Strategic Listening

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Abstract: We consider a cheap talk setting with two senders and a continuum of receivers with heterogenous preferences. Each receiver can only listen to one sender and strategically makes that choice. The model shows that strategic listening facilitates more informative communication and even allows full communication for a large set of sender preference pairs. We further investigate the size of the senders' audiences, the optimal choice of sender preferences to maximize the sender's audience, and the effects of entertainment benefits from listening to receivers.

1   Introduction

A well established observation in the literature is that an expert who seeks to influence the behavior of an audience is often unable to credibly communicate private information to that audience.[1] In many cases, however, individuals in the expert's audience are there by choice and, presumably, had the option to seek information from other experts. Hence, if one expert fails to communicate information, we would expect his audience to choose another expert. In other words, individuals strategically choose who to listen to. Such strategic listening, in turn, alters an expert's ability to credibly communicate by altering the expert's audience. What is less clear is how the process of individuals selecting among experts equilibrates, nor is the nature of an equilibrium well understood. We investigate how a sender's audience and his ability to communicate to that audience are determined jointly in equilibrium.

To analyze how strategic listening influences communication, we develop a cheap talk model with two equally informed senders and a continuum of receivers who seek information from the senders. In this setting, we study how a market "matches" receivers with senders and the attributes of equilibrium in such a market. Consistent with the standard tension in a cheap talk model, each sender can only send a public message and has preferences for each receiver's action that generally diverge from those of the receiver. The critical, and novel, assumption in our analysis is that each receiver listens to a single sender of her choosing, which reflects the fact that individuals cannot access all information sources because of cognitive and time constraints. For example, multiple news programs are available, but people watch "their" news show (e.g., PBS News Hour or Fox News Special Report) and multiple financial analysts usually cover any large firm, but investors typically read only a few reports.[2] Given our assumption of constrained strategic listening, we primarily focus on two attributes of most informative equilibria: the information ultimately communicated by the experts given the nature of their audience, and the nature of the audiences that align

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[1]See, for example, Crawford and Sobel (1982), Farrell and Gibbons (1989), or Goltsman and Pavlov (2011).

[2]Hirshleifer and Teoh (2003) formalize the notion of investors with limited attention.

with each expert.[3]

Within the context of our model, and similar to the single sender-multiple receiver setting studied by Farrell and Gibbons (1989) and Goltsman and Pavlov (2011), the ability of each sender to communicate information is determined by the divergence between the sender's preference and the average preference of their audience. This implies that communication is maximized when a sender faces a "balanced" audience, i.e. an audience with preferences that on average are in line with the sender's preference. We find that senders' information is fully communicated to all receivers as long as i) one of the senders is perfectly unbiased (i.e., has preferences that align with the average receiver preferences), or ii) the senders' preferences are not slanted in the same direction (i.e., are on opposite sides of average receiver preferences) and are not too far apart. These conditions ensure that all receivers can be matched with senders in a manner that leaves each sender with a balanced audience. Compared to settings where all receivers listen to a single sender, strategic listening enlarges the range of sender biases for which full communication occurs. This observation counters the assertion that individuals become less informed when there are many biased information providers. Instead, individuals may become more informed if they listen strategically. Furthermore, greater dispersion in receiver preferences enlarges the space of receiver preferences that allow for full communication. In other words, the more disagreement there is among receivers, the more communication is feasible in equilibrium.

In cases where senders have preferences on the same side of the receiver population mean, the sender with the least extreme preferences (i.e., preferences closest to the average receiver preference) attracts all receivers in a most informative equilibrium and communicates (weakly) better information than the sender with extreme preferences. In contrast, when the senders' preferences are on opposite sides of the population mean and their preferences are

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[3]Consistent with our assumption that receivers choose to listen in order to obtain information for decision making, Chiang and Knight (2011), DellaVigna and Kaplan (2007), Engelberg and Parsons (2011), and Gerber et al., (2009) suggest that voters tend to be influenced by the media, and thus watch in part to learn. Consistent with the cheap talk literature assumption that receivers take into account the bias driving sender reports, Chiang and Knight (2010) find that left-wing (right-wing) recommendations by left-biased (right-biased) media sources tend to be discounted.

not too disparate, each sender attracts some of the receivers in a most informative equilibrium and both senders provide equivalent information. Again, the sender with the least extreme preferences attracts the largest portion of the receivers, although not all of them. Hence, our model suggests that an information provider with preferences most aligned with the population preference will attract a wider audience, but generally not the entire audience.

We extend our primary model to a setting where sender preferences are chosen ex ante by competing parties who seek to attract as many receivers as possible to their respective senders, which is consistent with competing news organizations that seek to maximize viewers in order to maximize advertising profits (see Gentzkow and Shapiro, 2010, or Fang, 2015). We find that such competition leads to a centrality equilibrium where both parties commit to a preference parameter equal to the population average. It follows that in the communication stage, both senders can fully communicate with their audience. While consistent with the observation that local news media tends to exhibit bias reflective of their local population (Dalton et al., 1998), the centrality result does not seem to be a pervasive phenomenon at a broader level. Hence, we offer two alternatives to our primary model that unravel the centrality equilibrium and lead senders to locate on opposite sides of the average receiver preference. First, we consider a bivariate as opposed to continuous receiver action space, which can cause the senders to cater to receivers with similar preferences in order to enhance the decision usefulness of the information they can communicate. Second, we consider a setting in which sender preference choices are made before the average receiver bias is known. In this case, by deviating from a central bias, senders attract less receivers when the average bias is moderate, but this loss is more than compensated by the additional receivers they attract when the average bias is extreme.

In a final extension of our primary analysis, receivers derive an "entertainment" benefit from listening to a sender with a preference similar to their own, which reflects cases where information is bundled with entertainment. For example, individuals watch a news show not only for the information garnered, but also because they find the news show's anchor

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an engaging personality, or the anchor's method of conveying the information entertaining. We show that in this setting, unlike in our baseline model, full communication only arises in knife-edge cases, suggesting that bundling news and entertainment can be detrimental to information dissemination. The entertainment benefit hinders communication because receivers naturally listen to senders with similar preferences, which provides senders with an audience that is insufficiently balanced to sustain full communication. When full communication is not possible in the absence of an entertainment benefit, however, introducing an entertainment benefit can sometimes help to align the audience in a way that provides each sender with a more balanced audience, increasing communication. Hence, the impact on information dissemination of bundling news and entertainment is ultimately ambiguous. The reason that including an entertainment benefit can increase communication is that with an entertainment benefit, both senders no longer have to communicate the same amount of information in equilibrium. Relaxing this constraint can increase the information communicated by one sender without affecting the other sender's communication.

Our model has a variety of applications. First, local media outlets have explicit (e.g., editorial) and implicit biases that reflect the populations they cater to. This is consistent with the notion that these sources choose preferences that enable their audience to garner information from their news casts. Furthermore, at a broader (e.g., national) level, competing media outlets generally maintain fairly consistent biases in spite of the fact that their constituencies have volatile preferences. In this vein, we find that when senders must commit to a long-term bias in the face of uncertainty regarding the average population bias, they are likely to choose oppositional biases. Within the context of our model, the fact that media outlets may choose opposing biases is not due to an effort to enable viewers to juxtapose the messages of oppositional information sources. Instead, such biases arise in order to enable heterogeneously biased viewers to follow a single information source and still acquire credible information.

Second, some sell side financial analysts tend to be consistently optimistic whereas other

analysts, such as those who focus on identifying short sale opportunities and/or accounting irregularities, tend to be consistently pessimistic.[4] In such an environment, investors with relatively low loss aversion, which makes them relatively more interested in understanding a firm's upside, will likely turn to the analysis of the consistently optimistic sell side analysts. In contrast, investors with relatively high loss aversion, which makes them relatively more interested in understanding a firm's downside, will likely turn to the analysis of the more pessimistic analysts. Our analysis suggests that such strategic listening by investors may, in turn, allow each type of analyst to convey more credible buy/sell signals to their audience because they are not attempting to influence the behavior of the those who are inherently difficult to sway (e.g., sell side analysts do not attempt to sway highly loss averse investors because those investors do not listen to them).

We contribute to the literature on strategic communication by considering a setting with both multiple receivers *and* multiple senders. As noted above, a central element of our analysis follows Farrell and Gibbons (1989) and Goltsman and Pavlov (2011), who show that when a single sender engages in cheap talk with multiple receivers, the sender's ability to communicate is determined only by the *average* preference of the receivers. Battaglini (2002) considers a cheap talk model with multiple senders and a single receiver, showing that by "pitting" one sender against another, communication can improve. In contrast, we assume that each receiver can only listen to one sender, whom they strategically select. In the literature on persuasion games, Bhattacharya and Mukherjee (2013) investigate the problem of one receiver who listens to two senders with different preferences. They find that extreme sender preferences increase communication and that senders may actually communicate more if they have similar rather than opposing views. We contribute to this literature by considering the role played by strategic listening, demonstrating that receivers who listen

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[4]Butler and Lang (1991) provide evidence that some sell side analysts provide persistently optimistic recommendations and Hong and Kubik (2003) provide complimentary evidence that some brokerage houses internally promote analysts in a way that rewards optimistic forecasts. While there is no corresponding empirical analysis for analysts who are not on the sell side, the existence of analyst newsletters and websites more oriented towards short sales provides some anecdotal evidence consistent with the presence of more pessimistic analysts.

strategically can naturally improve the information communicated by each sender.

Our analysis also relates to the literature on media bias that considers the strategic choice of statistical biases in information gathering. In contrast to our analysis, this literature operates under the assumption that senders do not have preferences over the receivers' actions, and hence are able to fully communicate their information. For example, Stone (2011) and Fang (2015) investigate settings where senders care only about attracting receivers and commit to potentially biased information acquisition strategies, and where receivers have differing perceptions of the state distribution. Stone (2011) finds that when two media sources choose the bias of their reporters with the goal of attracting as many receivers as possible, choosing central reporters is the unique equilibrium, which is consistent with our centrality result. Fang (2015) allows receivers to listen to multiple media outlets at a cost. He finds that when the news consumption cost is sufficiently high, media outlets choose extreme biases, consistent with our auxiliary analyses in which centrality does not arise as the unique equilibrium. Relatedly, Gentzkow and Shapiro (2006) considers a setting in which the precision of media sources' information is unknown to receivers and these sources wish to build a reputation for having high quality information. In their setting, the media has incentives to bias information towards viewers' priors because signals are more likely to deviate from the prior when they are noisier. The presence of multiple senders increases communication, a result that also arises in our model. In their model, however, the presence of multiple senders facilitates communication because receivers are able to condition beliefs on the information of more news sources, while in our model, receivers can only listen to one sender.

Similar to the extension of our model in which receivers possess a desire for entertainment, Bernhardt et al. (2008) and Mullainathan and Shleifer (2005) investigate models where senders seek to attract viewers and receivers have an exogenous taste for information that corresponds to their views. When the population of potential viewers with moderate biases is small, media sources in Bernhardt et al. (2008) choose to report only negative information

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on one party, thereby attracting viewers of the other party. On the other hand, when the population of moderate viewers is large, unbiased media is sustained. Their findings mirror ours when we study the equilibrium choice of senders' biases in the face of uncertain receiver preferences or bivariate action choices. However, credible communication drives our results, whereas senders' desire to cater to receivers' preferences for bias is paramount in their research. In Mullainathan and Shleifer (2005), receivers both wish to receive messages that conform with their priors, and have an exogenous distaste for bias. In a duopoly setting, the media is polarized because polarization helps prevent them from competing on price. In our setting, competition itself leads to senders that choose the same, central, bias. In the extensions we consider where senders choose polarized biases in equilibrium, they do so because polarization helps facilitate communication, which attracts listeners.

Finally, media outlets in Baron (2006) choose the optimal amount of discretion to give to potentially biased journalists. Bias reduces the value of the messages to followers, but media outlets may be able to pay biased journalists lower salaries when journalists receive utility from having the ability to bias their messages. This trade-off determines the optimal level of discretion. In contrast, we assume that reporters always have full discretion to communicate as they please.

2 The Model

We consider a cheap talk model where a set of atomistic receivers has heterogeneous preferences and where two senders, 1 and 2, may also have divergent preferences. The set of receivers is distributed over the interval $[-\delta, \delta]$, where $\delta > 0$. A receiver's location, $b \in [-\delta, \delta]$, determines that receiver's preferences, which are characterized by the quadratic utility function $-(a_b - \theta - b)^2$, where a_b is the action taken by the type b receiver and θ is the realization of a state variable $\tilde{\theta}$. We refer to b as bias. The distribution of receiver biases is characterized by the differentiable density function $f(b)$ with mean normalized to 0. That

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is, we assume the measure of receivers in any suitable set $R \subset [-\delta, \delta]$ equals $\int_R f(b)\, db$. All actors believe that $\tilde{\theta}$ is uniformly distributed over $[0, 1]$.

Each sender $j \in \{1, 2\}$ privately observes $\tilde{\theta}$ and then costlessly publishes a message, m_j. Sender j sends a message to maximize the expectation of $-\int (a_b - \theta - \sigma_j)^2 f(b)\, db$, where σ_j is sender j's preference parameter that is referred to as sender j's bias. We assume throughout the paper that $\sigma_1 \geq \sigma_2$, without loss of generality. The utility function implies that the sender cares about the actions taken by each receiver and that, ideally, sender j would like to each receiver to take action $\theta + \sigma_j$. Therefore, sender j's utility is, loosely speaking, decreasing in the sum of the squared deviation of each receiver's action from the sender's ideal action.

While the assumptions above are relatively standard, the novel assumption in our model is that each receiver can only observe the message sent by one of the senders, which captures the notion that individuals cannot read or listen to all possible sources of information because they have other uses of their time. We capture this constraint by employing a model with two sources of information and constraining individuals to listen to only one source of information.

Finally, we adopt the convention that a receiver listens to neither sender if neither sender communicates information in equilibrium. In other words, receivers only listen to a sender when they can glean some information from the messages. This assumption does not affect our primary results but plays a role in Section 4.2 where senders' biases are endogenous.

3 Equilibrium

We characterize the equilibria in our model by backward induction. That is, for each set of receiver listening strategies we characterize the equilibrium in the subsequent communication stage game. We then step back and characterize the endogenous listening strategies.

3.1 Definition of Equilibrium

We denote a communication strategy for sender $j \in \{1, 2\}$ by a message function $m_j(\theta)$, where $m_j(\theta)$ is the message sent by sender j when the sender observes θ. An action strategy for a receiver type b who listens to sender j is denoted by the function $a_b(j, m)$, where m denotes the message issued by j. Finally, a listening strategy for each receiver type is characterized by $\boldsymbol{\pi}(b) = (\pi_1(b), \pi_2(b))$, where $\pi_j(b)$ is the probability that an individual receiver of type b chooses to listen to sender j, or equivalently, the proportion of type b receivers that listen to sender j. Formally, $\pi_1(b), \pi_2(b)$ are measurable functions with $\pi_1(b) : [-\delta, \delta] \longrightarrow [0, 1]$, $\pi_2(b) : [-\delta, \delta] \longrightarrow [0, 1]$, and $\pi_1(b) + \pi_2(b) \leq 1$.

Definition 1 *An equilibrium in our model is a communication strategy for each sender, $m_j(\theta)$, an action strategy for each receiver, $a_b(j, m)$, and a listening strategy, $\boldsymbol{\pi}(b) = (\pi_1(b), \pi_2(b))$, such that for all $j \in \{1, 2\}$:*

(i) $a_b(j, m) = \arg\max_{a_b} \left(-E\left[\left(a_b - \tilde{\theta} - b \right)^2 | m; \hat{m}_j(\theta) \right] \right)$ *for each m given beliefs about sender j's strategy, $\hat{m}_j(\theta)$.*

(ii) $-E\left[\left(a_b(j, m) - \tilde{\theta} - b \right)^2 ; \hat{m}_j(\theta) \right] \geq -E\left[\left(a_b(i, m_i) - \tilde{\theta} - b \right)^2 ; \hat{m}_i(\theta) \right]$ *if $\pi_j(b) > 0$*

and $-E\left[\left(a_b(j, m) - \tilde{\theta} - b \right)^2 ; \hat{m}_j(\theta) \right] \leq -E\left[\left(a_b(i, m_i) - \tilde{\theta} - b \right)^2 ; \hat{m}_i(\theta) \right]$ if $\pi_j(b) = 0$ for $i \in \{1, 2\}$ where $i \neq j$.

(iii) $m_j(\theta) = \arg\max_m -\int \left(\left(\hat{a}_b(1, m) - \tilde{\theta} - \sigma_j \right)^2 \pi_1(b) + \left(\hat{a}_b(2, m) - \tilde{\theta} - \sigma_j \right)^2 \pi_2(b) \right) f(b) \, db$
for all θ given beliefs about each receiver's listening and action strategy, $\hat{a}_b(1, m)$ and $\hat{a}_b(2, m)$.

(iv) $\hat{m}_j(\theta) = m_j(\theta)$ and $\hat{a}_b(j, m) = a_b(j, m)$ for all $b \in B$.

Condition (i) requires that the action strategy selected by receiver type b conditional upon their listening decision maximizes the receiver's expected utility. Condition (ii) requires that the listening strategy of each receiver type maximizes the receiver's expected utility conditional upon the receiver taking the expected utility maximizing action given the message observed. Condition (iii) requires that the communication strategy for each sender maximizes

the sender's expected utility conditional upon the receivers' listening strategies, and the sender's beliefs about how the receivers respond to the sender's messages. Finally, Condition (iv) requires that receiver and sender beliefs are fulfilled in equilibrium.

3.2   Communication Stage

Our analysis of the communication stage follows from the cheap talk framework of Crawford and Sobel (1982) extended to a setting of multiple receivers by Farrell and Gibbons (1989) and Goltsman and Pavlov (2011). Farrell and Gibbons (1989) and Goltsman and Pavlov's (2011) observation that senders are only influenced by the average bias of receivers that listen to them applies in our setting, in which there is a continuum of receivers rather than just two receivers as was the case in their models. Define $\mu_j\left(\boldsymbol{\pi}\left(b\right)\right)$ to be the average bias of receivers listening to sender j, that is, $\mu_j\left(\boldsymbol{\pi}\left(b\right)\right) \equiv \frac{\int_{-\delta}^{\delta} b\pi_j(b)f(b)db}{\int_{-\delta}^{\delta} \pi_j(b)f(b)db}$, assuming that $\int_{-\delta}^{\delta}\pi_j\left(b\right)f\left(b\right)db > 0$.

Lemma 1 *The set of equilibrium communication strategies for sender j when receiver listening strategies are characterized by $\boldsymbol{\pi}\left(b\right)$ is equal to the set of equilibrium communication strategies for sender j when a single receiver with bias $\mu_j\left(\boldsymbol{\pi}\left(b\right)\right)$ listens to j.*

Lemma 1 is useful in subsequent analysis. In particular, for a given set of receivers who listen to a sender, we know exactly the nature of the equilibria that exist simply by turning to the classic results in Crawford and Sobel (1982). Hence, information communicated can be characterized by a partition of the state space.

   To foreshadow how strategic listening can influence the information communicated in an equilibrium, note that, for a given realization of θ, some receivers who listen to a particular sender may prefer a higher action than the sender prefers and some may prefer a lower action. Given that the sender cannot tailor his message to each receiver, the fact that some listeners take a higher action than desired and some take a lower action than desired can counterbalance, such that the sender has a reduced incentive to distort their information. As an example, consider the case in which the average bias of receivers listening to sender j equals sender j's bias. By deviating from truthful communication and sending a message that

is interpreted as a higher state realization, sender j must trade off the fact that receivers with $b < \sigma_j$ move towards the sender j's preferred action, $\theta + \sigma_j$, against the fact that receivers with $b > \sigma_j$ will move further away from $\theta + \sigma_j$. The two effects cancel in our setting, such that the sender would not attempt to mislead receivers. Farrell and Gibbons (1989) refer to this notion as "mutual discipline."

Further note that a sender's equilibrium communication strategy does not depend on the average bias *of all receivers* (as in Farrell and Gibbons (1989) and Goltsman and Pavlov (2011)) but, instead, only on the average bias *of all receivers that listen to that sender*. The reasoning underlying this observation is simple - the sender cannot influence the actions of receivers who are not listening, which implies that they do not alter their message to influence those receivers. This observation suggests that full communication equilibria may be possible even when senders have biases that are not aligned with the average population bias.

3.3   Endogenous Listening Strategy

Receivers only care about the quality of the information they receive for making their individual decisions. Given the quadratic objective function, a receiver of type b who listens to and receives the message sent by sender j takes an action that satisfies

$$a_b \left(j \right) = E \left[\tilde{\theta} | m ; \hat{m} \left(j, \theta \right) \right] + b. \tag{1}$$

As a consequence, a receiver of type b's ex ante expected utility from listening to sender j is simply

$$-E \left[Var \left[\tilde{\theta} | m ; \hat{m} \left(j, \theta \right) \right] \right]. \tag{2}$$

Intuitively, then, a receiver of type j simply chooses the information source that minimizes the expected posterior uncertainty (i.e., variance) about the state. Because receivers care only about the value of information conveyed by each sender and because each receiver has

the same value function, $-E\left[Var\left[\tilde{\theta}|m;\hat{m}\left(j,\theta\right)\right]\right]$, the following lemma naturally follows.

Lemma 2 *In any equilibrium where*

(i) *both senders are listened to by some receivers, both senders convey the same amount of information:* $E\left[Var\left[\tilde{\theta}|m;m\left(1,\theta\right)\right]\right] = E\left[Var\left[\tilde{\theta}|m;m\left(2,\theta\right)\right]\right]$;

(ii) *all receivers listen to a single sender, j, sender j conveys weakly more information than sender $i \neq j$:* $E\left[Var\left[\tilde{\theta}|m;m\left(j,\theta\right)\right]\right] \leq E\left[Var\left[\tilde{\theta}|m;m\left(i,\theta\right)\right]\right]$.

The previous lemma, while unsurprising, is useful for understanding the amount of information conveyed in an equilibrium. Specifically, when both senders are heard by some receivers, they must provide the same amount of information in equilibrium. This results from the assumption that receivers choose a sender to minimize the expected posterior variance. If one sender communicates more information than the other, this sender has to attract all receivers because no receiver would choose to listen to the less informative sender.

3.4   Equilibrium Characteristics

As in other cheap talk models, establishing the existence of an equilibrium in our setting is trivial. In particular, for any choice of sender biases, there will exist an equilibrium in which both senders communicate no information, or "babble," and all receivers choose not to listen to any sender. Generally, however, there will exist other equilibria. Hence, consistent with prior literature and with the notion that a most informative equilibrium is plausibly focal, we focus our attention on equilibria that are most informative (i.e., equilibria that minimize $\min\left\{E\left[Var\left[\tilde{\theta}|m;m\left(1,\theta\right)\right]\right], E\left[Var\left[\tilde{\theta}|m;m\left(2,\theta\right)\right]\right]\right\}$). This focus is also consistent with maximizing social welfare because it decreases the posterior variance for all receivers and hence maximizes both senders' and receivers' expected utility. Finally, note that this focus not only entails restricting attention to the most informative subgame equilibrium in the communication stage, which is conditional upon the receivers' listening choices, but also the equilibria in which the receivers' listening strategies $\boldsymbol{\pi}\left(b\right)$ induce the senders to communicate as much information as possible.

3.4.1 Information

Lemma 1 shows the amount of information that is communicated is simply a function of the difference between the sender's preference and the average preference of her audience, $|\mu_j(\boldsymbol{\pi}(b)) - \sigma_j|$. We refer to the size of this difference as balance and refer to the audience of a sender with a small or zero value of $|\mu_j(\boldsymbol{\pi}(b)) - \sigma_j|$ as a balanced audience. A receiver will benefit when other receivers with potentially different preferences listen to the same sender when those receivers lead to greater balance. Maximizing the information communicated in equilibrium entails maximizing the balance of the senders' audiences, which is facilitated by strategic listening. In some cases, this involves each of the senders acquiring a following and in other cases, it involves all receivers listening to a single sender with bias close to zero.

We first investigate most informative equilibria where both senders have an audience. Here, Lemma 2 implies that both senders must have equally balanced audiences. In this case, to construct a most informative equilibrium, we first find the set of average audience biases $(\mu_1(\boldsymbol{\pi}(b)), \mu_2(\boldsymbol{\pi}(b)))$ that can be obtained by some listening strategy $\boldsymbol{\pi}(b)$ in which both senders attract a positive measure of receivers. Then we find the point in this set that minimizes the difference between each sender's bias and the bias of their audience, subject to these differences being equal. Next, we consider the case in which all receivers follow one sender. Finally, we compare the amount of information communicated in both cases to determine the most informative equilibrium.

A well known result from the literature is that the sender can communicate some information only if their preferences do not diverge too far from the preferences, or the average preferences, of the population of receivers. Proposition 1 shows that the presence of a second sender allows for communication under a much broader set of parameters.

Proposition 1 *Some information is communicated to receivers in a most informative equilibrium,* $\min\left\{E\left[Var\left[\tilde{\theta}|m; m(1,\theta)\right]\right], E\left[Var\left[\tilde{\theta}|m; m(2,\theta)\right]\right]\right\} < Var\left[\tilde{\theta}\right]$*, if and only if one of the following conditions is satisfied:*

(i) *One or both of the senders has a bias close to zero:* $\sigma_1 \in \left[-\frac{1}{4}, \frac{1}{4}\right]$ *and/or* $\sigma_2 \in \left[-\frac{1}{4}, \frac{1}{4}\right]$.

(ii) The senders are oppositional and not too polarized: $\sigma_1 \in \left(\frac{1}{4}, \delta\right]$ and $\sigma_2 \in \left[\sigma_2^C(\sigma_1), -\frac{1}{4}\right)$, where $\sigma_2^C(\sigma_1)$ is a strictly increasing function of σ_1 and $\sigma_2^C(\sigma_1) \leq 0$.

Proposition 1 highlights two cases in which at least one sender is able to communicate some information. In the first case, one of the senders has a bias close to zero. In this region, all receivers can listen to one of the senders and acquire information. This leads to an identical condition as the classic case of Crawford and Sobel (1982), in which the senders bias must be within $\frac{1}{4}$ of the receiver's bias.[5] On the other hand, in our setting, there is an additional region which allows for communication. In the second case, the senders are on opposite sides of the preference spectrum. If these senders are not too polarized (i.e., have biases that are not too divergent), then strategic listening allows for each sender to have a sufficiently balanced audience to communicate information. As an example, in the case where receivers' biases are uniformly distributed on $[-\delta, \delta]$, this region reduces to $\left\{(\sigma_1, \sigma_2) : \sigma_1 - \sigma_2 \leq \delta + \frac{1}{2}\right\}$. This implies, for instance, that if $\sigma_1 = -\sigma_2$, the senders' biases may be polarized by an additional δ beyond what is possible in the case of a single sender, and still allow for communication.

When both senders have highly polarized biases, it is impossible for these senders to simultaneously have balanced audiences. While it is often feasible to allocate the receivers such that one sender communicates information, the equilibrium constraint that receivers do not wish to change their listening strategy rules out such allocations. As an example, assume that $\sigma_2 < \sigma_2^C(\sigma_1)$ and that sender 1 attracts a balanced audience which enables her to communicate. The condition that $\sigma_2 < \sigma_2^C(\sigma_1)$ ensures that in this case, sender 2 has an unbalanced audience. Hence, receivers flock to sender 1, causing her audience to become sufficiently unbalanced and precluding the communication of information. Furthermore, note that with oppositional senders, the parameter space in which communication is possible increases in the divergence of receiver preferences, δ. It can be shown that as $\delta \rightarrow \infty$, $\sigma_2^C(\cdot) \rightarrow -\infty$. This implies that as δ grows large, it becomes possible in general to always

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[5]In many cases, there also exist equilibria when the condition in case i) is satisfied in which both senders attract an audience, and these equilibria will lead to more communication whenever they exist. However, for σ_1 and σ_2 sufficiently divergent, the only equilibrium which will lead to communication is the one in which the sender with bias close to zero attracts all receivers.

provide senders with balanced audiences. Intuitively, dispersion is relatively costless from a communication standpoint because opposing biases offset each other, and it creates the opportunity to balance the audiences of both senders.

To provide further insight into how communication is facilitated by strategic listening, note that in a setting in which receivers are restricted to listen to a single sender, full communication is only possible in special case in which the sender's bias equals the average receiver bias, 0. On the other hand, when there are two senders, full communication becomes feasible for a fairly large set of sender preference parameters.

Proposition 2 *Full communication occurs in a most informative equilibrium if and only if:*

   (i) at least one of the senders is central: $\sigma_1 = 0$ and/or $\sigma_2 = 0$; or

   (ii) the senders are oppositional and not too polarized: $\sigma_1 > 0 > \sigma_2$ and
      $\sigma_2 \in [\sigma_2^C \left(\sigma_1 + \frac{1}{4} \right) + \frac{1}{4}, 0]$.

Full communication is facilitated by strategic listening because receivers are able to match with senders in a manner that provides the senders with perfectly balanced audiences. The first case simply states that if one of the senders has zero bias, full communication is possible. This follows since all receivers can listen to that sender and acquire full information. The second case, which comprises a large set of sender preference parameters as illustrated in Figure 1, leads to equilibria in which both senders attract receivers.[6] The set of sender biases which allows for full communication is exactly the set which allows for partial communication, shifted towards the origin. For example, in the case of a uniform bias distribution, this region simplifies to $\{(\sigma_1, \sigma_2) : \sigma_1 - \sigma_2 \le \delta\}$.

It is only when senders are (a) simply too polarized or (b) not oppositional that strategic listening falls short of being able to induce full communication. To understand case (a), note that in order for a sender with an extreme bias to have a balanced audience, this audience must have preferences very close to the sender's preference, and hence is very small. This

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[6]Note that Figure 1 only plots the 4th quadrant. Comunication can also occur for biases in the other 3 quadrants.
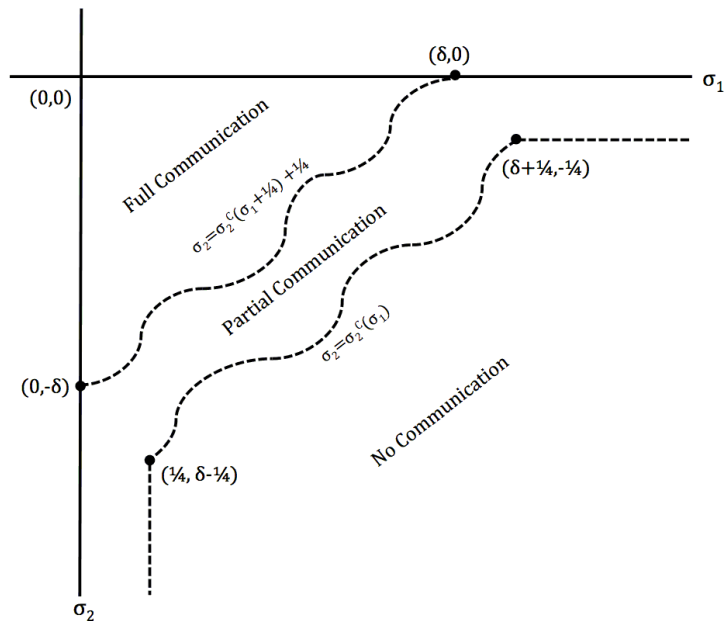
Figure 1: This figure depicts the regions in which partial, full, and no communication occur for a hypothetical distribution function yielding a boundary $\sigma_2 = \sigma_2^C(\sigma_1)$. Biases on this boundary are obtained by listening strategies in which all receivers above some threshold follow sender 1, and below which all receivers follow sender 2. The southwest boundary of the partial communication region is the graph of the function $\sigma_2 = \sigma_2^C(\sigma_1)$. It also includes the region where one of the senders' biases is no more than $\frac{1}{4}$ in magnitude. The boundary of the region in which full communication occurs is a shift towards the origin of the curve $\sigma_2 = \sigma_2^C(\sigma_1)$. Note that the full communication region also includes the axes, when one of the senders' biases equals zero.

inevitably leaves the other sender with the large majority of the population, and hence, her audience will have an average bias of close to zero. In general, as the bias of one of the senders grows extreme, providing that sender with a balanced audience imposes that the other sender's audience has a bias closer to zero. In case (b), senders are not oppositional such that balance is impossible to achieve because the mass of receivers with biases on the other side of the spectrum is simply too large to be balanced by the mass of receivers that are on the same side of the spectrum as the two senders. That is, providing one of the senders with a balanced audience requires that the other sender have an audience with a bias on the other side of the spectrum, precluding full communication by both senders.

The improvement of the information environment caused by the introduction of an additional sender provides a counter argument to assertions that a plethora of biased infor-

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mation providers leads to a less informed populous. Instead, it suggests that the populous may become more informed by the presence of additional biased information providers because strategic listening makes those providers more credible information sources for their respective audiences. Of course, this observation is predicated upon the assumption that individuals seek out information via their listening choices, as opposed to, say, psychological validation of their priors. Moreover, this result implies that a pundit who is ultimately concerned about the collective actions of the population as a whole is likely to value a competitor. In particular, given that senders are better off ex-ante when receivers obtain more information, and that a competitor results in more informed receivers, each sender can be made better off by the presence of a competing sender.

3.4.2 Audience Characteristics

Having established the extent to which information can be conveyed in the presence of strategic listening, we turn attention to characterizing the audience that each sender attracts. We consider first which types of receivers align with each sender in a most informative equilibrium and begin by characterizing the unique alignment of receivers with senders for cases where some communication of information occurs, but full information is not feasible.

Proposition 3 *If partial (i.e., not full) communication occurs in a most informative equilibrium and senders have different biases, the alignment of receivers with senders in any most informative equilibrium is characterized by a unique threshold bias, b_T, such that all receivers with $b < b_T$ listen to the sender with the lowest bias and those with $b > b_T$ listen to the sender with the highest bias.*

While the proposition is intuitive in a visual sense - receivers with high biases listen to senders with high biases, and vice versa - the underlying intuition is somewhat more nuanced. In particular, for partial, but not full communication to be feasible, senders must have biases that are sufficiently polarized (but not too much to preclude communication). Since it is not possible to provide a perfectly balanced audience to both senders, it has to be the case that both senders have an audience that has a less extreme average preference. Therefore,
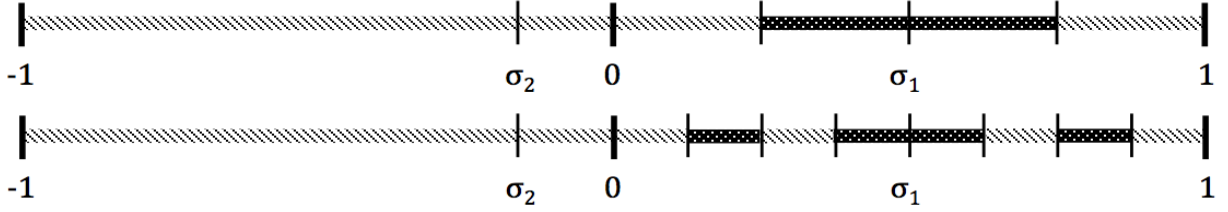
Figure 2: In this figure, the light shaded region represents P_2, while the dark shaded region represents P_1. Given sender biases $\sigma_2 = -\frac{1}{6}$ and $\sigma_1 = \frac{1}{2}$, the two partitions represented in the diagram are all equilibria.

senders will communicate more information when their audience becomes more extreme and the most extreme audience for both senders is one that is characterized by a threshold as in Proposition 3.

In contrast, when full communication is feasible, there is no unique alignment of receivers with senders that supports full communication as an equilibrium. In fact, the possible alignments are not even finite. To illustrate, consider the two equilibrium alignments depicted in Figure 2 for the case in which receiver types are uniformly distributed in the interval $[-1, 1]$, $\sigma_1 = \frac{1}{2}$, and $\sigma_2 = -\frac{1}{6}$. Let P_j denote the set of receivers that listen to sender j. In Figure 2, the dark shaded regions in the diagram represent P_1, while the light shaded regions represent P_2. In the first equilibrium depicted, $|E(b|b \in P_1) - \sigma_1| = |E(b|b \in P_2) - \sigma_2| = 0$. In particular, P_1 is an interval centered around σ_1, while P_2 is the union of two intervals, with mean σ_2. Since the average receiver bias is equal to the sender bias in each partition, there exists a full communication equilibrium. In the second example, full communication occurs again, i.e., $|E(b|b \in P_1) - \sigma_1| = |E(b|b \in P_2) - \sigma_2| = 0$, but P_1 and P_2 are now unions of several intervals. In fact, we can easily find an infinite number of full communication equilibria given this set-up because there are an infinite number of ways to allocate the population of receivers to achieve $|E(b|b \in P_1) - \sigma_1| = |E(b|b \in P_2) - \sigma_2| = 0$.

Although the sender and receiver alignment in a most informative equilibrium is unique only in certain cases, the proportion of receivers listening to each sender can always be characterized as long as some information is communicated in equilibrium. In any equilibrium,

it must be true that

$$\lambda_1 \mu_1 \left(\boldsymbol{\pi} \left(b \right) \right) + \lambda_2 \mu_2 \left(\boldsymbol{\pi} \left(b \right) \right) = 0, \tag{3}$$

where λ_j is the proportion of receivers who listen to sender j. In addition, it must be the case that $\mu_1 \left(\boldsymbol{\pi} \left(b \right) \right)$ and $\mu_2 \left(\boldsymbol{\pi} \left(b \right) \right)$ are the same across all most informative equilibria. Lemma 3 follows directly.

Lemma 3 *When $\sigma_1 \neq \sigma_2$, the proportions of receivers who listen to each sender are identical across all most informative equilibria.*

Lemma 3 states that, even though there may be multiple ways to allocate the receivers to senders to maximize credible communication, the share of receivers that listen to each sender is constant. In the case that $\sigma_1 = \sigma_2$, the proportions of receivers who listen to each sender are not unique.

With the proportion of receivers who listen to each sender fixed across all most informative equilibria, we can determine the exogenous determinants of those proportions.

Proposition 4 *Assume both senders are followed by some receivers in the most informative equilibrium and that some information is communicated. Then, i) the sender with bias closest to the average receiver bias attracts the largest proportion of receivers as listeners, and ii) the proportion is strictly decreasing in the distance between that sender's bias and the average receiver bias.*

The reasoning underlying Proposition 4 stems from the fact that it is more difficult to provide more extreme senders with a well balanced listenership when they attract a larger proportion of receivers. For example, consider a sender with a bias that is towards the left (right) end of the spectrum (i.e., closer to $-\delta$ (δ)). Obtaining such a balance is difficult because the are simply too few receivers who are further to the left (right) of that sender.

As a final aside, the case where one sender is followed by all receivers in the most informative equilibrium is fairly obvious. In that case, the sender who attracts all the receivers is the one with a bias closest to the receivers' average bias, which is consistent with the finding in Proposition 4 for the case where both senders have an audience.

4 Endogenous Sender Preferences

As an extension of our primary model, we investigate the ex ante choices of sender preferences. Our interest in this extension stems from the observation that media companies or, perhaps to a lesser extent, brokerage houses, benefit from attracting the attention of a larger audience. Moreover, in order to attract a larger audience, such companies may hire pundits or analysts who provide information that is slanted by a particular point of view. To add sender preference choices to the primary model, we introduce two competing parties who each select the preference parameter of their respective sender in an initial stage to maximize their sender's audience. The questions we seek to answer are: i) where do the parties position their senders? and, more importantly, ii) how much information is ultimately conveyed by those senders?

Formally, we assume that the two parties, 1 and 2, simultaneously select the bias for their respective senders, σ_1 and σ_2, after which the strategic listening and communication game commences. Each party's objective is to maximize the proportion of receivers who listen their receiver, which is consistent with media companies that are primarily concerned with attracting audiences. The two parties' preference choices are observable and, consistent with our earlier analysis, each party assumes a most informative equilibrium is played in the listening and communication subgame. Finally, we assume that if identical bias parameters are selected for each sender, the two senders evenly split the receivers who listen to the two senders, which is sufficient to establish a unique equilibrium. We briefly discuss this assumption later in the text.

An equilibrium is defined as a set of two sender preferences, sender reporting strategies, and receiver listening and action strategies such that: (i) the equilibrium conditions imposed for the primary model are satisfied and (ii) given party j's sender preference parameter, party i's sender preference parameter maximizes i's audience when a most informative equilibrium is played.

4.1 Centrality

Proposition 4 suggests that the sender with bias closest to the average receiver's preference attracts the largest audience. This suggests that the two parties will push their respective sender preferences towards the average receiver preference, which proves to be correct.

Proposition 5 *In any equilibrium in the preference choice game, each sender's preference is central, i.e., $\sigma_1 = \sigma_2 = 0$.*

The centrality result in Proposition 5 is a direct consequence of assuming that a most informative equilibrium is played in the listening and communication game. The essence of the proof is as follows. Suppose that sender 1 chooses $\sigma_1 \neq 0$, and sender 2 chooses $\sigma_2 \neq 0$. Then, sender 1 (or, alternatively, sender 2) can deviate to choosing a bias of 0 because the most informative strategic listening equilibrium when $\{\sigma_1 = 0, \sigma_2 \neq 0\}$ is for receivers to jointly listen to sender 1 and for sender 1 to fully communicate.

The centrality result in Proposition 5 appears to be a variant of Hotelling's Law, which suggests that two competing firms will strategically co-locate at the midpoint of a street or product spectrum. The underlying determinant of the centrality outcome in our information game, however, is substantively different. In particular, in Hotelling's set up, customers purchase from the firm that is closest to them in distance or on the product spectrum (Hotelling, 1929). As a consequence, if neither firm is centrally located, one firm can always capture more customers by moving inward. In contrast, in our setting, receivers strategically listen so that their sender has a well balanced audience, which maximizes the information communicated by their sender. When positioned closer to the average receiver preference, a sender can accommodate a larger audience while still maintaining a balanced audience.

The centrality result is consistent with the evidence that local media sources conform to the bias of the regional populace (see Dalton et al., 1998). The fact that these sources may choose biases to pander to local norms may lead to literal messages that appear very "biased" to outsiders. What is important, however, is whether these messages convey the sources' underlying information. If local constituents are able to filter these biased messages

appropriately, which is an assumption in the cheap talk framework, the "biased" messages will convey much or all of the sender's information. For instance, a "right wing" media source may simply take its information and add a large, right wing bias to that information. As long as its viewers can filter this bias, they can adapt their action choices to the underlying state.

We conclude our discussion of the centrality result by noting that one aspect of it is importantly tied to the assumption that the senders split their combined audience if they have identical preference parameters. If this assumption were relaxed so that the two parties can anticipate audiences not being evenly split in the event the senders have identical preferences, it is possible for there to be equilibrium in which one sender j is central, while the sender i is not central. Such an equilibrium can be sustained as long as party i believes that sender j will attract the entire audience if sender i is also central. Note, however, that all receivers listen to a centrally located sender in such an equilibrium, just sender j in this case, and all receivers obtain perfect information as well. Hence, these essential elements of the centrality result are preserved.

4.2 Deviations from Centrality

While the centrality result in Proposition 5 is consistent with some information markets, it is undoubtedly the case that some information providers appear to have preferences which diverge from those of the average receiver in their populace. Hence, we consider the centrality finding in Proposition 3 to be a benchmark of sorts and consider some reasons why that result may not hold.

4.2.1 Binary Action Choice

One critical feature that drives the centrality result is the fact that agent action choices are continuous and unbounded. In our model, the value of information is the same to every receiver because these receivers respond linearly to the information, independent of their

bias. To provide some intuition for how the assumption is important for centrality, we consider a version of our primary model but restrict the action choices of the receiver to bivariate. This example is consistent with a setting in which, say, the receiver votes in favor of or against a proposal, votes for one of two political parties, or buys a stock or does not buy a stock. When action choices are bivariate, a sufficiently biased receiver may not respond to all but the most extreme information and hence may not find it worthwhile to listen to central senders. Consequently, centrality may no longer be sustained.

To illustrate this reasoning formally with an example, assume that each receiver's action a_i is constrained to the set $\{0,1\}$ and that $\delta < \frac{1}{2}$.[7] Given these assumptions, a receiver with bias b_i chooses to take action 0 when $E[\theta|m] + b_i < \frac{1}{2}$ and 1 otherwise. Furthermore, because the action space is binary, the sender will try to convince as many receivers as possible to take the action that they prefer. This effectively constrains the message space to contain at most two distinct messages - take action 1 or take action 0. As a result, the information transmitted by a sender is of most value to receivers with biases similar to that of the sender, and will have no value to a receiver whose preferences diverge sufficiently from those of the sender.

Within the context of this illustrative example, we offer the following observation pertaining to cases where the distribution of receiver biases is uniform, symmetric and strictly quasiconcave, or symmetric and strictly quasiconvex.

Remark 2 *Suppose the receivers' action choice is binary, $\{0,1\}$, and that $\delta < \frac{1}{2}$.*

1. *For a symmetric, strictly quasiconcave bias distribution, the unique equilibrium is $(\sigma_1, \sigma_2) = (0,0)$.*

2. *For a uniform bias distribution, any pair $(\sigma_1, \sigma_2) \in \left[0, 2\delta - \frac{1}{2}\right) \times \left(-2\delta + \frac{1}{2}, 0\right]$ is an equilibrium.*

3. *For a symmetric, strictly quasiconvex bias distribution, the unique equilibrium is $(\sigma_1, \sigma_2) = \left(\max\left(2\delta - \frac{1}{2}, 0\right), \min(-2\delta + \frac{1}{2}, 0)\right)$.[8]*

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[7] Assuming $\delta < \frac{1}{2}$ is without loss of generality as receivers with biases greater in magnitude than $\frac{1}{2}$ always take the same action independent of the information they receive.

[8] Note that a symmetric, differentiable quasiconvex distribution function will be decreasing below 0 and

To understand the remark, consider a thought experiment where the two sender preferences are equidistant from 0 on opposite sides. A sender whose preference moves towards the center will loose audience members in the tail but attract members in the center. When the distribution is quasiconcave, i.e., is concentrated towards the center, the centrality result still holds because the loss in the tail is relatively small compared to the gain in the center. With a uniform bias distribution, the loss exactly equals the gain so a non-central equilibrium can be sustained. Finally, when the distribution is quasiconvex, the loss exceeds the gain and the unique equilibrium is one where senders choose extreme positions. That is, each party picks a sender to cater to one wing of the polarized population.

4.2.2 Uncertain Preference Distribution

In all of our analysis to this point, we have also assumed that the parties selecting the senders' biases have perfect knowledge of the distribution of the biases in the population of receivers. As a result, they are able to determine the bias that enables their sender to fully communicate when the entire population of receivers listens to them, i.e., they know the average bias in the population. It could be, however, that there is uncertainty about the receivers' biases at the time the senders' biases are chosen. For instance, when hiring a pundit, a media corporation may be unsure of how the political climate will evolve over the pundit's tenure. Consequently, they may be unable to choose a bias that enables them to fully communicate in all states of the world.

In order to illustrate how uncertainty over the receiver bias distribution might alter the centrality result, we again provide an example. Assume that the receiver bias distribution is uniform with support $[-\delta + \psi, \delta + \psi]$, where ψ is the realization of a random variable $\tilde{\psi}$ that is uniformly distributed on $[-\kappa, \kappa]$ and $\delta > 2\kappa$. Further, assume the realization for $\tilde{\psi}$ is observed by all parties after the sender bias is chosen, but prior to the sender/receiver listening and communication decisions. These assumptions are consistent with the notion

increasing above 0. Likewise, a symmetric, differentiable, quasiconcve distribution function will be increasing below 0 and decreasing above 0.

of media corporations being unaware of the future political climate when hiring a pundit, but with the pundit being aware of the political climate she faces when broadcasting occurs. Finally, assume that the parties choosing the senders' biases are risk neutral in that they act to maximize the expected measure of receivers who listen to their sender.

Due to the symmetry of the distribution of $\tilde{\psi}$ around zero, the natural candidate for a "central" equilibrium would be one in which both senders biases are chosen to be 0. That candidate, however, may fail to be an equilibrium. To see why, conjecture an equilibrium in which each sender has bias of 0 and assume $\kappa > \frac{1}{4}$. Given that $\left|\sigma_j - \mu_j\left(\boldsymbol{\pi}\left(b\right)\right)\right| > \frac{1}{4}$ implies that a sender fails to communicate information in equilibrium regardless of the behavior of the other sender, it follows that neither sender can communicate any information when $\psi > \frac{1}{4}$ or $\psi < -\frac{1}{4}$. By choosing a bias in the upper tail, however, the sender can attract all receivers when $\psi > \frac{1}{4}$ at the cost of losing the receivers they would attract when ψ takes on a value close to 0. Sometimes this trade-off is worthwhile.

Remark 3 *Assume the receiver bias distribution is distributed uniformly over $[-\delta + \psi, \delta + \psi]$, where ψ is the realization of a random variable $\tilde{\psi}$ that is uniformly distributed on $[-\kappa, \kappa]$ and $\delta > 2\kappa$, and that the realization of $\tilde{\psi}$ is observed prior to the sender bias choice but before receiver listening and sender communication decisions. In any equilibrium in the bias choice game, $\sigma_j = \max\left(\kappa - \frac{1}{4}, 0\right)$ and $\sigma_k = \min\left(-\kappa + \frac{1}{4}, 0\right)$, where $j \in \{1, 2\}$, $k \in \{1, 2\}$, and $j \neq k$.*

Remark 3 not only demonstrates that uncertainty about the distribution of receiver preferences can negate centrality of sender preferences, but it also suggests when we should observe deviations from centrality. In particular, such deviations will be observed when the uncertainty about the receiver population distribution is sufficiently large.

5   Information and Entertainment

Individuals not only read or listen to a particular individual for information, they also may do so because they prefer how that individual writes, speaks, spins, or otherwise conveys their information. In addition, individuals may have some psychological predisposition to listen

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to those with similar preferences.[9] We refer to these benefits as the entertainment benefit, which merely captures the idea the information is often bundled with a non-information consumption good. Given the plausibility of such bundling, we extend our primary model to address how the existence of entertainment benefits alters the nature of sender audiences, as well as the information conveyed by senders to their respective audiences.

To analyze how the bundling of information with entertainment influences the information environment and the nature of senders' audiences, we augment each receiver's objective in our base model by incorporating an explicit entertainment benefit that is determined by the distance between the receiver's and sender's preferences. Formally, assume that a receiver of type b seeks to choose a sender that maximizes the expectation of

$$ - (a_b - \theta - b)^2 + \alpha \left(\beta - (b - \sigma_j)^2 \right), \tag{4} $$

where j is the sender the receiver of type b listens to, the term $\alpha \left(\beta - (b - \sigma_j)^2 \right)$ represents the entertainment benefit type b receivers obtain from listening to sender j, $\alpha > 0$, and $\beta > 2\delta$. It follows from the objective that the receiver's benefit from listening to sender j is decreasing in the divergence between the receiver's and sender j's preferences. The assumption $\beta > 2\delta$ ensures that a receiver always prefers to listen to a sender than not.

Inherent to the objective function is the notion that individuals obtain a greater entertainment benefit from listening to a sender who has similar preferences. This assumption is arguably reasonable in that individual preferences are likely correlated with preferences regarding how information is conveyed. For example, individuals who watched the Daily Show with Jon Stewart likely had policy preferences similar to Stewart's preferences as well as how having a preference for how he delivered his stories, whereas individuals who watched The O'Reilly factor with Bill O'Reilly had policy preferences similar to O'Reilly's preferences as well as having a preference for how he delivered his stories. Similarly, an investor who

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[9]In the literature on media bias, Mullainathan and Shleifer (2005) and Bernhardt et al. (2008) consider models where individuals inherently prefer media sources that have biases similier to their own, which is consistent with our notion of an entertainment benefit.

adopts a value perspective is likely to read the reports of an analyst who writes from the value perspective, whereas an investor who adopts a growth or momentum perspective is likely to read the reports of an analyst who writes from the growth or momentum perspective.

Based on our notion of entertainment, we highlight some equilibrium characteristics and contrast them with the primary setting in which there is no entertainment benefit associated with listening to a particular sender. Unlike the primary setting, we begin by discussing some of the audience characteristics of any equilibrium and then turn to the nature of the information conveyed. We flip the order of presentation because, in this setting, the nature of the audience is primarily attributable to the entertainment benefit offered by each sender to each receiver.

Audience Characteristics

As we show above, when a receiver chooses which sender to listen to solely based upon information content, a sender's audience may not be clearly defined in the sense that equilibria with full communication can be characterized by a variety of allocations of receivers to senders. In contrast, Lemma 4 shows that both senders' audiences are clearly defined when receivers obtain an entertainment benefit from listening, regardless of the amount of information conveyed in equilibrium.

Lemma 4 *When receivers obtain entertainment benefits from listening to a particular sender and senders have different biases, $\sigma_2 < \sigma_1$, any equilibrium is characterized by a threshold receiver type, b_τ, such that all receivers with $b < b_\tau$ listen to sender 2 and those with $b > b_\tau$ listen to sender 1.*

The proposition shows that independent of σ_1 and σ_2, receivers with high biases listen to the sender with a high bias, sender 1, and vice versa, as was the case in Proposition 3. It is straightforward to see why a threshold equilibrium has to arise when receivers obtain an entertainment benefit. First, note that the value of the information communicated by one sender to all receivers that listen to this sender is the same. Second, assume a receiver of type $b = \tau$ prefers to listen to sender 2. It has to be the case that, as a result of the entertainment

benefit, all receivers of type $b < \tau$ have an even stronger preference for sender 2. Finally, we point out that in the special case where sender biases are identical, $\sigma_1 = \sigma_2$, equilibria not involving a threshold can exist. For example, if $\sigma_1 = \sigma_2 = 0$, there exists an equilibrium in which half of all receiver types listen to each sender and each sender fully communicates.

While Lemma 4 implies that entertainment benefits generally lead to threshold equilibria, it does not address the question of which sender attracts a larger audience. When α grows very large, the information content becomes virtually irrelevant, and the equilibrium threshold approaches the midpoint of the senders' biases, $\frac{\sigma_1 + \sigma_2}{2}$. Thus, as is the case in absence of an entertainment benefit, the sender whose bias is closest to the average receiver bias, 0, attracts a larger audience. Surprisingly, this need not be the case for a finite value of α. That is, even though a complete interest in information, $\alpha = 0$, and or a complete focus on entertainment benefit, $\alpha \to \infty$, each imply that the sender with bias closest to the average receiver bias has the largest audience, a presence of both forces does not lead to the same outcome.

To illustrate this point, consider the case in which receivers' biases are uniformly distributed, $\delta = 1$, $\sigma_1 = 0.6$, $\sigma_2 = -0.01$, and $\alpha = 0.1$. In this setting, there is a unique equilibrium threshold given by $b_\tau = -0.069$. As a consequence, sender 1 attracts slightly more than half of the receivers even though sender 1's bias is further from the population mean than sender 2's bias. In this equilibrium, sender 1 has a balanced audience and provides close to full information, while sender 2 has an imbalanced audience. Hence, the threshold receiver $b_\tau = -0.069$ favors sender 1 based on his concern for information. On the other hand, he prefers sender 2 from an entertainment perspective, since $b_\tau = -0.069$ is much closer to $\sigma_2 = -0.01$ than $\sigma_1 = 0.6$. Combining these two forces, he is indifferent between the two senders.

Information

When news is bundled with entertainment, receiver preferences for entertainment might be expected to sway their listening strategies. For example, a receiver may now listen to a less informative sender due to a greater entertainment benefit, which could be detrimental to credible information dissemination.

In the setting without any entertainment benefits, defining a measure that captures the extent to which receivers are informed is straightforward because all receivers obtain the same quality of information in any equilibrium. Furthermore, we focused on the most informative equilibrium because it is naturally focal in the sense that all parties are ex ante better off if the most informative equilibrium is played. In contrast, the introduction of entertainment benefits generally results in receivers obtaining different levels of information in an equilibrium (i.e., one sender provides higher quality information but the other sender still attracts receivers who find that sender sufficiently entertaining) and receivers may rank the equilibria differently because of differential entertainment benefits. Hence, defining what is meant by more informed receivers is not straightforward. Nonetheless, we are able to conduct a couple of thought experiments that allow us to provide some insight into how entertainment benefits affect the information conveyed in equilibrium.

Consider first the cases where full communication is fostered by strategic listening in the absence of an entertainment benefit. As demonstrated by Proposition (2), the set of cases is large in the sense that the set of sender biases (i.e., the set of $\{\sigma_1, \sigma_2\}$ pairs) for which a full communication equilibrium exists is a significant proportion of the set of possible sender biases (i.e., $\mathbb{R}^2$). Furthermore, given any pair of sender biases for which full communication is feasible, full communication can be attained with a wide variety of receiver allocations across senders. In the presence of an entertainment benefit, however, the only equilibria that may arise are threshold equilibria, which limits the set of receiver allocations significantly and does not permit a full communication equilibrium to arise in most cases. In particular, note that the only (σ_1, σ_2) that allow for full communication equilibria that are, at the same time,

threshold equilibria, are those on the border between the full communication and partial communication regions in Figure 1. As a consequence, full communication arises only as a knife-edge case when receivers obtain an entertainment benefit.

Proposition 6 *Consider the case in which full communication is achievable when receivers obtain no entertainment benefit. The information communicated to any receiver will be strictly reduced by the presence of an entertainment benefit almost surely: the set of (σ_1, σ_2) such that full communication can be achieved in the presence of an entertainment benefit has Lebesgue measure zero in $\mathbb{R}^2$.*

On the other hand, when full communication is not possible, the impact of bundling news and entertainment on communication is not as clear. When only partial communication is possible in the absence of an entertainment benefit, the most informative equilibrium listening strategies are characterized by a threshold type (see Proposition 3). Hence, the fact that an entertainment benefit constrains equilibria to thresholds does not inherently hinder strategic listening. Moreover, in the absence of entertainment, communication is limited by the equilibrium constraints that either (i) both senders must communicate the same level of information in an equilibrium or (ii) one sender is listened to by all receivers. Entertainment benefits may relax these constraints and, therefore, allow for greater levels of communication.

To demonstrate, consider the case in which the distribution of receiver biases is uniform. Moreover, assume that $\delta = 4$, $\sigma_1 = \frac{15}{4}$, and $\sigma_2 = -1$. Applying Proposition 1, it can be shown that the difference in the senders' biases is large enough that no information will be communicated in the absence of an entertainment benefit.[10] On the other hand, as the entertainment benefit grows large, i.e., $\alpha \to \infty$, the equilibrium threshold approaches the midpoint $\frac{\sigma_1 + \sigma_2}{2} = \frac{11}{8}$. For this threshold, the average bias of receivers listening to sender 2 is $\frac{\frac{11}{8} - 4}{2} = -\frac{21}{16}$, which enables sender 2 to communicate a nontrivial amount of information to her audience.

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[10]Technically, in the case of a uniform distribution, the curve $\sigma_2^C (\sigma_1) = \sigma_1 - \delta$. Hence, $\sigma_2 = \sigma_1 - \frac{19}{4} < \sigma_1 - \delta$.

On the other hand, it may still be the case that adding an entertainment benefit reduces communication. To see this, again consider the case of a uniform bias distribution, but now assume that $\delta = 4$, $\sigma_1 = 3$, and $\sigma_2 = -\frac{9}{8}$. In this case, the equilibrium in the absence of communication benefits is characterized by the threshold $\frac{15}{8}$, enabling partial communication by both senders. On the other hand, as the entertainment benefit grows large, i.e., $\alpha \to \infty$, the equilibrium threshold approaches the midpoint $\frac{\sigma_1+\sigma_2}{2} = \frac{15}{16}$, which leads to no communication by either sender.

In summary, when strategic listening determines audiences, bundling news and entertainment will hinder communication when senders can obtain perfectly balanced audiences in the absence of entertainment. In contrast, when it is impossible for the senders to obtain perfectly balanced audiences in the absence of entertainment, the impact of an bundling entertainment with news on communication is ambiguous, and may actually increase communication by relaxing the constraint that all senders' broadcasts are equally informative.

6   Conclusion

The cheap talk literature has investigated settings with a single receiver and a single sender (Crawford and Sobel, 1982), multiple receivers and a single sender (Farrell and Gibbons, 1989), and a single receiver and multiple senders (Battaglini, 2002). We extend this literature to study a setting in which a continuum of receivers choose to listen to one of multiple available information sources, with the goal of maximizing the information they acquire. This reflects a variety of empirical settings in which receivers are not simply exogenously paired with a sender, but rather have an element of choice in who provides them with their information. We find that it may be possible for senders to fully communicate even when their preferences deviate from the average receiver preference because senders only care about the average preference of the receivers that follow them. Hence, as long as there exists a possible pairing between senders and receivers such that the average preferences between the

senders and receivers are equal, full communication is possible. We find that such pairings exist for a wide range of sender biases, including biases for which single-sender cheap talk models would suggest no communication is possible. We also find, however, that when receivers obtain an entertainment benefit from listening to a sender, full communication is less likely to occur.

Our model suggests that market forces may naturally lead senders to have slants that maximize communication, the Pareto dominant outcome. We find that when information sources choose their slant with the intention of maximizing their audience, competition naturally leads them to choose preferences that are "central," i.e., equal to the population mean. Finally, when receiver action choices are binary instead of continuous or when senders are uncertain about the average preference in the population, sender slants may be opposing rather than central. However, even in these cases senders' slants maximize the expected amount of communication that can occur. Hence, market forces may be capable of overcoming the communication frictions that result from divergent preferences.

Finally, in some settings receivers choose senders not only to learn information but also to be entertained (e.g., talk shows). We find that including an entertainment benefit reduces the possibility of full communication to knife-edge cases (similar to those in the prior literature where all receivers listen to all senders). However, our model also suggests that an entertainment benefit can improve partial communication because equilibria are possible where senders communicate with different precision.

Appendix

Proof of Lemma 1. Note that the receivers' actions given a message m are $a_b = E(\theta|m; \hat{m}(j, \theta)) + b$. Thus, senders' loss functions can be written:

$$\int_{-\delta}^{\delta} -(E(\theta|m; \hat{m}(j, \theta)) + b - \theta - \sigma_j)^2 \pi_j(b) f(b) db$$
$$\equiv \hat{U}_j^S(E(\theta|m; \hat{m}(j, \theta)) - \theta - \sigma_j)$$

We show that this utility function leads to the same "Crawford-Sobel arbitrage conditions" as the utility function of a sender who faces a single receiver with bias $\mu_j(\boldsymbol{\pi}(b)) = \frac{\int_{-\delta}^{\delta} b\pi_j(b) f(b) db}{\int_{-\delta}^{\delta} \pi_j(b) f(b) db}$, $-(E(\theta|m; \hat{m}(j, \theta)) + \mu_j(\boldsymbol{\pi}(b)) - \theta - \sigma_j)^2$, and therefore, the partition equilibria are identical in the two cases.[11] These arbitrage conditions when the sender faces a single receiver with bias $\mu_j(\boldsymbol{\pi}(b))$, for partition elements $\{t_k\}$ (see Crawford and Sobel (1982) page 1441), are:

$$-(E(\theta|\theta \in (t_{k-1}, t_k)) + \mu_j(\boldsymbol{\pi}(b)) - t_k - \sigma_j) = E(\theta|\theta \in (t_k, t_{k+1})) + \mu_j(\boldsymbol{\pi}(b)) - t_k - \sigma_j$$

Returning to the case of multiple receivers, note that $\hat{U}_j^S(E(\theta|m; \hat{m}(j, \theta)) - \theta - \sigma_j)$ achieves its maximum at the point $E(\theta|m; \hat{m}(j, \theta)) - \theta - \sigma_j = -\mu_j(\boldsymbol{\pi}(b))$. To see this, note:

$$\left[\frac{\partial}{\partial y} \hat{U}_j^S(y)\right] = 0$$
$$\Leftrightarrow \int_{-\delta}^{\delta} -2(y + b) \pi_j(b) f(b) db = 0$$
$$\Leftrightarrow \left[\int_{-\delta}^{\delta} \pi_j(b) f(b) db\right] y + \int_{-\delta}^{\delta} b\pi_j(b) f(b) db = 0$$
$$\Leftrightarrow y = -\mu_j(\boldsymbol{\pi}(b))$$

---

[11] Clearly, the utility function we consider satisfies the requisite supermodularity conditions in Crawford and Sobel (1982) to guarentee that all equilibria are partition equilibria.

Furthermore, $\hat{U}_j^S$ is symmetric around $-\mu_j(\boldsymbol{\pi}(b))$ since it is quadratic. Hence, for type t_k to be indifferent between sending a message corresponding to $\theta \in (t_{k-1}, t_k]$ and a message corresponding to $\theta \in (t_k, t_{k+1}]$, we must have:

$$\hat{U}_j^S\left(E\left(\theta | \theta \in (t_{k-1}, t_k)\right) - t_k - \sigma_j\right) = \hat{U}_j^S\left(E\left(\theta | \theta \in (t_k, t_{k+1})\right) - t_k - \sigma_j\right)$$

which is equivalent to

$$\Leftrightarrow -\left(E\left(\theta | \theta \in (t_{k-1}, t_k)\right) - t_k - \sigma_j - \mu_j(\boldsymbol{\pi}(b))\right) = E\left(\theta | \theta \in (t_k, t_{k+1})\right) - t_k - \sigma_j - \mu_j(\boldsymbol{\pi}(b))$$

∎

In order to establish the rest of the results in the paper, it helps to first establish some notation and some preliminary results. Call a listening strategy $\boldsymbol{\pi}(b)$ complete if it satisfies $\pi_1(b) + \pi_2(b) = 1$ for all $b \in [-\delta, \delta]$. Let R be the set of measurable functions. For a complete listening strategy $\boldsymbol{\pi}(b)$, define $\lambda_1, \lambda_2 : R \times R \longrightarrow [0, 1]$ to equal $\lambda_1(\boldsymbol{\pi}(b)) = \int_{-\delta}^{\delta} \pi_1(b) f(b) \, db$, and $\lambda_2(\boldsymbol{\pi}(b)) = 1 - \lambda_1(\pi)$. That is, $\lambda_1(\boldsymbol{\pi}(b))$ is the measure of receivers listening to sender 1 and $\lambda_2(\boldsymbol{\pi}(b))$ is the measure of receivers listening to sender 2 under the listening strategy $\boldsymbol{\pi}(b)$.

We first wish to characterize the possible pairs of average biases $(\mu_1(\boldsymbol{\pi}(b)), \mu_2(\boldsymbol{\pi}(b)))$ which can be attained by some complete listening strategy $\boldsymbol{\pi}(b)$ of the receivers, with both senders attracting a strictly positive measure of receivers, i.e., $\lambda_1(\boldsymbol{\pi}(b)) \in (0, 1)$. More formally, we wish to characterize the set of pairs (E_1, E_2) such that there exists a complete listening strategy $\boldsymbol{\pi}(b)$ of the receivers which satisfies:

$$\mu_1(\boldsymbol{\pi}(b)) = E_1,$$
$$\mu_2(\boldsymbol{\pi}(b)) = E_2,$$

and $\lambda_1(\boldsymbol{\pi}(b)) \in (0, 1)$. Refer to this set as A. Note that without loss of generality, we

consider the case in which $E_1 \geq 0 \geq E_2$; by the law of iterated expectations, there do not exist any complete listening strategies $\boldsymbol{\pi}(b)$ with $\mu_1(\boldsymbol{\pi}(b))$ and $\mu_2(\boldsymbol{\pi}(b))$ on the same side of zero. Moreover, we consider here only the case in which $E_1 > 0 > E_2$; we separately consider the cases in which these expectations may be zero later. The following lemma states that A is a set such that E_1 and E_2 are not too distant.

Lemma 5 *There exists a strictly increasing, negative, and differentiable function $\sigma_2^C(\sigma_1)$ such that $A = \left\{ (E_1, E_2) : E_1 \in (0, \delta), E_2 \in (-\delta, 0), E_2 \geq \sigma_2^C(\sigma_1) \right\}$.*

Proof. Trivially, all $(E_1, E_2) \in A$ must satisfy $E_1 < \delta$ and $E_2 > -\delta$; for instance, any allocation $\boldsymbol{\pi}(b)$ with $\mu_1(\boldsymbol{\pi}(b)) = \delta$ would have $\lambda_1(\boldsymbol{\pi}(b)) = 0$. Therefore, fix any $\hat{E}_1 \in (0, \delta)$. We aim to characterize the set of E_2 such that $\left(\hat{E}_1, E_2 \right) \in A$. In order to do so, we proceed in a series of steps. We first show that, as a consequence of the law of iterated expectations, finding the set of E_2 such that $\left(\hat{E}_1, E_2 \right) \in A$ is equivalent to finding the range of λ such that there exists a complete listening strategy $\boldsymbol{\pi}(b)$ with $\lambda_1(\boldsymbol{\pi}(b)) = \lambda$ and $\mu_1(\boldsymbol{\pi}(b)) = \hat{E}_1$. We then show that the largest such λ, call it $\lambda^{\max}(E_1)$, is attained when $\boldsymbol{\pi}(b)$ satisfies $\boldsymbol{\pi}(b) = (1, 0)$ on an interval $[\gamma, \delta]$ and $\boldsymbol{\pi}(b) = (0, 1)$ on $[-\delta, \gamma)$. Finally, we show that any $\lambda \in (0, \lambda^{\max}(E_1)]$ can be attained by some complete listening strategy $\boldsymbol{\pi}(b)$.

Observation 1 *There exists a complete listening strategy $\boldsymbol{\pi}(b)$ that satisfies $(\mu_1(\boldsymbol{\pi}(b)), \mu_2(\boldsymbol{\pi}(b))) = (E_1, E_2)$ if and only if there exists a complete listening strategy $\boldsymbol{\pi}(b)$ which satisfies $\mu_1(\boldsymbol{\pi}(b)) = E_1$ and $\lambda_1(\boldsymbol{\pi}(b)) = \frac{E_2}{E_2 - E_1}$.*

Proof. This follows by the law of iterated expectations. For any complete listening strategy, we have that

$$\lambda_1(\boldsymbol{\pi}(b)) \mu_1(\boldsymbol{\pi}(b)) + (1 - \lambda_1(\boldsymbol{\pi}(b))) \mu_2(\boldsymbol{\pi}(b)) = 0$$
$$\implies \lambda_1(\boldsymbol{\pi}(b)) = \frac{\mu_2(\boldsymbol{\pi}(b))}{\mu_2(\boldsymbol{\pi}(b)) - \mu_1(\boldsymbol{\pi}(b))}$$
$$\implies \mu_2(\boldsymbol{\pi}(b)) = -\frac{\lambda_1(\boldsymbol{\pi}(b))}{(1 - \lambda_1(\boldsymbol{\pi}(b)))} \mu_1(\boldsymbol{\pi}(b))$$

The first equality implies that any complete listening strategy which has $(\mu_1(\pi(b)), \mu_2(\pi(b))) = (E_1, E_2)$ must satisfy $\lambda_1(\pi(b)) = \frac{E_2}{E_2 - E_1}$. The second inequality implies that any complete listening strategy which has $\mu_1(\pi(b)) = E_1$ and $\lambda_1(\pi(b)) = \frac{E_2}{E_2 - E_1}$ must satisfy $\mu_2(\pi(b)) = E_2$. This proves the claim. ∎

Our claim implies that finding the set of E_2 such that $\left(\hat{E}_1, E_2\right) \in A$ amounts to finding the range of $\lambda_1(\pi(b))$ that can be attained by complete listening strategies $\pi(b)$ with $\mu_1(\pi(b)) = \hat{E}_1$.

Observation 2 *The complete listening strategy $\pi(b)$ which maximizes $\lambda_1(\pi(b))$ subject to $\mu_1(\pi(b)) = E_1$ satisfies $\pi(b) = (1, 0)$ on an interval $\left[\gamma\left(\hat{E}_1\right), \delta\right]$ and $\pi(b) = (0, 1)$ on $\left[-\delta, \gamma\left(\hat{E}_1\right)\right)$.[12]*

Proof. First, note that the complete listening strategy $\pi(b)$ which maximizes $\lambda_1(\pi(b))$ subject to $\mu_1(\pi(b)) = \hat{E}_1$ must satisfy $\pi(b) = (1, 0)$ on the set $[\hat{E}_1, \delta]$. Otherwise, one could find another complete listening strategy $\pi'(b)$ with $\pi'(b) = (1, 0)$ on the set $[\hat{E}_1, \delta]$, as well as an additional set Z below $\hat{E}_1$ to guarantee that $\mu_1(\pi'(b)) = \hat{E}_1$. It is clear that such a set Z must always exist, because setting $\pi'(b) = (1, 0)$ on the entire interval $[-\delta, \delta]$ would yield $\mu_1(\pi'(b)) = 0 < \hat{E}_1$.

Next, note that the law of iterated expectations implies that for any listening strategy $\pi(b)$ with $\pi(b) = (1, 0)$ on the set $[\hat{E}_1, \delta]$, we have:

$$\left(\int_{-\delta}^{\hat{E}_1} f(b)\pi_1(b)\,db\right)\left(\hat{E}_1 - \frac{\int_{-\delta}^{\hat{E}_1} f(b)b\pi_1(b)\,db}{\int_{-\delta}^{\hat{E}_1} f(b)\pi_1(b)\,db}\right) = \left(\int_{\hat{E}_1}^{\delta} f(b)\,db\right)\left(\frac{\int_{\hat{E}_1}^{\delta} f(b)b\,db}{\int_{\hat{E}_1}^{\delta} f(b)\,db} - \hat{E}_1\right)$$

Trivially, $\frac{\int_{\hat{E}_1}^{\delta} f(b)b\,db}{\int_{\hat{E}_1}^{\delta} f(b)\,db} - \hat{E}_1 > 0$ and thus it must be the case that $\hat{E}_1 > \frac{\int_{-\delta}^{\hat{E}_1} f(b)b\pi_1(b)\,db}{\int_{-\delta}^{\hat{E}_1} f(b)\pi_1(b)\,db}$.

Hence, in order to maximize $\int_{-\delta}^{\hat{E}_1} f(b)\pi_1(b)\,db$ over all complete listening strategies $\pi(b)$, we must find the complete listening strategy $\pi(b)$ which minimizes $\hat{E}_1 - \frac{\int_{-\delta}^{\hat{E}_1} f(b)b\pi_1(b)\,db}{\int_{-\delta}^{\hat{E}_1} f(b)\pi_1(b)\,db}$.

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[12] Any other allocation which differs from this one only on a set of measure zero is of course also a maximizer; however, we can ignore these possibilities, as only the integrals $m_1(\cdot)$, $m_2(\cdot)$, $\lambda_1(\cdot)$, and $\lambda_2(\cdot)$ are important for our analysis.

Clearly, the complete listening strategy with $\boldsymbol{\pi}(b) = (1,0)$ on an interval of the form $\left[\gamma\left(\hat{E}_1\right), \delta\right]$, and $\boldsymbol{\pi}(b) = (0,1)$ on $\left[-\delta, \gamma\left(\hat{E}_1\right)\right]$ is the unique minimizer, where $\gamma\left(\hat{E}_1\right)$ solves:[13]

$$\frac{1}{1 - F\left(\gamma\left(\hat{E}_1\right)\right)} \int_{\gamma(\hat{E}_1)}^{\delta} b f(b)\, db = \hat{E}_1 \tag{5}$$

∎

We now define the function $\sigma_2^C(E_1)$. In particular, note that the minimum E_2 will be obtained when λ_2 is maximized. Hence, let

$$\sigma_2^C(\sigma_1) \equiv \frac{1}{F(\gamma(E_1))} \int_{\delta}^{\gamma(E_1)} b f(b)\, db \tag{6}$$

be the conditional mean $\mu_2(\boldsymbol{\pi}(b))$ under the listening strategy described in Observation 2. Since $f(b)$ is differentiable and nonzero, the function on the left hand side of the equation (5) is strictly increasing and differentiable in $\gamma\left(\hat{E}_1\right)$. This implies we can invert to ensure that $\gamma\left(\hat{E}_1\right)$ is the unique, strictly increasing differentiable function that solves this equation. This implies that $\sigma_2^C(E_1)$ is a strictly increasing, differentiable function of E_1.

Finally, we prove that any $E_2 > \sigma_2^C(E_1)$ can be obtained by some complete listening strategy with $\mu_1(\boldsymbol{\pi}(b)) = E_1$.

Observation 3 *For any $\xi \in (0, \lambda^{\max}(E_1)]$ there exists a complete listening strategy $\boldsymbol{\pi}^\xi(b)$ with $\mu_1(\boldsymbol{\pi}(b)) = E_1$ such that $\lambda_1\left(\boldsymbol{\pi}^\xi(b)\right) = \xi$.*

Proof. This follows since one may set $\pi_1^\xi(b) = \frac{\xi}{\lambda^{\max}(E_1)}$ on $[\gamma, \delta]$, and $\pi_1(b) = 0$ elsewhere, retaining $\mu_1(\pi_1(b)) = E_1$ while yielding $\lambda_1(\pi_1(b)) = \xi$. ∎

This completes the proof. ∎

Lemma 5 states that if E_2 is not too much smaller than E_1, i.e., the two expectations are not too polarized, then there is a complete listening strategy that attains them. This allows for easy proofs of the remainder of the results in section 3.

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[13] That is, unique up to a set of measure zero.

Proof of Proposition 1.

Part i) Under the assumptions of part i), having all receivers listen to one of the senders will allow that sender to communicate some information (Crawford and Sobel (1982) pg. 1441). Moreover, as a sender acquiring no receivers has no impact on any of the receivers' actions, any message strategy they adopt and that satisfies the equilibrium condition ii is consistent with our notion of an equilibrium. Hence, we can assume that they communicate no more than the sender attracting all receivers, such that those receivers will not wish to deviate.

Part ii) Here, we consider equilibria with a strictly positive measure of receivers listening to both senders, since these are the only equilibria which allow for communication. In any such equilibrium, both senders communicate some information, and hence all receivers must listen to a sender, i.e., $\pi_1(b) = 1 - \pi_2(b)$. For such an equilibrium to exist, there must exist a point $(E_1, E_2) \in A$ such that $|E_1 - \sigma_1| = |E_2 - \sigma_2| \in [0, \frac{1}{4}]$. In general, there will exist many such points. However, as our focus is on the point (E_1, E_2) which maximizes communication, we seek the point in A which minimizes $|E_1 - \sigma_1|$ subject to $|E_1 - \sigma_1| = |E_2 - \sigma_2|$. It is clear that when $(\sigma_1, \sigma_2) \in A$, the point is equal to (σ_1, σ_2), equating senders' biases with the average biases in their respective audiences. We next consider the case in which $(\sigma_1, \sigma_2) \notin A$. We first argue that the point in A closest to (σ_1, σ_2) subject to $|E_1 - \sigma_1| = |E_2 - \sigma_2|$ satisfies $E_1 < \sigma_1$ and $E_2 > \sigma_2$ and lies on the boundary of A.

Observation 4 Suppose $(\sigma_1, \sigma_2) \notin A$, i.e., $\sigma_2 < \sigma_2^C(\sigma_1)$. Then, the point $(E_1^m, E_2^m) \in A$ which solves:

$$\arg \min_{(E_1^m, E_2^m) \in A} |E_1^m - \sigma_1|$$
$$\text{subject to } |E_1^m - \sigma_1| = |E_2^m - \sigma_2|$$

satisfies $\sigma_1 > E_1^m$ and $\sigma_2 < E_2^m$ and $E_2 = \sigma_2^C(E_1)$.

Proof. Clearly, it cannot be the case that $\sigma_1 < E_1^m$ and $\sigma_2 > E_2^m$, as this would imply that $(\sigma_1, \sigma_2) \in A$. We next prove that it cannot be the case that $\sigma_1 > E_1^m$ and $\sigma_2 > E_2^m$.

The proof that it cannot be the case $\sigma_1 < E_1^m$ and $\sigma_2 < E_2^m$ follows similarly. Take any point (σ_1, σ_2) with $\sigma_1 > E_1^m$ and $\sigma_2 > E_2^m$. Then, consider the point $\left(E_1^{SW}, E_2^{SW}\right) \in A$ which satisfies:

$$
\begin{aligned}
\left(E_1^{SW}, E_2^{SW}\right) &= \arg \min_{(E_1, E_2) \in A} \sigma_1 - E_1 \qquad (7) \\
\text{subject to } \sigma_1 &> E_1, \sigma_2 > E_2 \\
\text{and } \sigma_1 - E_1 &= \sigma_2 - E_2
\end{aligned}
$$

If the constraint set is empty, we are done. Note that $\left(E_1^{SW}, E_2^{SW}\right)$ must belong to the boundary of A, i.e., $E_2^{SW} = \sigma_2^C\left(E_1^{SW}\right)$. Since, by assumption we have that $\sigma_2 < \sigma_2^C(\sigma_1)$, for any point (E_1, E_2) in the interior of A, we can find a point on the boundary which is closer to (σ_1, σ_2) and satisfies the constraints. Similarly, let $\left(E_1^{NW}, E_2^{NW}\right)$ satisfy:

$$
\begin{aligned}
\left(E_1^{NW}, E_2^{NW}\right) &= \arg \min_{(E_1, E_2) \in A} \sigma_1 - E_1 \qquad (8) \\
\text{subject to } \sigma_1 &> E_1, \sigma_2 < E_2 \\
\text{and } \sigma_1 - E_1 &= E_2 - \sigma_2
\end{aligned}
$$

There is a unique point on the boundary of A which satisfies these constraints; again, this point is the unique minimizer. Suppose by contradiction that the minimum of (7) is less than or equal to the minimum of (8). Then, $\sigma_1 - E_1^{SW} \leq \sigma_1 - E_1^{NW}$, i.e., $E_1^{SW} \geq E_1^{NW}$. Moreover, note that:

$$
\begin{aligned}
\sigma_2 &> E_2^{SW} = \sigma_2^C\left(E_1^{SW}\right) \qquad (9) \\
\sigma_2 &< E_2^{NW} = \sigma_2^C\left(E_1^{NW}\right) \qquad (10)
\end{aligned}
$$

and hence, $\sigma_2^C\left(E_1^{NW}\right) > \sigma_2^C\left(E_1^{SW}\right)$. However, this implies that there must be a region on which $\sigma_2^C(\cdot)$ is decreasing, which is a contradiction. ∎

With this result at hand, we characterize the set of points (σ_1, σ_2) such that the closest point in A to (σ_1, σ_2) satisfying $|E_1 - \sigma_1| = |E_2 - \sigma_2|$ has the property that $|E_1 - \sigma_1| \leq \frac{1}{4}$. In particular, this set equals A where the boundary, $\sigma_2 = \sigma_2^C(\sigma_1)$, has been shifted to the right by $\frac{1}{4}$ and down by $\frac{1}{4}$. Formally, the closest point $\left(E_1, \sigma_2^C(E_1)\right)$ on the boundary of A with $\sigma_1 > E_1$ and $\sigma_2 < E_2$ and $|E_1 - \sigma_1| = |E_2 - \sigma_2|$ will satisfy $\sigma_1 - E_1 = E_2 - \sigma_2 \leq \frac{1}{4}$ if and only if $\sigma_2 \geq \sigma_2^C\left(\sigma_1 - \frac{1}{4}\right) + \frac{1}{4}$.[14] Therefore, defining $\sigma_2^C(\sigma_1) = \sigma_2^C\left(\sigma_1 - \frac{1}{4}\right) + \frac{1}{4}$, we have the statement in part (ii). ∎

Proof of Proposition 2.

Part (i) of the proposition follows since $(\sigma_1, \sigma_2) \in A$ implies that there exists a listening strategy $\boldsymbol{\pi}(b)$ such that $\lambda_1(\boldsymbol{\pi}(b)) \in (0, 1)$, $\mu_1(\boldsymbol{\pi}(b)) = \sigma_1$ and $\mu_2(\boldsymbol{\pi}(b)) = \sigma_2$. Part (ii) of the proposition follows since if one of the senders has a bias of zero, all receivers listening to that sender leads to full communication. Again, any message strategy adopted by the sender attracting no receivers is consistent with our notion of an equilibrium. Hence, we can once more assume that they communicate no more than the sender attracting all receivers, such that those receivers will not wish to deviate. ∎

Proof of Proposition 3.

First, consider the case in which both senders attract an audience. Then, Observation 4 implies that the closest point $(E_1, E_2) \in A$ to (σ_1, σ_2) satisfies $E_2 = \sigma_2^C(E_1)$. From Observation 2, these were precisely the set of points obtained by a listening allocation $\boldsymbol{\pi}(b)$ with $\boldsymbol{\pi}(b) = (1, 0)$ on an interval $[b_\tau, \delta]$ and $\pi(b) = (0, 1)$ on $[-\delta, b_\tau)$. Second, consider the case in which all receivers listen to a sender with bias close to zero. Then, the proof follows since we can set $b_\tau = \delta \, (-\delta)$ when all receivers listen to sender 2 (1). ∎

Proof of Lemma 3.

In any most informative equilibrium with both senders attracting an audience, Observation 4

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[14]Note that when $\sigma_1 < \frac{1}{4}$, the condition for the existence of a point in A with $\sigma_1 > E_1$ and $\sigma_2 < E_2$ and $\sigma_1 - E_1 = E_2 - \sigma_2$ reduces to $\sigma_2 > -\sigma_1 - \delta$. If this condition did not hold, then all points (E_1, E_2) with $\sigma_1 > E_1$ and $\sigma_2 < E_2$ and $\sigma_1 - E_1 = E_2 - \sigma_2$ would fall under the set A. This can be verified by noting that equation (6) implies that $\lim_{x \to 0} \sigma_2^m(x) = \delta$. However, this constraint is only relevant when $\sigma_1 \leq \frac{1}{4}$, when we know that some communication is possible by having all receivers listen to sender 1; hence, we may ignore it here.

shows that $\mu_1\left(\boldsymbol{\pi}\left(b\right)\right) \leq \sigma_1$ and $\mu_2\left(\boldsymbol{\pi}\left(b\right)\right) \geq \sigma_2$. This implies that $\mu_1\left(\boldsymbol{\pi}\left(b\right)\right)$ and $\mu_2\left(\boldsymbol{\pi}\left(b\right)\right)$ are constant across all most informative equilibrium listening strategies $\boldsymbol{\pi}\left(b\right)$. Then, applying the law of iterated expectations, $\lambda_1\left(\boldsymbol{\pi}\left(b\right)\right) = \frac{\mu_1(\boldsymbol{\pi}(b))}{\mu_1(\boldsymbol{\pi}(b)) - \mu_2(\boldsymbol{\pi}(b))}$ is also constant across all most informative equilibrium listening strategies.

If the most informative equilibrium involves all senders attracting no receivers, or one of the senders attracting all the receivers, the lemma is trivial. ∎

Proof of Proposition 4.

Part i) Observation 4 shows that in a most informative equilibrium listening strategy $\boldsymbol{\pi}\left(b\right)$, $\mu_1\left(\boldsymbol{\pi}\left(b\right)\right) \leq \sigma_1$ and $\mu_2\left(\boldsymbol{\pi}\left(b\right)\right) \geq \sigma_2$. Moreover, for such a listening strategy, there exists an $(E_1, E_2) \in A$ and a constant $\chi \in [0, \frac{1}{4}]$ such that:

$$\lambda_1\left(\boldsymbol{\pi}\left(b\right)\right)\mu_1\left(\boldsymbol{\pi}\left(b\right)\right) + \lambda_2\left(\boldsymbol{\pi}\left(b\right)\right)\mu_2\left(\boldsymbol{\pi}\left(b\right)\right) = 0,$$
$$\mu_1\left(\boldsymbol{\pi}\left(b\right)\right) = \sigma_1 - \chi, \text{ and}$$
$$\mu_2\left(\boldsymbol{\pi}\left(b\right)\right) = \sigma_2 + \chi$$

Solving for $\lambda_1\left(\boldsymbol{\pi}\left(b\right)\right)$ and $\lambda_2\left(\boldsymbol{\pi}\left(b\right)\right)$ yields:

$$\lambda_1\left(\boldsymbol{\pi}\left(b\right)\right) = -\frac{\sigma_2 + \chi}{(\sigma_1 - \chi) - (\sigma_2 + \chi)} \text{ and } \lambda_2\left(\boldsymbol{\pi}\left(b\right)\right) = \frac{\sigma_1 - \chi}{(\sigma_1 - \chi) - (\sigma_2 + \chi)}$$

Note that $(\sigma_1 - \chi) - (\sigma_2 + \chi) > 0$ since $\sigma_1 - \chi > 0$ and $\sigma_2 + \chi < 0$. Hence, $\lambda_1 > \lambda_2$ if and only if:

$$-\frac{\sigma_2 + \chi}{(\sigma_1 - \chi) - (\sigma_2 + \chi)} > \frac{\sigma_1 - \chi}{(\sigma_1 - \chi) - (\sigma_2 + \chi)}$$
$$-(\sigma_2 + \chi) > \sigma_1 - \chi$$
$$-\sigma_2 > \sigma_1$$

This completes the proof.

Part ii) We prove these results for sender 1. First, consider $(\sigma_1, \sigma_2) \in A$. In this case, we

have that for the most informative equilibrium listening strategy $\boldsymbol{\pi}(b)$,

$$\lambda_1(\boldsymbol{\pi}(b)) = \frac{\sigma_2}{\sigma_2 - \sigma_1},$$

which is decreasing in σ_1. Next, consider $(\sigma_1, \sigma_2) \notin A$ but in the partial communication region. Let $(E_1^{NW}(\sigma_1, \sigma_2), \sigma_2^C(E_1^{NW}(\sigma_1, \sigma_2)))$ be the unique point on the boundary of A that solves the constrained minimization problem (8) for any given (σ_1, σ_2). The constraints of this problem imply that this point solves:

$$\sigma_2^C(E_1^{NW}(\sigma_1, \sigma_2)) + E_1^{NW}(\sigma_1, \sigma_2) - \sigma_2 - \sigma_1 = 0$$

Since σ_2^C is differentiable and strictly increasing, we may apply implicit function theorem. This yields:

$$\frac{\partial E_1^{NW}(\sigma_1, \sigma_2)}{\partial \sigma_1} = \frac{1}{1 + \sigma_2^{C\prime}(E_1^{NW}(\sigma_1, \sigma_2))} > 0$$

This implies that $E_1^{NW}(\sigma_1, \sigma_2)$ is an increasing function of σ_1. Moreover, recall that points $(E_1, E_2) \in \text{bd}A$ (that is, (E_1, E_2) on the boundary of A) are achieved via threshold listening strategies. This implies that a higher $E_1^{NW}(\sigma_1, \sigma_2)$ is attained by a higher threshold, which corresponds to a lower measure of receivers listening to sender 1.

Finally, note that the measure of receivers following each sender is continuous across the boundary of A, such that an increase in σ_1 which causes (σ_1, σ_2) to cross over $\text{bd}A$ also reduces the measure of receivers acquired by sender 1. To see this, note that as $(\sigma_1, \sigma_2) \to x$ for some $x \in \text{bd}A$, the solution to the minimization problem (8) becomes arbitrarily close to (σ_1, σ_2), and hence the measure of receivers acquired by the senders grows arbitrarily close to the measure acquired at x. ∎

Proof of Proposition 5. First, suppose that $\sigma_1 = 0$, $\sigma_2 \neq 0$. Then, proposition 2 shows that the Pareto dominant equilibrium is for all receivers to listen to sender 1. Thus, sender 2 does strictly better by choosing $\sigma_2 = 0$. This proves that $\sigma_1 = 0, \sigma_2 = 0$ is an equilibrium,

while one sender choosing a bias of zero and one not is not an equilibrium. The proof is completed by noting that if $\sigma_1 \neq 0$ and $\sigma_2 \neq 0$, by deviating to zero, a sender attracts the full measure of receivers. Thus, at least one of the senders always finds it beneficial to deviate to zero. Thus, $\sigma_1 \neq 0$, $\sigma_2 \neq 0$ is never an equilibrium. ∎

Proof of Remark 2.   We prove this proposition in three stages: first we characterize equilibria in the communication stage, then we move back to analyze equilibria when senders choose which receiver to listen to, and finally, we allow senders' bias choices to be endogenous. First, consider the communication game between a sender j and the receivers who listen to them. Clearly, due to the binary nature of the action space, only two relevant messages can be sent in equilibrium. To see this, note that for $\theta > \frac{1}{2} - \sigma_j$, the sender prefers all receivers take the action 1, and when $\theta < \frac{1}{2} - \sigma_j$, the sender prefers all receivers take action 0. Furthermore, it is clear that receiver's actions are increasing in the expected state conditional on the message sent. Thus, sender types $\theta < \frac{1}{2} - \sigma_j$ will always send a message m with $E(\theta|m) \leq E(\theta|m') \ \forall m'$, and sender types $\theta > \frac{1}{2} - \sigma_j$ will always send a message m with $E(\theta|m) \geq E(\theta|m') \ \forall m'$.

Clearly, the babbling equilibrium always exists. However, the *most informative* equilibrium involves two messages: the sender sends a message "m^1" when θ is above the threshold $T \equiv \frac{1}{2} - \sigma_j$, and sends a message "$m^0$" otherwise. Hence, for $\sigma_j \notin \left(-\frac{1}{2}, \frac{1}{2}\right)$, the most informative equilibrium always involves babbling. On the other hand, some communication can occur whenever $\sigma_j \in \left(-\frac{1}{2}, \frac{1}{2}\right)$.

Moving on to analyze the stage in which receivers choose a sender to listen to, a receiver with bias b acquires a strict benefit from communicating with a sender with bias σ_j if and only if they take action 0 given m^0 and action 1 given m^1. For $\sigma_j \in \left(-\frac{1}{2}, \frac{1}{2}\right)$, we have that $E(\theta|m^0) = \frac{1}{4} - \frac{\sigma_j}{2}$ and $E(\theta|m^1) = \frac{3}{4} - \frac{\sigma_j}{2}$. Using the fact that a receiver takes action 0 when the expected state is below $\frac{1}{2} - b$, and takes action 1 otherwise, they will acquire a strict

benefit from listening so long as:

$$b \in \left(\frac{\sigma_j}{2} - \frac{1}{4}, \frac{\sigma_j}{2} + \frac{1}{4} \right)$$

Furthermore, it is easy to show that receivers' utility is highest from listening to a sender whose bias is closest to their own. Thus, conditional on receivers acquiring a strict benefit from listening, they simply listen to the sender whose bias is closest to their own. This implies that if $\sigma_1 \neq \sigma_2$, all equilibria involve $\pi_1(b) \in \{0, 1\}$ for all $b \neq \frac{\sigma_1 + \sigma_2}{2}$. To summarize, when $\sigma_1, \sigma_2 \in \left(-\frac{1}{2}, \frac{1}{2} \right)$, assume $\sigma_1 > \sigma_2$, the unique equilibrium when receivers choose which sender to listen to is $\pi_1(b) = 1$ on a set P_1, and $\pi_2(b) = 1$ on a set P_2, where:

$$
\begin{aligned}
P_1 &= \left(\max \left\{ \frac{\sigma_1}{2} - \frac{1}{4}, \frac{\sigma_1 + \sigma_2}{2} \right\}, \min \left\{ \frac{\sigma_1}{2} + \frac{1}{4}, \delta \right\} \right) \\
P_2 &= \left(\max \left\{ \frac{\sigma_2}{2} - \frac{1}{4}, -\delta \right\}, \min \left\{ \frac{\sigma_2}{2} + \frac{1}{4}, \frac{\sigma_1 + \sigma_2}{2} \right\} \right)
\end{aligned}
$$

Finally, to analyze the stage in which senders' biases are chosen, first note that for any equilibrium choices of σ_1 and σ_2, it must hold that $\sigma_1 \in [0, 2\delta - \frac{1}{2}], \sigma_2 \in [\frac{1}{2} - 2\delta, 0]$. This follows since, for example, if $\sigma_1 > 2\delta - \frac{1}{2}$, sender 1 can deviate to $2\delta - \frac{1}{2}$, attracting receivers in the interval $\left(\max \left\{ \frac{2\delta - \frac{1}{2}}{2} - \frac{1}{4}, \frac{2\delta - \frac{1}{2} + \sigma_2}{2} \right\}, \frac{\sigma_1 + \sigma_2}{2} \right)$.

For any given pair $(\sigma_1, \sigma_2) \in [0, 2\delta - \frac{1}{2}] \times [\frac{1}{2} - 2\delta, 0]$, sender 1 gets a measure of receivers (the analysis for sender 2 follows using the same reasoning):

$$F \left(\frac{\sigma_1}{2} + \frac{1}{4} \right) - F \left(\frac{\sigma_1 + \sigma_2}{2} \right)$$

Differentiating with respect to σ_1,

$$\frac{1}{2} f \left(\frac{\sigma_1}{2} + \frac{1}{4} \right) - \frac{1}{2} f \left(\frac{\sigma_1 + \sigma_2}{2} \right) = 0$$

Note this is true for any $(\sigma_1, \sigma_2) \in [0, 2\delta - \frac{1}{2}] \times [\frac{1}{2} - 2\delta, 0]$, and thus, the sender acquires the

same measure of receivers for any choice $\sigma_1 \in \left[0, 2\delta - \frac{1}{2}\right]$. This implies that any $(\sigma_1, \sigma_2) \in \left[0, 2\delta - \frac{1}{2}\right] \times \left[\frac{1}{2} - 2\delta, 0\right]$ is an equilibrium. For a symmetric, quasiconcave bias distribution,[15] $\frac{1}{2}f\left(\frac{\sigma_1}{2} + \frac{1}{4}\right) - \frac{1}{2}f\left(\frac{\sigma_1 + \sigma_2}{2}\right)$ is always negative on $(\sigma_1, \sigma_2) \in \left[0, 2\delta - \frac{1}{2}\right] \times \left[\frac{1}{2} - 2\delta, 0\right]$, while for a symmetric, quasiconvex bias distribution, it is always positive. Therefore, centrality is the unique equilibrium in the former case, and $\sigma_1 = 2\delta - \frac{1}{2}, \sigma_2 = \frac{1}{2} - 2\delta$ is the unique equilibrium in the latter case. ∎

Proof of Remark 3. The proof of this remark is very lengthy and tedious and is available upon request. ∎

Proof of Proposition 6. Consider the case in which neither sender has a bias of 0; clearly, the set on which this does not hold has Lebesgue measure zero in $\mathbb{R}^2$.[16] In lemma (4), we argued that all equilibrium listening strategies in the presence of an entertainment benefit must be complete and be characterized by a threshold. Observation 2 demonstrated that the means $(\mu_1(\boldsymbol{\pi}(b)), \mu_2(\boldsymbol{\pi}(b)))$ which are obtainable through complete listening strategies which take this threshold form lie on the curve $\mu_2(\boldsymbol{\pi}(b)) = \sigma_2^C(\mu_1(\boldsymbol{\pi}(b)))$. Together, these results imply that full communication cannot occur in the presence of an entertainment benefit whenever (σ_1, σ_2) does not belong to the curve $\sigma_2 = \sigma_2^C(\sigma_1)$. This is a set of Lebesgue measure zero in $\mathbb{R}^2$.[17] ∎

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[15] By this, we mean a probability density function f_b that satisfies $f_b'' < 0$. Likewise, a convex bias distribution f_b is one that satisfies $f_b'' > 0$.

[16] Note that this set may also include points when one or both of the senders has a bias of zero. Consider the case when exactly one of the senders has a bias of 0. In this case, full communication was achieved when $\alpha = 0$ by having all receivers listen to the sender with 0 bias. By adding an entertainment benefit, this will remain an equilibrium as long as α is not so large that receivers close to the bias of the other sender prefer that sender. Clearly, as $\alpha \to 0$, the information benefit, which is discretely greater than zero, will dominate the entertainment benefit for even receivers with biases precisely equal to the other sender's bias.

Next, consider the case in which both senders have a bias of zero. Clearly, in this case adding an entertainment benefit will have no effect on the full communication equilibrium since all receivers are indifferent between the senders based on information benefit.

[17] Note that, while necessary, $\sigma_2 = \sigma_2^m(\sigma_1)$ is not a sufficient condition to ensure that full communication will occur in the presence of an information benefit; we also would need that:

$$\sigma_2 = E\left(b \middle| b < \frac{\sigma_1 + \sigma_2}{2}\right)$$
$$\sigma_1 = E\left(b \middle| b > \frac{\sigma_1 + \sigma_2}{2}\right)$$

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This holds since when both senders fully communicate, adding an entertainment benefit while not changing the equilibrium threshold mandates that this threshold is the midpoint of the two senders' biases. This further constrains the set of points which allow for full communication; in the uniform case, for instance, the only nonzero point which allows for full communication in the presence of an entertainment benefit is $\left(-\frac{\delta}{2}, \frac{\delta}{2}\right)$.

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