# Project Selection with Strategic Communication and Further Investigations

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**Abstract**

An uninformed principal first elicits soft information from privately informed agents regarding the quality of their projects and then may engage in further evaluation of the proposals. The principal's ability to acquire further information crowds out soft information and may even worsen organizational performance. Further, the impact of further investigations on the quality of soft information is non-monotone, with the crowding out effect strongest at intermediate costs of further investigations. As an alternative arrangement, the principal may delegate decision-authority to one of the agents, which has two relative advantages. First, the quality of decision-making is less dependent on the precision of strategic communication. Second, the expected level of investigation is generally lower. Both effects reduce the extent to which the additional investigation by the decision-maker crowds out valuable soft information, making delegation most attractive for intermediate costs of information and degrees of conflict between the agents.

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# 1 Introduction

One of the standard problems faced by organizations is how to choose a decision from a given set of alternatives: which employee to hire, which marketing strategy to implement, which research alternative to fund, and so forth. Such decisions pose a challenge to the organization because the information relevant to the decision is generally not directly available to the person responsible for a given decision. Instead, that information is dispersed inside the organization, and the members of the organization that are in possession of such information may have conflicting preferences over the final decisions made. Such conflicts then raise the challenge of how to efficiently transfer that information to the decision-maker, and the question of who should be responsible for a given decision in the first place.

Following the general recognition of this problem of strategic information transmission and the seminal work of Crawford and Sobel (1982) formalizing the problem, an increasingly large literature has examined various aspects of the challenge of transmitting soft information and its implications for the quality of decision-making and the allocation of authority.[1] One of the standard assumptions made in this literature has been that the only sources of information available to the decision-maker are the strategic agents in possession of that information.[2] In contrast, in most practical situations, the decision-maker has at least the option of engaging in direct information acquisition herself, thus either supplementing or even circumventing the information communicated by the agents.

This paper contributes to the literature on decision-making under strategic communication by investigating how the ability of a decision-maker to engage in direct information acquisition influences the quality of strategic recommendations made by privately informed agents and its implications for organizational performance. The particular setting I consider is one of "project selection," where an initially uninformed principal needs to choose between two discrete alternatives, advocated by two separate agents. Each agent is privately informed of the value of their alternative but is at the same time biased in favor of that alternative. This bias is such that if it was common knowledge that one of the alternatives is sufficiently better than the other, then both agents would prefer the better alternative. However, if the two alternatives have the same value to the organization (or the difference is too small), then each agent would prefer to have their alternative chosen for implementation. In the game, the principal first elicits recommendations from the two agents regarding the quality of their alternatives through cheap talk and then, should she find it to be in her interest, engages in further, direct information acquisition, and chooses which alternative to implement.

Such decision problems with partially aligned preferences appear relatively common in organization. As a stylized example, consider an economics department, composed of micro and macro groups. The department has one slot available for hiring, and both micro and macro groups perform their searches and find their favorite candidates (and their value). Each group cares about the overall quality of the department and thus wants to hire the best candidate overall, but at the same time has a bias in favor of hiring for their own group. In the game modeled, the head of

[1] A different strand, following Milgrom (1981) and Migrom and Roberts (1986) has examined the disclosure of hard information.

[2] The few recent exceptions are Dessein (2007), Chen (2009) and Moreno de Barreda (2011), discussed more in the next section.

the department (or the person with hiring authority) first invites recommendations regarding the quality of the two candidates from the respective groups and then, before making the final decision, may engage in additional information acquisition, such as independently evaluating the work and credentials of the candidates.[3] Or consider two heads of research groups, making claims regarding how promising their research strands are, two regional managers making claims where to locate a new manufacturing facility and so on. The key feature of such settings is that while the agents may learn the value of their alternative simply due to their role in the organization (or at least have a comparative advantage in acquiring that information), the decision-maker may also engage in direct evaluation of the alternatives (even if the cost may be extremely large).

The first basic observation relates to the value of strategic communication by the agents even when the principal is able to engage in direct information acquisition. When the cheap talk stage is able to achieve consensus in the group, there is no need for additional costly investigation by the decision-maker and thus allows the organization to economize on the costs of information acquisition. For example, if the micro group reveals that their candidate is mediocre while the macro group claims that their candidate is outstanding, then (in equilibrium) the principal knows that the macro candidate is better and will thus hire that candidate without needing to investigate the credentials of either candidate any further. It is only when the initial communication stage is unable to reach a consensus, such as both groups claiming that their candidates are either outstanding or mediocre, that additional investigation will be needed. Further, at this stage, the additional information will clearly be valuable because it will allow the principal to make more informed decisions.

The second (and key) insight relates to the interaction between the precision of cheap talk and the ability of the decision-maker to acquire further information. First, while the ability to acquire additional information is clearly valuable when no consensus is reached in the first stage, such ability to engage in direct information acquisition crowds out soft information communicated by the agents and thus reduces its overall value. Second, the amount of crowding out is non-monotone in the cost of further investigations. In particular, while further investigations and the quality of soft information are global substitutes, in the sense that the precision of cheap talk is always (weakly) lower in the case of any positive equilibrium investigation levels than when no further investigations take place, that precision converges back to its maximum of no investigations as further investigations become free.

The intuition for this result follows from the role that the additional information plays in influencing the final outcome. An investigation, when successful, is able to screen out poor-quality recommendations. As a result, it reduces the cost of making exaggerated initial claims. But at the same time, it also reduces the cost associated with admitting that one's project is only of mediocre quality, because it makes it less likely that the proposal will be replaced by an even worse alternative. However, because claims of higher quality need to be less precise to counter the incentives to advocate for one's alternative, the intensity of investigation by the decision-maker will be weakly increasing in the magnitude of claims, so that the cost of exaggeration is, in equilibrium, reduced

[3]The starting assumption is that the principal is ex ante uninformed and unbiased. It is naturally possible that the head of the department is a member of one of the groups, making her potentially biased, and already actively participated in the search for his group, making her already partially informed. This setting then resembles the case of delegation, which I consider as an alternative organizational arrangement.

relatively more than the cost of under-statements and thus the precision of cheap talk will be weakly less. But from this logic it also follows that it is the *asymmetry* in the investigation intensities that drives the effect, not the level. Thus, if investigations are very costly, the principal will not investigate much after any message, while if investigations are very cheap, the principal will examine all proposals carefully. As a result, the precision of cheap talk is not reduced that much in either case. But when the costs of investigation are intermediate, the decision-maker will place disproportionate attention on bolder claims, which in turn exacerbates the reduction in the precision of the messages.

The implications of this crowding out effect are two-fold. First, organizational performance may actually decrease as the ability of the decision-maker to investigate the proposals ex post goes up. The simple reason is that while valuable ex post, the increased expected intensity of investigations may reduce the precision of first-stage communication so much that the net value generated is actually negative. Second, the substitutability of investigations and the soft information transmitted through cheap talk may generate multiple equilibria, in terms of the equilibrium monitoring intensities chosen by the principal and the resulting most informative cheap talk equilibrium sustainable under those monitoring intensities. In particular, in a "high-trust" equilibrium, the decision-maker expects to receive precise recommendations from the agents, and given the expected precision, she will not investigate the proposals that intensely, which in turn makes precise recommendations incentive-compatible to the agents. In a "low-trust" equilibrium, on the other hand, the decision-maker expects the agents to exaggerate a lot and send very imprecise claims, which induces the principal to investigate intensely in particular claims of great alternatives, which in turn can support only imprecise communication.

Having established the basic influence of costly ex post investigations by the principal on the precision of pre-investigation communication and organizational performance, I then consider whether the organization could do better by delegating both decision-making and investigation responsibilities to one of the agents. For example, in the hiring example, the head of department may delegate the hiring authority to the micro group. The micro group may still consult the macro group regarding the quality of their candidate and may engage in an independent investigation of the credentials of that candidate, but is now free to pick whichever candidate they prefer.

The first result is that it continues to be the case that the ability of the decision-maker to engage in further investigations crowds out soft information communicated by the other agent, while the relationship between the cost of further investigations and the precision of cheap talk continues to be non-monotone. The reason is simply that the effect of such additional information remains fundamentally similar. The only difference is that now the decision-maker can condition his investigation intensity on his private information, which makes it possible that the precision of cheap talk may be locally increasing even in the asymmetry of (now expected) investigation intensities.

While the qualitative relationship between the quality of strategic communication and costly investigations is thus similar between the two alternative decision-making structures, there are two important quantitative differences. The first difference is that, to achieve the same level of performance, delegation is less dependent than centralization on the precision of strategic communication, for the simple reason that the agent is directly aware of the value of his own alternative. Second, because the information acquisition decision by the agent is conditioned on his private information, the expected level of information acquisition will generally be lower under delegation (as it will be targeted better). Both advantages, and thus the preference for delegation, are maximized for intermediate costs of investigation and levels of bias. If information is costly enough, no acquisition will take place under either structure and the final outcome is driven by the cheap talk solution, which in the present setting achieves the same level of performance across the two governance structures. If information is cheap enough, the final decision will be dominated by the additional information acquired, the use of which will always be better under centralization. Further, the crowding out effect vanishes when information becomes cheap enough. Relatedly, if the bias is large, communication will be very imprecise even under centralization and thus the value generated by information acquisition again dominates, making centralization preferred, while if the bias is small, then the precision of communication is already so high that the need for further information acquisition will be limited or non-existent under both structures. In other words, delegation will have its largest advantage in environments of moderate bias and reasonably costly investigations, because in such environments the tension between the two sources of information is the largest and delegation is better at managing that tension.

## 2 Related Literature

Broadly speaking, the present paper contributes to the literature on decision-making in groups, where a group of individuals needs to choose among a set of pre-defined alternatives, and the members of the group have potentially conflicting preferences over the alternatives. The paper most closely related to the present work is Dessein (2007), and to my knowledge the only other paper that considers the interaction between cheap talk statements and costly additional investigations. The key difference between the two settings is as follows. In Dessein, the "leader" of the group imposes an investigation or a discussion cost on all members of the group when additional investigation is warranted, which in turn can function as a deterrent to making proposals in the first place. In contrast, in my framework, the costs of additional investigation are solely borne by the decision-maker. As a result, different proposals don't directly impact the expected costs faced by the agents, such as the threat of needing to incur additional discussion costs if claiming to have a high-quality alternative. This structural difference then leads to different insights regarding the interaction of soft information with costly investigation and different comparative statics. For example, in Dessein, increasing the investigation costs increases the preference for decision-making by the uninformed principal, while here the conclusion is opposite, with increasing costs of investigation typically favoring delegation of decision authority to one of the agents. The other main difference is structural, where Dessein focuses on two alternatives of binomial quality, while I consider a setting where the value of the two alternatives is continuous. This difference makes the interaction among cheap talk, further investigation and the optimal allocation of authority richer. For example, the preference for delegating authority may be non-monotone in the degree of conflict instead of simply decreasing. Similarly, the impact of the cost of further investigations on the precision of cheap talk is non-monotone.

The model itself builds on the framework developed in Rantakari (2011b), but introduces the costly investigation stage to analyze the interaction between the two sources of information and to make the allocation of authority a relevant question. Other conceptually related papers are Li, Rosen and Suen (2001) and Dewatripont and Tirole (1999). Li, Rosen and Suen analyze a collective choice problem analogous to the present one when communication can take only the form of cheap talk, but with correlated information. Dewatripont and Tirole illustrate how settings of advocacy, such as the present model, often arise as the optimal arrangement when the agents need to be motivated to acquire information or generate alternatives in the first place. The present model illustrates the costs of such advocacy in terms of the compromised quality of information aggregation.

The link to the broader cheap talk literature is weaker because the focus of the present paper is on the interaction of cheap talk with additional information acquisition, a question that has received only limited attention. Two recent exceptions, but in the single sender setting are Chen (2009) and Moreno de Barreda (2011), of which the focus of Moreno de Barreda (2011) is closest to the present paper.[4] She also shows that if the principal is privately informed, she may be worse off in equilibrium because that information worsens the expected precision of the cheap talk stage. They key differences are that the present paper focuses on a setting with multiple agents, where the acquisition of additional information is a costly ex post choice, and where the key advantage of the communication stage is to economize on such costs if the group is able to reach a consenus on which alternative to implement. In contrast, in the single-sender setting of Moreno de Barreda, the additional information is readily available to the decision-maker and not a strategic choice variable as here. The key qualitative difference in the predictions is that in the single-sender setting, increasing the information of the principal always crowds out soft information because it makes the equilibrium decision less responsive to the information communicated. In the present setting the interaction is different and thus I find that the the relationship between the cost of further investigations and the precision of cheap talk is non-monotone, with the tradeoff driven by asymmetries in the decision-maker's information acquisition choices. In particular, if the decision-maker chose to acquire the same level of information following any messages, then the precision of cheap talk would be unaffected.

The second related strand within the cheap talk literature are the recent papers on comparative cheap talk which relates to the quality of distinct alternatives, as here, and where the contributions are Chakraborty and Harbaugh (2007, 2010) and Che, Dessein and Kartik (2011). These papers, however, focus on the complementary problem of a single receiver providing the rankings for multiple alternatives, in contrast to separate agents advocating for their preferred alternatives, as here. Finally, as a model of a group, the paper links distantly to the large literature on strategic voting and the efficiency of different voting rules, which more recently has been extended to consider prevoting communication, such as Austen-Smith and Feddersen (2006) and Gerardi and Yariv (2007), and information acquisition by the members, such as Li (2001), Persico (2004) and Gerardi and Yariv (2008). The focus of this literature has been on the efficiency of different decision or voting rules, while my focus is on the role of additional investigations in influencing the quality of strategic

[4] Other papers in this stream include Seidmann (1990) and Watson (1996). Much of this work, however, focuses on the implications that the correlation of beliefs has to the equilibrium structure of communication, which is not an issue here.

communication while simplifying the final decision rule to be incentive-compatible to one member of the group. One of the main messages from the literature on information acquisition is, however, the free-riding incentives that arise when the members are too aligned with each other, for which advocacy, which is assumed here, is one solution.

# 3 Model

The model consists of two strategic agents (he), $i$ and $j$, and a principal (she), $P$. Each of the two agents has access to a "project," which may be a potential employee, a research idea, a location for a factory and so forth. The value of this project to the organization is $\theta_i$, drawn from the uniform distribution on $\left[0, \overline{\theta}\right]$. The principal can implement only one of the proposals, and thus wants to choose $\max(\theta_i, \theta_j)$. The agency problem arises from the fact that each agent is privately informed of the value of their individual opportunity, and they are biased in favor of their own proposal. I model this bias by assuming that while the value realized by the principal is given by $\theta_i$, agent $i$ derives value $\theta_j$ if agent $j'$s proposal is implemented while deriving value $\theta_i + b$, with $b > 0$ if his idea is implemented. To return to the hiring example of the introduction, a micro candidate is worth $\theta_i$ to the department but the micro group will derive an additional benefit $b$ from having another member in the group, or a particular research idea is worth $\theta_i$ to the organization but will be worth an additional $b$ to the group that proposed it and will perform the research on the idea.

The goal of the analysis is to investigate how the decision-making structure of the organization influences the quality of the final choice from the perspective of the principal, where the authority to make the final decision resides either with the principal or is delegated to one of the agents (given the assumed symmetry, which one is irrelevant). The key informational assumptions are that the information held by the agents is soft, so that they can only make cheap talk statements regarding the quality of their alternatives, but the decision-maker is able to engage in further information acquisition before making the final choice.

Under centralization (decision-making and investigations by the principal), the game unfolds as follows. First, the principal elicits cheap talk messages regarding the quality of the agents' alternatives. Having received the messages, she forms beliefs regarding the quality of the two alternatives and decides whether to engage in further investigation of the two proposals. By incurring a personal cost $\mu C(p)$, where $\mu \in [0, \infty)$ parameterizes the cost of information, the principal will find out which of the two alternatives proposed is better with probability $p$, while learning nothing with the complementary probability.[5] While the only information that matters is which alternative is better, I will for concreteness assume that a successful investigation reveals $(\theta_i, \theta_j)$. I make the standard assumptions that $C'(p) \geq 0, C''(p) > 0$ and $\lim_{p \to \overline{p}} C'(p) = \infty$ with $\overline{p} \leq 1$. Finally, the principal will choose which alternative to implement, choosing the proposal with higher expected value. If indifferent, she will randomize 50/50 between the two alternatives.

[5] The results are robust to independent investigations by the principal, as illustrated in appendix B.1. The reason for using a single investigation is to balance the playing field with delegation, where only one investigation is needed.

Under delegation (decision-making and investigations by an agent), the game is similar, but with the exception that it is now one of the agents who will make the final decision and may engage in additional investigation before the final decision. First, the agent elicits a cheap talk message from the other agent regarding the quality of that alternative, after which he may acquire additional information and then chooses which alternative is better for him. I assume that the investigation technology is the same, so that the agent will find out which project is better for him with probability $p$ by incurring the cost $\mu C(p)$, while learning nothing with probability $(1-p)$. For concreteness, I will take this to imply that the agent learns $\theta_{-i}$.

**The nature of costly investigation and the absence of monetary transfers:** Before moving on with the analysis, few observations regarding the underlying assumptions of the model are in order. First, while I am assuming that the information held by the agents is soft, I have not taken an explicit stand on the nature of information acquired by the decision-maker. While the acquisition process resembles the large literature on costly state verification that has followed Townsend (1979), I am explicitly not allowing any transfers conditional on the success of such investigations, in particular on the relationship between the message sent by the agent and the information revealed by the investigation. This implies that either the information acquired by the decision-maker is soft as well, or we are explicitly ruling out additional monetary transfers.

Second, I am assuming that all the costs of investigation are borne by the decision-maker. This assumption is the key difference to Dessein (2007) and rules out the possibility of using the threat of additional costs of investigation to deter the agents from exaggerating the quality of their proposals. If such costs could be imposed, the impact on the cheap talk solution would be clearly different, but at the same time in many cases it would appear that it is impossible to force the agents to incur costs that are not incentive compatible to them. However, allowing the agents to provide hard information in an incentive-compatible manner, or even more realistically, modeling the additional investigation stage as a moral hazard in teams problem between the agents and the decision-maker along the lines of Dewatripont and Tirole (2006) appears an interesting avenue of further research by enriching the range of investigation methods available to the organization.

Third, I am assuming that no monetary transfers are available to further align the interests of the agents. With message- or outcome-contingent transfers, it would be simple to align the interests of the agents so that perfect transmission of information would be achieved and no further investigations are needed. However, admittedly, the present model is only a partial model of the various tasks performed by agents inside an organization, and optimally incentivizing other tasks may require the presence of conflict. In particular, as illustrated in Dewatripont and Tirole (1999), incentivizing information acquisition in the first place may require the introduction of conflict, so that the problem of optimal compensation faces an inherent tension between generating information and then using that information appropriately.[6] Because I am assuming that the information is already available to the respective agents to focus on the decision-making problem, I am taking the extent of conflict as exogenous. A promising avenue for future research is endogenizing the original information collection, team structure and compensation contracts to build a more complete picture

[6] See also Levitt and Snyder (1997), Friebel and Raith (2010), Ozbas and Rantakari (2011) and Rantakari (2011a).

of the problem at hand.

Fourth, I am assuming that the investigation takes place after the cheap talk stage. If there are no costs of delay, this will be the only incentive-compatible structure as the decision-maker will want to acquire information whenever the messages are such that the value generated will exceed the cost, while finding it worthwhile to wait for the initial messages to potentially avoid the need to investigate in the first place.[7]

# 4 Analysis

## 4.1 Centralization

Consider first the case of centralization (principal-authority), where the principal first receives proposals from the two agents in the form of cheap talk and then decides if and how much to investigate further the proposals made. Given that the two agents are ex ante symmetric, I will consider the most informative symmetric cheap talk equilibrium.[8]

The outline of the resulting game is as follows. First, each agent learns the value of their respective projects, $(\theta_i, \theta_j)$. Second, the agents choose from the set of messages $\{m_i^k\}$ a claim regarding the value of their alternative. For concreteness, I will use the terms "higher" or "larger" message to indicate evidence of higher value alternative (so that $E(\theta_i|m_i^k)$ is increasing in $k$). As discussed in Appendix B.3, this cheap talk stage will take a partition structure, where a given message reveals only that the state belongs to a particular interval: $m_i^k \to \theta_i \in \left[\theta_i^{k-1}, \theta_i^k\right]$, and where the thresholds are determined by the agent being indifferent between sending the lower or the higher message given his expectations regarding the payoff consequences of those messages. The presence of conflict necessitates the loss of information: if agent $i$ expected agent $j$ to reveal $\theta_j$ truthfully, he would exaggerate his own message by $b$, destroying the possibility of fully informative communication.

Third, having received the messages and formed the expectations regarding the quality of the proposals, the principal decides whether to engage in further investigation of the proposals. In the symmetric equilibrium, the principal then knows that if $m_i > m_j$, then $\min(\theta_i|m_i) \geq \max(\theta_j|m_j)$. Therefore, the principal will simply accept agent $i$'s proposal without any addition investigation. If, on the other hand, $m_i = m_j$, then $E(\theta_i|m_i) = E(\theta_j|m_j)$ and additional investigation is needed to find out which alternative is better. If the investigation succeeds, the principal will naturally implement the better alternative. If the investigation fails, she randomizes with equal probabilities between the two projects. Since $E(\theta_i|m_i) = E(\theta_j|m_j)$ under the symmetric cheap talk equilibrium, such randomization is incentive-compatible, and the 50/50 randomization generates a symmetric cheap talk equilibrium.

[7] If the principal could commit to investigate *only* ex ante, it is possible that such structure would do better because then there would be no distortion in the cheap talk stage. However, this benefit is undone whenever ex post investigation becomes feasible.

[8] An asymmetric equilibrium also exists, and is analyzed in Appendix B.2. The basic logic of the analysis is unchanged when we allow the principal to choose between communication equilibria under centralization.

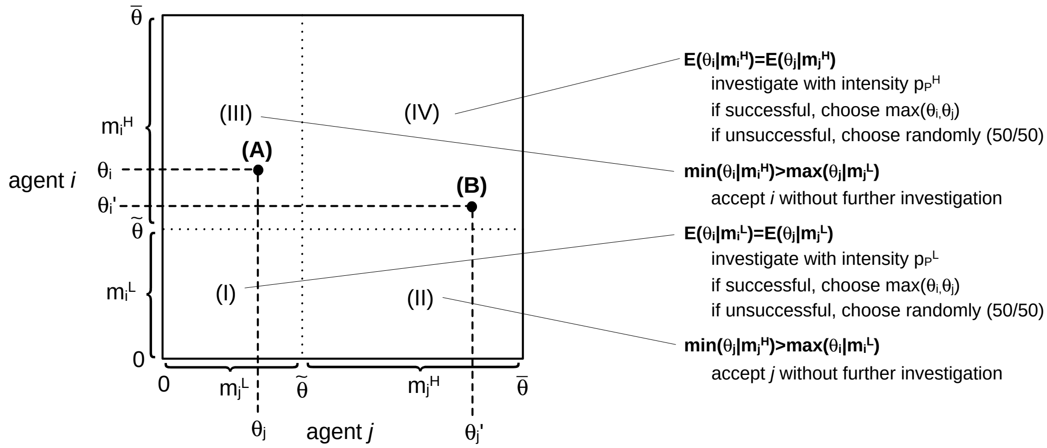



Figure 1: Outline of the game under centralization

The key role of the communication stage is thus to help the organization to economize on investigation costs. When the two agents agree on which alternative to implement after the communication stage (which arises when $m_i \neq m_j$), no further investigation is needed. In other words, if both the micro and macro groups agree on which candidate is better based on the initial discussion, no additional investigation of the merits of the candidates is needed. Similarly, the ability to investigate further when such consensus does not arise is also clearly valuable so that better decisions can be made. This basic structure is illustrated in figure 1 for a symmetric two-message equilibrium, where each agent sends the message $m_i^L$ if $\theta_i \in [0, \widetilde{\theta}]$ and $m_i^H$ if $\theta_i \in [\widetilde{\theta}, \overline{\theta}]$. Suppose that the realization of states is given by point (A). Then, agent $i$ sends $m_i^H$ and agent $j$ sends $m_i^L$, which implies that the group has reached a consensus on which project is better and so the principal will accept $i'$s proposal without any further investigation. If, on the other hand, the initial realization of the states is given by (B), then each agent will send the message $m_i^H$. Now, there remains conflict over which alternative is truly better, and the principal will engage in further investigation of the alternatives, choosing an investigation intensity $p_P^H$. If the investigation is successful, she will naturally choose the better alternative, while if the investigation fails, she will choose randomly between the two.

Finally, while both sources of information are thus clearly valuable, the key element of the analysis is that the precision of soft information that can be communicated in the first stage will be influenced by the expected level of investigation in the case of disagreement. As we will see, the expected surplus generated may actually decrease as investigation becomes cheaper because the expectation of high levels of investigation will generally crowd out soft information.

The solution to the model follows from backward induction. Having received the messages and given her expectations regarding the information content of these messages, the principal forms beliefs regarding the relative attractiveness of the two alternatives and chooses how much to investigate further. As discussed above, further investigation is valuable if and only if $m_i = m_j$. Then, suppose that the principal expects the information content of $m_i^k$ to be $\theta_i \in [\theta_i^{k-1,e}, \theta_i^{k,e}]$, with $\Delta_i^{k,e} = \theta_i^{k,e} - \theta_i^{k-1,e}$ and symmetrically for agent $j$ (where superscript $e$ denotes the expectation). Then, it is straightforward to calculate that the value of a successful investigation is given by

$$E\left(\max(\theta_i,\theta_j)|m_i^k,m_j^k\right)-\frac{1}{2}\left(E\left(\theta_i|m_i^k\right)+E\left(\theta_j|m_j^k\right)\right)=\left(\frac{\Delta_i^{k,e}}{6}\right),$$

and so the principal's investigation intensity $p\left(m^k\right)$ solves

$$\left(\frac{\Delta^{k,e}}{6}\right)=\mu C'\left(p\left(m^k\right)\right).$$

Given these investigation intensities following disagreement, the agents then compute their expected payoffs from sending different messages and choose the one that maximizes their payoff. For the communication equilibrium to be incentive-compatible, it then needs to be that at the threshold $\theta_i^k$ between two adjacent messages $m_i^k \to \theta_i \in [\theta_i^{k-1},\theta_i^k]$ and $m_i^{k+1} \to \theta_i \in [\theta_i^k,\theta_i^{k+1}]$, the agent is indifferent between sending the two messages: $E\left(u_i|m_i^k,\theta_i^k,p\left(m^k\right)\right)=E\left(u_i|m_i^{k+1},\theta_i^k,p\left(m^{k+1}\right)\right)$. The solution to this difference equation then defines the partition equilibrium for the cheap talk stage.[9] Simple algebra yields the following proposition regarding the structure of the equilibrium:

**Proposition 1** ***Communication and investigation equilibrium under centralization:***

*(i) The principal's investigation intensities $p\left(m^k\right)$ in the case of conflict solve $\left(\frac{\Delta^{k,e}}{6}\right)=\mu C'\left(p\left(m^k\right)\right)$*

*(ii) The communication partition solves $\Delta_i^{k+1}=b\left(1+\sqrt{1+\frac{\Delta_i^k\left(2b+\Delta_i^k\right)}{b^2\left(1-\zeta^{k+1,k}\right)}}\right)$,*

*where $\Delta_i^k=\theta_i^k-\theta_i^{k-1}$ and $\zeta^{k+1,k}=\frac{p\left(m^{k+1}\right)-p\left(m^k\right)}{\left(1-p\left(m^k\right)\right)}$.*

*(iii) The principal's expectations regarding the content of the messages are correct: $\theta_i^{k,e}=\theta_i^k\ \forall k$.*

**Proof.** See Appendix A.1 ■

From this solution we can then immediately infer the main conclusions regarding the interaction betwen the precision of cheap talk and the extent of further investigations, as given by the following corollary:

**Corollary 2** ***The relationship between further investigations and the precision of cheap talk:***

*(i) In any equilibrium partition, $\Delta_i^{k+1}>\Delta_i^k$ to counter the agents' incentives to exaggerate, which implies that the investigation intensities are (weakly) increasing in the size of the messages, $p\left(m^{k+1}\right)\geq p\left(m^k\right)$.*

*(ii) The precision of cheap talk $\left(\frac{\Delta_i^k}{\Delta_i^{k+1}}\right)$ is decreasing in $\zeta^{k+1,k}=\frac{p\left(m^{k+1}\right)-p\left(m^k\right)}{\left(1-p\left(m^k\right)\right)}$, which measures*

[9] Following the standard approach, I focus on the most informative partition that is sustainable given the investigation levels.

*the asymmetry in the investigation intensities. Since* $p\left(m^{k+1}\right) \geq p\left(m^{k}\right)$*, the ability to engage in further investigations always (weakly) crowds out soft information*

*(iii) The asymmetry in the investigation intensity,* $\zeta^{k+1,k}$*, is non-monotone in the cost of investigations,* $\mu$*. As a result, the impact of the cost of investigation itself on the quality of cheap talk is non-monotone, with the precision maximized both when* $\mu \to 0$ *and* $\mu \to \infty$ *(so that* $\zeta^{k+1,k} \to 0$*).*

The key result from the proposition and the corollary is that the ability of the principal to engage in further investigation of the proposals always reduces the quality of soft information transmitted. Further, this distortion is non-monotone in the cost of further information.

To build the intuition for this result, consider the indifference condition for agent $i$ who is contemplating between sending messages $m_i^k$ and $m_i^{k+1}$, which determines the threshold $\theta_i^k$. Knowing that this choice will matter only when agent $j$ sends either one of these messages, we can write the indifference condition as

$$\begin{aligned}&\Pr(m_j^{k+1})\left(\left(1-p\left(m^{k+1}\right)\right)\left(\tfrac{1}{2}E\left(\theta_j|m_j^{k+1}\right)+\tfrac{1}{2}\left(\theta_i^k+b\right)\right)+p\left(m^{k+1}\right)E\left(\theta_j|m_j^k\right)\right)+\Pr(m_j^k)\left(\theta_i^k+b\right)\\ &=\Pr(m_j^{k+1})E\left(\theta_j|m_j^{k+1}\right)+\Pr(m_j^k)\left(\left(1-p\left(m^k\right)\right)\left(\tfrac{1}{2}E\left(\theta_j|m_j^k\right)+\tfrac{1}{2}\left(\theta_i^k+b\right)\right)+p\left(m^k\right)\left(\theta_i^k+b\right)\right).\end{aligned}$$

The first line gives the relevant expected payoff from sending the higher message. With probability $\Pr(m_j^{k+1})$, the other agent sends the same message and an investigation is triggered. With probability $\left(1-p\left(m^{k+1}\right)\right)$, the investigation fails and the principal chooses randomly. With probability $p\left(m^{k+1}\right)$, she succeeds, in which case the other project is selected with probability one (since in equilibrium $\theta_i^k=\theta_j^k=\min\left(\theta_j|m_j^{k+1}\right)$). If, on the other hand, the other agent sends the lower message, agent $i'$s idea is chosen directly, giving a payoff of $\left(\theta_i^k+b\right)$. Similarly, the second line gives the payoff from sending the lower message. If the other agent sends the higher message, then that alternative is chosen now for sure, giving $E\left(\theta_j|m_j^{k+1}\right)$, while if he also sends the lower message, an investigation is triggered. The only key difference is that now a successful investigation will lead to the adoption of agent $i'$s project with probability one (since $\theta_i^k=\theta_j^k=\max\left(\theta_j|m_j^k\right)$).

Now, slightly rearranging the expression gives us

$$\begin{aligned}&\Pr(m_j^{k+1})\left(\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)+p\left(m^{k+1}\right)\left(E\left(\theta_j|m_j^{k+1}\right)-\left(\theta_i^k+b\right)\right)\right)\\ &=\Pr(m_j^k)\left(\left(E\left(\theta_j|m_j^k\right)-\left(\theta_i^k+b\right)\right)+p\left(m^k\right)\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^k\right)\right)\right).\end{aligned}$$

Suppose first that there would be no investigations. Then, the indifference condition reduces to

$$\Pr(m_j^{k+1})\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)=\Pr(m_j^k)\left(E\left(\theta_j|m_j^k\right)-\left(\theta_i^k+b\right)\right),$$

and since $E\left(\theta_j|m_j^k\right)<\left(\theta_i^k+b\right)$, it must be that $\left(\theta_i^k+b\right)<E\left(\theta_j|m_j^{k+1}\right)$. In other words, in equilibrium it must be the case that the loss from sending the lower message, which comes from the fact that a strictly worse project to me is selected with probability 0.5 instead of zero, equals the

loss from sending the higher message, which is that my proposal, now accepted with probability 0.5, will displace a project which is strictly more valuable in expectation to me.

When the investigation following the higher message is successful, the loss from sending the larger message is eliminated because the displacement will no longer occur. But similarly, the loss from sending the lower message is also eliminated because now the other project will no longer be accepted. If the investigation intensities were the same, then these two effects would exactly cancel each other out and the result is as if there was no investigation. However, since $\Delta^{k+1} > \Delta^k$ and the value of additional investigation is increasing in the amount of residual uncertainty, $p\left(m^{k+1}\right) \geq p\left(m^k\right)$ and thus, intuitively, bolder claims are exposed to more ex post scrutiny.[10] Therefore, the loss from exaggeration is reduced relatively more and thus the equilibrium quality of soft information is reduced.[11] Finally, because it is the *asymmetry* in the investigation intensities and not the level that matters, the actual amount of crowding out is non-monotone in the actual costs of investigation. The reason is that as information becomes infinitely costly, the investigation levels converge to zero, but at the same time, as information becomes free, the investigation levels converge to their maximal precision $\overline{p}$, in both cases eliminating the asymmetry. It is thus investigations under intermediate costs of information, which maximize the asymmetry in the investigation intensities (with bolder claims examined disproportionately more than conservative claims), that induce the most crowding out of soft information. It is also worth noting that while the exact solution to the model is derived under the assumption of a uniform distribution, the above discussion made no use of the distributional assumptions and so the basic tradeoff between further investigations and the crowding out of soft information, including the non-monotonicity between the cost of information and the amount of crowding out, generalizes immediately to other distributions as well.

Finally, while the access to an investigation technology thus decreases the expected quality of communication, there is clearly also value generated by allowing the principal to make more informed choices when the group is unable to reach a consensus in the communication stage alone. To take this value into account, we can compute the total expected payoff under centralization, as given by the following proposition:

**Proposition 3** ***Expected payoff under centralization:***

$$EU_P^C = \frac{\overline{\theta}}{2} + \frac{1}{2\overline{\theta}^2}\sum_{k=1}^{N}\theta^{k-1}\theta^k\Delta^k + \sum_{k=1}^{N}\left(\frac{\Delta^k}{\overline{\theta}}\right)^2\left(p\left(m^k\right)\left(\frac{\Delta^k}{6}\right) - \mu C(p\left(m^k\right))\right),$$

*where* $p\left(m^k\right)$ *solves* $\left(\frac{\Delta^k}{6}\right) = \mu C'\left(p\left(m^k\right)\right)$, $\theta^k$ *are the (symmetric) equilibrium cutoffs of the cheap talk partition and* $N$ *is the maximal number of elements in the partition, with* $\theta^0 = 0$ *and* $\theta^N = \overline{\theta}$.

[10] Conversely, if $p\left(m^{k+1}\right) < p\left(m^k\right)$, soft information would be better than in the absence of investigations. In equilibrium, however, this cannot arise. To see this, note that the maximal asymmetry is induced by having $p\left(m^k\right) = 1$ and $p\left(m^{k+1}\right) = 0$, but in this case $\Delta^{k+1} = 2b$, so at best we achieve equal-sized elements, implying $p\left(m^{k+1}\right) \geq p\left(m^k\right)$, which then makes the asymmetry strict, with $\Delta^{k+1} > \Delta^k$.

[11] The full independence of the overall level is somewhat of an artefact of the particular investigation technology. When independent investigations are allowed, then the crowding out effect is present even for a uniform increase in monitoring levels. The reason is that the independence of investigation provides additional protection from exaggeration. This extension is considered in Appendix B.

**Proof.** See Appendix A.2 ■

The expected payoff of the principal thus decomposes naturally into three parts. First, the expected payoff if the principal would simply choose randomly between the two projects is $\frac{\overline{\theta}}{2}$. The second component captures the value generated by the communication stage and the third component gives the value generated by the costly investigation stage. The key element of the model is the interaction between the cheap talk and the investigation stage, as discussed above, and the implications of this interaction for organizational performance are summarized in the following corollary:

**Corollary 4** ***Implications for organizational performance:***

*(i) Organizational performance may decrease as additional investigations becomes cheaper when information is sufficiently costly.*

*(ii) For the same environment, the organization may exhibit multiple equilibria in terms of the amount of soft information transmitted in the communication stage and the level of investigation intensities.*

The intuition for the first part of the corollary follows directly from the crowding out of soft information, and simply highlights that the crowding out effect can be so strong that the total surplus generated will actually decrease. Two conditions, however, need to be satisfied for this result to arise. First, the information needs to be sufficiently costly. Acquiring perfect (or balanced) information at zero cost is clearly better than relying on cheap talk alone. Second, the cost function should not be too convex, so that (i) the surplus generated by the investigation is limited and that (ii) the difference $p\left(m^k\right) - p\left(m^{k-1}\right)$ can be large, so that there is significant crowding out. This result is illustrated in figure 2 for a two-message equilibrium.[12] The first two panels illustrate the equilibrium investigation intensities following high and low messages, together with the asymmetry between the two, $\zeta^{H,L}$. As discussed, we can see that while reductions in the cost of information increase the expected level of investigation, the asymmetry is initially increasing and then decreasing. This is then reflected in the fact that the precision is cheap talk is initially decreasing and then increasing. The effect on expected performance is then illustrated in panel (iii), showing that the organizational performance is better under no information unless information is sufficiently cheap.

The crowding out effect also generates the possibility of multiple equilibria when the cost function is sufficiently flat. Of course, cheap talk games have naturally multiple equilibria of differing informativeness, one of them being the babbling one. Here, the meaning is different and relates to multiple equilibrium levels of investigation and the resulting maximal informativeness of the cheap talk stage that is consistent with the particular investigation strategy.

[12] Unless otherwise mentioned, the cost function used is $C(p) = -c\left((ap)^{\gamma} + \ln\left(1-(ap)^{\gamma}\right)\right)$, where $a \geq 1$ controls the maximal precision of information and $\gamma$ controls the convexity of the cost function, while $c$ is our variable of interest, parameterizing the (marginal) cost of information. This functional form provides a flexible formulation for capturing many different shapes with the restriction that $\overline{p} \leq 1$. The solution presented is based on $a = 1.3, \gamma = 0.5$ and $b = 1/5$, implying two equilibrium messages with a single interior cutoff.

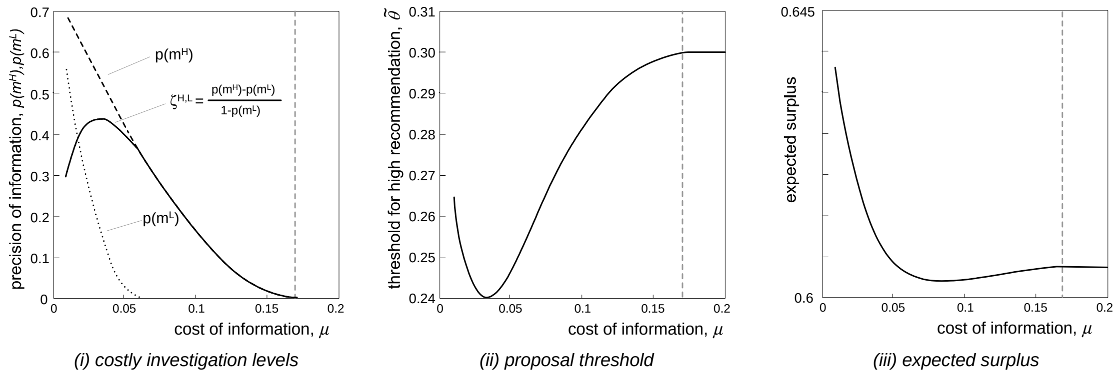



Figure 2: Equilibrium under centralization

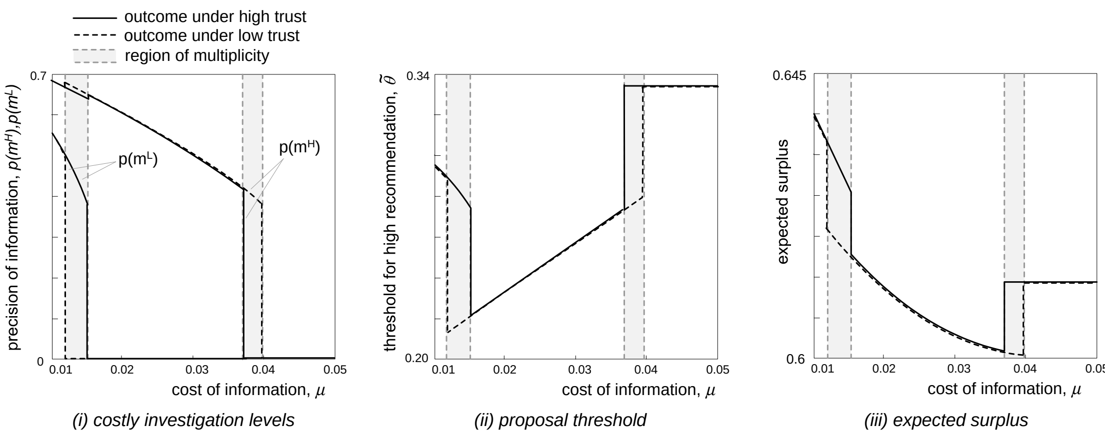



Figure 3: An illustration of the high trust and low trust equilibria

We can consider these equilibria as "high trust" or "low trust" equilibria, as represented by the precision of equilibrium cheap talk, and the intuition behind their self-enforcing nature is clear. If the principal expects the agents to exaggerate a lot, he will investigate bold claims disproportionately more intensively than more conservative claims, and the crowding out effect then sustains such exaggeration, a situation that one could describe as "low trust." Conversely, if the principal expects the agents not to exaggerate that much, the investigation intensities will be more balanced between bold and conservative statements, which in turn supports the agents being more forthcoming with their information. This outcome one could then describe as "high trust," as the principal limits the extent to which bold statements are scrutinized and instead trusts the agents to be forthcoming with their private information, which in turn is sustained because the fact that their recommendations are trusted more induces the agents to truly be more forthcoming with their private information. An illustration of this result is given in figure 3.[13]

[13] Relative to figure 2, we have reduced the convexity of the cost function from $\gamma = 0.5$ to $\gamma = 0.2$ and to slightly amplify the effects, reduced the bias from $b = 1/5$ to $b = 1/6$, thus increasing the precision of cheap talk while remaining in the world of only two equilibrium messages.

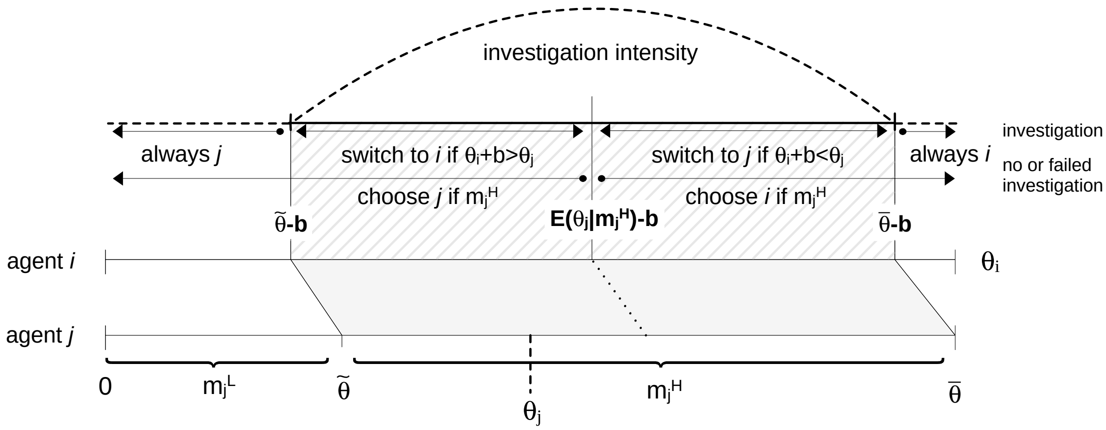



Figure 4: Outline of the game under delegation

## 4.2 Delegation

Suppose now that instead of making the final decision herself, the principal delegates decision-making (and thus investigation responsibility) to one of the agents.[14] For example, the department head delegates hiring authority to the micro group who will then choose between their candidate or the macro candidate following the recommendation of the macro group and their own (if any) investigation regarding the credentials of the macro candidate. The solution follows analogously, but with the additional technical complication that the agent's investigation intensity will now naturally depend on his private information. Otherwise, the game is similar to the above, as illustrated in figure 4. First, each agent learns the value of their alternative, $(\theta_i, \theta_j)$ . Second, the agent without authority (agent $j$) sends a message $m_j$ to the decision-maker. Suppose that this message is $m_j^k$. Then, the decision-maker (agent $i$) forms beliefs that $\theta_j \in [\theta_j^{k-1,e}, \theta_j^{k,e}]$ with an expected value of $E\left(\theta_j | m_j^k\right)$ and chooses whether and how much to investigate further. First, note that without an investigation (or with a failed investigation), agent $i$ will implement agent $j'$s proposal simply if that is more attractive to him, or $\theta_i + b \leq E\left(\theta_j | m_j^k\right)$ . Otherwise, he will implement his own alternative. But now the choice of how intensely to investigate will also depend on $\theta_i$. If $\theta_i + b \leq \theta_j^{k-1,e}$, then agent $i$ will implement $j'$s proposal no matter what the outcome of the investigation would be and thus will never investigate. Similarly, if $\theta_i + b > \theta_j^{k,e}$, then he will always implement his own project and again no investigation takes place. The incentives to investigate are thus maximized when $\theta_i = E\left(\theta_j | m_j^k\right) - b$, in which case the information is most likely to be pivotal and converge to zero at the bounds $\left[\theta_j^{k-1,e} - b, \theta_j^{k,e} - b\right]$ .

We can then again solve for the equilibrium by using backward induction. To solve the investigation intensities, suppose first that $\theta_i + b \in [E(\theta_j | m_j^k), \theta_j^{k,e}]$, so that the decision-maker (agent $i$) will implement his own project in the absence of additional information. Then, the value of information

[14]As an aside, it is worth noting that delegation is also credible in this setting, in the sense that if the principal only sees the recommendation of the agent, together with the final decision, she has no incentives to overrule the final decision.

is given by

$$\Pr(\theta_j \geq \theta_i + b | m_j^k)\left(E\left(\theta_j | \theta_j \geq \theta_i + b, m_j^k\right) - (\theta_i + b)\right) = \frac{\left(\theta_j^{k,e} - (\theta_i + b)\right)^2}{2\Delta_j^{k,e}}.$$

Similarly, if $\theta_i + b \in [\theta_j^{k-1,e}, E(\theta_j | m_j^k)]$, then the default decision for the decision-maker is to implement agent $j'$s alternative, so that the value of learning the true state is

$$\Pr(\theta_j \leq \theta_i + b | m_j^k)\left((\theta_i + b) - E\left(\theta_j | \theta_j < \theta_i + b, m_j^k\right)\right) = \frac{\left((\theta_i + b) - \theta_j^{k-1,e}\right)^2}{2\Delta_j^{k,e}}.$$

Having the investigation intensities $p\left(m_j^k, \theta_i\right)$, we can then solve for the message thresholds by using the agent's indifference condition as in the case of centralization, with the equilibrium summarized by the following proposition:

**Proposition 5** ***Communication and investigation equilibrium under delegation:***

*(i) The monitoring intensities by the decision-maker (agent i) conditional on $m_j^k$ solve*

$$\begin{array}{ll} \frac{\left(\theta_j^{k,e} - (\theta_i + b)\right)^2}{2\Delta_j^{k,e}} = \mu C'\left(p\left(\theta_i, m_j^k\right)\right) & \text{if } \theta_i + b \in [E(\theta_j | m_j^k), \theta_j^{k,e}] \\ \frac{\left((\theta_i + b) - \theta_j^{k-1,e}\right)^2}{2\Delta_j^{k,e}} = \mu C'\left(p\left(\theta_i, m_j^k\right)\right) & \text{if } \theta_i + b \in [\theta_j^{k-1,e}, E(\theta_j | m_j^k)] \end{array}$$

*(ii) The communication partition by agent j solves*

$$\int_{E\left(\theta_j | m_j^k\right) - b}^{E\left(\theta_j | m_j^{k+1}\right) - b} \left(\begin{array}{c} I_{m_i^{k+1}} p\left(\theta_i, m_j^{k+1}\right) \\ + I_{m_i^k} p\left(\theta_i, m_j^k\right) \end{array}\right)\left(\theta_i - \left(\theta_j^k + b\right)\right) d\theta_i + \frac{\left(\Delta_j^{k+1} + \Delta_j^k\right)}{8}\left[8b - \left(\Delta_j^{k+1} - \Delta_j^k\right)\right] = 0,$$

*where $I_{m_i} \in \{0, 1\}$ is an indicator function for whether the indicated message was sent. An exception arises if $E\left(\theta_j | m_j^1\right) - b < 0$, in which case the lowest threshold $k = 1$ is implicitly defined by*

$$\int_{0}^{E\left(\theta_j | m_j^{k+1}\right) - b} \left(I_{m_i^{k+1}} p_{\theta_i}^{k+1} + I_{m_i^k} p_{\theta_i}^k\right)\left(\theta_i - \left(\theta_j^k + b\right)\right) d\theta_i + \frac{\left(2\theta_j^k - 2b + \Delta^{k+1}\right)\left[2\theta_j^k - \Delta^{k+1} + 6b\right]}{8} = 0.$$

*(iii) The decision-maker's expectations regarding the content of the messages are correct: $\theta_j^{k,e} = \theta_j^k$ $\forall k$.*

**Proof.** See Appendix A.3 ■

Because the decision-maker's investigation intensities are now state-dependent, the indifference conditions are somewhat more cumbersome than under centralization, but the same basic intuition and thus corollary 2 continue to apply, with $8b - \left(\Delta_j^{k+1} - \Delta_j^k\right) = 0$ defining the cheap-talk equilibrium in the absence of any investigations, and the integral

$$\int_{E\left(\theta_j|m_j^k\right)-b}^{E\left(\theta_j|m_j^{k+1}\right)-b} \left(I_{m_i^{k+1}} p\left(\theta_i, m_j^{k+1}\right) + I_{m_i^k} p\left(\theta_i, m_j^k\right)\right)\left(\theta_i - \left(\theta_j^k + b\right)\right) d\theta_i \geq 0$$

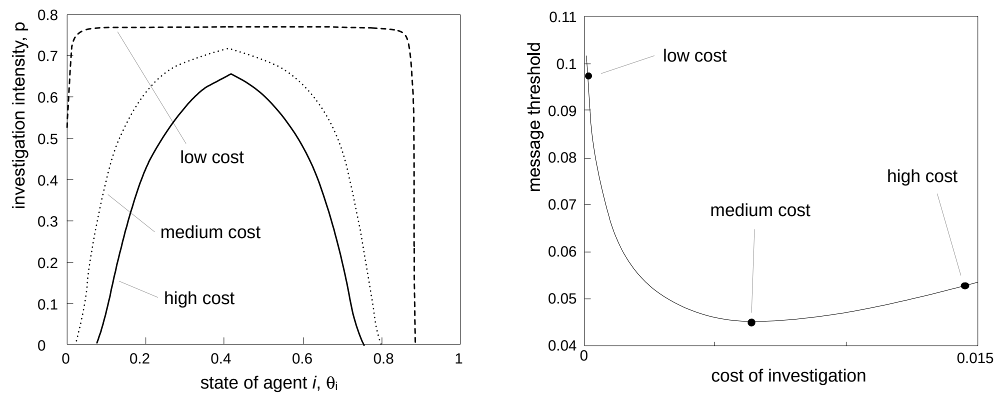
capturing the increase in the relative attractiveness of sending the higher message, with the same basic tradeoff that when sending the higher message, the impact of successful monitoring is that the proposed project is rejected while it would have been accepted in the absence of investigation, while when sending the lower message, the impact of successful monitoring is that the proposal will be accepted while it would would have been rejected otherwise. Thus, it continues to be the case that the main determinant for the quality of communication is the degree of asymmetry between the (now-expected) investigation intensities.

There is, however, one local qualitative difference in how the investigation intensities influence the precision of soft information. Under centralization, we had the unambiguous result that increasing $p\left(m^{k+1}\right)$ decreased the precision of communication while increasing $p\left(m^k\right)$ increased the precision of communication, as determined by the ratio $\left(\Delta^k/\Delta^{k+1}\right)$. Under delegation, it continues to be the case that increasing $p\left(\theta_i, m_j^k\right)$ for any $\theta_i$ unambiguously improves the precision of communication, and for the same reason as under centralization: increasing $p\left(\theta_i, m_j^k\right)$ for any relevant $\theta_i$ increases the likelihood that the proposer gets his alternative accepted, which will improve his payoff.

For the higher message, one the other hand, the impact is now ambiguous. The reason for this ambiguity is as follows. First, note that we can write the value generated to the marginal proposer from a successful investigation (where the outcome is always the decision-maker choosing his project over the proposed alternative) as

$$\int_{\theta_j^k-b}^{E\left(\theta_j|m_j^{k+1}\right)-b} p\left(\theta_i, m_j^{k+1}\right)\left(\theta_i - \left(\theta_j^k + b\right)\right) d\theta_i.$$

Second, note that while the sender benefits from this whenever $\left(E\left(\theta_j|m_j^{k+1}\right) - b\right) \geq \theta_i > \left(\theta_j^k + b\right)$, the sender is actually hurt by the success of the investigation when $\left(\theta_j^k + b\right) > \theta_i > \left(\theta_j^k - b\right)$, because then the decision-maker will replace the proposer's alternative with an alternative that is even worse from the proposer's perspective. Now, if $p\left(\theta_i, m_j^{k+1}\right)$ was constant over $\theta_i \in [\theta_j^k - b, E\left(\theta_j|m_j^{k+1}\right) - b]$, then the positive value generated dominates (as in the case of centralization), and so increased investigations would reduce the costs of exaggeration. However, as seen above, the monitoring intensity is *not* constant. Instead, it is weakly increasing in $\theta_i$ over the relevant range: $\frac{\partial p\left(\theta_i, m_j^{k+1}\right)}{\partial \theta_i} \geq 0$. Therefore, when investigation costs are relatively high, the agent will concentrate his investigation efforts around $E\left(\theta_j|m_j^k\right) - b$, which will thus improve the payoff from sending the larger message and thus lead to more exaggeration, as in the case of centralization. But as the investigation costs decrease, the decision-maker will start to investigate more intensely also at the lower end of the relevant range (which for higher costs were too marginal to warrant too much attention). Then, if $p\left(\theta_i, m_j^{k+1}\right)$ increases sufficiently more in the range $[\theta_j - b, \theta_j + b]$ relative to the range $[\theta_j + b, E\left(\theta_j|m_j^k\right) - b]$, the expected payoff of the agent will actually *decrease* and thus improve the precision of communication - investigation and soft information are thus local complements. This




*(i) Investigation intensity of the decision-maker* *(ii) message threshold*

Figure 5: An illustration of the local complementarity between investigation intensity and soft information.

result is illustrated in figure 5. The first panel illustrates how the distribution of investigation intensities following a high message varies as the cost of information changes, while the second panel plots the threshold between the higher and lower messages induced by the expected investigation levels. While the initial reduction in the cost of information lowers the quality of communication, further reductions actually start increasing the quality of communication.[15,16] But, as indicated earlier, this result is local and has limited impact on the overall results from the model.

Finally, as with centralization, we can then compute the expected payoff under delegation, which is summarized in the following proposition:

**Proposition 6** ***Expected payoff under delegation:***

$$EU_P^D = \frac{\overline{\theta}}{2} + \frac{1}{8\overline{\theta}^2}\sum_{k=1}^{N}\theta_j^k\theta_j^{k-1}\Delta_j^k + \frac{\left(\left(\overline{\theta}^3 - I_{E\left(\theta_j|m_j^1\right)-b<0}\left(\theta_j^1\right)^3\right) - 4b^2\left(\overline{\theta} - I_{E\left(\theta_j|m_j^1\right)-b<0}\theta_j^1\right)\right)}{8\overline{\theta}^2} + \sum_{k=1}^{N}\Pr(m_j^k)EV\left(p\left(\theta_i, m_j^k\right)\right),$$

*where $EV\left(p\left(\theta_i, m_j^k\right)\right)$ is the expected value generated by a successful investigation conditional on message $m_j^k$:*

$$EV\left(p\left(\theta_i, m_j^k\right)\right) = \int_{\max(0,\theta_j^{k-1}-b)}^{\theta_j^k - b}\left(p\left(\theta_i, m_j^k\right)\left(\begin{array}{c} I_{\theta_i \le E\left(\theta_j|m_j^k\right)-b}\left(\frac{\left(\theta_i - \theta_j^{k-1}\right)^2 - b^2}{2\Delta_j^k}\right) \\ +I_{\theta_i > E\left(\theta_j|m_j^k\right)-b}\left(\frac{\left(\theta_j^{k-1} - \theta_i\right)^2 - b^2}{2\Delta_j^k}\right)\end{array}\right) - \mu C\left(p\left(\theta_i, m_j^k\right)\right)\right)d\theta_i,$$

[15] The parameters were chosen so that $\max\left(p\left(\theta_i, m_j^L\right)\right) = 0$, so that the effect is truly driven by the increase in monitoring when the high message is sent. $b = 1/9, a = 1.3$ and $\gamma = 0.5$.

[16] We could generate the same effect even under centralization if we made the likelihood of success dependent on how different the two projects are: $p(e, |\theta_i - \theta_j|)$, where $e$ is the effort of the agent and $|\theta_i - \theta_j|$ measuring the distance between the two alternatives. The reason is that now high cost (low efforts) will disproportionately pick high $\theta_i$ for replacement, while as effort costs come down, $E(\theta_i|success)$ begins to decrease as the principal starts picking up even minute differences in the value of the ideas, and eventually starting to switch for projects that are actually damaging to the agent.

*with $I_F \in \{0,1\}$ an indicator function for whether the stated condition $F$ is true and $p\left(\theta_i, m_j^k\right)$ solving the decision-maker's information acquisition problem.*

**Proof.** See Appendix A.4 ■

Thus, we can decompose the expected payoff under delegation into the payoff that is generated by the cheap talk stage only and the additional value that is generated by the investigation technology, with the expected return to investigations again a more cumbersome expression simply because the investigation intensity itself now depends on $\theta_i$, the value of the decision-maker's alternative. The key differences to the value of investigations under centralization are two-fold. First, because the agent is already informed of the quality of his alternative, this information allows for better targeting of information acquisition and thus generally lower expected levels of investigation. Second, because the value of information to the agent is different from the value of information to the principal due to the presence of the bias, $b$, the incentives to acquire information are misaligned. Despite this misalignment, however, the incentives are such that the agent never over-invests in information acquisition from the principal's perspective, so it is the first effect that is is the more important one.[17]

With respect to the cheap-talk stage, the differences to centralization are also two-fold. First, because the agent knows the value of his own alternative, the importance of the cheap talk stage is lower. This is captured by the fact that the value generated by the cheap talk stage under centralization was given by $\frac{1}{2\overline{\theta}^2}\sum \theta^k \theta^{k-1} \Delta^k$, the value of this stage under delegation is only $\frac{1}{8\overline{\theta}^2}\sum \theta_j^k \theta_j^{k-1} \Delta_j^k$, which is thus smaller by a factor of four. Second, the decision-maker's direct use of his private information is captured by the second component,

$$\frac{\left(\overline{\theta}^3 - I_{E\left(\theta_j | m_j^1\right) - b < 0}\left(\theta_j^1\right)^3\right) - 4b^2\left(\overline{\theta} - I_{E\left(\theta_j | m_j^1\right) - b < 0}\theta_j^1\right)}{8\overline{\theta}^2},$$

which was absent under centralization since the decision-maker had no direct access to information. In particular, even if agent $j$ sends no informative messages, agent $i$ may still implement $j'$s alternative when his own alternative is sufficiently bad ($\theta_i + b \leq \overline{\theta}/2$), which improves upon a purely random selection of projects.

In short, because the basic structure of the game is the same under both centralization and delegation, so are the basic tradeoffs, with the ability of the decision-maker to investigate a proposal, while directly generating value, also indirectly crowding out the precision of soft information and may thus be detrimental to organizational performance. The key quantitative differences, which will play an important role below, are that delegation is less dependent on the precision of soft information communicated and is thus generally damaged less by any crowding out that may take place, and will generally engage in less intensive investigations, thus generating less crowding out in the first place.

[17] Shown in Appendix A.5.

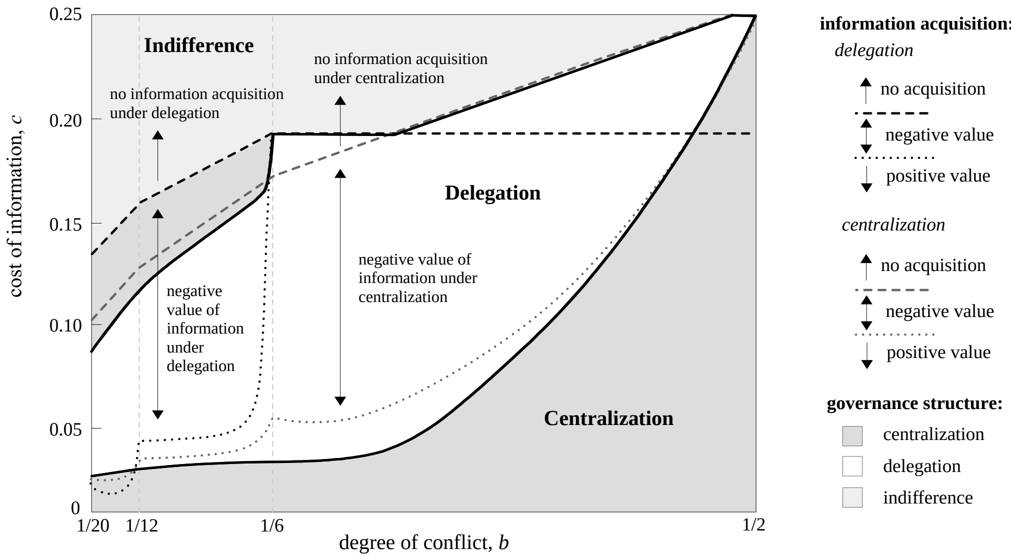



Figure 6: Allocation of authority

## 4.3 Allocation of authority

Given the equilibrium payoffs under the two structures, as derived above, we can then consider when one governance structure dominates the other. A typical solution to the allocation problem is illustrated in figure 6.[18] Consider first the solution in the absence of further investigations. Then, under centralization, the cheap talk equilibrium will have either two $\left(b \in \left[\frac{1}{6}, \frac{1}{2}\right]\right)$, three $\left(b \in \left[\frac{1}{12}, \frac{1}{6}\right]\right)$ or four $\left(b \in \left[\frac{1}{20}, \frac{1}{12}\right]\right)$ messages sent in equilibrium, reflecting how increased alignment improves the precision of communication. In contrast, under delegation, there will be either just one $\left(b \in \left[\frac{1}{6}, \frac{1}{2}\right]\right)$ or two $\left(b \in \left[\frac{1}{20}, \frac{1}{6}\right]\right)$ equilibrium messages communicated. But despite this less precise communication, delegation achieves exactly the same level of performance as centralization, as derived more generally in Rantakari (2011b). The reason is that the deciding agent has direct access to his own information and will naturally use that to supplement the information communicated by the other agent when making the final choice. In particular, for $b \in \left[\frac{1}{6}, \frac{1}{2}\right]$, even if the other agent always claims his alternative to be good, the deciding agent will screen away his own worst alternatives and implement the other proposal whenever $\theta_i \leq E\left(\theta_j\right) - b$. Similarly, while for $b \in \left[\frac{1}{12}, \frac{1}{6}\right]$, the low message by the other agent leads to a guaranteed rejection, for $b \in \left[\frac{1}{20}, \frac{1}{12}\right]$, the deciding agent will again sometimes accept even the proposal that is revealed to be low quality, as long as $\theta_i \leq E\left(\theta_j | m_j^1\right) - b$. Thus, even if there are only one or two messages sent, the number of different outcomes is two, three or four, as in the case of centralization. It is simply that we achieve the same outcome with less dependence on the transmission of soft information. As a result, whenever neither governance structure induces further information acquisition, the organization is indifferent between the two alternatives.

[18] For the figure, $a = 1.3$ and $\gamma = \frac{1}{2}$. The key effect here of the convexity of the cost function is that $C'(0) > 0$ so that for sufficiently high cost of information, no additional information is acquired, which helps to obtain a natural limiting benchmark.

Once information becomes sufficiently cheap, positive levels of investigation will take place under one or both governance structures. Consider first the region of $b \in \left[\frac{1}{6}, \frac{1}{2}\right]$, which provides the starkest contrast between the two alternatives. In this region, since no informative communication takes place under delegation, any information acquired by the deciding agent carries a positive value. In contrast, under centralization, there is a wide region over which information carries a negative value, and this region is increasing in the degree of alignment because the more the crowding out that is caused by the positive levels of investigation. Thus, delegation will be preferred until information is so cheap that the value generated by the additional information is sufficient to outweigh the crowding out of soft information that is taking place. Indeed, delegation can be preferred simply because no further information acquisition will take place. Also, as just mentioned, the bigger the bias, the smaller the amount of soft information that is crowded out under centralization and thus the preference for centralization is increasing in the degree of bias.

Once the bias becomes sufficiently low $\left(b \leq \frac{1}{6}\right)$, then informative communication will take place under both governance structures. In this region, we obtain a non-monotone relationship between the choice of governance structure and the cost of information, with centralization preferred for both high and low costs of information, while delegation preferred for intermediate costs of information. The intuition behind this result is as follows. Because communication is less precise under delegation, the maximal value of information under delegation is higher than the expected value under centralization. Thus, the agent will begin to acquire positive levels of information first, and that information acquisition will crowd out some of the soft information that now would be communicated even under delegation, thus leading to worsened organizational performance. Thus, centralization is initially preferred simply because it functions as a commitment to not acquiring any additional information.

As we decrease the cost of information further, then positive levels of information will be acquired under both governance structures, and eventually delegation becomes preferred. The reason is that because the acquisition is better targeted under delegation, the expected level of investigation is growing less rapidly. Further, the additional investigations are centered more around the more marginal states for the decision-maker, which also limits the increase in the value of exaggeration. Then, because the crowding out effect is more limited under delegation, delegation eventually becomes the preferred governance structure. Finally, as information becomes sufficiently cheap, centralization becomes again preferred. The reason for this result is two-fold. First, as information becomes sufficiently cheap, the investigation levels become more balanced across the messages, thus reducing the crowding out effect. Second, the principal will naturally make better use of the information found out in the investigation stage, and the amount of additional information acquired is naturally increasing as the cost of information becomes lower. Further, as the bias decreases, the smaller the range of costs for which any further information acquisition is optimal and thus the smaller the region for which delegation will be preferred.

To summarize, the basic advantage of delegation is two-fold. First, it is less dependent on the quality of soft information transmitted and, as a result, is generally less damaged by the crowding out effect that is generated by the acquisition of additional information. Second, the fact that the agent is directly aware of the quality of his alternative allows for more targeted information acquisition, leading often to lower levels of expected information acquisition and thus crowding out. Both advantages are maximized for intermediate costs of investigation and levels of bias. If information is costly enough, no acquisition will take place under either structure and thus the final outcome is driven by the cheap talk solution which here achieves the same level of performance under both governance structures. If information is cheap enough, then the investigation intensities will be similar across messages, thus minimizing the crowding out, and centralization will make better use of the additional information acquired than delegation does. If the bias is large, communication will be very imprecise even under centralization and thus the value generated by further information acquisition dominates, again leading to a preference for centralization, while if the bias is very small, then the precision of soft information is high enough to eliminate the need for further information acquisition altogether, converging the performance of the two governance structures. Further, in this region centralization may be able to provide the commitment not to acquire further information, leading to a strict preference for centralization.

# 5 Conclusion

This paper constructed a simple model of project selection, such as choosing which candidate to hire or which research alternative to fund, with the key innovation that the decision-maker could make the final decision based on both soft information communicated by privately informed agents advocating for their particular alternatives and any additional information acquired directly by the decision-maker. The value of strategic communication, even when the principal could acquire information directly, arose from the fact that if the group could achieve a consensus on which alternative to implement based on the communication stage alone, no additional information acquisition was needed to achieve the right decision. Similarly, the value of additional information acquisition arose from the fact that when the group failed to reach a consensus, the principal could still acquire additional information to reach a more informed decision, with the value of such information increasing in the residual uncertainty remaining after the initial discussion.

The key interaction between the two sources of information was that the principal's ability to acquire further information crowded out the precision of soft information communicated by the agents by reducing the relative cost of making exaggerated statements. As a result, the value of the ability to acquire additional information could be negative because it could crowd out more soft information than the direct value generated by the acquisition itself. Further, the amount of crowding out itself was non-monotone in the cost of further information acquisition, so that the crowding out effect was maximized at intermediate costs of information. This result arose because the key determinant behind the crowding out effect was not the expected level of investigations, but asymmetries in the investigation levels conditional on the information communicated in the cheap talk stage.

Given this crowding out effect, I then considered the potential benefits of delegating both decision-making and investigation authority to one of the agents. The benefits of delegation were two-fold. First, delegation was less dependent than centralization on the precision of soft information communicated, a result due to the simple fact that the agent was already aware of the value of his own alternative. Second, the expected level of investigation was typically lower under delegation because the agent was able to condition his investigation intensity on his private information. As a result, the value generated by delegation was highest for intermediate levels of bias and cost of information, or when the tension between the two sources of information was the largest. When information was sufficiently cheap, the investigation intensities were similar across the messages communicated in the cheap talk stage, minimizing the crowding out effect, and the principal made better use than the agent of the additional information acquired. Similarly, when the bias was sufficiently large, only a limited amount of soft information was transmitted even under centralization and so the final decision was dominated by the additional information, making centralization again preferred. In contrast, when information was sufficiently costly or the bias sufficiently small, the incentives to acquire information were limited under both structures and thus the two solutions converged.

Finally, while generating some new insights regarding decision-making in organizations by introducing the interaction between cheap talk and additional information acquisition, the model was clearly stylized in many dimensions and more research is needed to extend our understanding of such interactions to build a more complete picture of how to organize decision-making structures in organizations. Some natural extensions include alternative investigation technologies, more complex decision structures, endogenous incentives and the need to motivate the agents to generate (or acquire information regarding) their alternatives in the first place.

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# A Proofs and derivations

## A.1 Proof of proposition 1

Consider an agent that is contemplating between sending either the message $m_i^{k+1}$ or $m_i^k$. First, observe that this choice does not influence the outcome if $m_j > m_i^{k+1}$ or $m_j < m_i^k$, because then the alternative is either always rejected or always accepted. Note also that at this stage the agent takes the investigation intensities as given as they are based on the principal's expectations regarding the information content of the messages. The indifference condition thus becomes

$$\begin{aligned}&\Pr(m_j^{k+1})\left(\left(1-p\left(m^{k+1}\right)\right)\left(\tfrac{1}{2}E\left(\theta_j|m_j^{k+1}\right)+\tfrac{1}{2}\left(\theta_i^k+b\right)\right)+p\left(m^{k+1}\right)E\left(\theta_j|m_j^{k+1}\right)\right)+\Pr(m_j^k)\left(\left(\theta_i^k+b\right)\right)\\&=\Pr(m_j^{k+1})E\left(\theta_j|m_j^{k+1}\right)+\Pr(m_j^k)\left(\left(1-p\left(m^k\right)\right)\left(\tfrac{1}{2}E\left(\theta_j|m_j^k\right)+\tfrac{1}{2}\left(\theta_i^k+b\right)\right)+p\left(m^k\right)\left(\theta_i^k+b\right)\right).\end{aligned}$$

In other words, by sending the higher message, that is met with the same message with $\Pr(m_j^{k+1})$, which then triggers an investigation. If the investigation fails, then the choice is random and the value is given by $\left(\frac{1}{2}E\left(\theta_j|m_j^{k+1}\right)+\frac{1}{2}\left(\theta_i^k+b\right)\right)$, whereas if it succeeds, since by definition $\theta_i^k=\min\left(E\left(\theta|m^{k+1}\right)\right)$, the other project is accepted with probability one. But if the other agent sends the message below that, then agent $i$'s alternative is always accepted. Conversely, if the agent sends the lower message, then with $\Pr(m_j^{k+1})$, the other agent's message is just bigger and thus leads to the outcome $E\left(\theta_j|m_j^{k+1}\right)$, while if met with the lower message, then the outcome is either randomization (in case of failed investigation), or now since $\theta_i^k=\max\left(E\left(\theta|m^k\right)\right)$, acceptance with probability one (in case of successful investigation).

Rearranging the expression gives

$$\begin{aligned}&\Pr(m_j^{k+1})\left(\tfrac{1}{2}\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)+\tfrac{1}{2}p\left(m^{k+1}\right)\left(E\left(\theta_j|m_j^{k+1}\right)-\left(\theta_i^k+b\right)\right)\right)\\&=\Pr(m_j^k)\left(\left(\tfrac{1}{2}E\left(\theta_j|m_j^k\right)-\tfrac{1}{2}\left(\theta_i^k+b\right)\right)+p\left(m^k\right)\left(\tfrac{1}{2}\left(\theta_i^k+b\right)-\tfrac{1}{2}E\left(\theta_j|m_j^k\right)\right)\right),\end{aligned}$$

which we can then simplify to

$$\begin{aligned}&\left(1-p\left(m^k\right)\right)\left[\Pr(m_j^{k+1})\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)-\Pr(m_j^k)\left(E\left(\theta_j|m_j^k\right)-\left(\theta_i^k+b\right)\right)\right]\\&-\Delta p^{k+1,k}\Pr(m_j^{k+1})\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)=0,\end{aligned}$$

where $\Delta p^{k+1,k}=p\left(m^{k+1}\right)-p\left(m^k\right)$. Then, using the properties of the uniform distribution (and symmetry of the equilibrium, so that $\theta_i^k=\theta_j^k=\theta^k$), we get

$$\begin{aligned}&\left(1-p\left(m^k\right)\right)\left[\tfrac{\theta^{k+1}-\theta^k}{\bar{\theta}}\left(\left(\theta^k+b\right)-\tfrac{\theta^{k+1}+\theta^k}{2}\right)-\tfrac{\theta^k-\theta^{k-1}}{\bar{\theta}}\left(\tfrac{\theta^k+\theta^{k-1}}{2}-\left(\theta^k+b\right)\right)\right]\\&-\Delta p^{k+1,k}\left(\tfrac{\theta^{k+1}-\theta^k}{\bar{\theta}}\right)\left(\left(\theta^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)=0,\end{aligned}$$

which then simplifies to

$\frac{(1-p(m^k))[\theta^{k+1}-\theta^{k-1}]}{2\bar{\theta}}\left[2\left(\theta^k+b\right)-\left(\theta^{k+1}+\theta^{k-1}\right)\right]-\Delta p^{k+1,k}\left(\frac{\theta^{k+1}-\theta^k}{\bar{\theta}}\right)\left(\left(\theta^k+b\right)-\frac{\theta^{k+1}+\theta^k}{2}\right)=$
0.

Then, letting $\zeta^{k+1,k}=\frac{\Delta p^{k+1,k}}{1-p(m^k)}$ and $\Delta^k=\theta^{k+1}-\theta^k$ as the size of the interval, we get

$$\left[\Delta^{k+1}+\Delta^k\right]\left[2b-\left(\Delta^{k+1}-\Delta^k\right)\right]-2\zeta^{k+1,k}\left(\Delta^{k+1}\right)\left(b-\frac{\Delta^{k+1}}{2}\right)=0$$

$$\Delta^k\left(2b+\Delta^k\right)+2b\left(1-\zeta^{k+1,k}\right)\Delta^{k+1}-\left(1-\zeta^{k+1,k}\right)\left(\Delta^{k+1}\right)^2=0,$$

so that the difference equation, this time solving the size of the partitions instead directly the location of the cutoffs, is

$$\Delta^{k+1}=b\left(1+\sqrt{1+\frac{\Delta^k(2b+\Delta^k)}{b^2\left(1-\zeta^{k+1,k}\right)}}\right).$$

Finally, note that $\Delta^{k+1}\geq\Delta^k$, as $\Delta^{k+1}$ is increasing in $\zeta^{k+1,k}$, while $\zeta^{k+1,k}$ is minimized by having $p\left(m^k\right)\to 1, p\left(m^{k+1}\right)=0$, in which case $\Delta^{k+1}=2b$, so that the elements are of equal size. But then $p\left(m^{k+1}\right)\geq p\left(m^k\right)$, implying $\Delta^{k+1}>\Delta^k$.

Note that while deriving the actual partition structure requires the assumption of a uniform distribution, the generality of the non-monotone crowding out effect is valid for all distributions. To see this, note from above that the original indifference condition that needs to be satisfied was given by

$$\begin{aligned}&\left(1-p\left(m^k\right)\right)\left[\Pr(m_j^{k+1})\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)-\Pr(m_j^k)\left(E\left(\theta_j|m_j^k\right)-\left(\theta_i^k+b\right)\right)\right]\\&+\Delta p^{k+1,k}\Pr(m_j^{k+1})\left(E\left(\theta_j|m_j^{k+1}\right)-\left(\theta_i^k+b\right)\right)=0.\end{aligned}$$

Therefore, if the investigation intensities are symmetric, independent of their level, the solution to the communication equilibrium must satisfy

$$\Pr(m_j^{k+1})\left(\left(\theta_i^k+b\right)-E\left(\theta_j|m_j^{k+1}\right)\right)=\Pr(m_j^k)\left(E\left(\theta_j|m_j^k\right)-\left(\theta_i^k+b\right)\right).$$

Further, since $E\left(\theta_j|m_j^k\right)<\left(\theta_i^k+b\right)$ by definition, $E\left(\theta_j|m_j^{k+1}\right)>\left(\theta_i^k+b\right)$. Having $\Delta p^{k+1,k}>0$ then increases the value of exaggeration, which requires larger $\frac{\Delta^{k+1}}{\Delta^k}$ to restore incentive-compatibility. Thus, the basic tradeoffs illustrated by the model are fully general.

## A.2 Proof of Proposition 4

Computing the expected payoff is a simple matter of expectations. Suppose agent $i$ sends a message $m_i$. At that point, the principal's expected payoff absent investigation is

$$\Pr\left(m_j > m_i\right) E\left(\theta_j | m_j > m_i\right) + \Pr\left(m_j = m_i\right)\left(\tfrac{1}{2} E\left(\theta_j | m_j\right) + \tfrac{1}{2} E\left(\theta_i | m_i\right)\right) + \Pr\left(m_j < m_i\right) E\left(\theta_i | m_i\right),$$

and then adding over the other agent, we get

$$\sum_{m_i} \Pr(m_i)\left(\Pr\left(m_j > m_i\right) E\left(\theta_j | m_j > m_i\right) + \Pr\left(m_j = m_i\right)\left(\tfrac{1}{2} E\left(\theta_j | m_j\right) + \tfrac{1}{2} E\left(\theta_i | m_i\right)\right) + \Pr\left(m_j < m_i\right) E\left(\theta_i | m_i\right)\right)$$

$$\sum_{k=1}^{N} \left(\tfrac{\theta^k - \theta^{k-1}}{\overline{\theta}}\right)\left(\left(\tfrac{\overline{\theta} - \theta^k}{\overline{\theta}}\right)\left(\tfrac{\overline{\theta} + \theta^k}{2}\right) + \left(\tfrac{\theta^k - \theta^{k-1}}{\overline{\theta}}\right)\left(\left(\tfrac{\theta^k + \theta^{k-1}}{2}\right)\right) + \tfrac{\theta^{k-1}}{\overline{\theta}}\left(\tfrac{\theta^k + \theta^{k-1}}{2}\right)\right)$$

$$\tfrac{1}{2\overline{\theta}^2} \sum_{k=1}^{N} \Delta^k \left(\overline{\theta}^2 + \theta^k \theta^{k-1}\right) = \tfrac{\overline{\theta}}{2} + \tfrac{1}{2\overline{\theta}^2} \sum_{k=1}^{N} \Delta^k \theta^k \theta^{k-1}.$$

When the messages match, then we know that $E\left(\max\left(\theta_i, \theta_j\right) - \theta_i | m_i^k\right) = \left(\frac{\Delta^k}{6}\right)$, so the value generated by investigations is simply

$$\sum_{k=1}^{N} \Pr(m^k)^2 \left(p\left(m^k\right)\left(\tfrac{\Delta^k}{6}\right) - C(p\left(m^k\right))\right),$$

giving us the total of

$$\tfrac{1}{2\overline{\theta}^2} \sum_{i=1}^{N} \theta^{k-1} \theta^k \Delta^k + \tfrac{\overline{\theta}}{2} + \sum_{i=1}^{N} \left(\tfrac{\Delta^k}{\overline{\theta}}\right)^2 \left(p\left(m^k\right)\left(\tfrac{\Delta^k}{6}\right) - C(p\left(m^k\right))\right).$$

## A.3 Proof of proposition 5

Consider agent $j$ of type $\theta_j^k$ that is choosing between messages $m_j^k$ and $m_j^{k+1}$, and where $p_{\theta_i}^k$ is shorthand for $p\left(m_j^k, \theta_i\right)$, the investigation intensity of the recipient. If he sends the message $m_j^k$, his expected payoff conditional on the recipient being of type $\theta_i$ is

$$\begin{aligned} & p_{\theta_i}^{k+1}\left(I_{\theta_j^k \geq \theta_i + b}\left(\theta_j^k + b\right) + \left(1 - I_{\theta_j^k \geq \theta_i + b}\right)\theta_i\right) \\ & + \left(1 - p_{\theta_i}^{k+1}\right)\left(I_{E\left(\theta_j | m_j^{k+1}\right) \geq \theta_i + b}\left(\theta_j^k + b\right) + \left(1 - I_{E\left(\theta_j | m_j^{k+1}\right) \geq \theta_i + b}\right)\theta_i\right), \end{aligned}$$

where $I \in \{0, 1\}$ is an indicator function for whether the stated condition is true or not, determining the choice of alternative. In other words, with probability $p_{\theta_i}^{k+1}$ the recipient finds out the true state, in which case he chooses agent $j$'s alternative if $\theta_j^k \geq \theta_i + b$ and his own otherwise. Conversely, if the investigation fails, the decision is made based on the information content of the message, with agent $j$'s alternative chosen if $E\left(\theta_j | m_j^{k+1}\right) \geq \theta_i + b$ and vice versa. Note that we can then also write this expression as

$$p_{\theta_i}^{k+1}\left(I_{E\left(\theta_j | m_j^{k+1}\right) \geq \theta_i + b} - I_{\theta_j^k \geq \theta_i + b}\right)\left(\theta_i - \left(\theta_j^k + b\right)\right) + \left(I_{E\left(\theta_j | m_j^{k+1}\right) \geq \theta_i + b}\left(\theta_j^k + b\right) + \left(1 - I_{E\left(\theta_j | m_j^{k+1}\right) \geq \theta_i + b}\right)\theta_i\right).$$

Now, focusing on the marginal type to whom $E\left(\theta_j | m_j^{k+1}\right) > \theta_j^k$, $\left(I_{E\left(\theta_j | m_j^{k+1}\right) \geq \theta_i + b} - I_{\theta_j \geq \theta_i + b}\right) = 1$

for $\theta_i + b \in \left[\theta_j^k, E\left(\theta_j | m_j^{k+1}\right)\right]$ and zero otherwise. In other words, for the marginal type, the only impact of investigation is to lead to a rejection of the proposal where without investigation the proposal would be accepted, which would arise when $\theta_i + b \in \left[\theta_j^k, E\left(\theta_j | m_j^{k+1}\right)\right]$. Taking expectations over $\theta_i$ then simplifies the expression to (using the properties of the uniform distribution):

$$\int_{\theta_j^k - b}^{E\left(\theta_j|m_j^{k+1}\right)-b} p_{\theta_i}^{k+1}\left(\theta_i - \left(\theta_j^k + b\right)\right)\frac{1}{\overline{\theta}} + \frac{\left(E\left(\theta_j|m_j^{k+1}\right)-b\right)}{\overline{\theta}}\left(\theta_j^k + b\right) + \frac{\overline{\theta}^2 - \left(E\left(\theta_j|m_j^{k+1}\right)-b\right)^2}{2\overline{\theta}}.$$

In other words, in the absence of an investigation, with probability $\frac{\left(E\left(\theta_j|m_j^{k+1}\right)-b\right)}{\overline{\theta}}$, $\theta_i \leq E\left(\theta_j | m_j^{k+1}\right) - b$, in which case agent $j'$s proposal would be accepted, yielding $\left(\theta_j^k + b\right)$, whereas with complementary probability, $\theta_i > E\left(\theta_j | m_j^{k+1}\right) - b$ and agent $i$ will implement his own alternative, with expected payoff to agent $j$ of $\frac{\overline{\theta} + \left(E\left(\theta_j|m_j^{k+1}\right)-b\right)}{2}$. The impact of investigation is given by $\int_{\theta_j - b}^{E\left(\theta_j|m_j^{k+1}\right)-b} p_{\theta_i}^{k+1}\left(\theta_i - \left(\theta_j^k + b\right)\right)\frac{1}{\overline{\theta}}$, which is the region over which successful investigation leads to the replacement of agent $j'$s proposal with agent $i'$s alternative.

Similarly, we can repeat the computation for the lower message, where the only difference is that, as with centralization, the investigation under the lower message matters to agent $j$ only by leading to the acceptance of $j'$s alternative while the default would be to reject. This occurs when $\theta_i + b \in \left[E\left(\theta_j | m_j^k\right), \theta_j^k\right]$. Thus, the expected payoff from sending the lower message is

$$\int_{E\left(\theta_j|m_j^k\right)-b}^{\theta_j^k - b} p_{\theta_i}^{k}\left(\left(\theta_j^k + b\right) - \theta_i\right)\frac{1}{\overline{\theta}} + \frac{\left(E\left(\theta_j|m_j^{k}\right)-b\right)}{\overline{\theta}}\left(\theta_j^k + b\right) + \frac{\overline{\theta}^2 - \left(E\left(\theta_j|m_j^{k}\right)-b\right)^2}{2\overline{\theta}}.$$

The only exception arises when sending the lower message will lead to a rejection with probability one if the investigation fails (or is not undertaken), which is the case if $E\left(\theta_j | m_j^k\right) - b < 0$ and so the expected payoff from sending the lower (lowest) message becomes

$$\int_{E\left(\theta_j|m_j^k\right)-b}^{\theta_j^k - b} p_{\theta_i}^{k}\left(\left(\theta_j^k + b\right) - \theta_i\right)\frac{1}{\overline{\theta}} + \frac{\overline{\theta}}{2}.$$

Consider first the location of all but the first cutoff. The indifference condition that needs to be satisfied is then

$$\int_{\theta_j^k - b}^{E\left(\theta_j|m_j^{k+1}\right)-b} p_{\theta_i}^{k+1}\left(\theta_i - \left(\theta_j^k + b\right)\right)\frac{1}{\overline{\theta}} + \frac{\left(E\left(\theta_j|m_j^{k+1}\right)-b\right)}{\overline{\theta}}\left(\theta_j^k + b\right) + \frac{\overline{\theta}^2 - \left(E\left(\theta_j|m_j^{k+1}\right)-b\right)^2}{2\overline{\theta}} =$$

$$\int_{E\left(\theta_j|m_j^k\right)-b}^{\theta_j^k - b} p_{\theta_i}^{k}\left(\left(\theta_j^k + b\right) - \theta_i\right)\frac{1}{\overline{\theta}} + \frac{\left(E\left(\theta_j|m_j^{k}\right)-b\right)}{\overline{\theta}}\left(\theta_j^k + b\right) + \frac{\overline{\theta}^2 - \left(E\left(\theta_j|m_j^{k}\right)-b\right)^2}{2\overline{\theta}}.$$

First, rearranging the investigation-independent part, we get

$$\frac{\left(E\left(\theta_j|m_j^{k+1}\right)-b\right)}{\overline{\theta}}\left(\theta_j^k+b\right)+\frac{\overline{\theta}^2-\left(E\left(\theta_j|m_j^{k+1}\right)-b\right)^2}{2\overline{\theta}}=\frac{\left(E\left(\theta_j|m_j^{k}\right)-b\right)}{\overline{\theta}}\left(\theta_j^k+b\right)+\frac{\overline{\theta}^2-\left(E\left(\theta_j|m_j^{k}\right)-b\right)^2}{2\overline{\theta}}$$

$$\left(\frac{\theta_j^{k+1}-\theta_j^{k-1}}{2}\right)\frac{1}{\overline{\theta}}\left[\left(\theta_j^k+2b\right)-\frac{1}{4}\left(\theta_j^{k+1}+2\theta_j^k+\theta_j^{k-1}\right)\right]=0$$

$$\frac{\left(\Delta^{k+1}+\Delta^k\right)}{8\overline{\theta}}\left[8b-\left(\Delta^{k+1}-\Delta^k\right)\right]=0,$$

and bringing it back to the full indifference condition gives

$$\int_{\theta_j^k-b}^{E\left(\theta_j|m_j^{k+1}\right)-b} p_{\theta_i}^{k+1}\left(\theta_i-\left(\theta_j^k+b\right)\right)\frac{1}{\overline{\theta}}d\theta_i+\int_{E\left(\theta_j|m_j^{k}\right)-b}^{\theta_j^k-b} p_{\theta_i}^{k}\left(\theta_i-\left(\theta_j^k+b\right)\right)\frac{1}{\overline{\theta}}d\theta_i$$
$$+\frac{\left(\Delta^{k+1}+\Delta^k\right)}{8\overline{\theta}}\left[8b-\left(\Delta^{k+1}-\Delta^k\right)\right]=0,$$

which we can then rearrange to

$$\int_{E\left(\theta_j|m_j^{k}\right)-b}^{E\left(\theta_j|m_j^{k+1}\right)-b}\left(I_{m_i^{k+1}}p_{\theta_i}^{k+1}+I_{m_i^k}p_{\theta_i}^k\right)\left(\theta_i-\left(\theta_j^k+b\right)\right)d\theta_i+\frac{\left(\Delta^{k+1}+\Delta^k\right)}{8}\left[8b-\left(\Delta^{k+1}-\Delta^k\right)\right]=0.$$

The remaining threshold is the lowest threshold if $E\left(\theta_j|m_j^{k-1}\right)-b<0$, in which case sending the lower message leads to a guaranteed rejection in the case of a failed investigation. Then, the indifference condition becomes

$$\int_{\theta_j^k-b}^{E\left(\theta_j|m_j^{k+1}\right)-b} p_{\theta_i}^{k+1}\left(\theta_i-\left(\theta_j^k+b\right)\right)d\theta_i+\left(E\left(\theta_j|m_j^k\right)-b\right)\left(\theta_j^k+b\right)+\frac{\overline{\theta}^2-\left(E\left(\theta_j|m_j^{k+1}\right)-b\right)^2}{2}=$$
$$\int_0^{\theta_j^k-b} p_{\theta_i}^k\left(\left(\theta_j^k+b\right)-\theta_i\right)d\theta_i+\frac{\overline{\theta}}{2},$$

which then gives

$$\int_0^{E\left(\theta_j|m_j^{k+1}\right)-b}\left(I_{m_i^{k+1}}p_{\theta_i}^{k+1}+I_{m_i^k}p_{\theta_i}^k\right)\left(\theta_i-\left(\theta_j^k+b\right)\right)d\theta_i+\frac{\left(2\theta_j^k-2b+\Delta^{k+1}\right)}{8}\left[2\theta_j^k-\Delta^{k+1}+6b\right]=0.$$

Next, consider the implications of monitoring for the location of the thresholds, which in both cases is captured by the integral

$$\int_{E\left(\theta_j|m_j^{k}\right)-b}^{E\left(\theta_j|m_j^{k+1}\right)-b}\left(I_{m_i^{k+1}}p_{\theta_i}^{k+1}+I_{m_i^k}p_{\theta_i}^k\right)\left(\theta_i-\left(\theta_j^k+b\right)\right)d\theta_i.$$

Consider first monitoring for the lower message, where the impact is given by

$$\int_{E\left(\theta_j|m_j^k\right)-b}^{\theta_j^k-b} p_{\theta_i}^k\left(\left(\theta_j^k+b\right)-\theta_i\right)d\theta_i.$$

Since $\theta_i \leq \theta_j^k - b \leq \left(\theta_j^k+b\right)$, increasing the monitoring intensity conditional on the lower message unambiguously improves the value realized by the agent sending the lower message. For the higher message, the impact is given by

$$\int_{\theta_j^k-b}^{E\left(\theta_j|m_j^{k+1}\right)-b} p_{\theta_i}^{k+1}\left(\theta_i-\left(\theta_j^k+b\right)\right)d\theta_i.$$

For the higher message, the impact is ambiguous, contrary to the case of centralization. The reason is is that the impact of increased monitoring is dependent on $\theta_i$. If $\left(\theta_j^k+b\right) < \theta_i < E\left(\theta_j|m_j^k\right)-b$, successful monitoring improves the expected payoff of the the sender, as in the case of centralization, as the receiver spots a bad project that he would implement in the absence of a successful investigation, and implements his own alternative instead. Since $\left(\theta_j^k+b\right) < \theta_i$, this is preferred even by the sender. However, if $\left(\theta_j^k-b\right) < \theta_i < \left(\theta_j^k+b\right)$, then successful monitoring actually decreases the expected payoff of the sender, because now his alternative is replaced by an even worse alternative by the decision-maker.

If the investigation intensity was flat, as it is under centralization, successful monitoring will increase the payoff from sending the higher message. To see this, let $p_{\theta_i}^k = p$ over the whole range $\left[\theta_j^k-b, E\left(\theta_j|m_j^k\right)-b\right]$ (which maximizes the potential negative impact), in which case the expectation becomes

$$\frac{p}{\overline{\theta}}\int_{\theta_j^k-b}^{E\left(\theta_j|m_j^k\right)-b}\left(\theta_i-\left(\theta_j^k+b\right)\right)=\frac{p}{\overline{\theta}}\left[\frac{\left(E\left(\theta_j|m_j^k\right)-b\right)^2-\left(\theta_j^k-b\right)^2}{2}-\left(\theta_j^k+b\right)\left(E\left(\theta_j|m_j^k\right)-b-\left(\theta_j^k-b\right)\right)\right]$$

$$=\frac{p\left(E\left(\theta_j|m_j^k\right)-\left(\theta_j^k\right)\right)}{\overline{\theta}}\left[\left(\frac{E\left(\theta_j|m_j^k\right)-\left(\theta_j^k\right)}{2}\right)-2b\right]=\frac{p\left(E\left(\theta_j|m_j^k\right)-\left(\theta_j^k\right)\right)}{4\overline{\theta}}\left[\Delta_j^{k+1}-8b\right]>0$$

since $\Delta_j^{k+1} \geq 8b$ (in equilibrium). But under delegation, the monitoring intensity is not constant. Instead, it is monotone (weakly) increasing in $\theta_i$ over $\left[\theta_j^k-b, E\left(\theta_j|m_j^k\right)-b\right]$, with the value of investigation maximized at $E\left(\theta_j|m_j^k\right)-b$ while being zero at $\theta_j^k-b$. Therefore, a reduction in the cost of information may increase monitoring relatively more for low $\theta_i$, or $\frac{\partial^2 p_{\theta_i}^k}{\partial\mu\partial\theta_i} < 0$. In this case, the increase in the negative value realized may dominate the increase in the positive value and thus actually decrease the value of sending the higher message and thus improving communication.

The result is, however, local. What remains to be the case is that at best the equilibrium under additional investigation leads to a precision of soft information equivalent to no additional investigations. To see this, make first two observations. First, the expected investigation intensity will always be weakly lower for the low message because it is more precise and thus there is less expected value generated by finding out the truth. Second, from above we know that the increase in the value of investigation after the high message is minimized by having a flat investigation technology. Thus, from above we know that the high investigation leads to minimal value of

$$\frac{\underline{p}}{\overline{\theta}}\frac{\left(\theta_j^{k+1}-\theta_j^k\right)\left[\left(\theta_j^{k+1}-\theta_j^k\right)-8b\right]}{8},$$

while the low investigation leads to a maximal value of

$$\int\limits_{E\left(\theta_j|m_j^{k-1}\right)-b}^{\theta_j-b} p_{\theta_i}^{k-1}\left(\left(\theta_j+b\right)-\theta_i\right)\frac{1}{\overline{\theta}}=\frac{p\left(\theta_j^k-\theta_j^{k-1}\right)\left[\left(\theta_j^k-\theta_j^{k-1}\right)+8b\right]}{8\overline{\theta}},$$

so the relative increase in the attractiveness of the high message is equal to (which is then equivalent to worse communication)

$$\begin{aligned}&\frac{\underline{p}}{\overline{\theta}}\frac{\left(\theta_j^{k+1}-\theta_j^k\right)\left[\left(\theta_j^{k+1}-\theta_j^k\right)-8b\right]}{8}-\frac{p\left(\theta_j^k-\theta_j^{k-1}\right)\left[\left(\theta_j^k-\theta_j^{k-1}\right)+8b\right]}{8\overline{\theta}}\\&=\frac{p\left(\Delta_j^{k+1}+\Delta_j^k\right)}{8\overline{\theta}}\left[\left(\Delta_j^{k+1}-\Delta_j^k\right)-8b\right].\end{aligned}$$

But note that the expression in brackets is exactly equivalent to the indifference condition under no investigation, so in this case the quality of soft information is unchanged, but for all other investigation technologies the difference will be positive at the pure cheap talk solution, implying a worsening of communication. Finally, to confirm that $\Delta_j^{k+1}\geq\Delta_j^k$ in any partition equilibrium, let $p_{\theta_i}^k=1$, maximizing the value of sending the lower message, and $p_{\theta_i}^{k+1}=0$, minimizing the value of sending the higher message, and we get

$$\int\limits_{E\left(\theta_j|m_j^k\right)-b}^{\theta_j^k-b}\left(\theta_i-\left(\theta_j^k+b\right)\right)d\theta_i+\frac{\left(\Delta^{k+1}+\Delta^k\right)}{8}\left[8b-\left(\Delta^{k+1}-\Delta^k\right)\right]=0$$

$$\left(\frac{\left(\theta_j^k-b\right)^2-\left(E\left(\theta_j|m_j^k\right)-b\right)^2}{2}-\left(\theta_j^k+b\right)\frac{\left(\theta_j^k-b\right)-\left(E\left(\theta_j|m_j^k\right)-b\right)}{}\right)+\frac{\left(\Delta^{k+1}+\Delta^k\right)}{8}\left[8b-\left(\Delta^{k+1}-\Delta^k\right)\right]$$

$$\begin{aligned}&-\frac{\Delta^k}{8}\left[\left(\Delta^k+8b\right)\right]+\frac{\left(\Delta^{k+1}+\Delta^k\right)}{8}\left[8b-\left(\Delta^{k+1}-\Delta^k\right)\right]=0\\&\left(\Delta^{k+1}\right)\left[8b-\left(\Delta^{k+1}-\Delta^k\right)\right]-\Delta^k\left(\Delta^{k+1}\right)=0\\&\Delta^{k+1}=8b,\end{aligned}$$

so again at best the partition elements will be of equal size, negating the proposed structure of more intense monitoring for lower messages.

## A.4 Proof of proposition 6

To solve the expected payoff, let us again consider first the payoff in the absence of no (or unsuccesful) investigation. Conditional on the message of agent $j$, the expected payoff to the principal is given by

$$\Pr(\theta_i \geq E\left(\theta_j|m_j^k\right) - b)E\left(\theta_i|\theta_i \geq E\left(\theta_j|m_j^k\right) - b\right) + \Pr(\theta_i < E\left(\theta_j|m_j^k\right) - b)E\left(\theta_j|m_j^k\right),$$

and then adding over the messages we have

$$\sum \Pr(m_j^k)\left[\Pr(\theta_i \geq E\left(\theta_j|m_j^k\right) - b)E\left(\theta_i|\theta_i \geq E\left(\theta_j|m_j^k\right) - b\right) + \Pr(\theta_i < E\left(\theta_j|m_j^k\right) - b)E\left(\theta_j|m_j^k\right)\right],$$

which then becomes (supposing first that $E\left(\theta_j|m_j^k\right) - b > 0$ for all $k$)

$$\sum \Pr(m_j^k)\left[\frac{\overline{\theta}^2 - \left(E\left(\theta_j|m_j^k\right)-b\right)^2}{2\overline{\theta}} + \left(\frac{E\left(\theta_j|m_j^k\right)-b}{\overline{\theta}}\right)E\left(\theta_j|m_j^k\right)\right]$$

$$\frac{1}{2\overline{\theta}}\sum \Pr(m_j^k)\left[E\left(\theta_j|m_j^k\right)^2 - b^2\right] + \frac{\overline{\theta}}{2}.$$

If $E\left(\theta_j|m_j^1\right) - b < 0$, then the payoff to the lowest message is simply $\frac{\overline{\theta}}{2}$. Adding up gives then

$$\begin{aligned}
&\frac{1}{2\overline{\theta}}\sum\left(\frac{\theta_j^k-\theta_j^{k-1}}{\overline{\theta}}\right)\left(\frac{\theta_j^k+\theta_j^{k-1}}{2}\right)^2 - \frac{b^2}{2\overline{\theta}} + \frac{\overline{\theta}}{2} \\
&= \frac{1}{8\overline{\theta}^2}\sum\left(\left(\theta_j^k\right)^3 - \left(\theta_j^{k-1}\right)^3\right) + \theta_j^k\theta_j^{k-1}\left(\theta_j^k - \theta_j^{k-1}\right) - \frac{b^2}{2\overline{\theta}} + \frac{\overline{\theta}}{2} \\
&= \frac{1}{8\overline{\theta}^2}\sum\theta_j^{k-1}\theta_j^k\left(\theta_j^k - \theta_j^{k-1}\right) + \left(\frac{\overline{\theta}^2-4b^2}{8\overline{\theta}}\right) + \frac{\overline{\theta}}{2},
\end{aligned}$$

while if the lower constraint is bindng, the sum begins only from the second message, and so the payoff becomes

$$\frac{1}{2\overline{\theta}}\sum\nolimits_{k=2}\Pr(m_j^k)E\left(\theta_j|m_j^k\right)^2 - \frac{b^2}{2\overline{\theta}}\left(1 - \frac{\theta_1}{\overline{\theta}}\right) + \frac{\overline{\theta}}{2},$$

and $\sum\nolimits_{k=2}\Pr(m_j^k)E\left(\theta_j|m_j^k\right)^2 = \left(\overline{\theta}^3 - \left(\theta_j^1\right)^3\right) + \sum\nolimits_{k=2}\theta_j^{k-1}\theta_j^k\left(\theta_j^k - \theta_j^{k-1}\right),$

and so the expected payoff is

$$\frac{1}{8\overline{\theta}^2}\sum\theta_j^{k-1}\theta_j^k\left(\theta_j^k - \theta_j^{k-1}\right) + \frac{\left(\left(\overline{\theta}^3-\left(\theta_j^1\right)^3\right)-4b^2\left(\overline{\theta}-\theta_j^1\right)\right)}{8\overline{\theta}^2} + \frac{\overline{\theta}}{2}.$$

Therefore, the general expression is simply

$$\frac{\overline{\theta}}{2} + \frac{1}{8\overline{\theta}^2}\sum\theta_j^{k-1}\theta_j^k\Delta_j^k + \frac{\left(\left(\overline{\theta}^3 - I_{E\left(\theta_j|m_j^1\right)-b<0}\left(\theta_j^1\right)^3\right) - 4b^2\left(\left(\overline{\theta} - I_{E\left(\theta_j|m_j^1\right)-b<0}\theta_j^1\right)\right)\right)}{8\overline{\theta}^2}.$$

To evaluate the consequences of information acquisition, suppose that a given message reveals that the state following a message lies in the interval $m_{jk} \to \theta_j \in \left[\theta_j^{k-1}, \theta_j^k\right]$. Suppose first that $\theta_i + b \in \left[E\left(\theta_j|m_j^k\right), \theta_j^k\right]$, so that the default decision for the decision-maker is to implement his own project. Then, the value of investigation to the principal is given by

$$p\left(\Pr(\theta_j \leq \theta_i + b)\left(\theta_i\right) + \Pr(\theta_j > \theta_i + b)E\left(\theta_j|\theta_j > \theta_i + b\right)\right) + (1-p)\left(\theta_i\right),$$

so that the investigation-dependent component simplifies to $p\left(\frac{\left(\theta_j^{k-1}-\theta_i\right)^2-b^2}{2\Delta_j^k}\right)$. Similarly, we can compute for $\theta_i+b\in\left[\theta_j^{k-1},E\left(\theta_j|m_j^k\right)\right]$ the expected value generated as $p\frac{\left(\theta_i-\theta_j^{k-1}\right)^2-b^2}{2\Delta_j^k}$. Thus, the expected value generated by the investigation conditional on message $m_j^k$ is

$$\int_{\max(0,\theta_j^{k-1}-b)}^{\max\left(0,E\left(\theta_j|m_j^k\right)-b\right)}\left(p_{\theta_i}\left(\theta_i,m_j^k\right)\left(\frac{\left(\theta_i-\theta_j^{k-1}\right)^2-b^2}{2\Delta_j^k}\right)-C(p_{\theta_i})\right)d\theta_i+\int_{\max\left(0,E\left(\theta_j|m_j^k\right)-b\right)}^{\theta_j^k-b}\left(p_{\theta_i}\left(\theta_i,m_j^k\right)\left(\frac{\left(\theta_j^{k-1}-\theta_i\right)^2-b^2}{2\Delta_j^k}\right)-C(p_{\theta_i}$$

which we can then condense to

$$\int_{\max(0,\theta_j^{k-1}-b)}^{\theta_j^k-b}\left(p\left(\theta_i,m_j^k\right)\left(I_{\theta_i\leq E\left(\theta_j|m_j^k\right)-b}\left(\frac{\left(\theta_i-\theta_j^{k-1}\right)^2-b^2}{2\Delta_j^k}\right)+I_{\theta_i>E\left(\theta_j|m_j^k\right)-b}\left(\frac{\left(\theta_j^{k-1}-\theta_i\right)^2-b^2}{2\Delta_j^k}\right)\right)-C\left(p\left(\theta_i,m_j^k\right)\right)\right)d\theta_i.$$

## A.5 Proof of (weakly) too weak incentives to acquire information under delegation

To show that the agent, as a decision-maker, will never over-invest in information acquisition and thus directly waste resources from the perspective of total surplus, recall from above that the the (marginal) value information to the agent was given by

$$\frac{\left(\theta_j^k-(\theta_i+b)\right)^2}{2\Delta_j^k}\text{ and }\frac{((\theta_i+b)-\theta_{k-1})^2}{2\Delta_j^k}$$

for $\theta_i\geq E\left(\theta_j|m_j^k\right)-b$ and $\theta_i<E\left(\theta_j|m_j^k\right)-b$, respectively. The value is thus symmetric around $E\left(\theta_j|m_j^k\right)-b$. For the principal, on the other hand, the values were

$$\left(\frac{\left(\theta_j^k-\theta_i\right)^2-b^2}{2\Delta_j^k}\right)\text{ and }\frac{\left(\theta_i-\theta_j^{k-1}\right)^2-b^2}{2\Delta_j^k}.$$

Now, it is immediate that $\left(\frac{\left(\theta_j^k-\theta_i\right)^2-b^2}{2\Delta_j^k}\right)\geq\frac{\left(\theta_j^k-(\theta_i+b)\right)^2}{2\Delta_j^k}$ and $\frac{\left(\theta_i-\theta_j^{k-1}\right)^2-b^2}{2\Delta_j^k}\leq\frac{\left((\theta_i+b)-\theta_j^{k-1}\right)^2}{2\Delta_j^k}$, so that from the principal's perspective, the agent under-invests in information acquisition whenever $\theta_i\geq E\left(\theta_j|m_j^k\right)-b$ and vice versa. The reason for this asymmetry is that because the agent is biased in favor of accepting his own project, switching from the decision-maker's project to the other project is in expectation more valuable. As a result, when the default is to accept the decision-maker's project, the principal would want more information acquisition and when the default is to accept the other project, the principal would want less information acquisition relative to the agent.

Since the agent's information acquisition will be symmetric around $E\left(\theta_j|m_j^k\right)-b$, we can ask whether, subject to this constraint, the principal would want more or less information acquisition. So let $\theta_i=E\left(\theta_j|m_j^k\right)-b\pm x$, which implies that for both above and below, $\frac{\left(\frac{\Delta_j^k}{2}-x\right)^2}{2\Delta_j^k}=C'(p)$. Pooling these together, we get the agent's first order condition of

$$\frac{\left(\frac{\Delta_j^k}{2}-x\right)^2}{\Delta_j^k} = 2C'(p).$$

For the principal, on the other hand, the corrresponding first-order condition is given by

$$\left(\frac{\left(\left(\frac{\Delta_j^k}{2}-x\right)+b\right)^2-b^2}{2\Delta_j^k}\right)+\frac{\left(\left(\frac{\Delta_j^k}{2}-x\right)-b\right)^2-b^2}{2\Delta_j^k} = 2C'(p),$$

but note that we can rearrange the marginal value to

$$\left(\frac{\left(\left(\frac{\Delta_j^k}{2}-x\right)^2+2b\left(\frac{\Delta_j^k}{2}-x\right)\right)}{2\Delta_j^k}\right)+\frac{\left(\left(\frac{\Delta_j^k}{2}-x\right)-2\left(\frac{\Delta_j^k}{2}-x\right)b\right)}{2\Delta_j^k} = \frac{\left(\frac{\Delta_j^k}{2}-x\right)^2}{\Delta_j^k},$$

which is exactly equal to the pooled first-order condition of the agent. As a result, the agent will acquire exactly the level of information that the principal would want him to acquire, subject to the constraint that the level of information acquisition needs to be symmetric around $E\left(\theta_j|m_j^k\right)-b$. The only exception occurs when $E\left(\theta_j|m_j^k\right)-b-x<0$, so that the lower end of the information acquisition range is truncated. But then from above we know that the value to the principal for $\theta_i > E\left(\theta_j|m_j^k\right)-b$ exceeds the value to the agent, implying that when only positive $x$ exists, the incentives to acquire information are too weak from the perspective of the principal.

# B Extensions

## B.1 Separate investigations by the principal

To make the comparison with agent-authority more even, the model made the simplifying assumption that the single investigation revealed the payoff to either both or none of the alternatives. More realistically, the principal may engage in separate investigations. Indeed, the optimal approach is likely to be a sequential investigation, since what is learned on the first alternative is going to inform of the value of undertaking also the second investigation. The results are robust to more complex investigation strategies by the principal. Indeed, separate investigations can be even worse for the precision of cheap talk since they carry the additional insurance value that additional information is learned only regarding the other alternative.

Since the sequential model is significantly more complex and contains no particular additional insights, to illustrate this additional "insurance" effect, consider a model where the principal continues to engage only in a single investigation but now learns the payoff to each project with a probability $p$, independent across projects. Then, the outcomes of the investigation are: with probability $p^2$, the payoff to both alternatives is learned, with probability $p(1-p)$ the principal learns the payoff to project $i$ but not project $j$, and vice versa, and finally, with probability $(1-p)^2$, the principal fails to learn any additional information.

Given the investigation technology, the indifference condition for the agent can be written as

$$\Pr(m_j^k)\left(\begin{array}{c} p_k^2\left(E\left(\theta_j|m_j^k\right)\right)+(1-p_k)\,p_k\left(E\left(\theta_j|m_j^k\right)\right) \\ +(1-p_k)\,p_k\left(\frac{1}{2}E\left(\theta_j|\theta_j>E\left(\theta_i|m_i^k\right)\right)+\frac{1}{2}(\theta_i+b)\right) \\ +(1-p_k)^2\left(\frac{1}{2}E\left(\theta_j|m_j^k\right)+\frac{1}{2}(\theta_i+b)\right)\end{array}\right)+\Pr(m_j^{k-1})(\theta_i+b)$$
$$=\Pr(m_j^k)\left(E\left(\theta_j|m_j^k\right)\right)+\Pr(m_j^{k-1})\left[\begin{array}{c} p_{k-1}^2(\theta_i+b)+(1-p_{k-1})\,p_{k-1}(\theta_i+b) \\ +(1-p_{k-1})\,p_{k-1}\left(\frac{1}{2}E\left(\theta_j|\theta_j>E\left(\theta_i|m_i^{k-1}\right)\right)+\frac{1}{2}(\theta_i+b)\right) \\ +(1-p_{k-1})^2\left(\frac{1}{2}E\left(\theta_j|m_j^{k-1}\right)+\frac{1}{2}(\theta_i+b)\right)\end{array}\right].$$

If the value of the sending agent's project is found, then the problem is similar to the all-or-nothing investigation, in that for the high message, the proposal will always be rejected, while for the low message, the proposal will always be accepted. The key difference is that when the investigation of only the other proposal succeeds. In this case, the beliefs regarding the marginal project remain at $E\left(\theta_i|m_i^k\right)$, but if the other project is revealed to be even better than that, it will be accepted. This is the insurance value of the separate investigations, where the worse other projects still get screened away, while the better projects still get accepted, thus reducing the cost of exaggeration. Of course, the benefit remains for the lower message as well, but the absolute benefit will be lower. As a result, even a symmetric increase in the monitoring intensity will crowd out soft information. To see this effect even clearer, note that we can rearrange the indifference condition to

$$\begin{aligned}&\Pr(m_j^k)\left[p_k\left(E\left(\theta_j|m_j^k\right)\right)+(1-p_k)\tfrac{1}{2}\left[E\left(\theta_j|m_j^k\right)+(\theta_i+b)\right]\right]+\Pr(m_j^{k-1})(\theta_i+b)\\ &+\Pr(m_j^k)\tfrac{(1-p_k)p_k}{2}\left[E\left(\theta_j|\theta_j>E\left(\theta_i|m_i^k\right)\right)-E\left(\theta_j|m_j^k\right)\right]=\\ &\Pr(m_j^k)\left(E\left(\theta_j|m_j^k\right)\right)+\Pr(m_j^{k-1})\left[p_{k-1}(\theta_i+b)+\tfrac{(1-p_{k-1})}{2}\left[(\theta_i+b)+E\left(\theta_j|m_j^{k-1}\right)\right]\right]\\ &+\Pr(m_j^{k-1})\tfrac{(1-p_{k-1})p_{k-1}}{2}\left[E\left(\theta_j|\theta_j>E\left(\theta_i|m_i^{k-1}\right)\right)-E\left(\theta_j|m_j^{k-1}\right)\right],\end{aligned}$$

where the first and third lines are now equivalent to the indifference condition under all-or-nothing investigation, while the second and fourth lines are the additional insurance value provided by the independent investigations. Then, as long as exaggeration implies that larger messages are less precise, we both that $\left[E\left(\theta_j|\theta_j>E\left(\theta_i|m_i^k\right)\right)-E\left(\theta_j|m_j^k\right)\right]>\left[E\left(\theta_j|\theta_j>E\left(\theta_i|m_i^{k-1}\right)\right)-E\left(\theta_j|m_j^{k-1}\right)\right]$ and $\Pr(m_j^k)>\Pr(m_j^{k-1})$, so that the precision of cheap talk is compromised even when $p_k=p_{k-1}$. But note that it can also provide an attenuating force in other cases. If $p_k\to 1$, the insurance gain disappears for the larger message, while remaining for the lower message as $p_{k-1}<p_k$ in equilibrium.

Finally, note that our basic result, which was that intermediate costs of information may reduce total surplus relative to no information, will continue to hold and, indeed, generally made worse, because as long as $p_k<\frac{1}{2}$, $\frac{(1-p_k)p_k}{2}>\frac{(1-p_{k-1})p_{k-1}}{2}$ and the baseline distortion is made worse.

## B.2 Asymmetric proposals under principal-authority

The analysis focused on the symmetric cheap talk equilibrium under principal-authority, driven by the fact that the two agents were ex ante symmetric. This equilibrium was sustainable because in the case of indifference, the principal could choose either of the proposals because he was indifferent

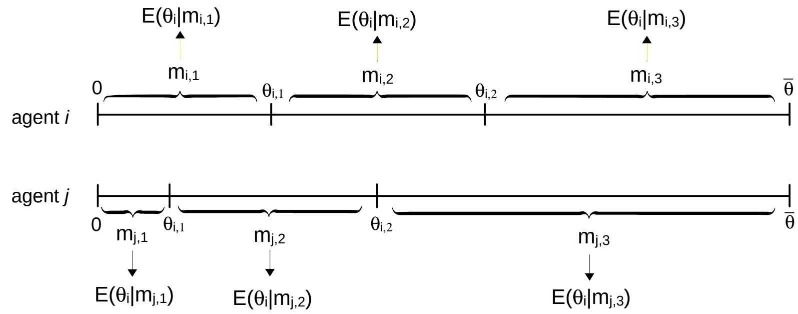



Figure 7: Structure of the asymmetric communication equilibrium.

between the two. But even with symmetric agents, the principal could choose one of the proposals with asymmetric probability, which would change the communication equilibrium and randomization would no longer be feasible. However, there is one asymmetric solution, which is equivalent in structure to agent authority: for equivalent messages, the principal will accept agent $i'$s project. This change in the treatment in proposals will in turn change the communication equilibrium in a fashion that indeed makes such an asymmetric solution optimal.

To solve for this alternative, we have now that agent $i's$ alternative will be chosen whenever $m_i \geq m_j$ while agent $j$'s alternative will be chosen only when $m_j > m_i$, in the absence of successful verification. This construction is illustrated in figure 7. Note that there will now be overlap between the messages, so that residual uncertainty will remain both when $m_i = m_j$, but also when agent $i$ (the favored agent), sends the message below agent $j'$s. Thus, we will have monitoring intensities $p^{i:k,j:k}$ and $p^{i:k-1,j:k}$.

With these observations, we can then go ahead and construct the cheap talk equilibrium. Consider first agent $i$. We can write his indifference condition between messages $m_i^k$ and $m_i^{k-1}$ as

$$\begin{aligned}
&\Pr(m_{j,k+1})\left[\begin{array}{c} \left(1-p^{i:k,j:k+1}\right)\left(E\left(\theta_j|m_{j,k+1}\right)\right) \\ +p^{i:k,j:k+1}\left(\Pr(\theta_j>\theta_i|m_{j,k+1})\left(E\left(\theta_j|\theta_j>\theta_i,m_{j,k+1}\right)\right)+\Pr(\theta_j<\theta_i|m_{j,k+1})\left(\theta_i+b\right)\right)\end{array}\right] \\
&+\Pr(m_{j,k})\left[\begin{array}{c} \left(1-p^{i:k,j:k}\right)\left(\theta_i+b\right) \\ +p^{i:k,j:k}\left(\Pr(\theta_j>\theta_i|m_{j,k})\left(E\left(\theta_j|\theta_j>\theta_i,m_{j,k}\right)\right)+\Pr(\theta_j<\theta_i|m_{j,k})\left(\theta_i+b\right)\right)\end{array}\right] \\
&+\Pr(m_{j,k-1})\left[\left(\theta_i+b\right)\right] \\
&= \\
&\Pr(m_{j,k+1})\left[E\left(\theta_j|m_{j,k+1}\right)\right] \\
&+\Pr(m_{j,k})\left[\begin{array}{c} \left(1-p^{i:k-1,j:k}\right)E\left(\theta_j|m_{j,k+1}\right) \\ +p^{i:k-1,j:k}\left(\Pr(\theta_j>\theta_i|m_{j,k})\left(E\left(\theta_j|\theta_j>\theta_i,m_{j,k}\right)\right)+\Pr(\theta_j<\theta_i|m_{j,k})\left(\theta_i+b\right)\right)\end{array}\right] \\
&+\Pr(m_{j,k-1})\left[\begin{array}{c} \left(1-p^{i:k-1,j:k-1}\right)\left(\theta_i+b\right) \\ +p^{i:k-1,j:k-1}\left(\Pr(\theta_j>\theta_i|m_{j,k-1})\left(E\left(\theta_j|\theta_j>\theta_i,m_{j,k-1}\right)\right)+\Pr(\theta_j<\theta_i|m_{j,k-1})\left(\theta_i+b\right)\right)\end{array}\right].
\end{aligned}$$

To simplify the expression, note that while an investigation is triggered for $(m_{i,k}, m_{j,k+1})$, the marginal agent knows that his project is worse with probability one, and similarly, for $m_{i,k-1}, m_{j,k-1}$, the agent knows that his project is better with probability one. Thus, the expression simplifies to

$$
\begin{aligned}
&\Pr(m_{j,k}) \left[ \begin{array}{c} \left(1-p^{i:k,j:k}\right)(\theta_i+b) \\ +p^{i:k,j:k}\left(\Pr(\theta_j>\theta_i|m_{j,k})\left(E\left(\theta_j|\theta_j>\theta_i,m_{j,k}\right)\right)+\Pr(\theta_j<\theta_i|m_{j,k})(\theta_i+b)\right) \end{array} \right] \\
&= \Pr(m_{j,k}) \left[ \begin{array}{c} \left(1-p^{i:k-1,j:k}\right)E\left(\theta_j|m_{j,k}\right) \\ +p^{i:k-1,j:k}\left(\Pr(\theta_j>\theta_i|m_{j,k})\left(E\left(\theta_j|\theta_j>\theta_i,m_{j,k}\right)\right)+\Pr(\theta_j<\theta_i|m_{j,k})(\theta_i+b)\right) \end{array} \right]
\end{aligned}
$$

which we can then also write as

$$
\begin{aligned}
&\Pr(m_{j,k})\left[(\theta_i+b)+p^{i:k,j:k}\Pr(\theta_j>\theta_i|m_{j,k})\left[E\left(\theta_j|\theta_j>\theta_i,m_{j,k}\right)-(\theta_i+b)\right]\right] \\
&= \Pr(m_{j,k})\left[E\left(\theta_j|m_{j,k}\right)+p^{i:k-1,j:k}\Pr(\theta_j<\theta_i|m_{j,k})\left[(\theta_i+b)-E\left(\theta_j|\theta_j<\theta_i,m_{j,k}\right)\right]\right].
\end{aligned}
$$

Let $\Delta p^{(i:k,j:k)-(i:k-1,j:k)} = p^{i:k,j:k} - p^{i:k-1,j:k}$, we get

$\left(1-p^{i:k-1,j:k}\right)\left((\theta_i+b)-E\left(\theta_j|m_{j,k}\right)\right) + \Delta p^{(i:k,j:k)-(i:k-1,j:k)}\left[E\left(\theta_j|\theta_j>\theta_i,m_{j,k}\right)-(\theta_i+b)\right] = 0.$

Similarly, for agent $j$ we can construct the indifference condition as

$$
\begin{aligned}
&\Pr(m_{i,k-1}) \left( \begin{array}{c} \left(1-p^{i:k-1,j:k}\right)(\theta_j+b) \\ +p^{i:k-1,j:k}\left(\Pr(\theta_i>\theta_j|m_{i,k-1})E\left(\theta_i|\theta_i>\theta_j,m_{i,k-1}\right)+\Pr(\theta_i<\theta_j|m_{i,k-1})(\theta_j+b)\right) \end{array} \right) \\
&= \Pr(m_{i,k-1}) \left( \begin{array}{c} \left(1-p^{i:k-1,j:k-1}\right)E\left(\theta_i|m_{i,k-1}\right) \\ +p^{i:k-1,j:k-1}\left(\Pr(\theta_i>\theta_j|m_{i,k-1})E\left(\theta_i|\theta_i>\theta_j,m_{i,k-1}\right)+\Pr(\theta_i<\theta_j|m_{i,k-1})(\theta_j+b)\right) \end{array} \right),
\end{aligned}
$$

which we can rearrange to

$$
\begin{aligned}
&\Pr(m_{i,k-1})\left((\theta_j+b)+p^{i:k-1,j:k}\Pr(\theta_i>\theta_j|m_{i,k-1})\left[E\left(\theta_i|\theta_i>\theta_j,m_{i,k-1}\right)-(\theta_j+b)\right]\right) \\
&= \Pr(m_{i,k-1})\left(E\left(\theta_i|m_{i,k-1}\right)+p^{i:k-1,j:k-1}\Pr(\theta_i<\theta_j|m_{i,k-1})\left((\theta_j+b)-E\left(\theta_i|\theta_i<\theta_j,m_{i,k-1}\right)\right)\right).
\end{aligned}
$$

Letting $\Delta p^{(i:k-1,j:k)-(i:k-1,j:k-1)} = p^{i:k-1,j:k} - p^{i:k-1,j:k-1}$, we get

$$
\begin{aligned}
&\left(1-p^{i:k-1,j:k-1}\right)\left((\theta_j+b)-E\left(\theta_i|m_{i,k-1}\right)\right) \\
&+\Delta p^{(i:k-1,j:k)-(i:k-1,j:k-1)}\Pr(\theta_i>\theta_j|m_{i,k-1})\left[E\left(\theta_i|\theta_i>\theta_j,m_{i,k-1}\right)-(\theta_j+b)\right]=0.
\end{aligned}
$$

So the solution is closely analogous to the case under symmetric communication, except now the message matters only for a single message by the opponent (as there is no randomization). Second, note that in the absence of any monitoring, the indifference conditions simplify to

$$
\theta_i^k + b = E\left(\theta_j|m_{j,k}\right) \qquad \textit{and} \qquad \theta_j^k + b = E\left(\theta_i|m_{i,k-1}\right).
$$

Then, by implication, $E\left(\theta_j|\theta_j>\theta_i,m_{j,k}\right) > (\theta_i+b)$ and $E\left(\theta_i|\theta_i>\theta_j,m_{i,k-1}\right) > (\theta_j+b)$, so that monitoring will lead to exaggeration as long as the monitoring intensity is increasing in the messages sent for both types of agents, $\Delta p^{(i:k,j:k)-(i:k-1,j:k)}, \Delta p^{(i:k-1,j:k)-(i:k-1,j:k-1)} > 0$, which intuitively follows from the fact that the messages get increasingly imprecise in their size. In the absence of cheap talk, note that

$$\theta_i^k + b = \frac{\theta_j^{k+1}+\theta_j^k}{2},$$

while $\theta_j^k = \frac{\theta_i^k+\theta_i^{k-1}}{2} - b$ and $\theta_j^{k+1} = \frac{\theta_i^{k+1}+\theta_i^k}{2} - b$, so that

$$0 = \theta_i^{k+1} - 2\theta_i^k + \theta_i^{k-1} - 8b \rightarrow \theta_i^{k+1} - \theta_i^k = \theta_i^k - \theta_i^{k-1} + 8b.$$

A similar recursion for agent $j$ gives $\theta_j^{k+1} - \theta_j^k = \theta_j^k - \theta_j^{k-1} + 8b$. But note that since $\theta_i^k > \theta_j^k$, the maximal informativeness will hold only for agent $i$, with $j'$s indifference conditions following from agent $i'$s partition. Further, note that we assumed above that $\theta_j^k \geq 0$, which need not hold. If $\theta_j^1 = 0$, then the initial step of the recursion is $\theta_i^1 + b = \frac{\theta_j^2}{2} \rightarrow \theta_i^1 = \frac{\theta_j^2 - 2b}{2}$. Consider now $\theta_j^1 = \frac{\theta_i^1+\theta_i^0}{2} - b$. No communication from agent $j$ implies $\theta_i^1 = \frac{\overline{\theta}-2b}{2}$, which implies that no credible communication from agent $j$ is indeed equilibrium as long as $\theta_j^1 = \frac{\theta_i^1+\theta_i^0}{2} - b < 0 \Leftrightarrow \frac{\overline{\theta}-6b}{4} < 0$. Thus, for $b \geq \frac{\overline{\theta}}{6}$, only agent $i$ sends an informative message, equivalent to the delegation solution. Now, if $\theta_j^1 > 0$, the next question is when agent $i$ becomes willing to send an additional message, i.e. $\theta_i^0 > 0$. This arises when

$$\theta_i^0 + b = \frac{\theta_j^1}{2} > 0,$$

while from above we know $\theta_j^1 = \frac{\theta_i^1+\theta_i^0}{2} - b$ and $\theta_i^1 = \frac{\overline{\theta}+\theta_j^1}{2} - b$, so we get

$$\theta_j^1 = \frac{\overline{\theta}+2\theta_i^0-6b}{3} \rightarrow \theta_i^0 + b = \frac{\theta_j^1}{2} > 0 \rightarrow \theta_i^0 = \frac{\overline{\theta}-12b}{4} \rightarrow b \leq \frac{\overline{\theta}}{12}.$$

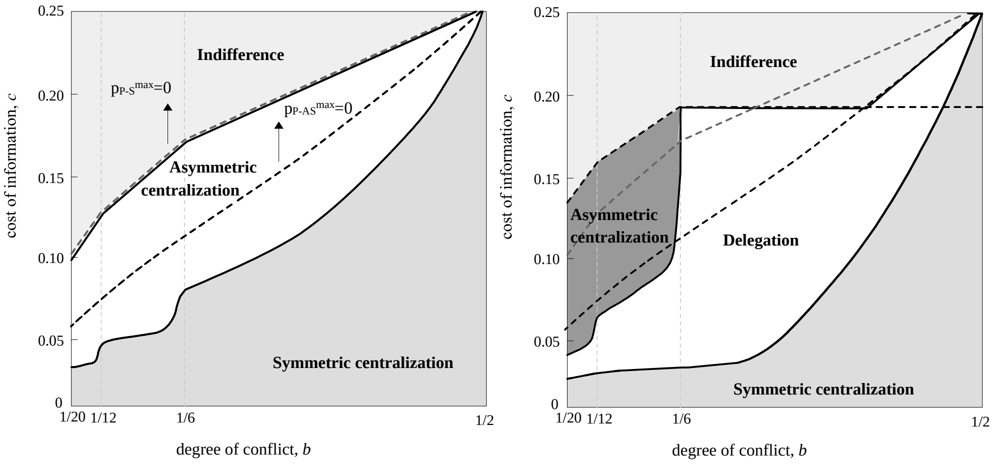
Finally, after $b \leq \frac{\overline{\theta}}{20}$, agent $j$ adds a third message and so on. Now, as before, we can solve the model numerically to compute the exact payoffs, noting that the value of information in the case of overlaps is given by, for matching messages:

$$\Pr(\theta_i \leq \theta_{j,k+1}) \Pr(\theta_j > \theta_{i,k}) \left(E\left(\max\left(\theta_i, \theta_j\right) - E\left(\theta_i\right)\right) | \theta_i, \theta_j \in [\theta_{i,k}, \theta_{j,k+1}]\right)$$
$$= \frac{(\theta_{j,k+1}-\theta_{i,k})}{(\theta_{i,k+1}-\theta_{i,k})} \frac{(\theta_{j,k+1}-\theta_{i,k})}{(\theta_{j,k+1}-\theta_{j,k})} \frac{(\theta_{j,k+1}-\theta_{i,k})}{6} = \frac{(\theta_{j,k+1}-\theta_{i,k})^3}{6(\theta_{j,k+1}-\theta_{j,k})(\theta_{i,k+1}-\theta_{i,k})},$$

and similarly, for non-matching messages we have

$$\Pr(\theta_j \leq \theta_{i,k}) \Pr(\theta_i > \theta_{j,k-1}) \left(E\left(\max\left(\theta_i, \theta_j\right) - E\left(\theta_i\right)\right) | \theta_i, \theta_j \in [\theta_{j,k-1}, \theta_{i,k}]\right)$$
$$= \frac{(\theta_{i,k}-\theta_{j,k})^3}{6(\theta_{i,k}-\theta_{i,k-1})(\theta_{j,k+1}-\theta_{j,k})}.$$

Given the structure of the communication equilibrium and the value of information for any pair of messages, we can then go ahead and solve the model numerically. The key difference between the symmetric and asymmetric cheap talk solutions are illustrated by the value of information, above. This key difference is that under the asymmetric communication structure, one of the proposals is always ex ante more attractive than the other. This asymmetry, in turn reduces the value of further investigation. Thus, the immediate advantage of the asymmetric communication structure is that when information is costly, such asymmetry artificially reduces the value of information and thus allows the principal commit to either no or lower investigation levels than under the symmetric




*(i) choice between symmetric and asymmetric centralization* *(ii) choice of governance structure*

Figure 8: Introducing centralization under asymmetric cheap talk as an alternative governance structure.

solution. Conversely, when information is cheap, this is bad because now the symmetric communication equilibrium is able to induce relatively balanced investigations across the different messages while the asymmetric structure will have a stronger asymmetry $\Delta p^{(i:k,j:k)-(i:k-1,j:k)}$ and thus more crowding out than under the symmetric communication structure.

This result, together with the choice among all three governance structures (symmetric and asymmetric centralization and delegation) are illustrated in figure 8. Panel (i) illustrates the choice between symmetric and asymmetric cheap talk structures, with the result simply confirming the intuition above. Asymmetric cheap talk is preferred for high costs of information to limit the amount of information acquisition and thus crowding out of soft information, while for low costs of information, symmetric cheap talk is preferred to provide better incentives to acquire information. Panel (ii) illustrates then the choice of governance structure. For low costs of information, symmetric cheap talk dominates asymmetric cheap talk and so the choice is between delegation and symmetric centralization, as before, and that boundary is thus not affected. For high costs of information, however, asymmetric cheap talk under centralization provides a better commitment device not to acquire further information, and thus that region is expanded to account for this additional benefit.

## B.3 Structure of the communication equilibrium

The analysis focused on partition equilibria without explicitly discussing the possibility of other equilibria. The reason for this focus was that such partitional equilibria, analogous to Crawford and Sobel (1982), are the only equilibria that exist of all parameter configurations.

To see this result, consider first the case in the absence of further investigations. Let the ordering of messages be such that $E\left(\theta_i|m_i^k\right) > E\left(\theta_i|m_i^{k'}\right)$ if $k > k'$ (otherwise, we could just reorder the messages). Then, note that in the absence of investigations, the principal will choose $i'$s project if

$E\left(\theta_i|m_i^k\right) > E\left(\theta_j|m_j^{k'}\right)$, while agent $j$ will choose $i'$s project if $E\left(\theta_i|m_i^k\right) > \theta_j + b$, which implies that the expected probability of acceptance $\Pr\left(A|m_i^k\right)$ will be increasing in $m_i^k$. Then, we can write the expected payoff to agent $i$ from sending a given message $m_i^k$ as

$$\Pr\left(A|m_i^k\right)(\theta_i + b) + \left(1 - \Pr\left(A|m_i^k\right)\right)\left(E\left(\theta_j|NA, m_i^k\right)\right).$$

In other words, while the final choice is discrete, we can view the problem as the principal choosing a probability of acceptance $\Pr\left(A|m_i^k\right) \in [0,1]$. We can then show supermodularity by noting that the payoff difference from sending messages $m_i$ and $m_i'$, with $m_i > m_i'$ can be written as

$$[\Pr(A|m_i) - \Pr(A|m_i')](\theta_i + b) + (1 - \Pr(A|m_i))(E(\theta_j|NA, m_i)) - (1 - \Pr(A|m_i'))(E(\theta_j|NA, m_i')),$$

and so

$$\frac{\partial E\left(u_i(m_i,\theta_i) - u_i\left(m_i',\theta_i\right)\right)}{\partial \theta_i} = [\Pr(A|m_i) - \Pr(A|m_i')] > 0.$$

Therefore, in the absence of further investigations, partitional equilibria are the only equilibria that exist. When further investigations are possible, then the analysis is complicated by the fact that now the probability of acceptance will also depend on the type, $\theta_i$. In this case, we can write the expected payoff as

$$\Pr(A|m_i,\theta_i)(\theta_i + b) + \int_{\theta_j} \left(p\left(m_i, m_j^k(\theta_j)\right)\left(I_{\theta_j > \theta_i}\theta_j\right) + \left(1 - p\left(m_i, m_j^k(\theta_j)\right)\right)\left(I_{E\left(\theta_j|m_j^k\right) > E(\theta_i|m_i)}\theta_j + I_{E\left(\theta_j|m_j^k\right) = E(\theta_i|m_i)} q\theta_j\right)\right) f(\theta_j)\, d\theta_j,$$

where $p\left(m_i, m_j^k(\theta_j)\right)$ is the investigation intensity given that the message sent by agent $j$ is $m_j^k(\theta_j)$, and $I_F \in \{0,1\}$ is an indicator function for whether the condition $F$ is true or not. In other words, if the investigation is successful, then the principal will accept agent $j'$s alternative if $\theta_j > \theta_i$, giving a payoff of $\theta_j$, while if the investigation fails, then agent $j'$s alternative is accepted for sure if $E\left(\theta_j|m_j^k\right) > E(\theta_i|m_i)$ and with probability $q$ if $E\left(\theta_j|m_j^k\right) = E(\theta_i|m_i)$. Similarly,

$$\Pr(A|m_i,\theta_i) = \int_{\theta_j} \left(\begin{array}{c} p\left(m_i, m_j^k(\theta_j)\right)\left(I_{\theta_j < \theta_i}\right) \\ + \left(1 - p\left(m_i, m_j^k(\theta_j)\right)\right)\left(I_{E\left(\theta_j|m_j^k\right) < E(\theta_i|m_i)} + I_{E\left(\theta_j|m_j^k\right) = E(\theta_i|m_i)}(1-q)\right) \end{array}\right) f(\theta_j)\, d\theta_j.$$

Now, to evaluate $\frac{\partial E(u_i(m_i,\theta_i))}{\partial \theta_i}$, the important element to note is that the only part where $\theta_i$ influences the probability of acceptance is when $\theta_i$ just successfully replaces $\theta_j$ in the case of successful monitoring. Thus, we have (for the uniform case)

$$\frac{\partial E(u_i(m_i,\theta_i))}{\partial \theta_i} = \Pr(A|m_i,\theta_i) + p\left(m_i, m_j^K(\theta_j)\right) b,$$

where $m_j^K$ is the message that contains $\theta_i$ for agent $j$. Then, the single-crossing condition holds as long as

$$\left[\Pr\left(A|m_i,\theta_i\right)-\Pr\left(A|m_i',\theta_i\right)\right]+\left[p\left(m_i,m_j^K\left(\theta_j\right)\right)-p\left(m_i',m_j^K\left(\theta_j\right)\right)\right]b>0.$$

Thus, partitional equilibria are the only equilibria that exists as long as (i) higher messages (in the sense of $E\left(\theta_i|m_i\right)>E\left(\theta_i|m_i'\right)$) lead to higher expected probability of acceptance, $\Pr\left(A|m_i,\theta_i\right)>\Pr\left(A|m_i',\theta_i\right)$, and higher messages are monitored more intensely, $p\left(m_i,m_j^K\left(\theta_j\right)\right)>p\left(m_i',m_j^K\left(\theta_j\right)\right)$. The latter is a common feature of the equilibrium solution because independent of the actual structure of communication, larger messages need to be less precise to counter the incentives to exaggerate. The second condition is also intuitively appealing, in the sense that evidence of a higher quality should in expectation lead to a higher probability of acceptance. Indeed, if the monitoring intensities are either sufficiently low or symmetric, we have that $E\left(\theta_i|m_i\right)>E\left(\theta_i|m_i'\right)\rightarrow\Pr\left(A|m_i,\theta_i\right)>\Pr\left(A|m_i',\theta_i\right)$, which in turn dominates any remaining asymmetry in the monitoring intensities, and so the partitional equilibria are the only equilibria that continue to exist. It is for this reason that the analysis solely focused on such equilibria.

It is, however, feasible that the single-crossing condition is not satisfied. The reason is that for sufficiently asymmetric monitoring technologies, it is theoretically possible that $\Pr\left(A|m_i,\theta_i\right)<\Pr\left(A|m_i',\theta_i\right)$ even if $E\left(\theta_i|m_i\right)>E\left(\theta_i|m_i'\right)$. To see this, recall that

$$\Pr\left(A|m_i,\theta_i\right)=\int\limits_{\theta_j}\left(\begin{array}{c}p\left(m_i,m_j^k\left(\theta_j\right)\right)\left(I_{\theta_j<\theta_i}\right)\\+\left(1-p\left(m_i,m_j^k\left(\theta_j\right)\right)\right)\left(I_{E\left(\theta_j|m_j^k\right)<E\left(\theta_i|m_i\right)}+I_{E\left(\theta_j|m_j^k\right)=E\left(\theta_i|m_i\right)}\left(1-q\right)\right)\end{array}\right)f\left(\theta_j\right)d\theta_j.$$

Now, for simplicity, let the decision rule of the principal be deterministic, so that ties, if they arise, are broken in favor of agent $j$. This then gives us

$$\begin{aligned}&\Pr\left(A|m_i,\theta_i\right)-\Pr\left(A|m_i',\theta_i\right)=\\&\int\limits_{\theta_j}\left(p\left(m_i,m_j^k\left(\theta_j\right)\right)\left(I_{\theta_j<\theta_i}\right)+\left(1-p\left(m_i,m_j^k\left(\theta_j\right)\right)\right)\left(I_{E\left(\theta_j|m_j^k\right)<E\left(\theta_i|m_i\right)}\right)\right)f\left(\theta_j\right)d\theta_j\\&-\int\limits_{\theta_j}\left(p\left(m_i',m_j^k\left(\theta_j\right)\right)\left(I_{\theta_j<\theta_i}\right)+\left(1-p\left(m_i',m_j^k\left(\theta_j\right)\right)\right)\left(I_{E\left(\theta_j|m_j^k\right)<E\left(\theta_i|m_i'\right)}\right)\right)f\left(\theta_j\right)d\theta_j,\end{aligned}$$

which we can rearrange to give

$$\begin{aligned}&+\int\limits_{\theta_j}\Delta p\left(m_i,m_j^k\left(\theta_j\right)\right)\left(\left(I_{\theta_j<\theta_i}\right)-\left(I_{E\left(\theta_j|m_j^k\right)<E\left(\theta_i|m_i'\right)}\right)\right)f\left(\theta_j\right)d\theta_j\\&+\int\limits_{\theta_j}\left(1-p\left(m_i,m_j^k\left(\theta_j\right)\right)\right)\left[I_{E\left(\theta_j|m_j^k\right)<E\left(\theta_i|m_i\right)}-I_{E\left(\theta_j|m_j^k\right)<E\left(\theta_i|m_i'\right)}\right]f\left(\theta_j\right)d\theta_j.\end{aligned}$$

Now, given the ordering of the messages, the second line is positive, giving the increase in the acceptance probability when monitoring is not successful. If the asymmetry is sufficiently small, then $\Delta p\left(m_i,m_j^k\left(\theta_j\right)\right)\rightarrow 0$, giving the desired result. But if the asymmetry is sufficiently large, it is clear that the general single-crossing condition is violated. However, whether this can hold in equilibrium is unclear, and thus appears more a theoretical curiosity than something of analytic relevance for the purposes of this paper.

An alternative way of seeing why such equilibria seem ex ante unreasonable is as follows. Suppose that we could construct an equilibrium, where a message pools both high and low types, where the reason why low types would be willing to choose the higher message over an intermediate message is that they don't want to risk their project being selected and only high messages are monitored sufficiently intensely. But then they should also be willing to directly separate themselves by sending a low message, restoring the partitional structure.[19]

[19] Similarly, for delegation we can establish following the same steps that the single-crossing condition is satisfied if

$$\left[\Pr\left(A|m_i,\theta_i\right)-\Pr\left(A|m_i',\theta_i\right)\right]+2\left[p\left(m_i,\theta_j=\theta_i-b\right)-p\left(m_i',\theta_j=\theta_i-b\right)\right]b>0,$$

where the impact of additional investigation is now $2b$ since the impact of the switch on agent $i$, if it occurs, is from $\theta_j=\theta_i-b$ to $\theta_i+b$.