30). Authoritative decision-making is thus more efficient than majority decision-making if and only if $L_m > L_{au}$, that is,

$$\alpha(1-\alpha)v(1-(1-\frac{b}{v})\frac{b}{k}) < \frac{k}{2}$$

or still

$$\left(\frac{k}{v}\right)^2 > 2\alpha(1-\alpha)\left[\frac{k}{v} - (1-\frac{b}{v})\frac{b}{v}\right]$$

or still

$$(1-\frac{b}{v})\frac{b}{v} > \frac{k}{v}\left[1 - \frac{1}{2\alpha(1-\alpha)}\frac{k}{v}\right] \tag{33}$$

Since $k/v < \alpha(1-\alpha)$, the RHS of (33) is increasing in k/v.

(3) Since $k/v < \alpha(1-\alpha)$, and the RHS of inequality (33) is increasing in k/v, (31) implies condition (33). It follows that if authoritative decision-making is more efficient for $k > \max\{k^m, k^{au}\}$, then authoritative decision-making is also more efficient for $k \in (k^{au}, k^m)$. Since authoritative decision-making is always more efficient for $k < k^{au}$, authoritative decision-making is more efficient for any k whenever $b/v < \beta(\alpha)$. This concludes the proof of part (i)

of proposition **5.**

(4) I now proceed to part (ii) where $b/v > \beta(\alpha)$. If $b/v > \beta(\alpha)$, then from part (1) of the proof, majority decision-making is more efficient for $k > \max\{k^m, k^{au}\}$.

(5) Next, consider $b/v > \beta(\alpha)$ and $k \in (k^{au}, k^m)$. Since the RHS of (33) is increasing in k/v, there exists a unique cut-off κ solving

$$(1-\frac{b}{v})\frac{b}{v} = \kappa\left[1 - \frac{1}{2\alpha(1-\alpha)}\kappa\right] \tag{34}$$

such that condition (33) is violated and majority decision-making is more efficient whenever $k/v > \kappa$. Moreover, it must be that $k^{au}/v < \kappa < k^m/v$. Indeed, condition (33) and condition (31) are equivalent for $k = k^m$, and we know that condition (31) is violated when both $k = k^m$ and $b/v > \beta(\alpha)$. It follows that condition (33) is then also violated for $k = k^m$ and, hence, $\kappa < k^m$. Similarly, we know that authoritative decision-making is always more efficient for $k = k^{au}$ and, hence, it must be that $\kappa > k^{au}$.

(6) Since $\kappa < \alpha(1-\alpha)$, the RHS of (34) is increasing in κ. Since $(1-\frac{b}{v})\frac{b}{v}$ is decreasing in b/v for $b/v > \beta(\alpha)$, (34) implies that κ is decreasing in b/v and $\alpha(1-\alpha)$. This conclude the proof of part (ii) of proposition 5. QED.

Proposition 6. *Given $b < v$, one can always find an α sufficiently small such that decision-making by authority is preferred for any k : $\partial\beta(\alpha)/\partial\alpha < 0$ for $\alpha < 1/2$ and $\lim_{\alpha\to 0}\beta(\alpha) = 1$.*

Proof. Note that (32) implies that $\beta > 1-\alpha$ for $\alpha < 1/2$. But then $(1-\beta)\beta$ is decreasing in β whereas $(1-\alpha)\alpha$ is increasing in α for $\alpha < 1/2$. It follows that $\partial\beta(\alpha)/\partial\alpha < 0$ for $\alpha < 1/2$. We trivially have $\lim_{\alpha\to 0}\beta(\alpha) = 1$. QED.

Authoritative Decision-making with voice: Equilibrium Characterization:

Let d^M be the equilibrium discussion intensity chosen by the moderator, let p^* be the probability with which an advisor with a mediocre idea proposes this idea, and let r^*be the equilibrium probability that the leader accepts a proposal following a non-conclusive discussion. I will restrict attention to equilibria where the out-of-equilibrium beliefs of the moderator about r^* are independent of his choice of d. That is if (r^*, d^M) is the equilibrium, then if the moderator were to choose $d \neq d^M$, then he believes that the leader still will play $r = r^*$.[38]

The following lemma characterizes separating equilibria in which L truthfully reveals the quality of her idea to the moderator and the moderator only engages in a discussion if L has a mediocre idea

Lemma A.1. If a separating equilibrium exists, it is characterized by the vector (p^*, d^M, r^*)

[38] As I show at the end of this subsection, if I were not to impose this assumption, then by cleverly chosing out of equilibrium beliefs, the moderator could commit to a first-best choice of d^M. Having an independent discussion leader would then be trivially optimal.

given by

$$\begin{aligned} \mu(p^*) &= b/v \\ d^M &= 1 + b/k - \sqrt{1 + (b/k)^2} \\ r^* &= 1 - \frac{k}{b}d^M < 1 \end{aligned}$$

A separating equilibrium exists if and only if

$$1 - b/v > \frac{k}{b}\frac{d^M}{2} \tag{35}$$

Proof: Assume a separating equilibrium exists, then d^M is given by

$$d^M = \arg\max_d \left\{ d\mu(p^*)v + (1-d)r^*\mu(p^*)v - kd^2/2 \right\}$$

If $d^M = 1$, R would never propose a mediocre idea, hence $d^M = 1$ cannot be an equilibrium. It follows that d^M is given by the following first order condition

$$(1 - r^*)\mu(p)v - kd^M = 0 \tag{36}$$

Note that $r^* = 1$ cannot be an equilibrium, as otherwise $d = 0$. Similarly, $r^* = 0$ cannot be an equilibrium as $r = 0$ implies $p = 0$. But if $p = 0$, then $r = 1$, a contradiction. It follows that $r^* \in (0,1)$, from which p^* is given by $\mu(p^*) = b/v$. Substituting in (36) we find

$$d^M = (1 - r^*)b/k \tag{37}$$

As before, r^* must be such that an advisor is indifferent between proposing his idea or not, that is

$$(1 - d)r^*b - kd^2/2 = 0 \tag{38}$$

From (37) and (38) then

$$d^M = 1 + b/k - \sqrt{1 + (b/k)^2}$$

and, hence

$$r^* = \sqrt{1 + (k/b)^2} - k/b$$

The above candidate separating equilibrium only exists if L prefers the discussion intensity d^M over a discussion intensity $d = 0$ whenever she has a mediocre idea. It follows that a separating equilibrium exists if and only if

$$d^M\mu(p^*)(v - b) > k(d^M)^2/2 \tag{39}$$

where the LHS are the expected informational benefits to the leader of the a potential discussion of intensity d^M and the RHS are the associated communication costs. If the communication costs are larger than the informational benefits, the leader will try to avoid a discussion by claiming that his idea is high-quality. Since $\mu(p^*) = b/v$, equation (39) holds if and only if

$$1 - b/v > \frac{k}{b}\frac{d^M}{2} \tag{40}$$

QED

The following lemma characterizes all pooling equilibria:

Lemma A.2. If (35) does not hold, then there exists a unique, pooling equilibrium in which the leader does not reveal the quality of his idea and the moderator engages in a discussion whenever the advisor proposes an idea. This equilibrium is characterized by the vector (p^*, d^M, r^*) given by

$$\begin{aligned} \mu(p^*) &= b/v \\ d^M &= 1 + (1-\alpha)b/k - \sqrt{1 + ((1-\alpha)b/k)^2} \\ r^* &= \sqrt{1 + (k/(1-\alpha)b)^2} - k/(1-\alpha)b \end{aligned}$$

No semi-separating equilibrium exist where a the leader L reveals his idea to be mediocre with positive probability.

Proof: In a pooling equilibrium, the equilibrium discussion intensity is given by

$$d^M = \max_d \left\{ d(1-\alpha)\mu(p^*)v + (1-d)r^*(1-\alpha)\mu(p^*)v - kd^2/2 \right\}$$

Following the same logic as for the separating equilibrium, one can show that $\mu(p^*) = b/v$ and $d^M < 1$. It follows that d^M is given by the first order condition

$$(1 - r^*)(1-\alpha)b - kd^M = 0,$$

and r^* is such that an advisor with a mediocre idea is be indifferent between proposing an idea or not:

$$(1 - d^M)(1-\alpha)rb - k(d^M)^2/2 = 0.$$

Solving the latter two equations, we find that

$$d^M = 1 + (1-\alpha)b/k - \sqrt{1 + ((1-\alpha)b/k)^2}$$

and

$$r^* = \sqrt{1 + (k/(1-\alpha)b)^2} - k/(1-\alpha)b,$$

Note that if α is sufficiently large, then one might potentially have that

$$d^M < d^{au}$$

Still, a leader with a mediocre idea does not want to reveal his idea to be mediocre, as this would result in a discussion intensity $d^* > d^{au}$ which violates (35).

Finally, I show that if (35) is violated, there exist no semi-separating equilibrium where the leader with a mediocre idea claims this idea to be high-quality with probability $q < 1$. If $q = 1$, this equilibrium would correspond to a pooling equilibrium, if $q = 0$, this equilibrium would correspond to a separating equilibrium. If condition (35) is violated, then a leader with a mediocre idea prefers $d = 0$ over $d = d^M$. For a semi-separating equilibrium to exists a leader with a mediocre idea would need to be indifferent between $d = d^M$ and $d^{'}$ where $d^{'}$ is the discussion intensity chosen by the moderator when L claims to have a high-quality idea. Since $q \in (0, 1)$, we have that $0 < d^{'} < d^M$. Since the leader strictly prefers $d = 0$ over $d = d^M$, it is straightforward to show that L also strictly prefers $d' > 0$ over d^M. Hence, no semi-separating equilibrium exists if (35) is violated. QED

Comment: Out-of-equilibrium beliefs under authoritative decision-making with voice:
In the above analysis, I have restricted attention to equilibria where the out-of-equilibrium beliefs of the moderator about r^* are independent of his choice of d. If I were not to impose this assumption, then by cleverly choosing out of equilibrium beliefs, the moderator could commit to a first-best choice of d^M. Having an independent moderator would then be trivially optimal. Formally, one could specify the moderator's out-of-equilibrium beliefs about r to be a function of d, that is $r = r(d)$. In this case d^M would be given by

$$d^M = \arg\max_d \left\{ d(1 - r(d))b - kd^2/2 \right\}$$

It is easy to see that any pair (r', d') then can be supported as an equilibrium as long as

$$(1 - d)rb - kd^2/2 = 0$$

and

$$d(1 - r)b - kd^2/2 > \max_d \left\{ db - kd^2/2 \right\}$$

For example, one can specify beliefs $r(d) = r'$ whenever $d = d'$ and $r(d) = 0$ otherwise. More generally, if $d' < d^*$, it will be sufficient to specify $r(d) = r'$ whenever $d \leq d'$ and $r(d) = 0$ otherwise, or if $d' > d^*$, it will be sufficient to specify $r(d) = r'$ whenever $d \geq d'$ and $r(d) = 0$.

Proposition 8. *The leader is optimally also the moderator if and only if* $d^{au} > d^M$.

Proof: If a separating equilibrium exists, then efficiency losses with and without a moderator are given by

$$\begin{aligned} L^{sep} &= \alpha(1 - \alpha)v(1 - d)(1 - r) + (1 - \alpha)(\alpha + (1 - \alpha)p)kd^2/2 && (41) \\ &= \alpha(1 - \alpha)v(1 - d)(1 - r) + (1 - \alpha)\frac{\alpha}{\mu(p)}kd^2/2 && (42) \\ &= L^{au} && (43) \end{aligned}$$

The only difference is that d and r are take different values depending on who leads the discussion. In both equilibria, the advisor R is indifferent between proposing a mediocre idea or not, that is

$$kd^2/2 = (1 - d)rb$$

from which

$$L^{sep} = L^{au} = L = \alpha(1-\alpha)v(1-d)(1-r) + (1-\alpha)\alpha(1-d)rb\frac{1}{\mu(p)} \tag{44}$$

Efficiency losses when there is an independent moderator but no separating equilibrium exists, are given by

$$L^{pool} = \alpha(1-\alpha)v(1-d)(1-r) + \frac{\alpha}{\mu(p)}kd^2/2,$$

but an advisor is now indifferent between proposing a mediocre idea only if

$$kd^2/2 = (1-\alpha)(1-d)rb$$

It follows that efficiency losses are again given by the same expression (44): $L^{sep} = L^{pool} = L^{au} = L$

Now consider two cases:
(1) If $k \geq k^{au}$, then $\mu(p) = b/v$ with or without a moderator. Substituting in (44) this yields

$$L = \alpha(1-\alpha)v(1-d)$$

from which a moderator reduces efficiency losses if and only if the moderator engages in more discussion than the leader would do herself, that is if and only if

$$d^M > d^{au}$$

(2) If $k < k^{au}$, then $\mu(p) > b/v$ and

$$L_{au} < \alpha(1-\alpha)v(1-d^{au})$$

Moreover, as I will show further, $k < k^{au}$ implies that $d^{au} > d^M$. Hence, if $k < k^{au}$, an independent decision-maker increases efficiency losses. This concludes the proof of proposition 8. *QED*

Proposition 9. *A necessary condition for an independent moderator to be optimal is that*

$$k/v \geq \frac{1}{2}\left(1 - \left(\frac{b}{v}\right)^2\right) \tag{45}$$

If $\alpha < 1/2$, *this condition is also necessary and sufficient.*

Proof. I discuss now when an independent moderator will choose a higher discussion intensity than the leader L would do. I distinguish again two cases. (1) Consider first the case where $k < k^{au}$. Then we know that $r = 1$ and d^{au} satisfies

$$(1-d^{au})b - k(d^{au})^2/2 = 0$$

such that the advisor is indifferent between proposing an idea or not. Similarly, from the proofs of Lemmas A.1. and A.2, d^M is given by

$$(1-d^M)r^M b - k(d^M)^2/2 = 0$$

in a separating equilibrium, and by

$$(1-\alpha)(1-d^M)r^M b - k(d^M)^2/2 = 0$$

in a pooling equilibrium. Since $r^M < 1$ if there is a moderator we always have that $k < k^{au}$ implies $d^{au} > d^M$.
(2) Consider next the case where $k > k^{au}$, such that $\mu(p) = b/v$ and $d^{au} = (1-b/v)b/k$. From Lemma A.1, in a separating equilibrium, then $d^{au} > d^M$ if and only if

$$(1-\frac{b}{v})\frac{b}{k} > 1 + b/k - \sqrt{1+(b/k)^2} \tag{46}$$

In contrast, from Lemma A.2. , in a pooling equilibrium, $d^{au} > d^M$ if and only if

$$(1-\frac{b}{v})\frac{b}{k} > 1 + (1-\alpha)b/k - \sqrt{1+((1-\alpha)b/k)^2} \tag{47}$$

Obviously, a separating equilibrium always exists as long as (46) is satisfied, as then L wants to engage in more discussion then the moderator would. One can further show that (47) implies that a separating equilibrium exists as long as $\alpha < 1/2$. Hence, if no separating equilibrium exists, then $d^{au} < d^M$ and a moderator is optimal.QED

Proposition 10. *For any $k > 1$ and any $b < v$, there exists an $\alpha\prime < b/v$ such that for $\alpha > \alpha\prime$, the leader optimally controls the discussion if no truthful communication is feasible between leader and moderator.*

Proof. In a pooling equilibrium, d^M is given by

$$d^M = 1 + (1-\alpha)b/k - \sqrt{1+((1-\alpha)b/k)^2}$$

and is strictly decreasing in α. For $\alpha = b/v$ we thus have that have that

$$d^M < 1 + (1-b/v)b/k - \sqrt{1+((1-b/v)b/k)^2}$$

Recall that d^{au} is given by $(1-b/v)b/k$. If $k > 1$, then

$$d^{\alpha u} - d^M = (1-b/v)b/k - d^M > \sqrt{1+((1-b/v)b/k)^2} - 1 > 0$$

Hence, if $k > 1$, there exists an $\alpha\prime < b/v$ such that $d^M < d^{au}$ if and only if $\alpha > \alpha\prime$. QED

APPENDIX B: Optimal communication design

Lemma 2. *Given equilibrium refinement (ER), no asymmetric equilibria exist where $p_L > p_R$.*

Proof: Consider an equilibrium where $p_R < p_L \leq 1$. Since $p_R = 0$ cannot be an equilibrium (if $p_R = 0$, the group always sets $d = 0$), it must be that $p_R \in (0,1)$. Let q_1 be the probability that the group accepts $L's$ idea when a discussion reveals that both L and R's idea are mediocre, and q_2 the probability that the group accepts $L's$ idea when a discussion is uninformative. Given (ER), in any asymmetric equilibrium where $p_L > p_R$ we have that $q_1 = q_2 = 0$. Assume further that when nobody proposes an idea, then $L's$ idea is selected with probability q. When two proposals are made, then a discussion will only be valuable if $L's$ idea is high quality and $R's$ idea is mediocre since the default is to pick $R's$ idea (given $p_L > p_R$). Hence, the group optimally chooses a discussion intensity given by

$$d^* = \arg\max_d \left\{(1-\mu(p_R))\mu(p_L)dv - kd^2/2\right\}$$

or still

$$d^* = \min\{1, (1-\mu(p_R))\mu(p_L)v/k\}$$

I postpone the case where $d = 1$, and assume for now that $d < 1$.

Assume that R has a mediocre idea. If R does not propose this idea, her expected pay-off is

$$(1-\alpha)(1-p_L)(1-q)b + \alpha v$$

If R does propose the mediocre idea, her expected pay-off is

$$(1-\alpha)b + \alpha\left[dv + (1-d)b\right] - (\alpha + (1-\alpha)p_L)\, kd^2/2$$

Hence, the value to R of proposing a mediocre idea is given by

$$V_p^R \equiv (1-\alpha)\left(p_L + (1-p_L)q\right)b - \alpha(1-d)(v-b) - (\alpha + (1-\alpha)p_L)\, kd^2/2$$

or still

$$V_p^R \equiv \left[\alpha + (1-\alpha)\left(p_L + (1-p_L)q\right)\right]b - \alpha v + \alpha d(v-b) - \left[\alpha + (1-\alpha)p_L\right]kd^2/2$$

The value to L of proposing an idea:

$$V_p^L \equiv (1-\alpha)(1-q)(1-p_R)b - \left[\alpha + (1-\alpha)p_R\right]kd^2/2$$

Since $p_R \in (0,1)$, we must have that $V_p^R = 0$. If $p_L < 1$, then also $V_p^L = 0$. My strategy of proof is to show that $V_p^R = 0$ (part (i)) or $V_p^R = V_p^L = 0$ (part (ii)) implies that $p_L < p_R$, a contradiction. For expositional simplicity, I first proof this for the case where $q = 0$. Intuitively, by setting $q = 0$, I minimize the incentives of R to propose an idea, making it a priori more likely that $p_R < p_L$, which I then show never can happen. It is easy, but notational tedious, to extend the proof for any $q \geq 0$. For completeness, I provide this proof at the end.[39]

A) If $q = 0$, then V_p^R and V_p^L are given by

$$V_p^R \equiv \left[\alpha + (1-\alpha)p_L\right]b - \alpha v + \alpha d(v-b) - \left[\alpha + (1-\alpha)p_L\right]kd^2/2$$

and

$$V_p^L \equiv (1-\alpha)(1-p_R)b - \left[\alpha + (1-\alpha)p_R\right]kd^2/2$$

[39] The proof for $q > 0$ is to be omitted for the final version of the paper.

(i) Assume first that $b > \mu(p_L)v$. Then $V_p^R = 0$ implies

$$[\alpha + (1-\alpha)p_L]\, b - \alpha v = d\left[(1-\mu(p_R))\alpha v \frac{1}{2} - \alpha\,(v-b)\right].$$

Since $b > \mu(p_L)v$, both the LHS and RHS are positive and thus

$$[\alpha + (1-\alpha)p_L]\, b - \alpha v < (1-\mu(p_R))\alpha v \frac{1}{2} - \alpha(v-b).$$

or still

$$b - \mu(p_L)v < \mu(p_L)\left[b - \frac{1}{2}(1+\mu(p_R))v\right]$$

A necessary condition for this inequality to hold is that

$$b - \mu(p_L)v < \left[b - \frac{1}{2}(1+\mu(p_R))v\right]$$

which is only possible if $\mu(p_L) > \mu(p_R)$ and thus, $p_L < p_R$, a contradiction.

(ii) Assume next that $b < \mu(p_L)v$. Since $b > \alpha v = \mu(1)v$, this implies that also $p_L \in (0,1)$ and $V_p^L = V_p^R = 0$. Then $V_p^R = 0$ implies that

$$\frac{(1-\alpha)(1-p_R)}{(1-\alpha)\mu(p_L)p_R} 2\frac{b}{v} = d$$

whereas $V_p^L = 0$ implies that

$$\frac{\alpha v - [\alpha + (1-\alpha)p_L]\, b}{\alpha(v-b) - \alpha(1-\mu(p_R)v/2} = d$$

From which p_L and p_R must satisfy

$$\frac{\mu(p_L) - b/v}{(1-b/v) - (1-\mu(p_R)/2} = \frac{(1-p_R)}{p_R} 2\frac{b}{v}$$

or still

$$\frac{1}{1+\mu(p_R) - 2b/v}\frac{p_R}{1-p_R} = \frac{1}{\mu(p_L)v/b - 1}$$

or still

$$\frac{p_R}{1-p_R} = \frac{1+\mu(p_R) - 2b/v}{\mu(p_L)v/b - 1}$$

Note that RHS is increasing in p_R whereas the LHS is decreasing in p_R. On the other hand, the LHS is increasing in p_L. Note further that we must have that $\alpha \leq b/v < \mu(p_L)$. Assume now that $p_L = p_H$, then one can show that

$$\frac{p}{1-p} < \frac{1+\mu(p) - 2b/v}{\mu(p)v/b - 1}$$

Indeed the RHS is increasing in b/v :

$$-2\left[\mu(p)v/b-1\right]+(1+\mu(p)-2b/v)\mu(p)(v/b)^2=2-\frac{\mu(p)}{b/v}\left[4-\frac{1+\mu(p)}{b/v}\right]>0$$

since

$$\frac{\mu(p)}{b/v}\left[4-\frac{1+\mu(p)}{b/v}\right]<2\frac{\mu(p)}{b/v}\left[2-\frac{\mu(p)}{b/v}\right]<2$$

But even for $b/v=\alpha$, we have that RHS is larger than the left hand side. Indeed the RHS then equals

$$\begin{aligned}\frac{1+\mu(p)-2\alpha}{\mu(p)/\alpha-1} &= \frac{[1-2\alpha]\left[\alpha+(1-\alpha)p\right]+\alpha}{1-[\alpha+(1-\alpha)p]}\\ &= \frac{2\alpha+(1-\alpha)p-2\alpha^2-2\alpha^2(1-\alpha)p}{(1-\alpha)\,(1-p)}\\ &= \frac{2\alpha+p-2\alpha^2p}{(1-p)}\\ &= \frac{2\alpha(1-\alpha p)+p}{(1-p)}\\ &> \frac{p}{1-p}\end{aligned}$$

It follows that in order to have $V_L=V_p$, it must be that $p_L<p_R$, which is not feasible.

B) I now extend the proof to include $q>0$.
(i) Assume first that

$$\left[\alpha+(1-\alpha)\left(p_L+(1-p_L)q\right)\right]b-\alpha v>0$$

In this case the proof follows the same logic as in (A.i) above, where $q=0$ and $(\alpha+(1-\alpha)p_L)b-\alpha v>0$.

(ii) Assume next that

$$\left[\alpha+(1-\alpha)\left(p_L+(1-p_L)q\right)\right]b-\alpha v<0,$$

in which case we must again have that $p_L\in(0,1)$. Then $V_p^L=V_p^R=0$ implies that

$$\frac{(1-\alpha)(1-p_R)(1-q)}{(1-\alpha)\mu(p_L)p_R}2\frac{b}{v}=d$$

$$\frac{\alpha v-\left[\alpha+(1-\alpha)\left(p_L+(1-p_L)q\right)\right]b}{\alpha(v-b)-\alpha(1-\mu(p_R)v/2}=d$$

from which p_L and p_R must satisfy

$$0<\frac{p_R}{1-p_R}=(1-q)\frac{1+\mu(p_R)-2b/v}{\mu(p_L)\frac{v}{b}-\left(1+\frac{(1-\alpha)(1-p_L)}{\alpha+(1-\alpha)p_L}q\right)},\tag{48}$$

The RHS of (48) is minimized for $q=0$ for $q\in[0,1]$. Indeed, the derivative with respect to q equals

$$\frac{\partial}{\partial q}(RHS)=\left[\frac{(1-q)\frac{(1-\alpha)(1-p_L)}{\alpha+(1-\alpha)p_L}}{\mu(p_L)\frac{v}{b}-\left(1+\frac{(1-\alpha)(1-p_L)}{\alpha+(1-\alpha)p_L}q\right)}-1\right]\frac{1+\mu(p_R)-2b/v}{\mu(p_L)\frac{v}{b}-\left(1+\frac{(1-\alpha)(1-p_L)}{\alpha+(1-\alpha)p_L}q\right)}$$

Since the RHS of (48) is positive, I only need to show that the terms in brackets is strictly positive. This will be the case if and only if

$$\frac{(1-\alpha)(1-p_L)}{\alpha+(1-\alpha)p_L}+1-\mu(p_L)\frac{v}{b}>0$$

which will be satisfied if an only if $b>\alpha v$. It follows that the RHS of (48) is minimized for $q=0$. Recall from (A.ii) that $V_p^R=V_p^L=0$ implies that

$$\frac{p_R}{1-p_R}<(1-q)\frac{1+\mu(p_R)-2b/v}{\mu(p_L)\frac{v}{b}-\left(1+\frac{(1-\alpha)(1-p_L)}{\alpha+(1-\alpha)p_L}q\right)},$$

whenever $q=0$ and $p_L=p_R$. Since the RHS of the above inequality is increasing in q, it follows that the above inequality also hold when $q>0$ and $p_L=p_R$. Moreover, the LHS of this inequality is increasing in p_R and the RHS is decreasing in p_R and increasing in p_L.[40] So keeping p_R fixed, to achieve inequality (48), p_L has to be decreased. So $p_L<p_R$, a contradiction.

C) Finally, I consider the case where $d=1$. For simplicity, I assume again that $q=0$, the proof can be easily extended to include $q>0$. We then have

$$\begin{aligned} V_p^R &\equiv (1-\alpha)bp_L-\left[\alpha+(1-\alpha)p_L\right]k/2 \\ &= (\alpha+(1-\alpha)p_L)\left[(1-\mu(p_L))b-k/2\right] \end{aligned}$$

and

$$\begin{aligned} V_p^L &\equiv (1-\alpha)b(1-p_R)-\left[\alpha+(1-\alpha)p_R\right]k/2 \\ &= (\alpha+(1-\alpha)p_R)\left[\frac{1-\alpha}{\alpha}\mu(p_R)b-(1-\mu(p_R))b-k/2\right] \end{aligned}$$

If $p_L=1$, then $b>\mu(p_L)v=\alpha v$ and the proof provided in (A.i) applies. Assume therefore that $p_L\in(0,1)$, in which case $V_p^R=V_p^R=0$ implies that

$$p_L = \frac{\alpha k}{(2b-k)(1-\alpha)} \tag{49}$$

$$p_R = \frac{2b(1-\alpha)-\alpha k}{(2b+k)(1-\alpha)} \tag{50}$$

[40] This is not obvious at first sight, but can be shown by making use of the fact that $\mu(p_L)\frac{v}{b}-\left(1+\frac{(1-\alpha)(1-p_L)}{\alpha+(1-\alpha)p_L}q\right)>0$ and $b>\alpha v$.

Note that p_L is increasing in k whereas p_R is decreasing in k. It follows that $p_L > p_R$ if and only if $k > \bar{k}$, where $\bar{k}$ is given by setting $p_L = p_R$. Manipulating expressions (49) and (50), we find that

$$\bar{k} \equiv 2b\frac{1-\alpha}{1+\alpha}$$

I now show that $d = 1$ only if $k < \bar{k}$. We have that $d = 1$ if and only if

$$(1-\mu(p_R))\mu(p_L)v \geq k$$

From $V_p^R = 0$ and $V_p^R = 0$,

$$\mu(p_L) = 1 - k/2b, \tag{51}$$

$$(1-\mu(p_R)) = 1-\alpha-\frac{\alpha k}{2b} \tag{52}$$

hence $d = 1$ if and only if

$$\left(1-\alpha-\frac{\alpha k}{2b}\right)(1-k/2b)\,v \geq k$$

or still

$$\left(\frac{1-\alpha}{k}-\frac{\alpha}{2b}\right)(1-k/2b)\,v \geq 1$$

Since both factors are decreasing in k, it follows that if $d < 1$ for $k = \bar{k}$, then $d < 1$ for any $k > \bar{k}$. Substituting the expression for $\bar{k}$ in (51) and (52), we have that for $k = \bar{k}$

$$(1-\mu(p_R))\mu(p_L)v = \frac{2\alpha(1-\alpha)}{(1+\alpha)^2}v < 2b\frac{1-\alpha}{1+\alpha} \equiv \bar{k}$$

and thus $d < 1$. It follows that $d = 1$ implies that $k < \bar{k}$ and hence $p_L < p_R$, a contradiction. QED

Lemma B.1. *Under majority decision-making, efficiency cannot be improved by having more than one round of cheap talk..*

Proof: Assume that agent L communicates first. Let p_L be the probability that L proposes a mediocre idea when he has one, and p_R the probability that R proposes a mediocre idea, conditionally on L having proposed an idea. If L does not propose an idea, then R knows that $L's$ idea must be mediocre, and therefore always proposes his idea. We show that in equilibrium, it must be that $p_L = p_R = 1$ and, hence, sequential communication does not affect the pay-offs.

Note first that no equilibrium exists in which $p_L < p_R = 1$. Indeed, from the point of view of L, the sequence of communication then does not matter, and we know that under simultaneous communication, the only equilibrium has $p_L = p_R = 1$. Similarly, no equilibrium exists in which $p_R < p_L = 1$, as from the point of view of R, the sequence of communication then does not matter. Finally, no equilibrium exists in which $p_L = 0$ and/or $p_R = 0$ as the organization then never would engage in any discussion and we know that for $b > \alpha v$, no informative cheap talk is feasible in the absence of discussions.

It follows that the only feasible equilibria are those where $p_L = p_R = 1$ or $0 < p_L < 1$ and $0 < p_R < 1$. Moreover, we again must have that $p_R = p_L = p$ following the same argument as in lemma 2.[41] Consider first the value to L, the first mover, of proposing a mediocre idea. Assume that $R's$ idea is mediocre as well. If L does not propose her mediocre idea, then R always proposes and $L's$ idea is never implemented. If L does propose her idea, then R only proposes with probability $(1-p)$, and $L's$ idea is implemented with probability $1-p+p/2$. The value to L of proposing an idea is thus given by

$$\begin{aligned} V_p^L &\equiv (1-\alpha)(1-p+p/2)b - \frac{1}{2}\alpha\left[1-d\right](v-b) - \left[\alpha + (1-\alpha)p\right]\frac{kd^2}{2} \\ &> \frac{1}{2}(1-\alpha)b - \frac{1}{2}\alpha\left[1-d\right](v-b) - \left[\alpha + (1-\alpha)p\right]\frac{kd^2}{2}bv \\ &= V_p \end{aligned}$$

where V_p is the value to L of proposing a mediocre idea in a game with simultaneous communication. Following the same logic as in the proof of proposition **3**, it then follows that $V_p^L > 0$ and, hence, no equilibrium exists where $p_L < 1$. The only equilibrium in the sequential communication game is thus the one where $p_L = 1$ and $p_R = 1$.QED.

Lemma B.2. *Under majority decision-making, efficiency cannot be improved by favoring one agent in case of a tie, that is when a discussion is uninformative, when a discussion reveals that both ideas are mediocre or when none of the agents proposes his idea.*

Proof: Following the same logic as in lemma 2, we must have that $p_R = p_L = p$ in equilibrium. Let q_1 be the probability with which the group selects $L's$ idea if a discussion is uninformative, q_2 the probability that the group selects $L's$ idea when a discussion reveals that both ideas are mediocre, and q_3 the probability that the group selects $L's$ idea when none of them proposes an idea. Let $V_p(p)$ be the value of proposing a mediocre idea to L given that L knows that R proposes a mediocre idea with probability p and the group engages in a discussion of intensity

$$d = \max\left\{1, (1-\mu(p))\mu(p)v/k\right\}$$

whenever two ideas are proposed. Similarly, defining $V_p^R(p)$ as the value to R of proposing a mediocre idea to R, we have that $V_p^L(p) =$

$$(1-\alpha)(1-p)b(1-q_3) + (1-\alpha)pbdq_2 + \left[1-d\right]\left[(1-\alpha)pb - \alpha\left(v-b\right)\right]q_1 - \left[\alpha + (1-\alpha)p\right]\frac{kd^2}{2}$$

and $V_p^R(p) =$

$$(1-\alpha)(1-p)bq_3 + (1-\alpha)pbd(1-q_2) + (1-d)\left[(1-\alpha)pb - \alpha\left(v-b\right)\right](1-q_1) - \left[\alpha + (1-\alpha)p\right]\frac{kd^2}{2}$$

[41] Given equilibrium refinement (ER), the group never selects a mediocre idea from agent i if $p_i > p_j$, but then that agent i has no incentive to propose a mediocre idea, a contradiction.

Let us denote by $Z(p)$ the value of $V_p^L(p)$ and $V_p^R(p)$ when $q_1 = q_2 = q_3 = 1/2$ (note that $q_1 = q_2 = q_3 = 1/2$ implies that $V_p^L = V_p^R$). Let us denote $\Delta_i = q_i - 1/2$, for $i = 1, 2, 3$, and

$$\begin{aligned} x &= (1-\alpha)(1-p)b \\ y &= 1-\alpha)pbd \\ z &= [1-d]\left[(1-\alpha)pb - \alpha\,(v-b)\right] \end{aligned}$$

then

$$\begin{aligned} V_p^R(p) &= Z(p) - hx\Delta_3 + y\Delta_2 + z\Delta_1 \\ V_p^L(p) &= Z(p) + x\Delta_3 - y\Delta_2 - z\Delta_1 \end{aligned}$$

For $0 < p < 1$, it must be that $V_p^L(p) = V_p^R(p) = 0$, implying that

$$x\Delta_3 - y\Delta_2 - z\Delta_1 = -x\Delta_3 + y\Delta_2 + z\Delta_1$$

or still

$$x\Delta_3 - y\Delta_2 - z\Delta_1 = 0$$

Hence $V_p^R(p) = V_p^L(p)$ implies that

$$V_p^R(p) = V_p^L(p) = Z(p)$$

But we know from proposition 3 that $Z(p) > 0$. $V_p^R(p) = V_p^L(p) = Z(p) > 0$ and thus $p = 1$. Hence, the only equilibria in which the group treats the agents asymmetrically are such that $p = 1$ and proposals are uninformative. Since favoring a particular agent in case of tie does not improve communication, and since the neutral members are indifferent between choosing $L's$ or $R's$ idea in case of a tie (by definition), it follows that favoring a particular agent cannot improve efficiency. QED

Lemma B.3. *Under majority decision-making, efficiency cannot be improved by having more than one round of cheap talk.*

Proof: I will provide the proof assuming simultaneous communication in each round and random selection of a project whenever there is a tie (ties occur when no agent proposes a project, a discussion is non-informative or a discussion reveals both projects to be mediocre. Following the same logic as in lemma B.2, it is straightforward to show that allowing asymmetric treatment of agents in case of a tie cannot improve the outcome. Similarly, using a similar logic as in lemma B.1., one can show that allowing for multiple rounds of sequential communication cannot improve the outcome.[42]

I first show that if there are n rounds of cheap talk and one of these rounds is fully informative, then all the previous rounds must be non-informative. Hence the same outcome

[42] Obviously, one can never improve communicaton by letting one agent communicate several rounds while the other agent is forced to remain silent, as this would be economically equivalent to having one round of communication with the probability of of this agent not send.

can also be achieved in one round of communication. Let round j be fully informative and assume that there exists a round $i < j$ where agent L and R propose a mediocre idea with probability $0 < p_i < 1$,[43] and moreover, let round i be the last round prior to round j for which this is true, that is either $j = i + 1$ or all rounds in between i and j are non-informative. Consider now the value to L of proposing a mediocre idea in round i. If $R's$ idea is high-quality, then given that round j is fully informative, R's idea will be implemented regardless of whether L proposes his idea in round i or not. In contrast, if $R's$ idea is also mediocre, then by proposing his own mediocre idea, L increases the likelihood of his idea being adopted by $1/2$, regardless of the strategy of R. It follows that it is a dominant strategy for L to propose his mediocre idea in round i, which is a contradiction with $0 < p_i < 1$. Hence, if round j is fully informative, all previous rounds must be uninformative.

Consider now n rounds of cheap talk where round j is partially informative. I show that communication in rounds $i < j$ must then be non-informative. I say that round k is partially informative if agents L and R propose a mediocre idea with probability $p_{Lk} < 1$ and $p_{Rk} < 1$ provided that both L and R have proposed their idea in all previous rounds. Whenever agent L has not proposed his idea in a given round $l < k$, but agent R did, then $L's$ idea is revealed to be mediocre and given $b > \alpha v$, he proposes his idea in all subsequent rounds. Hence, if one agent does not propose his idea in a given round, the communication game is over. If both agents have not proposed their idea in a given round, it is common knowledge that both ideas are mediocre and the communication game is over as well. Assume that there are at least two rounds which are partially informative. Let round i and j be the last two rounds which are partially informative, where $j > i$ and either $j = i + 1$ or the rounds in between i and j are uninformative. Following the same logic as in lemma 2, one can again rule out asymmetric equilibria, that is $p_{Li} = p_{Ri} = p_i$ and $p_{Lj} = p_{Rj} = p_j$. Let μ_k be the posterior probability that both L and $R's$ ideas are high quality given that they have proposed their idea in every round up to round k. Given that $0 < p_i < 1, 0 < p_j < 1$, and $j > i$, it must be that $1 > \mu_j > \mu_i > \mu_{i-1}$. Since $0 < p_i < 1$ both L and R must be indifferent between proposing or not proposing in round i, given that both of them have proposed up to round $i - 1$. Similarly, since $0 < p_j < 1$, both agents must be indifferent between proposing or not proposing in round j, given that both of them have been proposing their idea up to round $j - 1$. Let us denote by V_p^j the value to L and R of proposing a mediocre idea in round j, given that both L and R have proposed their idea in all rounds prior to round j. Since $0 < p_j < 1$, it must be that $V_p^j = 0$. Consider now V_p^i, the value to L of proposing a mediocre idea in round i, given that both L and R have proposed their idea in all previous rounds. We have that

$$\begin{aligned} V_p^i &\equiv (1 - \mu_{i-1})(1 - p_i)b/2 + \left[(1 - \mu_{i-1})p_i + \mu_{i-1}\right] p_j V_p^j \\ &= (1 - \mu_{i-1})(1 - p_i)b/2 > 0, \end{aligned}$$

a contradiction, given that $0 < p_i < 1$. *QED*

[43] Asymmetric equilibria where L and R propose mediocre ideas with different probabilities can be ruled out following the same logic as in lemma 2.