Paper 1 of 2

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Peddling Influence through Intermediaries: Propaganda*

Wei Li
University of California, Riverside
wei.li@ucr.edu

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Abstract

Information may be transmitted directly from a sender to a receiver, or indirectly through intermediaries. How do intermediaries affect the reporting truthfulness of an informed sender? When does he prefer using intermediaries? In this model, an objective sender or intermediary passes on information truthfully, while a biased one wants to push a particular agenda but also has reputational concerns. This paper shows that intermediaries reduce a biased sender's reputation cost, but they also lessen his influence on the receiver. Biased agents' truth-telling incentives are strategic complements, and each additional intermediary reduces everyone's reporting truthfulness. If the sender's existing reputation is sufficiently high and his signal sufficiently informative, ex ante, he prefers using intermediaries. If the sender has sufficiently low reputational concerns, he prefers direct communication. Moreover, a biased sender may prefer a less truthful intermediary to a more truthful one.

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1 Introduction

Suppose that a government administration is intent on pushing a particular agenda or selling a policy. It may convey the relevant information to the public directly. However, doing so may be risky, especially if the agenda is unsupported by later evidence or the policy turns out wrong. The government may also convey its information to the media, both traditional and online, under condition of anonymity ("background briefing" only).[1] The media then chooses what to inform the public. The public's reactions have major policy ramifications. Such practices are common, for instance, information such as pre-war intelligence on Iraq was intentionally leaked to news media (CNN 2006a, CNN 2006b); the recent trial and conviction of I. Lewis Libby Jr. indicated that classified intelligence was disclosed to reporters for political purposes (Lewis 2007). What are the advantages and drawbacks of influencing public opinion though intermediaries?

This paper develops a model of communication through strategic intermediaries. In this model, the government—a partially informed sender—sends a message to an intermediary who then sends a message to the uninformed public.[2] The public takes an action based on what it hears, but eventually observes the true state. The government and the intermediary can each be objective or biased: an objective agent is assumed to pass on information truthfully, but a biased one wants to sell a particular agenda *and* to appear objective. A biased government must balance two opposing considerations. Communicating through an intermediary reduces its reputation cost of releasing inaccurate information, because the public may think that it is mislead by the messenger if the information turns out wrong. This *blame sharing effect* makes it more attractive for the government to use intermediaries. However, the intermediary also dilutes the effectiveness of any message the government uses to push its agenda because, not having good information of its own, the intermediary introduces possible distortions without adding to the message's accuracy. This *credibility reducing effect* makes it less attractive for the government to use intermediaries.

The net effect of using an intermediary, however, is unambiguous: the government reports less accurately because the blame sharing effect strictly outweighs the credibility reducing effect. The reason, and the first insight emerging from this model, is that the government and the intermediary's truth-telling

[1] Anonymity is widely granted in the news media, but this practice is currently under debate. For instance, in the first week of April 2005, 47% of all A-section articles published in the New York Times used anonymous sources, 46% of which were identified as "officials" or "aids" only (Okrent 2005).

[2] Throughout this paper, the informed sender and intermediaries are male and the decisionmaker is female.

incentives are strategic complements: if one reports less truthfully, so does the other. To see why, observe that the decisionmaker, the public in the example, acts based on what she hears. Later, she observes the true state and forms an opinion of the objectivity of the government and the intermediary. Hence there is a crucial difference in available information. When the decisionmaker hears from the intermediary, she believes that it is accurate with some probability because of the presence of objective agents. Thus the message still has a major effect on her despite the possible distortions. Afterwards, she observes the true state, at which point a wrong message is more likely to result from distortion than from a wrong signal of nature. Because she attributes, ex post, a larger share of any agenda-pushing message to the agents' distortions, the intermediary shares the sender's blame more than reduces the message's credibility. Thus communicating through a potentially biased intermediary who may report inaccurately enables the government to be less truthful as well.

The public, then, should evaluate anything learned from intermediaries cautiously: not only the intermediaries may introduce distortions of their own, they also worsen the government's incentives to report accurately. The information loss of indirect communication may increase sharply with the number of intermediaries. The very complementarity between the government and the intermediary, though, may also aid the public in reducing this information loss. Each biased agent's truth-telling incentives are shown to increase in how much *any* agent cares about his reputation. Thus if the decisionmaker cannot reach all agents, perhaps for legal or practical reasons, she can still improve everyone's truth telling by making it more costly for the intermediary to lie. This suggests that policies such as stricter enforcement of disclosure laws or higher standards for granting anonymity make everyone more truthful.

The government with an agenda may prefer either direct or indirect communication before receiving his private information. His preference hinges on how important the blame sharing effect from using intermediaries is, given his characteristics, relative to the credibility reducing effect. The second insight from this model is that a biased sender prefers direct communication if either his reputational concerns are so low that they are strictly dominated by the loss in credibility, or if he needs to appear highly objective to exert influence in the future. In contrast, the sender prefers indirect communication if his information is highly informative and he has moderately high reputational concerns. With direct communication, if his information does not support his agenda, he risks losing (almost) all reputation if he lies: he knows that the message is likely wrong. And he can ill afford it due to his reputational concerns. Moreover, his high signal quality implies that he still exerts a lot of influence even through intermediaries. Thus a government expecting highly accurate information may nonetheless choose to hide behind intermediaries.

These results suggest that a government sufficiently concerned about pushing its agenda prefers more objective, and thus very truthful intermediaries. Because he is primarily interested in agenda pushing, the less biased an intermediary is, the more credible is the message that reaches the decisionmaker. As the government becomes more concerned about his reputation, however, he increasingly prefers more biased intermediaries: they are better able to share the blame when a message turns out wrong. A new rationale for media bias arises endogenously from this model. In certain situations, a biased sender can be shown to prefer direct communication to an intermediary of sterling objectivity: it shares so little blame that it is not worth the loss in credibility. Thus, the intermediary may cultivate a biased image to gain access to information it would not have otherwise.

Following Crawford and Sobel (1982), many have studied the incentives of a biased sender who aims to influence the action of a receiver by manipulating the information he sends (Austen-Smith 1990, Dewatripont and Tirole 1999, Chevalier and Ellison 1999, Krishna and Morgan 2001, Morris 2001, Prat 2005, Ottaviani and Sorensen 2006, among others). In these models, the informed sender always communicates directly with the receiver. Instead, this paper gives conditions under which the sender may prefer indirect to direct communication—a step toward explaining the widespread use of intermediaries.

In term of the setup of the model without intermediaries, this paper is related to Sobel (1985) and Bénabou and Laroque (1992), who considers a model in which the objective type reports honestly, but the biased type (insiders) need to appear credible in order to manipulate the market's belief of an asset's price through possibly distorted messages. Bénabou and Laroque (1992) focus on a sender's reputation building over time, and show that in the presence of imperfect private information and noise traders, a biased sender's message always has some influence on the asset price, but his type is only learned asymptotically. Morris (2001) endogenized the role of the objective type such that an objective agent also faces reputational concerns. He shows that there exists a "politically correct" equilibrium in which the message associated with bias may be avoided by an objective agent sufficiently concerned about future reputation.

It has long been recognized that intermediaries provide important services in an economy (Spulber

1996). Financial intermediaries provide liquidity in securities markets (Garman 1976); market intermediaries improve matching and reduce search costs for the buyers and sellers (Rubinstein and Wolinsky 1987); and they provide monitoring and serve as guarantors of quality (Diamond 1984, Biglaiser 1993). Several recent papers zoom in on the information transmission role of non-strategic intermediaries by extending the Crawford and Sobel (1982) framework to more general communication protocols (Blume, Board, and Kawamura 2007, Goltsman, Horner, Pavlov, and Squintani 2007). In particular, Blume, Board, and Kawamura (2007) show that adding randomness to the communication process may enable more information to be transmitted than is possible in Crawford and Sobel, partly because the noise dampens the receiver's response to any message and thus reduces the sender's incentive to distort his signal. The current paper shares the feature that intermediaries do not provide any other services but to transmit information. However, because they are strategic and care about their reputations, they introduce distortions (noise) as well as affect the truth-telling incentives of all biased agents. As a result, less information is transmitted as the number of intermediaries increases.

Section 2 sets up the indirect communication game. Section 3 and 4 analyze, respectively, the biased sender's behavior without and with an intermediary. Section 5 studies a sender's ex ante preference of communication channels. Section 6 extends the model and discusses several main assumptions. Section 7 concludes. All proofs are collected in the Appendix.

2 The Indirect Communication Game: Setup

There are three agents: A, B and C. Agent C is the decisionmaker whose optimal decision depends on the state of the world $\eta \in \{0, 1\}$. Each state occurs with equal probability. The decisionmaker C chooses an action $a \in \Re$ to maximize her utility, which is simply assumed to be given by the quadratic loss function $-(a - \eta)^2$. Her optimal action is to choose a equal to the probability she attaches to $\eta = 1$. In the opening example with a potentially biased government, the true state may be "no military threat" (state 0) and "high military threat" (state 1). Decisionmaker C, then, represents the public who needs to choose an appropriate level of war mobilization.

Agent A, and only A, observes a private signal s_A about the state of the world. This signal is equal to the true state with probability $p_A > \frac{1}{2}$; otherwise it is wrong. Agent B is assumed to be a pure intermediary who has no signal of his own. This assumption simplifies away the information aggregation complications, and makes it possible to focus on how A's incentives to report truthfully depends on the intermediary's presence, not his information. It also captures the situation that A's signal, perhaps of a classified nature, is significantly more informative than that of B's.[3] After observing his signal, A sends a message $m_A \in \{0, 1\}$ to B, who in turn sends a message $m_B \in \{0, 1\}$ to C. Information flows only in one direction, from A to B to C. Each agent can only observe the message sent to him directly. Moreover, the true state and all messages are assumed to be observable but unverifiable, thus no transfers can be made based on the messages.

Agent i ($i = A, B$) may be either objective (type o) or biased (type b). Each agent's type is independently drawn from $\{o, b\}$: $Pr(i = o) = \theta_i$, $Pr(i = b) = 1 - \theta_i$. Parameter θ_i, which captures agent i's existing reputation, is referred to as i's prior objectivity in this paper. An objective agent is assumed to report his information (s_A or m_A) honestly. Honesty here is interpreted either as an institutional goal or a behavioral trait, similar to Sobel (1985), Bénabou and Laroque (1992), and Kartik, Ottaviani, and Squintani (2007). Some media and non-profit organizations may adhere to an ethical standard of only informing the public in an impartial way; people may simply prefer behaving honestly, as suggested by psychological experiments (Evans, Hannan, Krishnan, and Moser 2001).[4]

A biased agent always favors action $a = 1$, but he also wants to appear objective due to reputational concerns. Denote agent i's posterior probability of being objective as π_i, which is formed after C observes the true state η. Biased A and B's payoffs are assumed to be, respectively:

$$u_A = a + \alpha\pi_A \quad \text{and} \quad u_B = a + \beta\pi_B.$$

The first half of biased i's payoff function is C's action. The more likely C takes action $a = 1$, which is the favorite agenda of a biased agent, the better off he is. The second half is a reduced form formulation representing a biased agent's reputational payoffs used in many existing papers, (Scharfstein and Stein

[3] Main results of this paper hold qualitatively if B observes a sufficiently uninformative signal s_B, e.g., $Pr(s_B = \eta) = p_B \approx \frac{1}{2}$. In a companion piece, Li (2007b) considers the case where the intermediary is a well informed expert in the market for credence goods. See further discussions on well-informed intermediaries in Section 6.

[4] For instance, BBC's editorial guideline states that "We will be objective and even handed in our approach to a subject. We will provide professional judgments where appropriate, but we will never promote a particular view on controversial matters of public policy or political or industrial controversy."

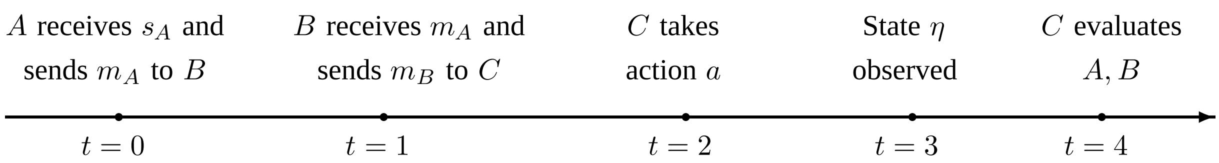


Figure 1: Timeline of the Indirect Communication Game

1990, Prendergast and Stole 1996, Ottaviani and Sorensen 2006). It reflects the fact that an agent is less influential if he is considered highly biased.[5] Parameters $\alpha, \beta \in [0, \infty)$ are the weights A and B attach to their reputations, which have two alternative, and economically relevant interpretations. First, the ratios $\frac{1}{\alpha}, \frac{1}{\beta}$ reflect the extent, or the intensity, of A, B's bias. The lower is α, the more keenly biased A cares about pushing his agenda in this game. Second, if there are several identical agents who may send a message to B, then A's reputation is only affected to the extent that C believes that he is the source: it is equivalent to a decrease in α. The indirect communication game is summarized in Figure 1.

In this game, biased agent i simply sends a message $m_i \in \{0, 1\}$ as a function of his information (s_A or m_A). Given message m_B, C chooses an action a. Later, she rationally updates her opinion on A and B's objectivity π_A, π_B as a function of their prior objectivity, the message received and the observed state. This paper looks for perfect Bayesian equilibrium (PBE): each agent chooses a message to maximize his expected payoff, given his information, the other agent's strategy as well as C's action and inferences.

Although messages are assumed to be unverifiable, they are not cheap talk in this model. Due to the presence of objective type who always passes on information truthfully, any message is informative and always directly influences the sender's payoff. This also implies that if a biased agent lies to push his agenda, ex post, his message is more likely to be wrong, thus he receives a lower reputational payoff than reporting truthfully. Consequently, there are no babbling equilibria in which the message is uncorrelated with the agent's signal, and ignored by the decisionmaker.

Before turning to the analysis, it may be useful to keep in mind two possible applications of this model.

1. In an application to electoral campaigns, the decisionmaker C represents the voters who need to choose a candidate in the upcoming election. Agent A is a campaign manager of a political candidate

[5] For simplicity, the agents' reputational payoffs are assumed to be linear in their respective posterior objectivity. In general, the agent's reputational payoffs are determined by C's decision problem in the future, which is discussed in details in Section 6. Specifically, the reputational payoffs may be linear (Example 1 in Section 6) or convex (Example 2 and 3 in Section 6), in which case higher levels of perceived objectivity matter disproportionately more than lower levels.

who is interested in discrediting an opponent but still appears objective in the eyes of voters. He may launch a direct advertisement attacking the opponent. Under the Bipartisan Campaign Reform Act (BCRA) enacted in 2002, he must disclose his identity.[6] Alternatively, he may convey the information to agent B, another political organization or an activist group who may choose what to tell the voters. Such groups, for example the 527 organizations or Internet forums, are not subject to the same disclosure rules.[7]

2. In an application to the financial market, the decisionmaker C represents investors who need to make buy/sell decisions depending on whether a company is performing poorly. Agent A, a market insider, may have genuine information about the company's subpar performance; or it may want the market to believe so to reap large profits. A is concerned about his reputation, perhaps for legal reasons. Intermediary B is a financial analyst who issues reports about the company in question. Several lawsuits in the recent years involve alleged uses of intermediaries to manipulate prices, which has led to Congressional investigations.[8] For example, according to Fortune magazine: "Canadian insurer Fairfax Financial Holdings sues a group of hedge funds and research analysts for $5 billion in New Jersey state court, alleging a stock market manipulation scheme in which the funds sold Fairfax's shares short, got analysts to write negative research reports that pushed the stock down, and made fortunes."[9]

3 The Baseline Case: Direct Communication

This section examines the case where A sends a message to C directly.[10] It illustrates the basic tradeoff biased A faces in a simple setting, and thus serves as a useful benchmark against which the indirect communication model will be compared. Also, it is relevant when voters or consumers need to evaluate platforms or advertisements directly from potentially biased sources.

[6] Political candidates for federal office need to comply with the "stand by your ad" provision of BCRA, which requires "a statement by the candidate that identifies the candidate and states that the candidate has approved the communication."

[7] The 527 groups are tax-exempt organizations that engage in political advocacy. They are not regulated by the Federal Election Commission and may raise unlimited amount of soft money contributions. In the 2006 election cycle, for example, the Democratic/liberal 527 groups spent over $45 million and the Republican/conservative ones spent over $64 million. The data was based on IRS records released on February 28, 2007. For more details, see http://www.opensecrets.org/527s/.

[8] For instance, on June 28, 2006, the U.S. Senate Judiciary Committee began an investigation into the links between hedge funds and independent analysts, and other issues related to the funds.

[9] Bethany McLean, Fortune editor-at-large, "The inside story of a Wall Street battle royal", March 6, 2007.

[10] This is equivalent to the case where A hires a known objective intermediary ($\theta_B = 1$), or if the biased B faces an infinitely high reputation cost ($\beta = \infty$).

Objective A reports $m_A = s_A$, but biased A wants to push his agenda $\eta = 1$ and to appear objective. Given signal s_A, biased A chooses m_A to maximize his expected payoff:

$$EU_A(m_A|s_A) = Pr(\eta = 1|m_A) + \alpha E_\eta[Pr(A = o|m_A, \eta)|s_A].$$

The first part is the decisionmaker's optimal action upon receiving A's message, for example, what level of war mobilization should be taken. The second part, reflecting A's reputational concerns, is his (expected) posterior objectivity where the expectation is taken with respect to state η. Clearly, given his signal, A chooses a message that leads to a higher expected payoff.

Before analyzing a biased sender's behavior, it is helpful to begin by identifying the key equilibrium properties of this model. The following definition greatly eases the exposition:

Definition 1 *An "agenda-pushing equilibrium" is an equilibrium in which biased A reports $m_A = 1$ truthfully if his information supports his agenda ($s_A = 1$); and reports $m_A = 0$ truthfully with a probability strictly smaller than 1 if it does not support his agenda ($s_A = 0$).*

The corresponding strategy is referred to as an "agenda-pushing strategy". It can be shown that:

Lemma 1 *Every equilibrium of this game is an agenda-pushing equilibrium.*

Honesty is never the best policy for a biased agent: if he always reports $s_A = 0$ truthfully, the decisionmaker knows the message she hears reflects the true signal and acts accordingly. Then by reporting $m_A = 1$, A's agenda pushing is most effective, yet he pays no reputation cost. Biased A thus strictly profits from lying (if $s_A = 0$), which is a contradiction.

Lemma 1 also shows that it never pays for a biased agent to intentionally distance himself from pushing his agenda. More precisely, even though the direction of bias is known, there does not exist a perverse equilibrium in which A reports $s_A = 0$ truthfully, but lies after receiving $s_A = 1$. If there were such an equilibrium, $m_A = 1$ indicates $s_A = 1$ for sure and is thus very convincing. Moreover, $m_A = 1$ becomes a better sign of objectivity. Again, this encourages A to deviate and report $m_A = 1$ if $s_A = 0$.

Given Lemma 1, biased A's strategy can be restricted to an agenda-pushing one. Let him report $m_A = 0$ with probability x^d if $s_A = 0$. Then the difference in his expected utility if he reports $m_A = 1$ versus $m_A = 0$ can be decomposed into two parts: how strongly A's message changes C's action, and how much it affects his reputation. First, examine A's agenda pushing effectiveness, which is the *net* difference in C's action induced by A's message. For both signals, this difference:[11]

$$Pr(\eta = 1|m_A = 1) - Pr(\eta = 1|m_A = 0) = \frac{p_A - 0.5}{0.5 + 0.5(1 - x^d)(1 - \theta_A)}, \tag{1}$$

is strictly positive because of the presence of objective A. Thus A strictly benefits from reporting $m_A = 1$ in term of his agenda pushing. The higher is this difference, the more A is tempted to lie. In particular, this difference increases in x^d, because the more truthful A is, the more credible $m_A = 1$ becomes, and the more C believes it.

Second, examine the toll on A's reputation if he pushes his agenda. Given signal s_A, if A reports $m_A = 1$ instead of $m_A = 0$, the net difference in his posterior objectivity is:

$$\alpha[Pr(A = o|m_A = 0) - E_\eta[Pr(A = o|m_A = 1, \eta)|s_A]].$$

This difference reflects the reputation cost of A's agenda pushing. It is non-negative because $m_A = 0$ is more likely to come from an objective agent: A always suffers a loss in reputation by sending $m_A = 1$. Moreover, this difference is decreasing in x^d, because the more truthful A is, the less C modifies her view of his objectivity from the message itself. Intuitively, if even a biased agent reports very truthfully, $m_A = 0$ is not a strong signal of objectivity; nor is $m_A = 1$ a strong signal of bias.

A biased sender lies against signal $s_A = 0$ if his net benefit from agenda pushing by sending $m_A = 1$ outweighs his net reputation cost. The following proposition summarizes A's behavior:

Proposition 1 (Direct Communication) *There exists a cutoff value $\overline{\alpha}$ such that, in the unique agenda-pushing equilibrium, biased A always reports $m_A = 1$ if $\alpha \leq \overline{\alpha}$; and reports $s_A = 0$ truthfully with probability $x^d > 0$ if $\alpha \geq \overline{\alpha}$.*

If the signal does not support A's agenda, Proposition 1 shows that he reports truthfully sometimes if he cares sufficiently about his future reputation; or equivalently, if he is not extremely keen about pushing his agenda.[12] A natural question, then, is how A's reporting accuracy x^d depends on who he is, such as his prior objectivity and signal quality. In the aforementioned examples, one may ask whether a political

[11] The second part is true because, given A's strategy, the true signal $s_A = 0$ if $m_A = 0$.

[12] The cutoff values $\overline{\alpha}$ and the equilibrium truthful reporting probability x^d are defined in the proof in the Appendix.

candidate lies less (against the opponent) if he is perceived to be very objective; or whether the government pushes its agenda less often if its private information becomes more accurate. The following result provides some answers.

Corollary 1 *(1) Reporting accuracy and A's prior objectivity. If A's reputation weight $\alpha \leq \frac{1}{2}$, A always lies. If $\alpha > \frac{1}{2}$, then given signal quality p_A, there exist cutoff values $\underline{\theta}_A, \overline{\theta}_A \in (0,1)$ such that x^d increases in θ_A if $\theta_A \in [0, \underline{\theta}_A]$; decreases if $\theta_A \in [\underline{\theta}_A, \overline{\theta}_A]$; and becomes zero if $\theta_A \in [\overline{\theta}_A, 1]$.*

(2) Reporting accuracy and A's signal quality. Given α and θ_A, if α is sufficiently low, then x^d first decreases in A's signal quality p_A and becomes zero as p_A becomes sufficiently high. If α is sufficiently high, then x^d first decreases in p_A; but eventually increases as p_A becomes sufficiently high.

One might expect that a politician with a good reputation at stake should lie very little: after all, he has more to lose. Corollary 1 shows that instead, A is most truthful when his reputation is most responsive to his message, which occurs if his prior objectivity is in the intermediate range, e.g., when a political candidate is relatively unknown. To see this, observe that if biased A is thought to be very objective ($\theta_A > \overline{\theta}_A$), a wrong message has a minimal impact on his reputation, because C attributes most of the mistake to a wrong signal. At the other extreme ($\theta_A \approx 0$), even though A lies almost completely, he reports more truthfully as θ_A increases. Because $m_A = 0$ is almost a sure sign of objectivity, a marginal increase in truthful reporting makes him appears very objective. As θ_A increases further, A's reputation after reporting $m_A = 0$ decreases while that after reporting $m_A = 1$ increases. Together, this reduces biased A's net reputation cost, thus his reporting accuracy actually falls as θ_A becomes sufficiently high.[13]

Surprisingly, biased A may lie more, not less, as his signal becomes more accurate. A's signal quality has two opposing effects on his truth telling. Suppose that A is sufficiently concerned about his reputation, or that he is not very keen on agenda-pushing. On the one hand, the more accurate his signal is, the more informative it becomes. Thus his agenda pushing has a stronger impact on C's action, increasing his incentive to lie. As a result, A may become less "fair and balanced." On the other hand, as p_A increases, whenever message $m_A = 1$ turns out wrong, it is more likely that A has lied. This higher reputation cost decreases A's incentive to lie. Corollary 1 shows that if the signal is very uninformative ($p_A \approx \frac{1}{2}$), even

[13] This is similar to Bénabou and Laroque (1992), who show that a biased agent has little incentive to invest in his reputation (report truthfully) when his existing reputation is very high or very low. Because they are interested in long term reputation formation, the agent's truth-telling incentives when his prior objectivity is in the intermediate range may be ambiguous.

an objective agent is often wrong, thus A's gain in agenda pushing dominates and he lies more. However, when p_A becomes sufficiently high, a wrong message is (almost) a sure sign of bias. Lying leads to a complete loss of reputation, which outweighs any gain from agenda pushing, and he lies less eventually.

4 Indirect Communication

Building on the direct communication model, this section shows how a possibly biased intermediary may dilute the effectiveness of A's message, but boost his perceived objectivity. It also considers how the decisionmaker may improve the reporting accuracy of indirect communication in some applications to the media and law.

Similar to Lemma 1, it can be shown that every equilibrium is an agenda-pushing equilibrium. Therefore, biased A and B both adopt an agenda-pushing strategy such that they report $s_A = 0$ and $m_A = 0$ truthfully with probability x, y respectively. Given this strategy, biased B chooses a message m_B to maximize his expected payoff: $EU_B(m_B|m_A) = Pr(\eta = 1|m_B) + \beta E_\eta[Pr(B = o|m_B, \eta)|m_A]$.

To begin with, even information learned through an intermediary still influences the decisionmaker. Consider the net influence of B's message on C's optimal action, $Pr(\eta = 1|m_B = 1) - Pr(\eta = 1|m_B = 0)$, which is equal to:

$$\frac{p_A - 0.5}{\underbrace{0.5[1 + (1-\theta_A)(1-x)]}_{Pr(m_A=1)} + \underbrace{0.5(\theta_A + (1-\theta_A)x)(1-\theta_B)(1-y)}_{Pr(m_A=0,\ m_B=1)}}. \tag{2}$$

This influence is always positive: the presence of objective agents implies that even if all biased agents lie completely, C still believes more in $\eta = 1$ if $m_B = 1$.[14] Moreover, this difference increases in the truth-telling probabilities x, y: the more truthful A and B are, the more likely C is swayed by B's message.

Note also that the mere presence of an intermediary makes A's agenda pushing less effective. A potentially biased message from B has a smaller impact on C than that from A, holding A's behavior constant.[15] Specifically, $Pr(\eta = 1|m_A = 1) - Pr(\eta = 1|m_B = 1) > 0$, is the *credibility reducing*

[14] Formally, $Pr(\eta = 1|m_B = 1) > Pr(\eta = 0|m_B = 1)$ if $x = y = 0$. This also shows that, by reporting $m_B = m_A$, the objective B passes on the most accurate information he has.

[15] This can be seen from a comparison of Expression (1) and Expression (2 at $x = x^d$. The part labeled $Pr(m_A = 0, m_B = 1)$ is B's possible distortion when C hears $m_B = 1$.

effect of having an intermediary. Because A's signal is the only available information; B simply induces further distortion. But the intermediary B also shares A's blame of sending inaccurate information. In comparison with direct communication, C's evaluation of A and B's objectivity becomes more subtle because she does not observe m_A. If $m_B = 0$, C knows that A's signal is $s_A = 0$: neither agent has distorted it. However, three things may have occurred if she hears $m_B = 1$: the true signal $s_A = 1$; agent B is a messenger of a lie $m_A = 1$; or B has distorted A's message to push his agenda. The last one is the *blame sharing* effect non-existent in the direct communication case.

A new complicating factor of indirect communication is that, at first glance, it may seem unclear how uncertainty about B's message affects A. After all, a truthful message of $m_A = 0$ may still be distorted by B, which affects C's action and A's perceived objectivity. Interestingly, both A's net benefit from agenda pushing and his net reputation cost of lying are multiplied by a common factor: $Pr(m_B = 0|m_A = 0)$, the probability that B passes on A's message 0. More precisely, the net agenda-pushing benefit for A if he reports $m_A = 1$ versus $m_A = 0$ is $Pr(m_B = 0|m_A = 0)[Pr(\eta = 1|m_B = 1) - Pr(\eta = 1|m_B = 0)]$. Similarly, A's net reputation cost can be decomposed into $Pr(m_B = 0|m_A = 0)E_\eta[Pr(A = o|m_A = 0, \eta) - Pr(A = o|m_A = 1, \eta)]$. The pivotal event for agent A — which drives his message choice — is whether he could change what C hears. His message only matters when it does. Intuitively, because C cannot observe m_A, both A's influence on C and his posterior reputation are filtered through B's message. This observation greatly simplifies the analysis, because A's incentive to lie vis-a-vis B's can be analyzed with this factor taken out. Thus, A and B receive the same benefit from agenda pushing *relative* to his reputation cost: any difference in their reporting accuracy must be driven by differences in A and B's reputation costs.[16] The following proposition describes the key properties of equilibrium in the indirect communication game:

Proposition 2 *A unique agenda-pushing equilibrium exists. In this equilibrium,*

(2.1) If both agents place sufficiently low weights on their reputations (α and β sufficiently close to 0), or if their prior objectivities θ_A and θ_B are sufficiently high, they lie completely: $x = 0, y = 0$.

(2.2) There exist cutoff values $\tilde{\alpha}, \tilde{\beta}$ such that if both agents place sufficiently high weights on their reputations ($\alpha \geq \tilde{\alpha}$ and $\beta \geq \tilde{\beta}$), $x, y \in (0, 1)$.

[16] This also implies that an agent's truth-telling incentives are independent of his location with many intermediaries; see Proposition 5 for details.

If a biased agent has little reputational concerns; or if his prior objectivity is so high that his message has a negligible marginal impact on his reputation, Proposition 2 shows that the agenda pushing effect dominates and he always lies. This is particularly relevant in settings where one out of several agents may have leaked information to the intermediary, but A's exact identity is unknown. In the electoral campaign example, the voters may be aware that A is one, among other interest groups, possible source of negative attacks against his opponent. In these situations, α decreases in the number of possible sources, consequently biased A is more apt to lie completely. In contrast, if an agent has sufficiently high reputational concerns ($\alpha \geq \tilde{\alpha}$ or $\beta \geq \tilde{\beta}$), he cannot afford to lie completely even if the other agent does so, thus he reports truthfully sometimes.[17]

The key to understand biased A, B's truth-telling incentives is to see how the reporting accuracy of one affects that of the other. To illustrate this, suppose that A's signal is perfect ($p_A = 1$), which makes it simpler for C to assign blame if B's message is wrong — either A or B must have lied. Biased A's saving in reputation cost if he lies through an intermediary is $Pr(A = o|m_B = 1, \eta = 0)$: how likely his truthful message is distorted by the messenger. Now, suppose that B is slightly more truthful (y increases slightly), two opposing effects surface. On the one hand, A now faces a higher reputation cost if $m_B = 1$, because C rationally attributes more blame of initiating a biased message to A. Intuitively, A and B free ride on each other: each agent's net reputation cost increases in the other's truthful reporting, but decreases in his own. A's saving $Pr(A = o|m_B = 1, \eta = 0)$ decreases by an amount inversely proportional to $Pr(m_B = 1, \eta = 0)$, which is the probability that a wrong message reaches the decisionmaker. This encourages A to lie less (x rises). On the other hand, B's message becomes more credible, thus C is more likely to take an action in favor of his agenda. As a result, A's agenda pushing effectiveness, as given by Expression (2), increases by an amount (up to the same factor as the reputation cost) inversely proportional to $Pr(m_B = 1)$, the *total* probability that a message $m_B = 1$ reaches C. This encourages A to lie more (x falls).

In net, it becomes more costly for A to lie and he wants to report more truthfully. Because $Pr(m_B = 1)$ is clearly larger than $Pr(m_B = 1, \eta = 0)$, if B is more truthful, A's saving in reputation cost falls

[17] The cutoff values $\tilde{\alpha}$ and $\tilde{\beta}$ are defined in the appendix. Observe that if one agent, say B, is very concerned about his future reputation, but the other one does not ($\beta > \tilde{\beta}, \alpha \leq \tilde{\alpha}$), then in the unique equilibrium, B reports truthfully sometimes ($y > 0$). But A, who cares little about his reputation, may either lie completely or reports truthfully with some probability, depending on B's characteristics.

by more than his gain in agenda-pushing effectiveness. In equilibrium, A and B's truth telling are strategic complements: x and y increase together. Intuitively, this complementarity arises because different information is available to C: she only knows B's message when she chooses her action; but later on, she forms her belief about the agent's objectivity based on both m_B and the observed true state η. For example, negative information about a political candidate may reach, and influence, the voters before the truth is learned.[18] Here, upon hearing $m_B = 1$, C assigns a higher probability to the true signal $s_A = 1$ than to A and B's lying. Thus B's message is relatively effective despite the possible distortions. Ex post, however, C knows for sure that either A or B has lied. Therefore, B takes away more blame from A than reduces his credibility.

This complementarity between biased agents explains why the indirect communication game has a unique equilibrium. Suppose that A and B are symmetric, then no asymmetric equilibrium in which biased A and B behave differently exists: $x = y$ if $\theta_A = \theta_B$ and $\alpha = \beta$. If instead, $x > y$, then controlling for a wrong signal from nature, C is more likely to attribute the distortion to B than to A. Also, B pays a higher reputation cost of *not* reporting $m_A = 0$ than A. This leads to an impossibility: A and B receive the same (relative) benefit in term of agenda pushing, yet B pays a higher net reputation cost than A by fabricating $m_B = 1$. If $\alpha \neq \beta$, then given similar prior objectivity, a biased agent more concerned about his reputation reports more truthfully: $x > y$ if $\alpha > \beta$; $x < y$ otherwise.

This complementarity between biased agents also means that changes in one's reputational concerns affect the other, which is of practical importance for a decisionmaker who cannot reach all agents directly, perhaps due to existing anonymity granting rule of the media or laws protecting whistle blowers. For instance, several courts in recent years have grappled with setting appropriate legal guidelines for when intermediaries can be compelled to divulge the identities of their customers. In Doe v. Cahill (Del. 2005), the Delaware Supreme Court considered what a plaintiff must show in order to obtain a subpoena requiring an Internet service provider to disclose who posted anonymous comments about a politician on the Internet. What are the consequences if the decisionmaker imposes a higher cost — financial or reputational — on some agent? In the legal examples above, the financial cost of the intermediary (the Internet service

[18] For instance, in the Bush-McCain campaign of 2000, South Carolina voters were asked, in an anonymous push-poll, "Would you be more likely or less likely to vote for John McCain for president if you knew he had fathered an illegitimate black child?". Later, John McCain lost South Carolina, effectively ending his run for the presidency. It turned out that McCain has an adopted Bangladeshi daughter with whom he campaigned (CNN 2000).

provider) increases if he is more likely to be held liable for libel; while the cost for the source (bloggers) increases if the intermediary is easily compelled to reveal his identity. The following result shows how a change such as stronger protection of customer identity in the law or stricter rules of sourcing in the media, modeled as an increase in β, may influence all agents' reporting truthfulness.

Proposition 3 (Overall effect of disciplining the intermediary) *Suppose that $x, y > 0$ in the equilibrium of the indirect communication game. Then biased A and B become more (less) truthful if either agent becomes more (less) concerned with their reputation: both x and y increase in both α and β. Moreover, if θ_A is sufficiently close to θ_B, a biased agent responds more to any change in his own reputational concerns than that in the other.*

Clearly, as a media outlet, B reports more truthfully if he faces higher fines for granting anonymity too casually, but Proposition 3 shows that this makes it more costly for A to lie as well. Therefore the decisionmaker can improve the overall reporting accuracy by increasing the reputation cost of the intermediary. For example, the New York Times recently imposed a higher anonymity granting standard, because "the proliferation of critics and the growing public cynicism about the news media pose a threat to our authority and credibility that cannot go unanswered".[19]

However, the flip side of the coin is that information deteriorates quickly even if only one agent, such as a politician whose public life is drawing to an end, cares less about his reputation. Also, even the positive effect of C's policies may be quite limited, because a biased source responds more to a change in his own reputational concerns than that in an intermediary's (if they have similar prior objectivity). In addition, if A is so biased that he lies completely in equilibrium, a small change in B's reputation cost does not affect him.[20] For example, the media may become more scrupulous in reporting due to stricter anonymity granting rules, but the government barely increases its reporting accuracy. Since it takes only one biased agent to distort the information, a wrong message may still reach C with a high probability.

[19] In a June 23, 2005 memo titled "Assuring Our Credibility" by Bill Keller, the executive editor of the New York Times.

[20] If $x = 0$ in equilibrium, a large increase in β is necessary, but not sufficient, for A to report truthfully with positive probability.

5 Comparing Communication Channels

This section addresses two questions. The first concerns the information loss associated with these communication channels, which affects how the decisionmaker interprets messages. For instance, the voters may evaluate a piece of news differently if it comes from a political candidate directly instead of an activist group citing confidential or obscure sources. The second question is how biased A may rank these channels for propaganda purposes. Which channel, and what type of intermediaries, does he prefer?

5.1 Information Loss of Indirect Communication

Sometimes an agent may only communicate in a particular way, perhaps for legal or institutional reasons. Biased A's reporting truthfulness in these channels is important to C's proper evaluation of what she hears. Propositions 1 and 2 show that biased A reports $s_A = 0$ truthfully with probability x^d without intermediary B, and x with him. When is A's message more truthful?

Corollary 2 *Biased A lies less under direct communication: $x^d \geq x$. The inequality is strict if $x^d > 0$.*

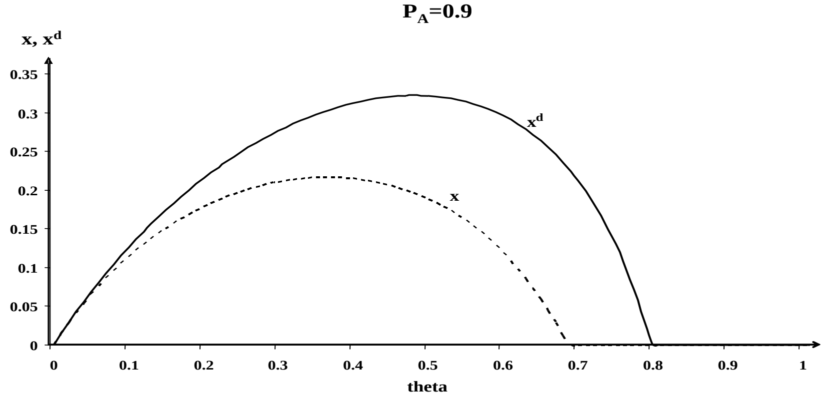
The government in the opening example is always more truthful in direct communication because the intermediary B saves more in his reputation cost than reduces his message's credibility. This result is a consequence of Proposition 3, because direct communication is nothing but indirect communication where the biased intermediary has infinitely high reputational concerns and thus is always truthful ($\beta = \infty$). Proposition 3 shows that if the intermediary becomes less concerned with his reputation, which is the case when A changes from direct to indirect communication, both agents report less truthfully.[21] As an illustration, Figure 2 shows that if $p_A = 0.9$ and A and B are symmetric ($\alpha = \beta = 1, \theta_A = \theta_B = \theta$), the probability A reports truthfully via an intermediary, x, always lies below x^d, his truth-telling probability in direct communication.

More importantly, Corollary 2 shows that not only may an intermediary introduce bias, he also enables everyone to lie more. As a result, the decisionmaker prefers direct communication in the current model because of its smaller information loss. Indirect communication leads to two types of information losses:

[21] The insight that the intermediary reduces A's reputation cost more than his agenda pushing effectiveness also holds when there are many intermediaries, which is presented as an extension in Section 6.

it is prone to the propagation of distorted information; and it makes true signal $s_A = 1$, and thus $m_A = 1$, much less useful for the decisionmaker. In the opening example where the public needs to decide on war or peace according to information learned through intermediaries, not only the country is more likely to go to war on false grounds, it may also be lulled into a false peace by discounting genuine threats.[22]

Figure 2: Reporting Accuracy With and Without Intermediary
P_A=0.9



5.2 Biased A's Choice of Communication Channels

The government in the opening example with an agenda to push faces a key tradeoff: releasing information directly is more credible while using an intermediary reduces reputation cost. How should it balance these considerations and choose a communication channel given its own characteristics as well as those of the intermediaries? This section considers biased A's channel choice from an ex ante point of view: namely, which channel gives him a higher expected payoff before he observes the signal s_A.[23]

[22] The mean absolute error introduced by the biased agents can be shown to be increasing and concave in the fraction of biased agents if θ_A, θ_B are sufficiently large. An infinitesimal fraction of biased agents thus has a disproportionate impact on information accuracy.

[23] Ex ante choice before receiving private information is widely used in the literature on information sharing among oligopolies, where information exchange decisions are taken prior to the arrival of private information (such as the realization of cost). Thus truthful revelation after a firm is already aware of its own costs is not considered. See for instance Shapiro (1986), Malueg and Tsutsui (1996) and the references within. Also, A's channel choice is one way for him to manipulate the informativeness of his signal, in particular the decisionmaker C's belief about his objectivity. Mirman, Samuelson, and Schlee (1994) examines strategic manipulation of signal informativeness in a duopoly context, where firms may adjust their outputs away from myopically optimal

To begin with, assume that objective A, who is non-strategic, uses direct communication with probability $\mu \in (0,1)$.[24] This assumption may be justified for institutional reasons or resource constraints. For instance, many government agencies routinely give press briefings to the media; whistleblowers' identity may be protected by law; political candidates may be limited to a small number of direct campaign ads.

Even from an ex ante point of view, which communication channel makes biased A better off is rather non-obvious: in addition to the tradeoff between credibility and reputation, now the channel choice signals A's objectivity. Specifically, the channel more likely to be chosen by biased A becomes a negative signal and affects how his message is interpreted. Let $EU_A^d(\theta_A^d), EU_A^i(\theta_A^i)$ denote, respectively, A's expected equilibrium payoff from direct and indirect communication given C's posterior estimate of his type θ_A^d, θ_A^i. Suppose that biased A chooses direct communication with probability γ, then θ_A^d decreases in γ while θ_A^i increases in it. Because the state is distributed symmetrically, the difference in his ex ante expected payoff is simply $\frac{1}{2}[EU_A^d(\theta_A^d) - EU_A^i(\theta_A^i)]$. The following result gives some conditions under which A prefers direct communication; and conditions under which A prefers an intermediary.

Proposition 4 (Biased A's Channel Choice) *(4.1) If α is sufficiently small, and θ_A or μ is sufficiently high, biased A always uses direct communication: $\gamma = 1$. Otherwise, biased A uses both channels with positive probabilities in any equilibrium: $\gamma \in (0,1)$. Moreover, such an equilibrium exists.*

(4.2) If β is sufficiently small, there exist cutoffs $\alpha_1 \in [p_A - \frac{1}{2}, \overline{\alpha}], \alpha_2 \in (\overline{\alpha}, \tilde{\alpha}]$ such that in the unique equilibrium, (i) if $\alpha < \alpha_1$, biased A uses direct communication more often than objective A: $\gamma \in (\mu, 1]$; (ii) If $\alpha \in [\alpha_1, \alpha_2]$, biased A uses direct communication less often than objective A: $\gamma \in (0, \mu]$; and (iii) if $\alpha > \alpha_2$, biased A uses direct communication with the same probability as objective A: $\gamma = \mu$.

Proposition 4 first shows that biased A never avoids direct communication completely. Imagine that he eschews direct communication, then a direct message must come from an objective agent and reflect the true signal. Thus biased A is strictly better off sending $m_A = 1$ directly, which is at its most credible and he is believed to be objective. Moreover, if biased A's reputational concerns are sufficiently high, he uses both channels with positive probabilities in any equilibrium.[25]

levels to affect the informativeness of the market price.

[24] This makes it possible to focus on the biased A's choice, especially whether he is more or less likely to choose a particular channel than the objective A.

[25] Relatedly, this result also holds for biased A's choice of communication channels after observing signal s_A: a government with moderate reputational concerns will not use one channel exclusively, direct or indirect, for all possible news.

To better understand biased A's choice, consider the case when β is sufficiently low such that he always reports $m_B = 0$.[26] If α is sufficiently low, then, the credibility of a direct message outweighs the loss of reputation. In particular, if $\alpha \leq \alpha_1$, biased A strictly prefers direct communication at a given θ_A, when no inference is made about his objectivity.[27] Therefore, even though using direct communication more often than objective A reduces his message's credibility, biased A still prefers doing so. Intuitively, the negative inference about his objectivity is outweighed by the gain in credibility. In fact, if the negative inference is not too strong, which is the case when either his prior reputation is high, or if objective A uses direct communication with a high probability, then biased A may use direct communication exclusively.

If biased A's reputational concerns are moderate ($\alpha \in [\alpha_1, \alpha_2]$), then the blame sharing effect of indirect communication becomes more pronounced. In particular, biased A strictly prefers indirect communication at his prior objectivity θ_A. Thus biased A is more likely to use intermediary B for a better posterior reputation even though he sacrifices his message credibility, both because of the intermediary's possible distortion and the fact that indirect communication becomes a negative signal of his type. Intuitively, this occurs when biased A can "afford" to lie completely through an intermediary while he cannot do so directly: this is when the intermediary saves the most in his reputation.

As his reputational concerns become sufficiently high ($\alpha > \alpha_2$), biased A behaves exactly like objective A in term of channel choice. The last part of Proposition 4 can be seen more easily by observing that biased A is indifferent between these two channels for any given θ_A in this case. The reason is that a biased agent's payoff function amounts to a weighted sum of C's posterior beliefs (of the true state and of A's type). If biased A reports truthfully with positive probability in any channel ($x > 0$), then his ex ante expected payoff of sending any message is equal to the sum of C's prior beliefs, $\frac{1}{2} + \alpha\theta_A$, by the law of iterated expectations. Intuitively, A can only distort C's belief about the state to the extent that he lowers his (expected) posterior objectivity. This occurs if A is sufficiently concerned about his reputation, thus he is ex ante indifferent and has no incentive to manipulate C's inferences by his channel choice.

A related question is how biased A's choice may be affected by the type of intermediary he faces, some more objective than others. For instance, media outlets and think tanks may differ in how strongly

[26] If β is high, then $y > 0$, in which case biased A's expected payoff from indirect communication increases in θ_A^i but decreases in y. The net effect depends on the specific parameter values.

[27] The cutoff $\alpha_1 \in [p_A - \frac{1}{2}, \overline{\alpha}]$ is defined such that even if biased A only uses direct communication, he still lies completely: $x = 0$ at $\gamma = 1$

they care about a particular agenda. The ensuing result describes how some characteristics of intermediary B may affect biased A's channel choice.

Corollary 3 *Suppose that there exists a mixed strategy equilibrium such that $\gamma \in (0,1)$. (1) If α is sufficiently low, then biased A is more likely to use intermediary B if he is more objective: γ decreases in θ_B, β. (2) If β is sufficiently low, and if α is smaller but sufficiently close to α_2, biased A is less likely to communicate through intermediary B if he is more objective: γ increases in θ_B.*

Biased A is more likely to use a more objective intermediary than direct communication if α is sufficiently low, because he chooses channels primarily based on message credibility. In this case, if either θ_B or β increases, B becomes a more truthful messenger, thus C's is less likely to discount m_B.[28] This makes indirect communication more attractive: if the government is extremely keen to push its agenda, it would prefer the most objective media outlet to pass on his information.[29]

However, if biased A has moderate reputational concerns, an intermediary perceived to be rather biased may be more helpful to A than one who is more objective. A more objective intermediary is more credible, but also a poor choice in term of blame sharing. Because biased A's agenda pushing effectiveness increases in B's truthfulness; while his expected reputational payoff decreases in it, as α increases, A's reputational concerns become increasingly important. If $\alpha \approx \alpha_2$, the latter effect outweighs the former, thus A's ex ante payoff decreases in θ_B. Since his expected payoff from using direct communication is not affected by B, he is more likely to use direct communication if B becomes more objective. A biased intermediary is more likely to have access to A than a more objective one.

What about biased B in this case? Because agent B has little private information of his own, he cannot influence C at all without A. If β is sufficiently low, biased B's (expected) influence on C's action becomes $\frac{1}{2}\gamma + \frac{2p_A - 1}{2 - \theta_A^i \theta_B}(1-\gamma)$. The first half is when he is not used and thus has no influence, while the second half is when he is used and reports $m_B = 1$ due to his low reputational concerns.[30] Because $\frac{2p_A - 1}{2 - \theta_A^i \theta_B} > \frac{1}{2}$, B prefers being used, in which case his influence increases in θ_B because his message becomes more credible. However, Corollary 3 shows that a higher θ_B makes it less likely for him to be

[28] If β is sufficiently high that $y > 0$ in equilibrium, then it can be shown that y increases in θ_A^i. Because in this case, biased A's expected utility increases in θ_A^i and y, he uses it more often.

[29] This also explains why A chooses direct communication with a high probability in this case.

[30] Formally, if $\alpha \approx \alpha_2$, $x^d > 0$, thus $E_{s_A}[Pr(\eta = 0|m_A = 1)] = \frac{1}{2}$.

used. Thus if γ is very high, this effect may be strong enough that biased B prefers a lower θ_B as well. This result may provide a new rationale for media bias: agent B may prefer to appear more biased to encourage biased A to communicate through him, and in turn makes him more influential. Consequently, even if the public prefers accurate media outlets, some may still cultivate a less objective image in order to gain access to sensitive information. This "bias for access" effect has been observed in political reporting and documented in corporate earnings forecasting (Lim 2001).[31]

6 Extensions and Discussions

This section discusses several main assumptions on the number of intermediaries, the sender's interim preference of communication channels, as well as intermediary's lack of private information. It also suggests how the agents' behavior may be affected if these assumptions were varied.

A. Endogenizing reputational payoffs. A biased agent's reputational payoffs are simply assumed to be his posterior objectivity, which is not without loss of generality. As mentioned in Section 2, this can be thought of as a reduced form capturing the biased agents' future influence on the decisionmaker. The following two examples use simple two-stage games, where the first stage is exactly as the indirect communication model, to illustrate how both linear and convex reputational payoffs may arise endogenously.

Example 1: Midterm elections. Continue with the government example, where C is the voting public and A is the government with a possible pro-war agenda. Suppose that the public has acted and then observed the true state (whether there was any military threat). Afterwards, the administration faces a midterm congressional election. Here C needs to determine what control A's party should be given over war related policy. She takes action $a_2 \in \Re$ to minimize $(a_2 - \pi_A)^2$, and her optimal action is to set $a_2 = \pi_A$. That is, A and his party's control over the war (measured by number of seats in the Congress) depends linearly on the public's perception of A's objectivity. $\square$

Example 2: Media subscriptions. Similar to Li (2007a), suppose that B is a cable news channel with a possible pro-war bias; C is the public. In the second stage, the public needs to decide whether to stop the war ($a_2 = 0$) or to continue ($a_2 = 1$). If C continues the war, its outcomes depend on the true

[31] Lim (2001) assumes that analysts can gain more private information about a company from the management if he publishes reports with bias favorable to the company.

(and independent) state of the world in the second stage, η_2, which is ex ante good or bad ($\eta_2 = \{g, b\}$) with equal probability. It is simplest to equate the war outcome with the state: it is either good ($g > 0$) or bad ($b < 0$); C gets 0 if she stops the war. Agent B first receives a signal s_B: $Pr(s_B = \eta_2) = p_B > 0.5$. As this is the last stage, biased B always reports the war will go well ($\eta_2 = g$). If C hears a pro-war report from B, her expected payoff of continuing the war is simply $0.5(g + b) + (p_B - 0.5)(g - b)\pi_B$. If $g + b \geq 0$, the expected value of B's news increases linearly in π_B: C always chooses $a_2 = 1$, but the more objective B is, the more she is willing to pay for his news (in term of subscriptions). If $g + b < 0$, however, C's default action is to stop, which implies that B's value of information is 0 if π_B is below a cutoff value, and increasing and affine in π_B otherwise.[32] Intuitively, in the second stage, news from a very biased B has no value: C always stops the war and never subscribes. But if B is considered highly objective, the value of his news increases in his posterior objectivity. Hence, B's first stage reputational payoff is convex, increasing and piece-wise linear. □

How may convex reputational payoffs affect the biased agents? In direct communication, for example, politicians and media outlets perceived to be very objective may exert disproportionately more influence on the decisionmaker than those with uncertain objectivity.[33] To study how this may affect biased A, consider a marginal increase in the convexity of his reputational payoff. Suppose $V_A(\pi_A) = (\pi_A)^\rho,\ \rho > 1$, then:

Corollary 4 *If in equilibrium $x^d > 0$, and ρ is sufficiently close to 1, then x^d increases in ρ if θ_A is sufficiently close to 0; but decreases in ρ if θ_A is sufficiently close to $\overline{\theta}_A$.*

At first glance, biased A may want to push his agenda more: his expected reputational payoff from lying should increase because it is riskier than that from $m_A = 0$. This is not the entire picture, though. Corollary 4 suggests that if higher levels of perceived objectivity matter more in the future, an agent perceived to be very biased reports more truthfully. The reason is that the "top prize" in term of reputation is to report $m_A = 0$, and A can boost it significantly by doing so more often. This outweighs any gain from reporting $m_A = 1$, which remains very low. If A has a good prior, say, a major news outlet, this may encourage and reward further distortion: if he is lucky and the distorted message turns out right, he becomes very credible in the future; and his reputation loss is relatively low if he is wrong. In addition,

[32] The value of B's report is 0 if $\pi_B < -\frac{0.5(g+b)}{(p_B-0.5)(g-b)}$. Otherwise, it is $(p_B - 0.5)(g - b)\pi_B + 0.5(g + b)$.

[33] In this case, information about an agent's objectivity itself has positive value in the future.

convex reputational payoffs also influence biased A's channel choice. The main advantage of indirect communication is the saving in A's reputation cost. Should such savings be negligible, which is the case if A needs to drastically improve C's perception of him to exert future influence, then A may favor direct communication more.

B. Multiple intermediaries. This model can be easily extended to the case with many intermediaries. Suppose that there are k agents, each of whom sends a message to his immediate successor, and agent $k+1$ is the decisionmaker. For simplicity, let $p_A = 1, \theta_i = \theta, \alpha_i = \alpha, i = 1, 2, ..., k$. Namely, the agents are symmetric. The first agent $i = 1$, and only the first agent, receives a perfect signal: $Pr(s_1 = \eta) = 1$. All other assumptions remain. Then:

Proposition 5 (Indirect communication with many intermediaries) *If α is sufficiently low, or θ is sufficiently close to 1, all agents report $m_i = 1$. If $\alpha(1-\theta) \geq \frac{1-\theta^k}{2-\theta^k}$, then the unique equilibrium is an agenda-pushing one in which biased i reports $m_i = 0$ with the same probability $x_k \in (0,1)$. Moreover, each agent lies more as the number of agents increases: x_k decreases in k.*

Proposition 5 shows that each biased agent's reporting accuracy decreases in the number of intermediaries. The condition $\alpha(1-\theta) \geq \frac{1-\theta^k}{2-\theta^k}$ ensures that each biased agent faces such a high reputation cost that he does not lie completely. Specifically, this condition holds if the reputation weight α is sufficiently high, or the fraction of objective agents is sufficiently low, or the number of agents k is sufficiently small. To see why no asymmetric equilibrium exists, note that if the last message is correct ($m_k = \eta$), all agents are considered equally objective. Each agent's posterior objectivity is simply θ if $\eta = 1$; and $\frac{\theta}{\theta+(1-\theta)x_k}$ if $\eta = 0$. However, if the last message is wrong, then some biased agent i has lied (all agents after him follow his message). Agent i's reputation is clearly unaffected if the distortion occurs before or after i: the pivotal case is if $m_{i-1} = 0$, but $m_i = 1$.

For biased agent i, all that matters is how likely he can change the final report from $m_k = 0$ by reporting truthfully (and if all other agents pass it on truthfully) to $m_k = 1$. Similar to the two agents case, each agent is shown to receive the same net benefit from agenda pushing relative to his net reputation cost. Thus one's position does not matter when indirect communication is used: each biased agent's truth-telling incentives depend on his prior objectivity and the weight he attaches to his reputation, not where he is.[34] Also, because all agent's truth-telling incentives are strategic complements, each additional intermediary reduces every biased agent's reputation cost of lying more than he reduces their agenda-pushing effectiveness.

C. Better informed intermediaries. The current model examines the case of a pure intermediary. In many marketing, medicine and lobbying settings, however, B may in fact have good information of his own. Li (2007b) considers the case where an objective expert reports the best information available, and studies how a source (such as a pharmaceutical company) tries to use well informed experts (such as physicians) to influence the decisionmaker. Because of B's superior information, he would, if objective, always follow his own signal, which means that independence becomes the prized sign of the objective. It also means that biased A and B are no longer sharing blame. B cannot use the excuse that he is misled: he is not supposed to be influenced in the first place. One main implication is that, if the agents are sufficiently concerned about their reputations, A and B's lying are now substitutes: any improvement in B's incentive worsens that of A's. In fact, this effect may be so strong that the net effect is negative. A practical consequence is that strengthening campaign finance laws may lead, perversely, to more biased information being transmitted.

7 Conclusion

The intermediary in the opening example shares the government's blame of releasing inaccurate information, thereby reducing the government's reputation cost. But indirect messages are less credible. The government should inform the public directly if it cares little about its reputation, but it should leak to the intermediary instead if it has moderate reputational concerns. The intermediary may benefit from appearing biased, because it encourages an agenda-pushing government to send him information he would not receive otherwise. For the public, though, the intermediary reduces everyone's incentive to report truthfully in addition to introducing potential bias of its own. This information loss may be reduced, to a

[34] In a different context, a similar pivotal argument have been used in Li, Rosen, and Suen (2001) and Dekel and Piccione (2000) to show that the order of voting does not affect the voting outcomes in equilibrium. In a non-strategic social network context, DeMarzo, Vayanos, and Zwiebel (2003) shows that one's influence on other people in a social network depends not only on his information accuracy, but also on his position in a given social network. In their model, the agents report truthfully, but have a "persuasion bias". Namely they fail to account for possible repetitions in the information that reaches them.

limited extent, by imposing higher financial or legal costs on the intermediary.

Indirect communication matters in studying the structure of firms and organizations. Previous literature analyzed the information aggregation role of the firm and the resulting optimal firm structure (Arrow and Radner 1979, Arrow 1985). In many firms, however, both formal, direct communication and informal, indirect communication exist. How the co-existence of various communication channels affects a firm's information processing as well as the associated incentive problems is a topic of further research. This model may also be extended to study military operations. For instance, false intelligence has been fed to unfriendly media by the Pentagon as part of a disinformation campaign (Shanker and Schmitt 2004). Using intermediaries may be particularly fruitful here: typical military operations are zero sum, thus direct communication is unlikely to be effective (Crawford 2003, Hendricks and McAfee 2006).

Appendix

A Proofs (except Proposition 4)

Proof of Lemma 1:

In the direct communication model, the decisionmaker C's optimal action is simply $a = Pr(\eta = 1|m_A)$. To simplify notations, let $a_1^A \equiv Pr(\eta = 1|m_A = 1)$ and $a_0^A \equiv Pr(\eta = 1|m_A = 0)$ respectively. Then, given signal s_A, biased A's expected utility if he reports $m_A = 1$ is $a_1^A + \alpha E_\eta[Pr(A = o|m_A = 1, \eta)|s_A]$. Similarly, his expected utility if he reports $m_A = 0$ is $a_0^A + \alpha E_\eta[Pr(A = o|m_A = 0, \eta)|s_A]$. For biased A to report his signals truthfully, the following two incentive constraints (IC) need to hold:

$$EU_A(m_A = 1|s_A = 1) \geq EU_A(m_A = 0|s_A = 1);$$
$$EU_A(m_A = 1|s_A = 0) \leq EU_A(m_A = 0|s_A = 0).$$

Rearranging terms, these two ICs can be rewritten as:

$$a_1^A - a_0^A \geq \alpha E_\eta[Pr(A = o|m_A = 0, \eta) - Pr(A = o|m_A = 1, \eta)|s_A = 1]; \quad (3)$$
$$a_1^A - a_0^A \leq \alpha E_\eta[Pr(A = o|m_A = 0, \eta) - Pr(A = o|m_A = 1, \eta)|s_A = 0]. \quad (4)$$

We now analyze IC (3) and IC (4). Suppose that biased A reports $s_A = 1$ truthfully with probability $z \in [0, 1]$, and he reports $s_A = 0$ truthfully with probability $x \in [0, 1]$. Thus $z = x = 1$ if both ICs hold, and $z = x = 0$ if neither IC holds. Given this strategy, A's posterior objectivities are respectively:

$$\begin{aligned}
Pr(A = o|m_A = 1, \eta = 0) &= \frac{(1-p_A)\theta_A}{(1-p_A)\theta_A + (1-\theta_A)[(1-p_A)z + p_A(1-x)]};\\
Pr(A = o|m_A = 1, \eta = 1) &= \frac{p_A\theta_A}{p_A\theta_A + (1-\theta_A)[p_A z + (1-p_A)(1-x)]};\\
Pr(A = o|m_A = 0, \eta = 1) &= \frac{(1-p_A)\theta_A}{(1-p_A)\theta_A + (1-\theta_A)[(1-p_A)x + p_A(1-z)]};\\
Pr(A = o|m_A = 0, \eta = 0) &= \frac{p_A\theta_A}{p_A\theta_A + (1-\theta_A)[p_A x + (1-p_A)z]}.
\end{aligned}$$

And C's actions after receiving m_A are respectively:

$$\begin{aligned}
a_1^A &= \frac{p_A(\theta_A + (1-\theta_A)z) + (1-p_A)(1-\theta_A)(1-x)}{\theta_A + (1-\theta_A)z + (1-\theta_A)(1-x)};\\
a_0^A &= \frac{p_A(1-\theta_A)(1-z) + (1-p_A)(\theta_A + (1-\theta_A)x)}{\theta_A + (1-\theta_A)x + (1-\theta_A)(1-z)}.
\end{aligned}$$

Claim 1: there does not exist an equilibrium in which $x \in [0, 1)$ and $z \in [0, 1)$. Observe that the left hand side (LHS) of IC (3) and IC (4) are identical while the difference in the right hand side (RHS) is:

$$\begin{aligned}
& \alpha(2p_A - 1)[Pr(A = o|m_A = 1, \eta = 0) + Pr(A = o|m_A = 0, \eta = 1)]\\
- & \alpha(2p_A - 1)[Pr(A = o|m_A = 1, \eta = 1) + Pr(A = o|m_A = 0, \eta = 0)] < 0.
\end{aligned}$$

This inequality holds because $Pr(A = o|m_A = 1, \eta = 0) < Pr(A = o|m_A = 1, \eta = 1)$, and $Pr(A = o|m_A = 0, \eta = 1) < Pr(A = o|m_A = 0, \eta = 0)$. Intuitively, since A's signal is assumed to be informative ($p_A > \frac{1}{2}$), a wrong report in either direction is a worse sign of one's objectivity because objective A always reports truthfully. Thus if IC (4) fails to hold strictly ($x \in [0, 1)$), IC (3) must hold strictly ($z = 1$).

Claim 2: there does not exist a truth-telling equilibrium in which $x = z = 1$. If there were a truth-telling equilibrium, then the LHS of IC (3) and IC (4) become $2p_A - 1 > 0$ and their RHS become zero. The reason is that if the agent reports truthfully, his posterior objectivity is simply the prior, which does not depend on the message or the observed state. This clearly violates IC (4), thus a biased agent will never be completely truthful.

Claim 3: there does not exist an equilibrium in which $x = 1, z \in [0, 1)$. If such an equilibrium exists, then IC (4) holds strictly in equilibrium. Simple algebra can show that the LHS of IC (4) is equal to:

$$a_1^A - a_0^A = \frac{2p_A - 1}{1 + (1-\theta_A)(1-z)} > 0. \tag{5}$$

But the RHS of IC (4) can be shown to be strictly negative, therefore it is impossible for IC (4) to hold, a contradiction. Intuitively, reporting $m_A = 1$ is good for agenda pushing, and it becomes a sign of objectivity in this case, thus biased A strictly prefers reporting $m_A = 1$. Consequently, there does not exist a perverse equilibrium in which the biased agent distances himself away from $m_A = 1$ if $s_A = 1$.

Finally, the only remaining possibility is $x \in [0, 1), z = 1$, which is precisely the agenda-pushing equilibrium defined in the text. □

Proof of Proposition 1:

From Lemma 1, we now restrict attention to agenda-pushing equilibria. From the text, if $s_A = 0$, biased A reports $m_A = s_A$ truthfully with probability x^d. On one hand, biased A's net gain of reporting $m_A = 1$ over reporting $m_A = 0$ is:

$$a_1^A - a_0^A = \frac{2p_A - 1}{1 + (1 - \theta_A)(1 - x^d)} > 0. \tag{6}$$

This gain is strictly increasing in x^d: the more truthfully biased A reports, the more informative $m_A = 1$ becomes, and the more likely C believes $\eta = 1$. On the other hand, if $s_A = 0$, biased A's net reputation cost of reporting $m_A = 1$ over $m_A = 0$ is:

$$\alpha[Pr(A = o|m_A = 0) - (1 - p_A)Pr(A = o|m_A = 1, \eta = 1) - p_A Pr(A = o|m_A = 1, \eta = 0)]. \tag{7}$$

This cost is strictly decreasing in x^d: the higher x^d is, the more truthful biased A is, and $m_A = 1$ is less likely a sign of bias. If at $x^d = 0$, the LHS of IC (4) is strictly larger than the RHS, then IC (4) never holds and IC (3) holds strictly. This occurs if biased A's weight on reputation $\alpha < \overline{\alpha}$, where

$$\overline{\alpha} \equiv \frac{(2p_A - 1)(1 - p_A\theta_A)[1 - (1 - p_A)\theta_A]}{(2 - \theta_A)(1 - \theta_A)(1 - 2p_A(1 - p_A)\theta_A)}.$$

In this case, biased A always reports $m_A = 1$ regardless of his signal.

If $\alpha \geq \overline{\alpha}$, the LHS of IC (4) is smaller than the RHS at $x^d = 0$. Because the LHS is strictly increasing in x^d and the LHS is strictly decreasing, there exists a unique x^d such that IC (4) binds. The equilibrium mixing probability is implicitly defined by:

$$\begin{aligned} & \frac{2p_A - 1}{2 - (\theta_A + (1 - \theta_A)x^d)} \\ = \quad & \frac{\alpha\theta_A(1 - \theta_A)(1 - x^d)[1 - 2p_A(1 - p_A)(\theta_A + (1 - \theta_A)x^d)]}{[\theta_A + (1 - \theta_A)x^d][1 - p_A(\theta_A + (1 - \theta_A)x^d)][1 - (1 - p_A)(\theta_A + (1 - \theta_A)x^d)]}. \end{aligned} \tag{8}$$

Thus there exists a unique agenda-pushing equilibrium. $\square$

Proof of Corollary 1:

Proposition 1 shows that biased A always reports $m_A = 1$ if α is smaller than the cutoff value $\overline{\alpha}$, which is increasing in θ_A. Because $\overline{\alpha} = p_A - \frac{1}{2}$ at $\theta_A = 0$, $x^d = 0$ if $\alpha \leq p_A - \frac{1}{2}$ for all θ_A. For any $\alpha \geq \frac{1}{2}$, there exists a cutoff value $\overline{\theta}_A$ such that $x^d = 0$ if $\theta_A > \overline{\theta}_A$; otherwise $x^d > 0$. The cutoff $\overline{\theta}_A$ is implicitly defined by $g(p_A, \overline{\theta}_A, \alpha) = 0$, where

$$g(p_A, \theta_A, \alpha) \equiv \frac{2p_A - 1}{2 - \theta_A} - \frac{\alpha(1-\theta_A)[1 - 2p_A(1-p_A)\theta_A]}{[1 - p_A\theta_A][1 - (1-p_A)\theta_A]}.$$

In particular, $\overline{\theta}_A$ increases in α: the higher α is, the more costly it is for biased A to lie completely. Also, $\overline{\theta}_A$ decreases in p_A at $p_A \approx \frac{1}{2}$, because it becomes easier for biased A to afford lying completely as p_A rises. Eventually, it may decrease in p_A (for low levels of α), or increase in it (for a sufficiently high α).

(1) To prove the first claim, fix signal quality p_A and α. If $\theta_A \leq \overline{\theta}_A$, there exists a mixed strategy equilibrium. From IC (4), we know that x^d is the solution to $h(x^d, \theta_A) = 0$, where

$$\begin{aligned} h(x^d, \theta_A) \quad &\equiv \quad \frac{2p_A - 1}{1 + (1-\theta_A)(1-x^d)} \\ &- \quad \alpha\theta_A\Big[\frac{1}{\theta_A + (1-\theta_A)x^d} - \frac{p_A(1-p_A)}{1 - p_A + p_A(1-\theta_A)(1-x^d)} - \frac{p_A(1-p_A)}{p_A + (1-p_A)(1-\theta_A)(1-x^d)}\Big] \end{aligned}$$

By the implicit function theorem, $\frac{dx^d}{d\theta_A} = -\frac{\partial h}{\partial \theta_A} / \frac{\partial h}{\partial x^d}$. From the proof of Proposition 1, $\frac{\partial h}{\partial x^d} > 0$, and $\frac{\partial h}{\partial \theta_A} < 0$ at $\theta_A \approx 0$, which implies that x^d increases in θ_A when θ_A is sufficiently small. Intuitively, if $\theta_A \approx 0$, a marginal increase in x^d improves biased A's reputation significantly, thus biased A becomes more honest. Next, suppose that $\theta_A \in (\overline{\theta}_A - \epsilon, \overline{\theta}_A)$, then we can show that $\frac{\partial h}{\partial \theta_A} > 0$. Moreover, because $\frac{\partial^2 h}{\partial {\theta_A}^2} > 0$, the mixing probability x^d first increases in θ_A and then decreases in θ_A. Thus there exists a value θ_A^1 such that biased A is most honest if his prior objectivity $\theta_A = \theta_A^1$.

(2) To prove the second claim, fix A's prior objectivity θ_A and reputation weight α. Note that at $p_A \approx \frac{1}{2}$, the LHS of IC (4) is always smaller than the RHS, thus $x^d > 0$. IC (4) then implicitly defines a function $f(x^d, p_A)$ such that x^d is the solution to $f(x^d, p_A) = 0$. Differentiate with respect to p_A:

$$\frac{\partial f}{\partial p_A} = \frac{2}{1 + (1-\theta_A)(1-x^d)} - \frac{(2p_A - 1)\alpha\theta_A(1-\theta_A)(1-x^d)[1 + (1-\theta_A)(1-x^d)]}{[1 - p_A + p_A(1-\theta_A)(1-x^d)]^2[p_A + (1-p_A)(1-\theta_A)(1-x^d)]^2}.$$

Clearly, if $p_A \approx \frac{1}{2}$, $\frac{\partial f}{\partial p_A} > 0$, thus $\frac{dx^d}{dp_A} < 0$. That is, if biased A's signal is very uninformative, he reports less truthfully as his signal quality improves. Simple algebra also show that $\frac{\partial^2 f}{\partial p_A^2} < 0$, thus $\frac{\partial f}{\partial p_A}$ decreases in p_A. Intuitively, both biased A's agenda pushing effectiveness and his reputation cost increase in his signal quality, but the latter increases faster.

As p_A increases, there are two possibilities. First, if $\alpha \leq \frac{1}{2-\theta_A}$, then it can be shown that for some cutoff value $\hat{p}_A$ such that if $p_A \leq \hat{p}_A$, the LHS of IC (4) is always larger than the RHS even at $x^d = 0$. In this case, x^d first decreases in p_A and becomes zero if $p_A \leq \hat{p}_A$. Second, if $\alpha \geq \frac{1}{2-\theta_A}$, then we always have a mixed strategy equilibrium for all p_A. At $p_A \approx 1$, then if $\alpha\theta_A \geq \frac{1}{2}$, $\frac{dx^d}{dp_A} > 0$. Thus if $\alpha \geq \max\{\frac{1}{2-\theta_A}, \frac{1}{2\theta_A}\}$, there exists a threshold quality $\overline{p}_A$ such that the equilibrium mixing probability x^d decreases with p_A for $p_A \in (\frac{1}{2}, \overline{p}_A]$ but increases if $p_A \geq \overline{p}_A$. □

Proof of Proposition 2:

We first consider biased agent B and biased A's truth-telling incentives before characterizing the equilibrium properties.

Step 1: B's truth-telling incentive constraints. To find the equilibrium of the indirect communication game, first consider biased B's incentives after hearing m_A. On the one hand, B is concerned about C's action given his message. Let $a_1^B \equiv Pr(\eta = 1|m_B = 1), a_0^B \equiv Pr(\eta = 1|m_B = 0)$. Given the strategies of biased A and B described in the text, then $a_1^B - a_0^B$ is the marginal benefit B gets for reporting $m_B = 1$ versus $m_B = 0$:

$$a_1^B - a_0^B = \frac{2p_A - 1}{2 - (\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)}.$$

This net benefit increases in x and y: the more truthful biased A or B is, the more C believes in m_B.

On the other hand, agent B is concerned about how objective C thinks about him given his message and the true state. Specifically, B is concerned about how m_B affects his expected posterior reputation $E_\eta[Pr(B = o|m_B, \eta)|m_A] = \sum_\eta Pr(\eta|m_A)Pr(B = o|m_B, \eta)$. In particular, B's posterior objectivities given his message m_B and the (later) observed true state η are respectively:

$$\begin{aligned}
\tau_1 &\equiv Pr(B = o|m_B = 1, \eta = 0) = \frac{\theta_B[1 - p_A(\theta_A + (1-\theta_A)x)]}{1 - p_A(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)};\\
\tau_2 &\equiv Pr(B = o|m_B = 0, \eta = 0) = \frac{\theta_B}{\theta_B + (1-\theta_B)y};\\
\tau_3 &\equiv Pr(B = o|m_B = 0, \eta = 1) = \frac{\theta_B}{\theta_B + (1-\theta_B)y};\\
\tau_4 &\equiv Pr(B = o|m_B = 1, \eta = 1) = \frac{\theta_B[1 - (1-p_A)(\theta_A + (1-\theta_A)x)]}{1 - (1-p_A)(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)}.
\end{aligned}$$

Combining these, we can show that, if $m_A = 0$, the net difference in B's posterior objectivity if he reports $m_B = 1$ as opposed to $m_B = 0$ is: $\tau_2 - p_A\tau_1 - (1 - p_A)\tau_4$, which is positive, increasing in x but decreasing in y.

For biased B to report truthfully after $m_A = 0$ and $m_A = 1$ respectively, the following two incentive constraints must hold at $y = 1$:

$$a_1^B - a_0^B \leq \Delta_1 \equiv \beta \cdot [\tau_2 - p_A\tau_1 - (1 - p_A)\tau_4]; \qquad (IC_1^B)$$

$$a_1^B - a_0^B \geq \Delta_2 \equiv \beta \cdot [\tau_2 - (1 - p_A)\tau_1 - p_A\tau_4]. \qquad (IC_2^B)$$

Next, note that $\tau_2 > \tau_1$, $\tau_2 > \tau_4$ and $\tau_4 > \tau_1$, therefore the difference between biased B's *net* reputation cost is: $\Delta_1 - \Delta_2 = \beta(2p_A - 1)(\tau_4 - \tau_1) \geq 0$. This inequality shows that B's net reputation cost (of lying) after hearing $m_A = 1$ is always higher than that after hearing $m_A = 0$. Because even though a message of $m_B = 1$ is associated with bias, it is much worse for B's reputation if it turns out wrong. Moreover, observe from the incentive constraint IC_1^B above, the RHS is 0 while the LHS is strictly positive at $y = 1$, thus biased B never reports completely truthfully. It also implies that IC_1^B never holds strictly. For agent B, there can only be two possibilities: (IC_1^B) binds and (IC_2^B) holds strictly, in which case B mixes with probability $y > 0$ if $m_A = 0$ and report $m_B = m_A$ if $m_A = 1$; or (IC_1^B) does not hold, in which case B always reports $m_B = 1$.

Step 2: biased A's truth-telling incentive constraints. Agent A needs to compare his expected payoff after sending $m_A = 1$ versus $m_A = 0$, given B's strategy. Recall that x is the probability that he reports $s_A = 0$ truthfully. Then if $s_A = 0$, the net difference in biased A's expected payoff is:

$$\begin{aligned}
& EU_A(m_A = 1, s_A = 0) - EU_A(m_A = 0, s_A = 0) \\
= \;& a_1^B + p_A Pr(A = o|m_B = 1, \eta = 0) + (1 - p_A)Pr(A = o|m_B = 1, \eta = 1) \\
- \;& Pr(m_B = 1|m_A = 0)[a_1^B + p_A Pr(A = o|m_B = 1, \eta = 0) + (1 - p_A)Pr(A = o|m_B = 1, \eta = 1)] \\
- \;& Pr(m_B = 0|m_A = 0)[a_0^B + Pr(A = o|m_B = 0)] \\
= \;& Pr(m_B = 0|m_A = 0)[a_1^B + p_A Pr(A = o|m_B = 1, \eta = 0) + (1 - p_A)Pr(A = o|m_B = 1, \eta = 1)] \\
- \;& Pr(m_B = 0|m_A = 0)[a_0^B + Pr(A = o|m_B = 0)]
\end{aligned}$$

Observe first that both the net benefit and the net reputation cost are multiplied by a common factor:

$Pr(m_B = 0|m_A = 0) = \theta_B + (1-\theta_B)y$, the probability that message $m_A = 0$ reaches C. Since biased B may distort m_A, both the improvement in biased A's objectivity and the loss in agenda pushing are affected similarly. Taking out the common factor from biased A's expected payoff, then biased A derives the same relative benefit from agenda pushing $a_1^B - a_0^B$ as biased B. If $s_A = 0$, then biased A's relative reputation cost after reporting $m_A = 1$ is: $\alpha[Pr(A = o|m_B = 0) - p_A Pr(A = o|m_B = 1, \eta = 0) - (1-p_A)Pr(A = o|m_B = 1, \eta = 1)]$.

Moreover, biased A's posterior objectivities are respectively:

$$
\begin{aligned}
Pr(A = o|m_B = 0, \eta = 1) = Pr(A = o|m_B = 0, \eta = 0) &= \frac{\theta_A}{\theta_A + (1-\theta_A)x};\\
Pr(A = o|m_B = 1, \eta = 0) &= \frac{\theta_A[1 - p_A(\theta_B + (1-\theta_B)y)]}{1 - p_A(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)};\\
Pr(A = o|m_B = 1, \eta = 1) &= \frac{\theta_A[1 - (1-p_A)(\theta_B + (1-\theta_B)y)]}{1 - (1-p_A)(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)}.
\end{aligned}
$$

biased A faces two incentive constraints. Arguments similar to those about agent B can be used to show that there are only two possibilities: either biased A always reports $m_A = 1$; or biased A reports $m_A = s_A$ if $s_A = 1$, but reports $s_A = 0$ truthfully only with probability x.

Step 3: equilibrium. We now characterize the equilibrium of the indirect communication game. To simplify notations, define the following functions of x, y:

$$
\begin{aligned}
\xi(x,y) \equiv\ & \frac{2p_A - 1}{2 - (\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)}\\
& - \alpha\Big[\frac{\theta_A}{\theta_A + (1-\theta_A)x} - \frac{p_A\theta_A[1 - p_A(\theta_B + (1-\theta_B)y)]}{1 - p_A(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)} -\\
& \frac{(1-p_A)\theta_A[1 - (1-p_A)(\theta_B + (1-\theta_B)y)]}{1 - (1-p_A)(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)}\Big]. \qquad (9)
\end{aligned}
$$

$$
\begin{aligned}
\psi(x,y) \equiv\ & \frac{2p_A - 1}{2 - (\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)}\\
& - \beta\Big[\frac{\theta_B}{\theta_B + (1-\theta_B)y} - \frac{p_A\theta_B[1 - p_A(\theta_A + (1-\theta_A)x)]}{1 - p_A(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)} -\\
& \frac{(1-p_A)\theta_B[1 - (1-p_A)(\theta_A + (1-\theta_A)x)]}{1 - (1-p_A)(\theta_A + (1-\theta_A)x)(\theta_B + (1-\theta_B)y)}\Big]. \qquad (10)
\end{aligned}
$$

The truth-telling incentive constraints of biased A and B when $s_A = 0$ and $m_A = 0$ can then be rewritten into: $\xi(1, y) \le 0$ and $\psi(x, 1) \le 0$. From the analysis of A, B's incentive constraints above, biased

A, B always report information supporting their agenda truthfully. If $s_A = 0$ or $m_A = 0$, there are three possible types of equilibria: (1) a fully mixed strategy equilibrium in which both agents report truthfully with positive probability: $x > 0, y > 0$. (2) A pure strategy equilibrium in which both A, B lie completely: $x = y = 0$. (3) A hybrid equilibrium in which one agent always lies, and the other reports truthfully sometimes: $x = 0, y > 0$; or $x > 0, y = 0$. We consider these three types of equilibria in turn.

First, suppose that $\xi(0,0) < 0, \psi(0,0) < 0$, which occurs if $\alpha > \tilde{\alpha}$ and $\beta > \tilde{\beta}$. The cutoff values are defined such that $\xi(0,0) = 0, \psi(0,0) = 0$ respectively at $\tilde{\alpha}, \tilde{\beta}$:

$$\tilde{\alpha} \equiv \frac{(2p_A - 1)(1 - p_A\theta_A\theta_B)(1 - (1 - p_A)\theta_A\theta_B)}{(1 - \theta_A)(2 - \theta_A\theta_B)(1 - 2p_A(1 - p_A)\theta_A\theta_B)}; \qquad \tilde{\beta} \equiv \frac{(2p_A - 1)(1 - p_A\theta_A\theta_B)(1 - (1 - p_A)\theta_A\theta_B)}{(1 - \theta_B)(2 - \theta_A\theta_B)(1 - 2p_A(1 - p_A)\theta_A\theta_B)}.$$

Intuitively, if α, β are sufficiently high, even if one agent lies completely, the other still prefers reporting truthfully sometimes. Moreover, $\tilde{\alpha}$ strictly decreases in θ_B, and is equal to $\overline{\alpha}$ at $\theta_B = 1$. This implies that $\tilde{\alpha} > \overline{\alpha}$, the cutoff in direct communication, because the possible presence of biased B makes it less costly for biased A to lie, everything else being equal.

If there exists a mixed strategy equilibrium, then $\xi(x, y) = 0$ implicitly define the best response of agent biased A to B's truth telling: $x^{BR}(y)$; and $\psi(x, y) = 0$ implicitly define B's best response to biased A's: $y^{BR}(x)$. Both these best response functions are continuous. Also, because $\xi(1,0) > 0, \psi(0,1) > 0$, and $\xi(x, y)$ increases in x and $\psi(x, y)$ increases in y, there exists some x', y' such that $\xi(x', 0) = 0, \psi(0, y') = 0$. Hence, biased A's best response to y satisfies $x^{BR}(0) \in (0,1), x^{BR}(1) \in (0,1)$, and B's best response to x satisfies $y^{BR}(0) \in (0,1), y^{BR}(1) \in (0,1)$. Finally, because $x, y \in [0,1]$, by the intermediate value theorem, the two best response functions intersect: there exists some x, y such that $\xi(x, y) = 0, \psi(x, y) = 0$. This establishes that if $\xi(0,0) < 0, \psi(0,0) < 0$, an equilibrium exists and it must involve fully mixed strategies.

Second, for uniqueness, let x, y be part of a mixed strategy equilibrium. Also, let ξ_1, ξ_2 respectively be the partial derivative of ξ with respect to x and y; ψ_1, ψ_2 are similarly defined. Then, $\frac{d}{dy}x^{BR}(y) = -\frac{\xi_2}{\xi_1}$, and $\frac{d}{dx}y^{BR}(x) = -\frac{\psi_1}{\psi_2}$. From the analysis above, $\xi_1 > 0$, $\psi_2 > 0$. Moreover, it can be shown that $\xi_2 < 0$ and $\psi_1 < 0$. Together, this means that the best response functions of biased A and B are strictly increasing: $\frac{d}{dy}x^{BR}(y) > 0, \frac{d}{dx}y^{BR}(x) > 0$. Straightforward calculations can show that $\xi_1\psi_2 - \xi_2\psi_1 > 0$, which guarantees that whenever biased A and B's best responses intersect, biased A's best response function always has a steeper slope than that of B's. This rules out multiple equilibria involving mixed strategies. Hence the equilibrium is unique if $\xi(0,0) < 0, \psi(0,0) < 0$.

Third, because biased A and B receive the same benefit from agenda pushing, it is straightforward to see that if $\alpha = \beta$ and $\theta_A = \theta_B$, the RHS of the above equations are equal. Thus if the agents are symmetric, they lie with the same probability in the unique equilibrium of this game. Finally, consider the case that they care differently about their reputation, wlog, let $\alpha > \beta$. Then if in equilibrium, $x \le y$, biased A's net reputation cost is higher than that of B's, which is impossible. The only possibility is $x > y$. This shows that if $\theta_A = \theta_B$, the agent who cares about his reputation more reports more truthfully.

Next, if both α, β are sufficiently close to 0, or if both θ_A and θ_B are sufficiently close to 1 such that $\xi(0,0) \ge 0, \psi(0,0) \ge 0$, this game has a pure strategy equilibrium in which the agents always report $m_A = 1$, $m_B = 1$. In this case, an agent prefers lying regardless of the other agent's report.

Finally, if α is sufficiently close to $\tilde{\alpha}$, but $\beta > \tilde{\beta}$, then $\xi(0,0) \ge 0, \psi(0,0) < 0$. Because $\psi(x,y)$ increases in y, and $\psi(0,1) \ge 0$, unique y' exists such that $\psi(0,y') = 0$. There are two possibilities: (1) if $\xi(0,y') \ge 0$, then in the unique equilibrium, biased A always reports $m_A = 1$ while B reports $m_B = m_A$ with probability y' if $m_A = 0$. (2) If $\xi(0,y') < 0$, then in the unique equilibrium, biased A and B both report truthfully with positive probabilities. Which equilibrium may occur depends on β and biased A and B's prior objectivities. Similarly, if $\xi(0,0) < 0, \psi(0,0) \ge 0$, then in equilibrium, either $x > 0, y = 0$ (if $\xi(x',0) = 0, \psi(x',0) \ge 0$) or $x > 0, y > 0$ (if $\xi(x',0) = 0, \psi(x',0) < 0$). $\square$

Proof of Proposition 3:

Suppose that biased A, B are sufficiently concerned about their reputation such that $x, y > 0$ in the unique agenda-pushing equilibrium. How does a small increase in β affect the equilibrium behavior of both agents? Recall that biased A, B's mixing constraints are given in Equation (9) and (10) respectively: $\xi(x,y) = 0$ and $\psi(x,y;\beta) = 0$. let ξ_1, ξ_2 respectively be the partial derivative of ξ with respect to x and y; ψ_1, ψ_2 are similarly defined. Differentiate with respect to β, then:

$$\xi_1 x' + \xi_2 y' = 0, \quad \psi_1 x' + \psi_2 y' + \psi_3 = 0,$$

Solving these, the mixing probabilities change with a change in β in the following way:

$$\begin{cases} \frac{dx}{d\beta} = \frac{\psi_3 \xi_2}{\xi_1 \psi_2 - \xi_2 \psi_1}; & \text{indirect effect on biased } A \\ \frac{dy}{d\beta} = -\frac{\psi_3 \xi_1}{\xi_1 \psi_2 - \xi_2 \psi_1}, & \text{direct effect on } B. \end{cases}$$

Signs of some of the above partial derivatives are straightforward, namely, $\xi_1 > 0, \psi_2 > 0, \psi_3 < 0$. From proof of Proposition 2 above, we know also that in a mixed strategy equilibrium, $\xi_2 < 0$ and $\psi_1 < 0$. That is, even though both the benefit of agenda pushing and one's reputation cost increase when the other agent becomes more honest, the net effect is strictly negative. Also, we know that $\xi_1\psi_2 - \xi_2\psi_1 > 0$. This shows that the product of each agent's own response to changes in his honesty is larger than the product of his response to the other agent's changes in honesty. Therefore both x, y increases in β if there exists a fully mixed strategy equilibrium.

In addition, note that $\frac{x'}{y'} = \frac{|\xi_2|}{\xi_1} < 1$ if $\xi_1 > |\xi_2|$. Therefore if the slope of $x^{BR}(y)$, $\frac{\xi_1}{|\xi_2|}$, is larger than 1, biased B responds more to the increase in his own reputational concerns than biased A does. Also, biased agents respond to a change in α similarly if $|\psi_1| < \psi_2$. Simple calculations can show that both conditions are satisfied if $\theta_A \approx \theta_B$. □

Proof of Corollary 4:

Suppose that $V_A(\pi_A) = \pi_A^\rho$ and $x^d > 0$ in the direct communication game where $\rho = 1$. Then similar to IC (4), the incentive constraint for the biased A when $s_A = 0$ becomes $g(x, \rho) = 0$, where

$$\begin{aligned} g(x,\rho) \;\; &\equiv \;\; \frac{2p_A - 1}{1 + (1-\theta_A)(1-x)} \\ &- \;\; \alpha\Big[[\frac{\theta_A}{\theta_A + (1-\theta_A)x}]^\rho - p_A[\frac{(1-p_A)\theta_A}{1 - p_A(\theta_A + (1-\theta_A)x)}]^\rho - (1-p_A)[\frac{p_A\theta_A}{1-(1-p_A)(\theta_A + (1-\theta_A)}]^\rho\Big]. \end{aligned}$$

If $\rho \approx 1, x \approx x^d$. Moreover, $\frac{dx}{d\rho} = -\frac{\partial g}{\partial \rho}/\frac{\partial g}{\partial x}$. At $\theta_A \approx 0, x^d \approx 0$, thus

$$\frac{\partial g}{\partial \rho} = -\alpha[ln(\frac{\theta_A}{\theta_A + (1-\theta_A)x})(\frac{\theta_A}{\theta_A + (1-\theta_A)x})^\rho + \infty] < 0.$$

Hence $\frac{dx}{d\rho} > 0$ if $\theta_A \approx 0$. Intuitively, biased A's posterior reputation after reporting $m_A = 1$ falls $\rho > 1$, because the convexity makes extremely low posteriors indistinguishable from zero. Hence biased A's net reputation cost actually increases and he needs to report more honestly.

Similarly, if $\theta_A \in (\overline{\theta}_A - \epsilon, \overline{\theta}_A), x^d \approx 0$. Then it can be shown that $\frac{\partial g}{\partial \rho} > 0$, thus $\frac{dx}{d\rho} < 0$. Intuitively, reporting $m_A = 0$ is almost a sure sign of objective agent ($Pr(A = o|m_A = 0) \approx 1$), thus the reputation changes little if $\rho \approx 1$. However, sending $m_A = 1$ is a risky gamble for biased A, thus his expected reputation increases if $\rho \approx 1$. This implies that his net reputation cost falls, and he lies more. □

Proof of Proposition 5:

First, consider the k agents model where, for simplicity, $p_1 = 1, \theta_i = \theta, \alpha_i = \alpha$ for all agents. Similar to the proof of Proposition 1 and 2, each biased agent i faces two truth-telling constraints ($s_1 = 0$ and $s_1 = 1$ respectively for agent 1):

$$EU_i(m_i = 1|m_{i-1} = 0) \leq EU_i(m_i = 0|m_{i-1} = 0);$$
$$EU_i(m_i = 1|m_{i-1} = 1) \geq EU_i(m_i = 0|m_{i-1} = 1).$$

Suppose that each biased agent i reports $m_{i-1} = 1$ truthfully ($s_1 = 1$ for agent 1), but $m_{i-1} = 0$ truthfully only with probability x_i ($s_1 = 0$ for agent 1). Then, if agent i hears $m_{i-1} = 0$ ($s_1 = 0$ for agent 1), the difference in his expected utility if he reports $m_i = 1$ instead of $m_i = 0$ is:

$$\begin{aligned} & EU_i(m_i = 1|m_{i-1} = 0) - EU_i(m_i = 0|m_{i-1} = 0) \\ = \; & Pr(m_k = 0|m_i = 0)\Big[Pr(\eta = 1|m_k = 1) - Pr(\eta = 1|m_k = 0)\Big] \\ - \; & Pr(m_k = 0|m_i = 0)\Big[\alpha Pr(i = o|m_k = 0) - \alpha Pr(i = o|m_k = 1, \eta = 0)\Big]. \end{aligned}$$

We can see that all biased agents derive the same net benefit from agenda pushing relative to their net reputation costs. The net benefit is the change in the decisionmaker's action induced by agent k:

$$Pr(\eta = 1|m_k = 1) - Pr(\eta = 1|m_k = 0) = \frac{1}{2 - \prod_i(\theta + (1-\theta)x_i)}.$$

Let $j \neq i$, thus each agent j reports m_{j-1} truthfully with probability x_j. The net reputation cost for i is:

$$\begin{aligned} & \alpha[Pr(i = o|m_k = 0) - Pr(i = o|m_k = 1, \eta = 0)] \\ = \; & \alpha\Big[\frac{\theta}{\theta + (1-\theta)x_i} - \frac{\theta(1 - \prod_j(\theta + (1-\theta)x_j))}{1 - \prod_i(\theta + (1-\theta)x_i)}\Big] \\ = \; & \frac{\alpha\theta(1-\theta)(1-x_i)}{(\theta + (1-\theta)x_i)(1 - \prod_i(\theta + (1-\theta)x_i))}. \end{aligned}$$

Similar to Proposition 1 and 2, there are only two possibilities for agent i: either always reports $m_i = 1$, or reports $m_{i-1} = 1$ truthfully, but reports $m_{i-1} = 0$ truthfully with probability x_i. If α is sufficiently high, or θ is sufficiently small such that $\alpha(1-\theta) > \frac{1-\theta^k}{2-\theta^k}$, there exists a mixed strategy equilibrium such that for each agent i:

$$\frac{1}{2 - \prod_i(\theta + (1-\theta)x_i)} = \frac{\alpha\theta(1-\theta)(1-x_i)}{(\theta + (1-\theta)x_i)(1 - \prod_i(\theta + (1-\theta)x_i))}.$$

Observe from this mixing condition that all agents report truthfully with the same probability, $x_i = x_k$ for all i, are clearly an equilibrium. Moreover, note that this equilibrium is unique. For any two agents l and $l+1 \leq k$, suppose that $x_l > x_{l+1}$, then agent l receives the same net benefit from reporting $m_l = 1$, but pays a smaller net reputation cost than agent $l+1$, thus they cannot both be mixing, which is a contradiction. Similarly, in a $k+1$ symmetric agents model, $x_{k+1} > 0$ if $\alpha(1-\theta) > \frac{1-\theta^{k+1}}{2-\theta^{k+1}}$.

Second, to compare x_k and x_{k+1}. Suppose that $x_k = x_{k+1}$, then for any agent $i \leq k$, the difference in the decisionmaker's action after receiving a positive message becomes:

$$Pr(\eta = 1|m_k = 1) - Pr(\eta = 1|m_{k+1} = 1) = \frac{(\theta + (1-\theta)x_k)^k(1-\theta)(1-x_k)}{(2-(\theta+(1-\theta)x_k)^k)(2-(\theta+(1-\theta)x_{k+1})^{k+1})}.$$

The difference in the same agent's net reputation cost becomes:

$$\frac{\alpha\theta(1-\theta)(1-x_k)(\theta+(1-\theta)x_k)^k(1-\theta)(1-x_k)}{(\theta+(1-\theta)x_k)(1-(\theta+(1-\theta)x_k)^k)(1-(\theta+(1-\theta)x_k)^{k+1})}.$$

Next, let EU_i^k, EU_i^{k+1} denote respectively agent i's expected utility when there are k and $k+1$ agents. Compare the differences in his expected utility and use his equilibrium mixing condition, we can show that at $x_k = x_{k+1}$:

$$\begin{aligned}
& EU_i^k(m_i = 1|m_{i-1} = 0) - EU_i^k(m_i = 0|m_{i-1} = 0) \\
- \;& [EU_i^{k+1}(m_i = 1|m_{i-1} = 0) - EU_i^{k+1}(m_i = 0|m_{i-1} = 0)] \\
= \;& Pr(\eta = 1|m_k = 1) - Pr(\eta = 1|m_{k+1} = 1) - \alpha[Pr(i = o|m_{k+1} = 1, \eta = 0) - Pr(i = o|m_k = 1, \eta = 0)] \\
< \;& 0.
\end{aligned}$$

Note that agent i is mixing in both cases, this difference should be zero, which is a contradiction. Because i's expected utility after hearing $m_{i-1} = 0$ strictly increases in x_k, the only possibility is for $x_k > x_{k+1}$. Intuitively, the decrease in i's influence on the decisionmaker in term of agenda pushing is strictly smaller than the reduction in reputation cost for him. Thus if biased i lies in both cases with some probability, he lies more when there are $k+1$ agents. □

B Biased A's Ex ante Channel Choice

Step 1: biased A's ex ante expected payoffs. First consider biased A's ex ante expected payoffs in these two channels for a given prior objectivity and level of reputational concerns. This is equivalent to the case when he uses direct communication with the same probability μ as the objective type. In this way, neither the intermediary nor the decisionmaker makes any inference about the sender's type, which helps illustrate biased A's preference over channels alone.

Let EU_A^d, EU_A^i denote, respectively, biased A's expected equilibrium payoff from direct and indirect communication before receiving s_A. Given that the state is distributed symmetrically, his ex ante expected payoff from direct communication is:

$$\begin{aligned} EU_A^d &= E_{s_A}\Big[Pr(\eta = 1|m_A) + E_\eta[Pr(A = o|m_A, \eta)]\Big|s_A\Big] \\ &= \frac{1}{2}x^d[Pr(\eta = 1|m_A = 0) + \alpha Pr(A = o|m_A = 0)] \\ &+ \frac{1}{2}(2 - x^d)[Pr(\eta = 1|m_A = 1) + \alpha E_\eta[Pr(A = o|m_A = 1)]] \\ &= Pr(\eta = 1|m_A = 1) + \frac{\alpha}{2}[Pr(A = o|m_A = 1, \eta = 1) + Pr(A = o|m_A = 1, \eta = 0)]. \quad (11) \end{aligned}$$

The last equality holds because if $x^d = 0$ in equilibrium, biased A always reports $m_A = 1$. If $x^d > 0$, then biased A is indifferent between reporting $m_A = 1$ or $m_A = 0$ if $s_A = 0$. In equilibrium, his ex ante payoff is the same as if he always sends $m_A = 1$. Moreover, biased A's payoff amounts to a sum of C's posterior beliefs, and his payoff before sending any message is simply $\frac{1}{2} + \alpha\theta_A$. If $x^d > 0$, then use Equation (11), we have:

$$\begin{aligned} & EU_A^d - (\frac{1}{2} + \alpha\theta_A) \\ = \;& Pr(\eta = 1|m_A = 1) - [Pr(\eta = 1|m_A = 1)Pr(m_A = 1) + Pr(\eta = 1|m_A = 0)Pr(m_A = 0)] \\ + \;& \alpha Pr(A = o|m_A = 1) - \alpha[Pr(A = o|m_A = 1)Pr(m_A = 1) + Pr(A = o|m_A = 0)Pr(m_A = 0)] \\ = \;& 0. \end{aligned}$$

The first equality is due to the law of iterated expectations, while the second is due to biased A's mixing condition IC (4). If biased A cares sufficiently about his reputation to report $m_A = 0$ sometimes, his net gain in term of agenda-pushing effectiveness must exactly be equal to his loss in posterior objectivity. If $x^d = 0$, then IC (4) fails to hold and biased A's ex ante expected payoff is strictly higher than the prior: $EU_A^d > \frac{1}{2} + \alpha\theta_A$. Because his reputational cost is so low that if $s_A = 0$, $EU_A^d(m_A = 1) > EU_A^d(m_A = 0)$ at $x^d = 0$, thus he is worse off if he reports truthfully with any infinitesimally small $x^d > 0$.

Similar arguments can show that biased A's ex ante expected payoff from indirect communication is:

$$EU_A^i \;=\; Pr(\eta = 1|m_B = 1) + \frac{\alpha}{2}[Pr(A = o|m_B = 1, \eta = 1) + Pr(A = o|m_B = 1, \eta = 0)]. \quad (12)$$

Moreover, if $x > 0$ in equilibrium, EU_A^i is equal to $\frac{1}{2} + \alpha\theta_A$; but if $x = 0$, $EU_A^i > \frac{1}{2} + \alpha\theta_A$. Therefore if $x^d > 0, x > 0$, biased A is indifferent in ex ante terms between these two channels.

Step 2: Compare biased A's ex ante expected payoffs for a given θ_A. As shown in Proposition 1, $x^d = 0$ if $\alpha \leq \overline{\alpha}$ and $x^d > 0$ otherwise; moreover, $\overline{\alpha}$ increases in θ_A. Holding the intermediary's characteristics fixed, a similar cutoff α_2 exists with indirect communication such that $x = 0$ if $\alpha \leq \alpha_2$ and $x > 0$ otherwise. Moreover, $\overline{\alpha} < \alpha_2$.

To see this, recall from the proof of Proposition 2 that $\xi(x, y) = 0, \psi(x, y) = 0$ are the respective mixing constraint of biased A, B if $x > 0, y > 0$. In addition: $\xi_1 > 0, \psi_2 > 0$ and $\xi_2 < 0$ if $x > 0$; $\psi_1 < 0$ if $y > 0$ in equilibrium. If $\beta \leq \tilde{\beta}$, then $\psi(0, 0) \geq 0$: biased B always reports $m_B = 1$ if $x = 0$. Because at $\alpha = \tilde{\alpha}$, $\xi(0, 0) = 0$, if $\alpha \leq \tilde{\alpha}, x = 0, y = 0$ is an equilibrium. If $\alpha > \tilde{\alpha}$, then there exists a $x' > 0$ such that $\xi(x', 0) = 0$. If $\psi(x', 0) \geq 0$, which is the case if β is sufficiently small, then in equilibrium: $x' > 0, y = 0$. If $\psi(x', 0) < 0$, then because $\psi(x, y)$ increases in y, and $\psi(0, 1) \geq 0$, there exists a unique $y' > 0$ such that $\psi(x', y') = 0$. Because $\xi(x', y') < \xi(x', 0) = 0$, the equilibrium is interior, and $\alpha_2 = \tilde{\alpha}$ in this case. If $\beta > \tilde{\beta}$, then there exists a $y' > 0$ such that $\psi(0, y') = 0$. Let α_2 be implicitly defined such that $\xi(0, y') = 0$ at $\alpha = \alpha_2$. Similar arguments can show that $x > 0$ if $\alpha > \alpha_2$. Because $\xi(0, 1) < \xi(0, y') = 0 < \xi(0, 0)$ at α_2 and $\xi(0, 1) = 0$ at $\overline{\alpha}$ (direct communication is equivalent to $y = 1$), also because $\xi(x, y)$ decreases in α, $\overline{\alpha} < \alpha_2 < \tilde{\alpha}$.

Given biased A's ex ante expected payoffs in different channels, we can see that for a given θ_A, if $\alpha \in [0, \overline{\alpha}]$, $x^d = x = 0$. If $\alpha \in (\overline{\alpha}, \alpha_2]$, $x^d > 0, x = 0$, and $EU_A^i(\theta_A) > EU_A^d(\theta_A)$; and finally, if $\alpha > \alpha_2$, $x^d > 0, x > 0$, $EU_A^i(\theta_A) = EU_A^d(\theta_A)$.

Step 3: biased A's channel choice for any given intermediary. Recall that objective A uses direct communication with probability μ. Suppose that biased A chooses direct communication with probability γ, and indirect with probability $1 - \gamma$. Then the choice of channel becomes a signal of A's type, in particular, the posterior probability of A's objectivity given his channel choice is:

$$\theta_A^d \equiv Pr(A = o|\text{direct}) = \frac{\theta_A\mu}{\theta_A\mu + (1 - \theta_A)\gamma}; \; \theta_A^i \equiv Pr(A = o|\text{indirect}) = \frac{\theta_A(1 - \mu)}{\theta_A(1 - \mu) + (1 - \theta_A)(1 - \gamma)}.$$

Clearly, $\theta_A^d \geq \theta_A \geq \theta_A^i$ if $\mu \geq \gamma$ and vice versa.

Biased A chooses a communication channel by comparing $EU_A^d(\theta_A^d)$ with $EU_A^i(\theta_A^i)$, given the inferences about his objectivity from his channel choice as described above. First, the difference in his message's credibility $Pr(\eta = 1|m_A = 1) - Pr(\eta = 1|m_B = 1)$ is:

$$\frac{2p_A - 1}{2 - (\theta_A^d + (1-\theta_A^d)x^d)} - \frac{2p_A - 1}{2 - (\theta_A^i + (1-\theta_A^i)x)(\theta_B + (1-\theta_B)y)}. \tag{13}$$

Second, the difference in his (expected) posterior objectivity is:

$$\begin{aligned} & Pr(A = o|m_A = 1) - Pr(A = o|m_B = 1) \\ = \ & [\frac{p_A\theta_A^d}{1 - (1-p_A)(\theta_A^d + (1-\theta_A^d)x^d)} + \frac{(1-p_A)\theta_A^d}{1 - p_A(\theta_A^d + (1-\theta_A^d)x^d)}] \\ - \ & [\frac{[1-(1-p_A)(\theta_B + (1-\theta_B)y)]\theta_A^i}{1-(1-p_A)(\theta_A^i + (1-\theta_A^i)x)(\theta_B + (1-\theta_B)y)} + \frac{[1-p_A(\theta_B + (1-\theta_B)y)]\theta_A^i}{1-p_A(\theta_A^i + (1-\theta_A^i)x)(\theta_B + (1-\theta_B)y)}]. \end{aligned} \tag{14}$$

Proposition 4, given in the text, characterizes the equilibrium choice of biased A for any given B as well as the case if β is sufficiently low such that B always reports $m_B = 1$. We proceed to prove it.

Proof of Proposition 4: First, note that it is never part of the equilibrium for biased A to use indirect communication exclusively ($\gamma = 0$). If it were the case, then $\theta_A^d = 1$, $\theta_A^i < \theta_A$. Clearly, from Expressions (13) and (14), $Pr(\eta = 1|m_A = 1) - Pr(\eta = 1|m_B = 1) > 0$, and $Pr(A = o|m_A = 1) = 1 > Pr(A = o|m_B = 1)$, thus $EU_A^d(1) > EU_A^i(\theta_A^i)$. Intuitively, biased A's message is the most credible and he is considered objective if he uses direct communication, which a contradiction. Thus $\gamma > 0$ in any equilibrium.

Second, we have shown above that at θ_A, if $\alpha \in [\overline{\alpha}, \alpha_2)$, $x^d = 0, x > 0$ and $EU_A^d(\theta_A) < EU_A^i(\theta_A)$. Suppose that $\gamma = 1$, then $\theta_A^i = 1, \theta_A^d = \overline{\theta}_A^d \equiv \frac{\theta_A\mu}{\theta_A\mu + (1-\theta_A)} < \theta_A$. On one hand, because $\overline{\alpha}(\theta_A^d)$ increases in θ_A^d, $\overline{\alpha}(\theta_A^d) < \overline{\alpha}(\theta_A)$. Thus $x^d(\theta_A^d) > 0$ at $\alpha = \overline{\alpha}$, and $EU_A^d(\theta_A^d) = \frac{1}{2} + \alpha\theta_A^d < \frac{1}{2} + \alpha\theta_A$. On the other hand, $EU_A^i(1) = \frac{2p_A - 1}{2-(\theta_B + (1-\theta_B)y)} + (1 - p_A) + \alpha > \frac{1}{2} + \alpha\theta_A$. Thus it is impossible for biased A to use direct communication only. This shows that for all $\alpha > \overline{\alpha}(\overline{\theta}_A^d)$, $EU_A^d > EU_A^i$ at $\gamma = 0$ and $EU_A^d < EU_A^i$ at $\gamma = 1$. Since EU_A^d, EU_A^i are both continuous, there exists a mixed strategy equilibrium: $\gamma \in (0, 1)$ if $\alpha \in [\overline{\alpha}(\overline{\theta}_A^d), \alpha_2]$.

Third, if $\alpha \geq \alpha_2$, similar to above, we can show that there exists a mixed strategy equilibrium. In equilibrium, biased A is indifferent between the channels. Recall that $EU_A^d(\theta_A) = EU_A^i(\theta_A)$ because biased A receives his prior $\frac{1}{2}+\alpha\theta_A$ in either channel, it is a mixed strategy equilibrium to behave like the objective A: $\gamma = \mu$.

If $\alpha \leq \overline{\alpha}(\overline{\theta}^d_A)$, then $x^d = 0$ even at $\overline{\theta}^d_A$. Then compare $EU^d_A(\overline{\theta}^d_A)$ with $EU^i_A(1)$: use Expressions (13) and (14), we can see that if α is sufficiently close to 0 and $\overline{\theta}^d_A$ is sufficiently large (or if θ_B, β are sufficiently low), $\gamma = 1$ is an equilibrium. Otherwise, the equilibrium is a mixed one.

From Expression (13) and (14), EU^d_A strictly increases in θ^d_A (and decreases in γ). If β is sufficiently low, then $y = 0$. In this case, EU^i_A strictly increases in θ^i_A (and increases in γ). Because $EU^d_A(\theta_A) > EU^i_A(\theta_A)$ at $\alpha = 0$ and $EU^d_A(\theta_A) < EU^i_A(\theta_A)$ if $\alpha > \overline{\alpha}$, there exists a cutoff α_1 such that $EU^d_A(\theta_A) \geq EU^i_A(\theta_A)$ if $\alpha \leq \alpha_1$ and $EU^d_A(\theta_A) < EU^i_A(\theta_A)$ if $\alpha \in (\alpha_1, \alpha_2]$.

Next, suppose that $\alpha \leq \alpha_1$. If $\theta_B < \overline{\theta}^d_A$, then Expression (13) is positive. Thus for α sufficiently small, direct communication gives biased A a higher expected payoff than indirect. Because EU^d_A decreases in γ, biased A always uses direct channel in the unique equilibrium. If $\theta_B \geq \overline{\theta}^d_A$, then we know from Proposition **??** that a mixed strategy equilibrium exists. Moreover, the equilibrium is unique and $\gamma > \mu$ because $EU^d_A(\theta_A) \geq EU^i_A(\theta_A)$, EU^d_A decreases in γ and EU^i_A strictly increases in γ. Intuitively, biased A prefers direct communication more because of its higher credibility, thus he is willing to use direct communication more often even though it is a worse signal about his objectivity. If $\alpha \in [\alpha_1, \alpha_2]$ instead, similar argument can show that $\gamma < \mu$ in the unique mixed strategy equilibrium. Here indirect communication reduces reputation cost, and biased A is more likely to use it despite the lower perceived objectivity from using an intermediary.

Finally, note that EU^i_A decreases in θ_B for α sufficiently close to α_2. Also, EU^i_A strictly increases in γ, in the mixed strategy equilibrium, γ increases in θ_B. Thus biased A is more likely to use B if B has a lower prior objectivity. □

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