Confidence and Communication: Too much air time for some?*

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Abstract

This paper studies how beliefs about one's own relative skill affect communication, especially the decision to talk - instead of letting other people do the talking. I use a laboratory experiment to investigate whether overconfidence leads to less successful conversations. In a communication game with aligned incentives, two senders try to inform a receiver. The accuracy of each sender's information depends on his relative skill, such that the more skillful sender should do the talking. Senders who overestimate their skill may fail to be informative. A treatment variation creates an exogenous shock to senders' confidence level. The results confirm that increased confidence leads to more talking. The conversation, however, does not become less informative. In the treatment with upward shift in confidence, senders coordinate better who should talk and who should stay silent. I find that competition for attention impedes coordination, whereas feedback about relative skill facilitates it.

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1 Introduction

Effective communication is essential for successful collaboration, negotiation, and problem-solving. However, the question of how people coordinate on who should talk remains a subject of ongoing research. The transfer of accurate information and knowledge requires a high level of coordination. Specifically, individuals with greater expertise or proficiency should do the talking while others should refrain from it. This level of coordination may not always be achieved in practice. Are individuals who decide to speak up in team meetings, present to audiences, or share content on social media really more competent relative to others? Some research says no: various experts (managers, securities analysts, lawyers, etc.) are often criticized for being overconfident about their relative skill or the quality of information they have (Huffman et al. 2022, Chen and Jiang 2006, Goodman-Delahunty et al. 2010). Users of social networks who are typically driven by an accuracy motivation, seeking to share information that is self- and socially relevant (Cosme et al. 2023), develop misconceptions about their own level of competence (Ward et al. 2023), which potentially result in the dissemination of incorrect information. Additionally, research indicates that individuals with limited expertise tend to overestimate their relative skill, while highly competent individuals exhibit less overconfidence in their relative self-assessments (Kruger and Dunning 1999). As a result, less competent talkers who overestimate their relative skill may engage in conversations and provide misleading information to their listeners.

This paper investigates the question of effective coordination between talkers in the setting where talkers and listeners have aligned incentives. In particular, potential talkers share the common objective of informing listeners as good as possible.[1] Examples of aligned incentives in real life include advisory boards appointed to deliver advice to the management, brainstorming sessions that foster innovation within organizations, feedback rounds during seminars that improve research outcomes, and guest speakers at news channels who offer the most reliable information to the audience. Many of these interactions

[1]Inducing aligned incentives between talkers and listeners allows me to examine the case where the high level of coordination of talkers is promoted by design. In situations where talkers and listeners have conflicting interests, talkers tend to transmit less information, resulting in listeners being unable to extract the full truth from the messages they get. Vespa and Wilson (2016) explored several scenarios of the cheap talk game with multiple senders where full information extraction is possible theoretically. Their study showed that receivers got accurate messages and could reveal the truth only when their incentives were aligned with those of the senders. Thus, the design with aligned incentives, where high level of coordination is the most desired outcome, enables me to study the upper bound of coordination.

are limited in time, meaning that not all participants can actively engage and add to the conversation. To make the most of the limited time and achieve the shared goal of delivering valuable information, more competent individuals should contribute to conversation while less competent individuals should not. There are several reasons that can impede effective coordination. First, talkers may have inaccurate beliefs about their own relative skill, leading them to overestimate the quality of their information and provide advice when they should not. Second, they may have additional incentives to speak up, such as seeking attention for advertising or self-promotion purposes.

To study these questions, I rely on a laboratory experiment. The experiment is based on a communication game with aligned incentives, where two senders (both "he") aim to provide a receiver ("she") with the most accurate information. Both senders share a common goal to inform the receiver as well as possible, but differ in their relative competence. More competent sender possesses more accurate information than the other sender.[2] When the time or attention of the receiver is scarce, effective coordination would imply that the more competent sender with more accurate information should do the talking while the less competent sender should remain silent. However, if the senders misjudge their own levels of competence, the effective coordination between them may not occur. For instance, if the less competent sender is overly confident and takes control of the conversation, while the more competent and less confident sender does not contribute, the communication will be less efficient as less accurate information will be transmitted to the receiver.

The laboratory experiment allows to establish a causal relationship between confidence and communication. By introducing a treatment that provides an exogenous shock to the senders' confidence levels, I can measure the causal effect of the shift in beliefs on selection into talking. The results confirm that an upward shift in confidence of 57% translates into a 65% increase in decisions to talk. Surprisingly, this does not lead to a decrease in the accuracy of shared information. In fact, senders from the treatment with an upward shift in confidence solve their coordination problem with higher precision, as they coordinate better who should talk and who should remain silent.

[2] Participants in the experiment are informed that within each triple, the more competent sender receives fully accurate information, the less competent sender receives less accurate information. The exact identity of the more/less competent sender is unknown to both senders and the receiver, and cannot be inferred from the information shared with the senders.

Another aspect highlighted in my paper is that talkers often compete for the attention of their listeners. For example, on social media platforms, content creators vie for likes, retweets, and views from their followers. Similarly, within an organizational setting, employees compete against each other for recognition, bonuses, and promotions from management. When talkers compete for attention, their motivation for communication changes. They face a trade-off between providing the most accurate information and ensuring their presence or visibility to the listener.[3] The decision to talk depends on the relative importance of these two motivations, on the sender's relative competence, and on his belief about the importance of the message to the receiver. Thus, if the sender believes that the receiver highly values the message, the sender is motivated to share only the most accurate information. On the other hand, if the sender believes that the receiver does not consider the message important, he may still choose to communicate even if his competence is low. This is because transmitting less accurate information gives him a chance to reap the competition reward. Simulating this situation in the experiment, I find that competition for attention leads to a 27% increase in talking. The decision to talk is no longer based on the belief about the sender's relative competence. As a result, competition for attention does not improve coordination of senders.

The final aspect that I investigate is the impact of feedback on one's own relative competence on the outcome of communication. I find that providing feedback enhances the coordination between senders. In 83% of groups, senders coordinate correctly on who should talk and who should stay silent. This is because more competent senders consistently contribute to the conversation, while less competent senders tend to opt out from talking. As a result, more accurate information is transmitted to the receivers. Interestingly, although the receivers anticipate this improvement, they underestimate how the feedback impacts the accuracy of the information they receive and do not fully adjust their beliefs.

In the experiment, the communication game is modeled in the following way. I consider a setting with two experts (senders) who give advice to one decision maker (receiver). Each expert receives a signal about a binary state of the world. The accuracy of the expert's signal depends on his relative performance in a reasoning task.[4] If the expert

[3] This is relevant in cases of one-shot communication where senders have no reputation concerns.

[4] I use relative performance as a proxy for relative skill.

scores higher than the other expert, he is referred to as the High Performer and receives a correct signal. The other expert is referred to as the Low Performer and receives either a correct or an incorrect signal. After both experts observe their signals, each expert simultaneously decides on whether or not to forward his signal to the decision maker. If only one expert decides to forward, his signal is directly transmitted to the decision maker. If neither expert or both experts decide to forward their signals, one of the signals is randomly chosen and transmitted to the decision maker.[5] The decision maker gets one signal which is called advice and reports her opinion on how likely it is that the advice coincides with the true state of the world.[6] All three participants have aligned incentives. Both experts should provide the most accurate information to the decision maker. The optimal communication outcome occurs when the High Performer forwards his signal, while the Low Performer refrains from doing so. The decision maker should then follow the provided advice. However, if the Low Performer is overly confident, both experts may forward their signals. This impedes the transfer of knowledge, as the decision maker would now get the correct advice with a lower probability. The communication outcome deteriorates further if the High Performer lacks confidence and does not share his signal. In this scenario, the decision maker receives advice that is accurate only with a probability of 50%.

The experiment consists of four treatments: Hard, Easy, Reward, and Feedback. The Hard treatment serves as a baseline. In the Easy treatment, I boost the confidence levels of all participants. To identify how beliefs about one's own relative performance affect communication, I rely on the hard-easy effect. Moore and Healy (2008) show that individuals tend to underestimate their skills compared to others when it comes to hard tasks (underplacement), and overestimate their skills compared to others when it comes to easy tasks (overplacement). By manipulating the difficulty of the reasoning task, I create an exogenous shock to the experts' beliefs about their relative performance. The experiment allows me to elicit these beliefs in an incentive-compatible manner. I

[5] With this design, I aim to model the limited time or attention of the receiver. In many practical scenarios, the communication time is limited, so that not every expert has a chance to contribute to the conversation. If there are too many/few experts willing to share their information, we can think of some random mechanism, like a moderator, who selects the talker. Research in organizational behavioral economics that studies voice and silence behavior of employees indicates that employees frequently choose to withhold their input (see Morrison 2014 and Morrison 2023 for literature reviews). Moreover, time constraints are often mentioned as an important factor for not seeking advice in a work setting (Heursen et al. 2023).

[6] The ex-ante probability is 50%.

find that in the Hard treatment with a difficult reasoning task, experts' beliefs about being the High Performer are much lower on average than those in the Easy treatment with an easy reasoning task. Comparing beliefs about the relative performance to the actual relative performance in the reasoning task, I am able to quantify the degree of over/underplacement which would be challenging to assess using observational data. To study the effect of competition for attention, I design the Reward treatment. In this treatment, the expert whose signal is transmitted to the decision maker gets an additional small reward. I then compare the results of the Reward treatment to those of the Hard treatment which is the same except for the additional reward. To examine how feedback about one's own relative skill influences the decision to talk, I implement the Feedback treatment where experts get feedback about being the High/Low Performer.

This paper helps to develop a better understanding of why people talk, whether they talk when they should, and gives some directions on how to design environments that support fruitful conversations. I find that the exogenous shift in confidence level causally influences an individual's decision to talk. In the treatment with induced high confidence more talking takes place and listeners have a higher chance to hear the truth. This is because more competent talkers who typically lack confidence are more inclined to participate in conversations when their confidence is boosted. Competition for the listener's attention also drives talkers to share their information more often. However, in this case, the average accuracy of conversations does not improve due to lack of coordination among talkers. On the other hand, feedback about one's own relative skill improves coordination and leads to more efficient communication. The listeners though tend to underestimate the effect of the feedback.

The paper makes contributions to several strands of literature. First, it contributes to the literature studying information transmission which shows both theoretically (Crawford and Sobel 1982, Battaglini 2002) and experimentally (Blume et al. 1998, Vespa and Wilson 2016) that when incentives of talkers and listeners are aligned, full information transmission is possible. I find that even in the absence of strategic goals, the outcome of conversation is not straightforward due to the following standard reasons: (1) biased beliefs about relative skill; and (2) the difficulty of solving the coordination problem. Kawamura (2015) investigates the effect of biased beliefs in a standard two-person cheap talk model where talkers and listeners have aligned incentives. He theoretically shows that talkers' over- and underestimation of their own competence leads to information loss in communication. My paper confirms this result empirically. With respect to coordination, Enke et al. (2023) examine the impact of giving individuals the freedom to choose their level of involvement in decision-making processes. They investigate whether this freedom can help individuals to filter out their own irrationalities and lead to more efficient aggregate outcomes. The study's results suggest that coordination on optimal outcomes is very heterogeneous and depends on the type of the bias that should be filtered. Similar to Enke et al. (2023), I find that less confident individuals tend to self-select out of communication and that individuals with lower performance are more overconfident than those with high performance. My paper is related in spirit to Vespa and Weizsaecker (2023) who investigate whether people talk when they should.

Second, it adds to the existing body of literature on the competition between talkers. Studies by Charness et al. (2018) and Schwardmann and Van der Weele (2019) demonstrate that when talkers aim to persuade others of their superior performance, they tend to boost their confidence. In my paper, when talkers compete for the attention of listeners, their incentives remain partially aligned. They face a trade-off between delivering the most accurate information and capturing the attention of listeners. This resembles the theoretical framework proposed by Li et al. (2016) which suggests that as the competition between speakers intensifies, the accuracy of communication decreases. I find that the competition for attention leads to more talking, and does not improve coordination.

Third, my paper relates to the literature on knowledge sharing (e.g., Mondak and Anderson 2004, Coffman 2014, Bordalo et al. 2019) that shows that individuals are less willing to share their knowledge with others in areas that are stereotypically outside of their gender's domain. From a broader perspective, my research demonstrates that individuals are more inclined to share their knowledge when they are more confident about their relative skill. On the other hand, individuals are less likely to contribute to conversations if they struggle to recognize their own expertise. More skillful individuals are often less confident about the relevance of their information and, thus, remain silent.

Fourth, my paper contributes to the literature documenting the effect of confidence on choices (e.g., Fehrler et al. 2020, Barron and Gravert 2022). Although a vast number of articles study overconfidence, assessments of how an endogenous shift in confidence affects behavior are relatively rare. I extend this literature by examining the effect of an increase in confidence on talking.

The remainder of the paper is structured as follows. Section 2 describes the experiment and procedures. Section 3 presents the theoretical framework and outlines hypotheses. Section 4 presents my results, and Section 5 concludes.

2 Experiment

In this section, I describe experimental design[7], treatments, and procedures.

2.1 Design

The experiment is divided into two parts. During the first part, participants complete a reasoning task and state their beliefs about how they performed compared to others. This part serves several purposes: first, it allows to determine how participants perform relative to others to proxy their relative skills. Second, by manipulating the task difficulty, I can create an exogenous shift in participants' confidence levels. Finally, measuring participants' beliefs about their own relative performance allows me to assess whether they have accurately evaluated their relative skills or if their assessments are either underestimated or overestimated. The second part of the experiment is the communication game that is designed to collect data on talkers' decisions to engage in conversations and on listeners' beliefs about talkers' competence. To avoid hedging, participants receive general instructions at the beginning of the experiment, and they are given more detailed instructions before each task.

The reasoning task. The reasoning task consists of 14 questions from the Raven's Advanced Progressive Matrices Test (RAPM, Raven 2000), which is frequently used to assess IQ levels. The questions are shown in the same order. In each question, participants need to identify the missing element that completes a pattern out of eight possible options.[8] Participants have 7 minutes to solve as many questions as they can. During this time, participants are allowed to go back and forth between the questions and change

[7] The text of the instructions is provided in Appendix A.
[8] An example question from the RAPM test is illustrated in Figure A1 in Appendix A.

their answers. Each correct answer is worth 0.20 euro and each incorrect or incomplete answer is worth 0.00 euro.

Following the completion of the reasoning task, I elicit participants' beliefs regarding their relative performance. Specifically, participants estimate the likelihood of being the High Performer (HP), i.e. "scoring higher than the other participant randomly matched with you". To incentivize accurate guesses, I use the binarized scoring rule (Hossain and Okui 2013, Wilson and Vespa 2018). Participants can earn either 2 or 0 euro in the belief elicitation task. To prevent them from hedging, they are informed about the details of the belief elicitation task and its incentive scheme only after they have completed the reasoning task.

To create an exogenous shock to participants' confidence levels, I expose them to either a hard or an easy version of the reasoning task. In the easy version, the 14 questions are selected from the easy and moderate difficulty levels of the RAPM Test. In the hard version, the questions are selected from the moderate and hard difficulty levels.[9] Table 1 summarizes how many answers were submitted by the participants, the number of correct answers, and participants' beliefs on scoring higher than other participant for each version of the reasoning task.[10]

Table 1: Summary Statistics

Reasoning Task	Mean	S.D.	Min	Median	Max	N
Hard						
N of submitted answers	9.39	3.54	1	10	14	345
N of correct answers	2.74	1.85	0	2	9	345
Subjective belief of being the HP	36.8	21.5	0	40	100	345
Easy						
N of submitted answers	12.4	1.91	7	13	14	129
N of correct answers	9.69	2.33	4	10	14	129
Subjective belief of being the HP	63.4	18.2	8	60	100	129

The communication game. After completing the first part of the experiment, participants proceed with the communication game. All participants are randomly assigned to groups of three: Expert A, Expert B, and Decision Maker. The following is a summary of interaction within one group.

[9]In particular, I use questions 27-31, 26, 23, 24, 20, 22, 32-34, 36 in the hard version and questions 2, 4, 5, 7, 8, 10, 12, 13, 16-21 in the easy version of the reasoning task.

[10]The difference in participants' beliefs on being the High Performer between the hard and the easy version of the reasoning task was preregistered to be larger than 15 percentage points on average.

The Decision Maker ("she") would like to know the state of the world which could be either a or b with equal probability. She does not know the correct state, but can get an advice from an expert.

Each of the two experts (both "he") receives a signal (a or b) about the state of the world. One of the two experts receives the 100%-accurate signal, i.e., the correct signal that coincides with the state of the world. The other expert receives the 50%-accurate signal, i.e., it is equally likely that the signal is correct or incorrect. The accuracy of the experts' signals depends on their performance in the reasoning task. Whether Expert A or Expert B receives the correct signal (rather than the random signal) depends on his performance relative to the other expert in the first part of the experiment. The High Performer – the expert who answered more questions correctly – receives the fully informative signal, and the Low Performer – the other expert – receives the uninformative signal.[11] If both experts have an equal number of correct answers, the High Performer is determined by a computerized coin flip. Each expert observes his signal, but does not get any information about its accuracy.

Each expert simultaneously decides whether to forward his signal to the Decision Maker, thereby advising the Decision Maker. If exactly one of the experts decides to forward his signal, the signal is directly transmitted to the Decision Maker. If both or none of the experts forward their signals, one of the two signals is randomly selected and transmitted to the Decision Maker.[12]

Upon observing the advice from *one* expert, the Decision Maker has to evaluate its accuracy, i.e., to report how likely it is that the advice coincides with the state of the world.

The report of the Decision Maker determines the payment in the second part of the experiment. All three participants receive the same payment, which increases with the accuracy of the Decision Maker's assessment. The assessment is incentivized using the binarized scoring rule. The group members can earn either 8 or 0 euro. In order to earn

[11] The state of the world is unrelated to the reasoning task. However, I believe that, much like in real-life situations where those who excel in academics get access to more reliable information, in my study, experts who outperform others receive more precise signals about the state of the world.

[12] This is when both experts should coordinate on forwarding their signals. If their beliefs about being the High Performer are correct, they can coordinate effectively. The expert who scored higher on the reasoning task forwards his (fully informative) signal, while the other experts refrains from forwarding his (uninformative) signal.

the highest possible payment, (1) experts should inform the Decision Maker as well as possible; and (2) the Decision Maker should aim to correctly assess how well informed she is.

2.2 Treatments

The experiment has a between-subjects design. In each session, participants are assigned to one of the four treatments.

Hard (H). In the Hard treatment, participants solve the hard version of the reasoning task. Their highest payment from the communication game is fixed at $X = 8$ euro.

Easy (E). In the Easy treatment, participants solve the easy version of the reasoning task. The payment scheme is the same as in the Hard treatment.

Feedback (F). The Feedback treatment is similar to the Hard treatment. The only difference is that in the Feedback treatment, each expert receives feedback about his relative performance[13] before deciding on forwarding his signal to the Decision Maker.

Reward (R). The Reward treatment is similar to the Hard treatment. In the Reward treatment, experts can earn additional reward for being visible. The Expert whose signal is transmitted to the Decision Maker earns $Y = 2$ euro in addition.

2.3 Procedures

The experiment was programmed in z-Tree (Fischbacher 2007) and conducted at the WZB-TU experimental laboratory in 2023. Participants were recruited through an online database using ORSEE (Greiner 2015) from a subject pool of mostly undergraduate students from all faculties. In total, 474 participants participated in 27 sessions, with 9 to 21 in each: 193 of them were female, 277 male, and 4 chose the option "diverse". Participants received a show-up fee of 7 euro plus their earnings from the two parts of the experiment. Mean earnings for the 60-minute sessions amounted to 16.15 euro. The relevant instructions were shown on the computer screens. In addition, participants were provided with the printed version of the instructions for the second part of the experi-

[13] The expert is informed if he is the High Performer or the Low Performer in his group.

ment. Participants had to answer a set of the comprehension questions before proceeding with the communication game: 53.59 % answered all 7 questions correctly, 29.54 % made one mistake, the rest 16.88 % made 2.73 mistakes on average.

3 Theoretical Considerations

In this section, I present a theoretical framework that is closely related to the experimental design. This framework serves to develop hypotheses and lays the groundwork for the subsequent discussion of results in the next section.

3.1 Communication Game

I consider an information-transmission game with two senders (both "he") and one receiver ("she") that mirrors my experimental design. In this game, the receiver's goal is to form an accurate belief about the true state of the world θ, $\theta \in \{a, b\}$, that has ex-ante probabilities $P(\theta = a) = P(\theta = b) = 0.5$. To form this belief, the receiver may draw on a sender's advice.

Senders. Each Sender i gets a private signal $s_i \in \{a, b\}$ about the state θ. The accuracy of the signal $\eta_i \in \{\overline{\eta}, \underline{\eta}\}$ depends on the Sender's relative performance in the reasoning task. If Sender i performs better than Sender $-i$, he is the High Performer and observes a perfectly informative signal with accuracy of 100%, $P(s_i = \theta) = \overline{\eta} \equiv 1$. Whereas Sender $-i$, the Low Performer, observes a signal with accuracy of 50%, $P(s_{-i} = \theta) = \underline{\eta} \equiv 0.5$. Senders know neither their relative performance nor the accuracy of their signals, but form beliefs about it, $\hat{\eta}_i = P(\eta_i = \overline{\eta})$. Upon observing his signal, each Sender simultaneously decides if he wants to costlessly forward it to the Receiver to inform her about the true state of the world.[14] If exactly one sender decides to forward the signal, his signal is directly transmitted to the Receiver. If none of the senders or both senders decide to forward their signals, one of the two senders is randomly selected and his signal is transmitted to the Receiver. The signal $s \in \{s_i, s_{-i}\}$ that is transmitted to the Receiver is called advice.

[14] I am restricting the communication game to a setting where senders are truth-telling, i.e., they forward their private information truthfully.

Receiver. The Receiver observes the advice s, *one* Sender's signal that has been transmitted to her, and gives a belief report μ that the true state θ is identical to the advice, $\mu = P(\theta = s)$.

Incentives. Payoffs are computed using a binarized scoring rule. All three participants receive a non-negative reward X with probability $1 - (1-\mu)^2$ if $\theta = s$ and $1 - \mu^2$ if $\theta \neq s$ where the randomness is resolved in a single draw.

3.2 Strategies and Equilibrium Definition

Strategy of the Receiver. The Receiver reports her belief μ that the observed advice s, $s \in \{a, b\}$, coincides with the true state of the world. The report of the Receiver can be expressed as $\mu = 0.5 \cdot P(\eta = \overline{\eta}) + 0.5$, where $P(\eta = \overline{\eta})$ is the probability that the observed signal is forwarded by the High Performer.[15]

Given the true belief $p = P(\theta = s)$ of the Receiver, the probability of receiving the reward X is given by

$$\pi(p, \mu) = p \cdot (1 - (1-\mu)^2) + (1-p) \cdot (1 - \mu^2)$$

and the Receiver maximizes the probability of receiving the reward X by reporting $\mu = p$, i.e., she reports her true belief. Notably, the experiment uses a separate property of the binarized scoring rule: it not only induces the truth telling of the Receiver, but also encourages senders to forward the correct signal because the probability of receiving the reward X increases with the probability that the advice is equal to the true state of the world.[16]

Strategy of the Sender. Sender i forwards his signal s_i if his expected payoff from forwarding it is larger than his expected payoff from not forwarding it. If Sender i believes that he is the High Performer with probability $\hat{\eta}_i$ and projects this information as in Madarász (2012), i.e., Sender i believes that Sender $-i$ has access to the same private information and agrees that Sender i is the High Performer with probability $\hat{\eta}_i$. Thus, Sender i believes that Sender $-i$ believes that he is the High Performer with the remaining

[15] See Appendix B.1 for the formal derivation of the strategy of the Receiver.

[16] Appendix B.2 presents the two properties of the BSR.

probability $\hat{\eta}_{-i} = 1 - \hat{\eta}_i$ and this is commonly known. In this case, the equilibrium strategy of Sender i is to forward the signal if and only if his belief about being the High Performer is larger than a threshold N:

$$\hat{\eta}_i > 0.5 \equiv N$$

Equilibrium. Assuming that every participant plays an intrapersonal game[17] with beliefs $\hat{\eta}_i$, $\hat{\eta}_{-i} = 1 - \hat{\eta}_i$, and μ, and that these believes are seen as common knowledge by all participants, there exist two candidate equilibria.

(1) Separating equilibrium where Sender i with $\hat{\eta}_i > N$ forwards his signal, Sender $-i$ with $\hat{\eta}_{-i} < N$ does not forward his signal, and the Receiver believes that the observed signal coincides with the true state with probability $\mu = 0.5 \cdot \hat{\eta}_i + 0.5$.

(2) Pooling equilibrium where both senders with $\hat{\eta}_i = \hat{\eta}_{-i} = 0.5$ are indifferent between forwarding their signals or not, and the Receiver believes that the randomly selected signal that she observes coincides with the true state with probability $\mu = 0.75$.

3.3 Confidence Bias

Sender i has a confidence bias if his belief about his relative performance differs from his actual relative performance:

$$\hat{\eta}_i^b = \eta_i + b_i$$

where $\hat{\eta}_i^b$ is the Sender i's biased belief about his own relative performance, η_i is the Sender i's actual relative performance and b_i is the confidence bias (if $b_i > 0$, Sender i is overconfident; if $b_i < 0$, Sender i is underconfident).

One sender is biased. Consider the following set of beliefs. Sender i has a confidence bias. He over/underestimates the actual probability η_i of performing better than Sender $-i$ by b_i, $b_i \neq 0$. Thus, Sender i believes that his relative performance is $\hat{\eta}_i^b$ and Sender

[17] In the intrapersonal game, Sender i mistakenly believes that his private information – probability of being the High Performer $\hat{\eta}_i$ – is projected on the other participants. In particular, Sender i believes that Sender $-i$ and Receiver know that Sender i's probability of being the High Performer is $\hat{\eta}_i$, agree with it, and choose their strategies upon this information.

$-i$'s relative performance is $1 - \hat{\eta}_i^b$. Moreover, Sender i assumes that his beliefs are seen as common knowledge by other participants. Sender $-i$ holds correct beliefs about his relative performance $\hat{\eta}_{-i} = \eta_{-i}$ and the relative ability of Sender i, $1 - \hat{\eta}_{-i}$. Sender $-i$ does not realize that Sender i is biased and assumes that his beliefs are common knowledge for other participants.[18]

With this set of beliefs, Sender i forwards the signal if his expected payoff from forwarding s_i is larger than his expected payoff from not forwarding s_i. Thus, the equilibrium strategy of Sender i is to forward his signal if and only if

$$\hat{\eta}_i^b = \eta_i + b_i > 0.5 \equiv N$$

If Sender i is overconfident, he forwards s_i if his (biased) belief $\hat{\eta}_i^b$ about being the High Performer is larger than the threshold N. Thus, his actual threshold decreases by b_i. Compared to the unbiased Sender, the overconfident Sender forwards his signal if his actual performance is larger than $N - b_i$, $b_i > 0$. Applying similar logic, the underconfident Sender has a higher actual threshold. He forwards his signal if his actual performance is larger than $N - b_i$, $b_i < 0$.

The strategy of the unbiased Sender $-i$ remains unchanged. He forwards the signal if and only if

$$\hat{\eta}_{-i} > 0.5 \equiv N$$

Both senders are biased. If both senders have confidence biases, do not realize it, and assume that their beliefs are seen as common knowledge for other participants, their strategies coincide with the strategy of the biased Sender i described above.

Welfare. Though in many settings overconfidence is beneficial, my analysis yields a different result. As long as participants cannot directly observe each other's states of mind, I show that they cannot be better off by being over/underconfident. In particular, participants with a confidence bias are unable to attain the highest expected total welfare of $3X + Y$, which can be achieved with optimal coordination of unbiased participants.[19]

[18] Ludwig and Nafziger (2011) present experimental findings suggesting that the majority of individuals believe that others are unbiased.

[19] It is important to highlight that when the confidence bias goes in the same direction as the relative

The intuition for this result is simple and compelling. In equilibrium, each participant correctly anticipates strategies of other participants. While the Sender's choice depends on his perceived characteristics, his actual payoff depends on his actual characteristics. If overconfident, the Sender mistakenly plays a strategy that would be optimal if his own relative performance was higher than it actually is. Hence, his actual payoff cannot be larger than the payoff of the unbiased Sender with the same characteristics, correctly playing his optimal strategy. Same holds if the Sender is underconfident.

Hypotheses. To study the effect of confidence, I manipulate the difficulty of the reasoning task. Providing participants with the easy task in the Easy treatment, I aim to shift the confidence about one's own relative performance upwards compared to the Hard treatment with the difficult task. My first hypothesis tests whether the hard-easy effect takes place and the upwards shift in beliefs occurs.[20]

H_0^S (H vs E): *Beliefs about one's own relative performance in the Easy treatment will be higher, on average, than beliefs in the Hard treatment.*

Two further hypotheses focus on how the upward shift in beliefs influences actions of senders and how the receivers evaluate the accuracy of signals that result from these actions. The underlying rationale for these hypotheses is that senders who hold upward biased beliefs about their relative performance are more likely to forward their signals and that receivers should expect this effect.

H_1^S (H vs E): *An exogenous increase in confidence will lead to a higher fraction of senders forwarding their signals.*

H_1^R (H vs E): *Receivers expect less informative signals in the Easy treatment than in the Hard treatment.*

performance (i.e., the High Performer is overconfident or the Low Performer is underconfident), there is no deviation from optimal strategies. Thus, the highest expected total welfare can be attained.

[20]To evaluate the effect of confidence on communication, there should be sufficient exogenous variation in beliefs across treatments. I have pre-registered that the difference between average beliefs about one's own relative performance between the Easy and the Hard treatments should be larger than 15 percentage points.

3.4 Competition for Attention

Incentives. Competition for attention of receivers is introduced by providing the sender whose signal is transmitted to the receiver with an additional small non-negative reward Y, $Y < X$.

Strategy of the Sender. The Sender faces a trade-off between advising the Receiver correctly and being the one whose signal is transmitted to the Receiver. His strategy changes accordingly. Making same assumptions as in Subsection 3.2, the equilibrium strategy of Sender i is to forward the signal if and only if his belief about being the High Performer is larger than the threshold N_c:

$$\hat{\eta}_i > 0.5 - \frac{Y}{2X(\mu - 0.5)} \equiv N_c$$

where $\hat{\eta}_i$ is the Sender i's belief about being the High Performer, X and Y are the rewards, and μ is the Receiver's belief that the advice corresponds to the true state.[21]

The threshold N_c decreases as the ratio of the rewards Y/X increases and as the report μ decreases. This implies that if the Sender's belief, $\hat{\eta}_i$, remains fixed, he is more likely to forward the signal when the reward for being visible to the Receiver, Y, outweighs the common reward for giving accurate advice, X. Additionally, he is more likely to forward the signal when he believes that the Receiver's report about observing the accurate advice is low.

Equilibrium. Assuming (1) common knowledge of $\hat{\eta}_i$, $\hat{\eta}_{-i}$, and μ for all three participants, and that (2) beliefs of both senders about being the High Performer add up to one, $\hat{\eta}_i = \eta_i = 1 - \eta_{-i} = 1 - \hat{\eta}_{-i}$, there exist two candidate equilibria.

(1) Separating equilibrium where Sender i with $\hat{\eta}_i > N_c$ forwards his signal, Sender $-i$ with $\hat{\eta}_{-i} < N_c$ does not forward his signal, and the Receiver believes that the observed signal coincides with the true state with probability $\mu = 0.5 \cdot \hat{\eta}_i + 0.5$.

(2) Pooling equilibrium where both senders forward their signals and the Receiver believes that the randomly selected signal that she observes coincides with the true state with probability $\mu = 0.75$.

[21] See Appendix B.4 for the derivation of senders' strategies.

Figure 1 shows the equilibrium strategies of the Sender whose belief about being the High Performer is less than 0.5.[22] The strategy to forward the signal depends on the ratio of rewards Y/X and Sender i's belief about being the High Performer $\hat{\eta}_i$. The vertical lines represent the areas with separating equilibrium (1), whereas the horizontal lines represent the areas with pooling equilibrium (2). For example, if the ratio of rewards is fixed at $Y/X = 0.1$ and Sender i's belief about being the High Performer is $\eta_i = 0.15$, than Sender i's optimal strategy is not to forward his signal, whereas the Sender $-i$ with belief $\eta_{-i} = 0.85$ should forward his signal, and the Receiver should report her belief $\mu = 0.925$. Alternatively, if the ratio of rewards is still fixed at $Y/X = 0.1$, but Sender i's belief about being the High Performer is now $\eta_i = 0.45$, then Sender i's optimal strategy is to forward his signal, Sender $-i$ with $\eta_{-i} = 0.55$ should forward his signal as well, and the Receiver should report her belief $\mu = 0.75$.

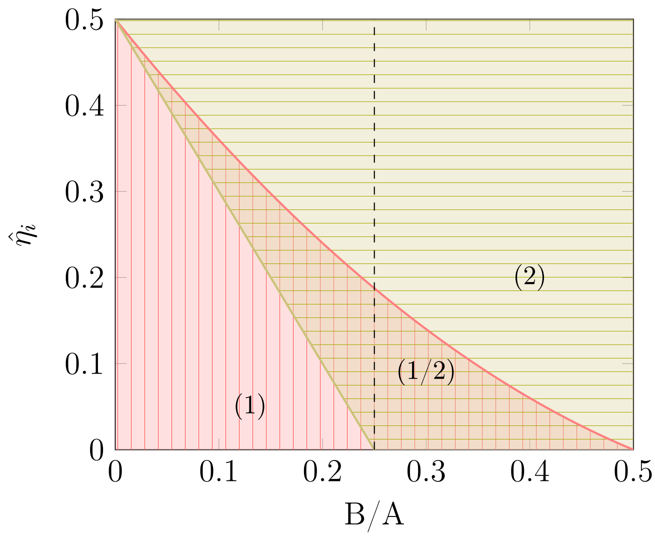

Figure 1: Equilibrium strategies.

The check pattern of the Figure 1 represents areas of multiple equilibria (1/2). In these areas, the decision to forward the signal is based not only on the ratio of the rewards and the Sender's belief about being the High Performer, but also on his beliefs about what other participants will do. Thus, the coordination problem of participants becomes more complex.

Hypotheses. To study the effect of the competition for the receivers' attention, I compare the results of the Reward treatment, where the Sender receives an additional

[22] The equilibrium strategy of the Sender who believes to be the High Performer with more than 0.5 is straightforward. This sender should always forward his signal.

reward Y when his signal is transmitted to the Receiver, with the results of the Hard treatment. The Hard treatment is similar to the Reward treatment, except that it does not include the reward Y.

Two further hypotheses test how the competition for the receivers' attention influences the actions of senders and how receivers evaluate the accuracy of the messages that result from these actions. The logic behind these hypotheses is that individuals who compete for attention are more likely to forward their signals and that listeners should expect this effect.

H_2^S (H vs R): *Competition for the receivers' attention will lead to a higher fraction of senders forwarding their messages.*

H_2^R (H vs R): *Receivers expect less informative messages in the Reward treatment than in the Hard treatment.*

3.5 Feedback

I investigate how feedback about relative performance of senders influences their decisions to forward their signals and how it affects the report of listeners.

Strategy of the Sender. If senders get feedback about their relative performance, the equilibrium strategy is straightforward. Sender i should forward his signal if he is the High Performer, $\hat{\eta}_i = 1$, and does not forward his signal otherwise, $\hat{\eta}_i = 0$.

Hypotheses. In the experiment, I study the effect of providing feedback to the senders by comparing the results of the Feedback treatment to those in the Hard treatment.

The last two hypotheses test if feedback improves coordination of senders. In particular, if High Performers forward their signals and Low Performers do not. Moreover, I examine if receivers expect this and adjust their reports upwards.

H_3^S (H vs F): *Providing feedback about one's own relative performance will lead to a higher fraction of sender pairs who successfully coordinate the forwarding of signals.*

H_3^R (H vs F): *Receivers expect more informative messages in the Feedback treatment than in the Hard treatment.*

4 Results

The main objective of my treatment manipulation is to exogenously shift participants' beliefs about their relative performance in the reasoning task. Figure 2 shows that there is a significant difference in the experts' average confidence between the Hard treatment and the Easy treatment, where confidence refers to the experts' stated probability of being the High Performer (diff. = 23 pp; t-test, $p < 0.01$).

Result 1. In line with the previous hard-easy effect literature, reducing the difficulty level of the reasoning task increases the average confidence of participants about their own relative performance.

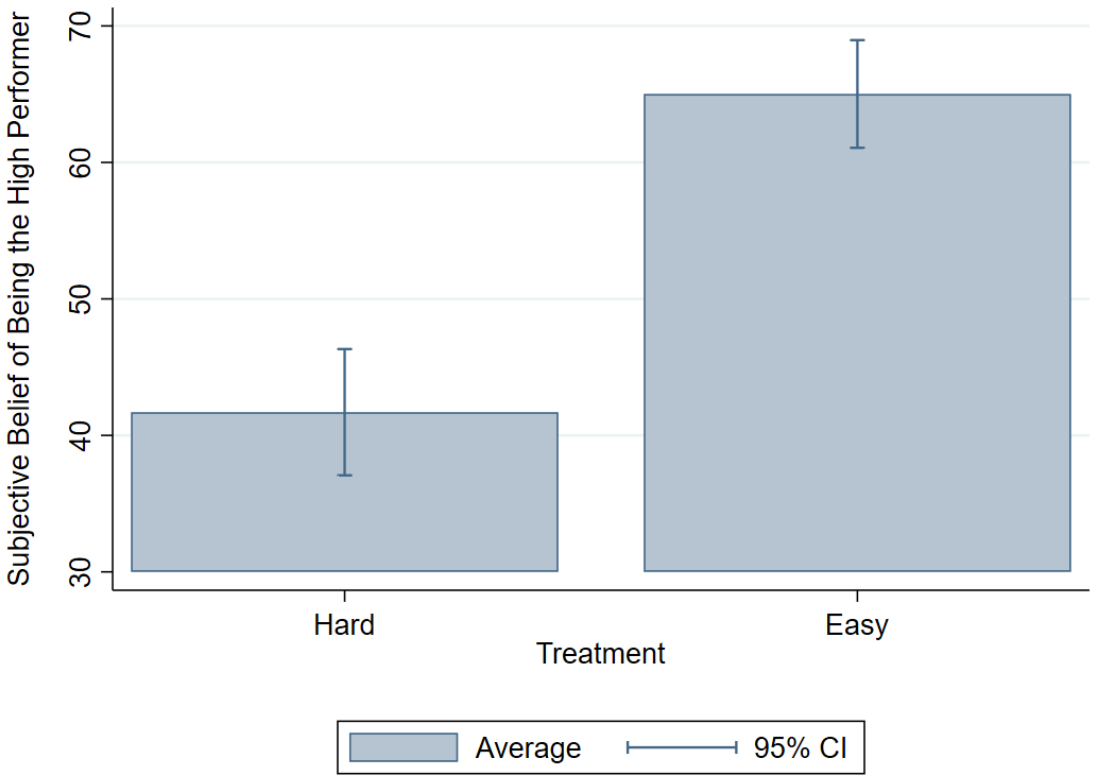

Figure 2: Average subjective beliefs of experts by treatment.

This increase in confidence translates into a higher fraction of experts who forward their signals. Figure 3 shows that experts forward their signals significantly more often in the Easy treatment than in the Hard treatment (diff. = 33 pp; t-test, $p < 0.01$).[23] Even though in both treatments, half of the experts are High Performers and the other

[23]See Appendix C for the regression analysis.

half are Low Performers, solving the easier reasoning task in the Easy treatment makes participants mistakenly believe that they performed better than others, overlooking the fact that all participants in the Easy treatment had to solve the same easy reasoning task.

Result 2. An exogenous increase in confidence leads to a higher fraction of experts forwarding their signals.

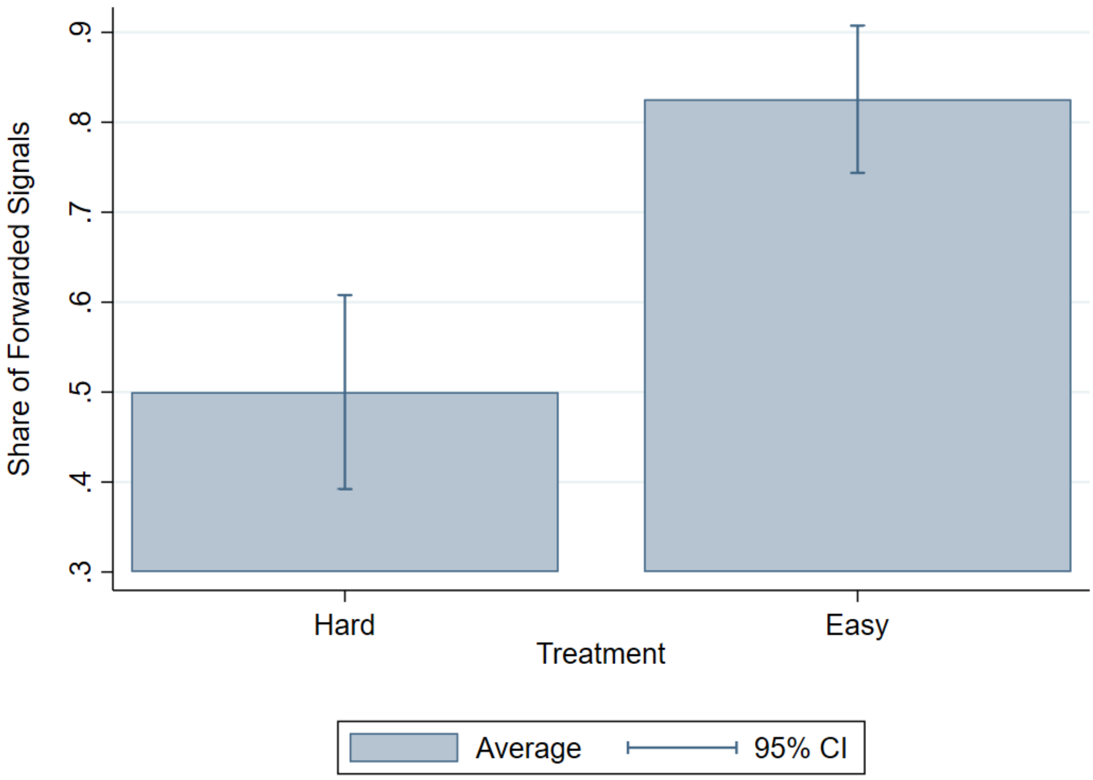

Figure 3: Share of forwarded signals by treatment.

In addition to documenting the treatment effect on choices, it is informative to provide more direct evidence on whether this treatment effect operated via beliefs. To do this, Column 1 of Table 2 shows that the experts' reported beliefs about being the High Performer are highly predictive of their choice to forward their signal – a 1 percentage point (pp) increase in the expert's belief is associated with forwarding the signal 1.17 pp more often. However, this relationship may be endogenous.[24] An advantage of the experimental design is that I can study the causal relationship between subjective beliefs and decisions to talk using the treatment variation as an instrument for beliefs. Column

[24]One possible scenario is that individuals who are more socially dominant tend to make more confident judgments and may choose to speak more often in order to demonstrate their allegedly superior abilities to others (Burks et al. 2013).

2 reports the results from this exercise, indicating that the exogenous shift in beliefs leads to a direct change in choices to forward the signal, illustrating the causal relationship between subjective beliefs and choices.

Table 2: Propensity to forward a signal.

	OLS	IV
	(1)	(2)
Subjective belief	1.1705***	1.3965***
	(0.1077)	(0.2560)
Constant	0.0383	−0.0823
	(0.0750)	(0.1433)
N	172	172
R-squared	0.3269	0.3147

Note: $^{*} p < 0.1$; $^{**} p < 0.05$; $^{***} p < 0.01$

Besides establishing that an upward shift in confidence results in more talking, it is important to determine who opts into talking. Figure 4 shows the share of forwarded signals by relative performance of experts in each of the four treatments. In the Feedback treatment, the behavior of experts is the closest to the theoretical prediction: 100 % of High Performers and only 17 % of Low Performers forward their signals compared to 100 % and 0 % in theory. In the Easy treatment, the share of High Performers forwarding their signals remains high (98 %). However, a large share of Low Performers forward their signals as well (67 %). The decrease in confidence observed in the Hard treatment leads to a lower share of forwarded signals. Compared to the Easy treatment, the share of Low Performers forwarding their signals decreases by 18 pp. However, the share of High Performers forwarding their signals decreases even more significantly by 47 pp. In the Reward treatment, the total share of forwarded signals is higher than in the Hard treatment. Additional reward for being visible to the receivers increases the shares of signals forwarded by High Performers (16 pp) and Low Performers (11 pp) compared to those in the Hard treatment.

Result 3. Providing feedback about experts' relative performance leads to a higher fraction of expert pairs who successfully coordinate the forwarding of signals. Among the four treatments, the results of the Feedback treatment are the closest to the theoretically optimal results: all High Performers and only a small fraction (17 %) of Low Performers forward their signals compared to 100 % of High Performers and 0 % Low Performers predicted by the model.

Result 4. Introducing additional reward for experts whose signals were observed by decision makers leads to a higher fraction of experts forwarding their signals. In the Reward treatment, the share of forwarded signals is higher than in the Hard treatment (64 % vs 50 %). This result holds for both High Performers and Low Performers.

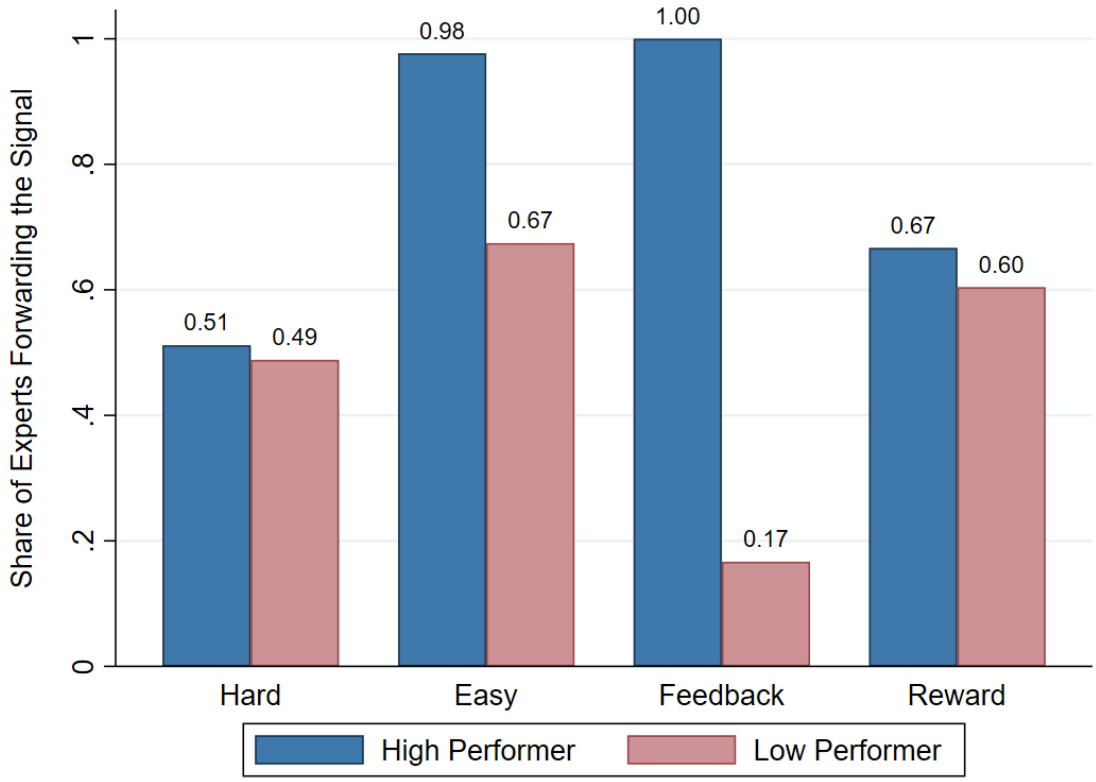

Figure 4: Share of forwarded signals by treatment and relative performance of experts.

Figure 5 shows how experts coordinate on forwarding their signals in groups. I distinguish four coordination outcomes. Each outcome is described by the pair of choices a_H, a_L of the High Performer and the Low Performer to forward or not to forward their signals: $a_H, a_L \in \{\text{F, NF}\}$.

The best coordination outcome is F, NF. It describes the situation when the High Performer forwards his signal and the Low Performer does not. In this case, both advice informativeness and the expected total welfare of all participants in the group are the highest. The largest share of groups with this coordination outcome is in the Feedback treatment: in 83 % of groups experts coordinate correctly on who should talk and who should stay silent. In three other treatments this coordination outcome is achieved in about 30 % of groups: 28 % in the Hard treatment, 33 % in the Easy treatment, and 31 % in the Reward treatment. Chi-square tests with Bonferroni correction across different treatment pairs show that the Feedback treatment has a significantly higher number of groups with the best coordination outcome compared to those in the three other treatments. No significant differences were found among other treatments.

The second coordination outcome is F, F when both experts forward their signals. It is characterized by lower advice informativeness and lower expected total welfare compared to the F, NF outcome. The second coordination outcome is mostly present in the Easy treatment: in 65 % of groups both experts forward their signals. Chi-square tests with Bonferroni correction across different treatment pairs show that the Easy treatment has a significantly higher number of groups with this coordination outcome compared to those in the three other treatments. No significant differences were found among other treatments.

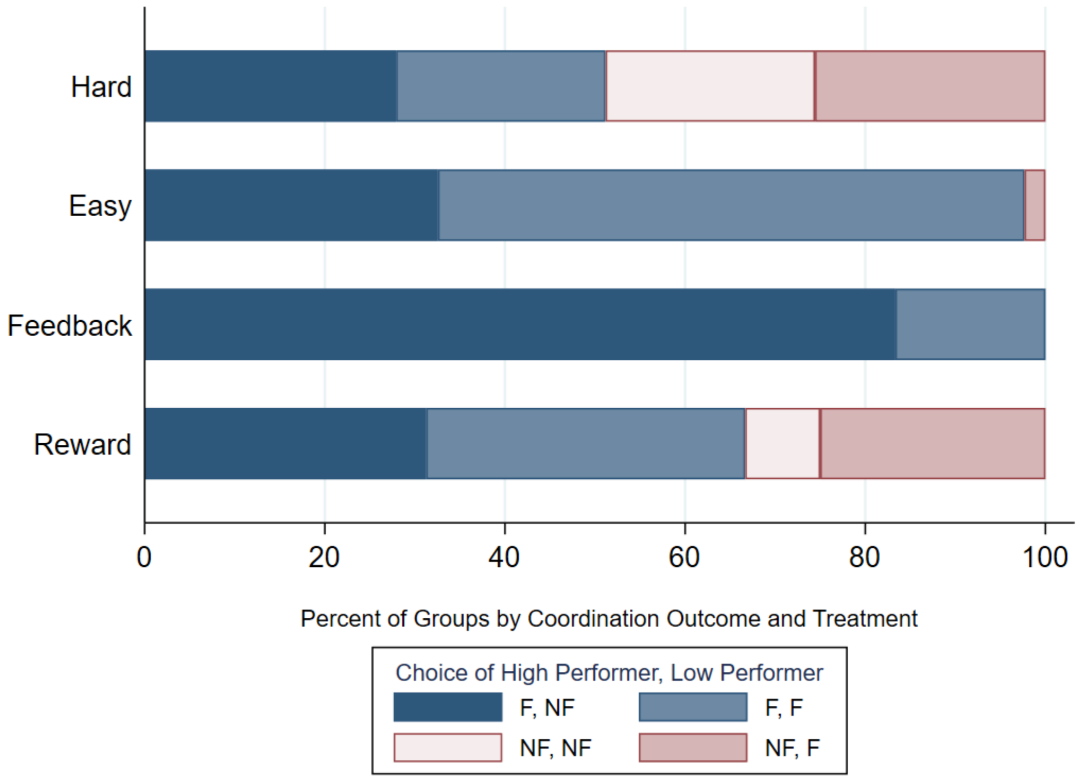

Figure 5: Coordination of experts.

Note: Chi-square and Fisher's exact tests reveal that treatments and coordination outcomes are significantly associated ($p < 0.01$). Pairwise comparisons of treatments with Bonferroni correction show that treatments Hard and Reward do not differ significantly with respect to coordination outcomes.

The third coordination outcome – NF, NF – is equivalent to the second coordination outcome F, F in terms of advice informativeness and expected total welfare. It is present in the Hard treatment (23 %) and in the Reward treatment (8 %). Since the second and the third coordination outcomes are equivalent in terms of advice informativeness, it might be useful to combine them. In this case, the combined outcome describes 47 % of groups in the Hard Treatment and 44 % of groups in the Reward Treatment.

The last coordination outcome is NF, F. It describes the situation when the High Performer does not forward his signal and the Low Performer does. In this case, both advice informativeness and the expected total welfare of all participants in the group are the lowest. This outcome is present mostly in the Hard treatment (26 %) and in the Reward treatment (25 %). Chi-square tests with Bonferroni correction across different treatment pairs show that the Hard and the Reward treatments are not significantly different with respect to the number of groups with this coordination outcome. The same result holds for the Easy and the Feedback treatments where the NF, F coordination outcome is almost or completely absent. There are significant differences among other pairwise comparisons.

The lower average advice informativeness and the occurrence of the least effective coordination outcome in a quarter of groups in the Hard and Reward treatments could be linked to the lack of confidence exhibited by High Performers. Figure 6 summarizes the data on the relative performance of experts. For all depicted treatments, it holds that the actual relative performance of High Performers is on average higher than that of Low Performers. Consistent with the Dunning-Kruger effect (Kruger and Dunning 1999), Low Performers overestimate their relative performance, whereas High Performers underestimate it in the Hard and the Reward treatments, but not in the Easy treatment. Inducing higher confidence for all experts in the Easy treatment, leads to an increase in confidence among the High Performers, encouraging them to forward signals more often. This, in turn, leads to higher average advice informativeness compared to the other treatments

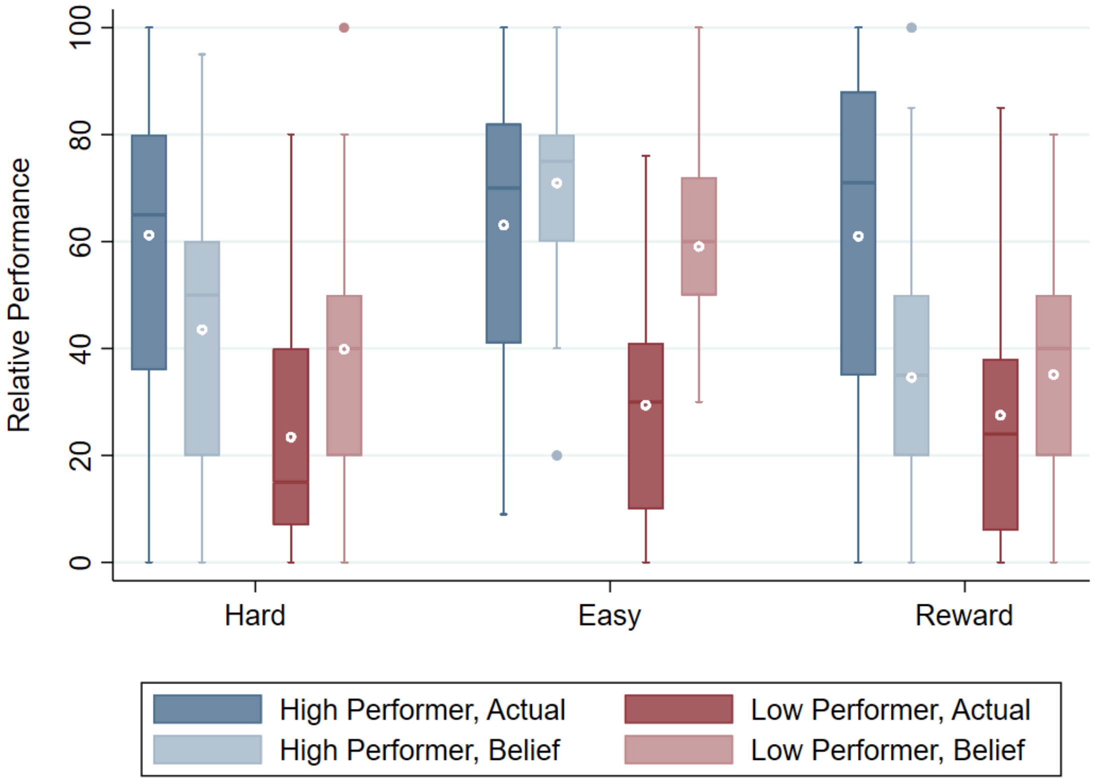

Figure 6: Confidence bias of experts by their relative performance.

Note: A box of the vertical boxplots represents the lower and upper quartiles, with the length of the box indicating the interquartile range. The median is represented by the line subdividing the box. The mean is represented by the white circle.

Figure 7 shows choices of experts according to their subjective belief about being the High Performer. In the Hard and the Easy treatments, experts who forward their signals have on average higher subjective beliefs compared to those who do not forward their signals. This result supports theoretical prediction: in case when the reward for being visible is absent, $Y = 0$, experts forward their signals if their beliefs about being the High Performer is higher than a certain threshold and do not forward their signal otherwise. Thus, there is evidence for a separating equilibrium for these two treatments.[25]

[25] The two-sample Kolmogorov-Smirnov test that compares distributions of subjective beliefs in two groups defined by the decision to forward the signal finds a significant difference between distributions in the Hard and the Easy treatments (p< 0.01), but no significant difference in the Reward treatment (p=0.43). See Appendix C for the results of the t-tests.

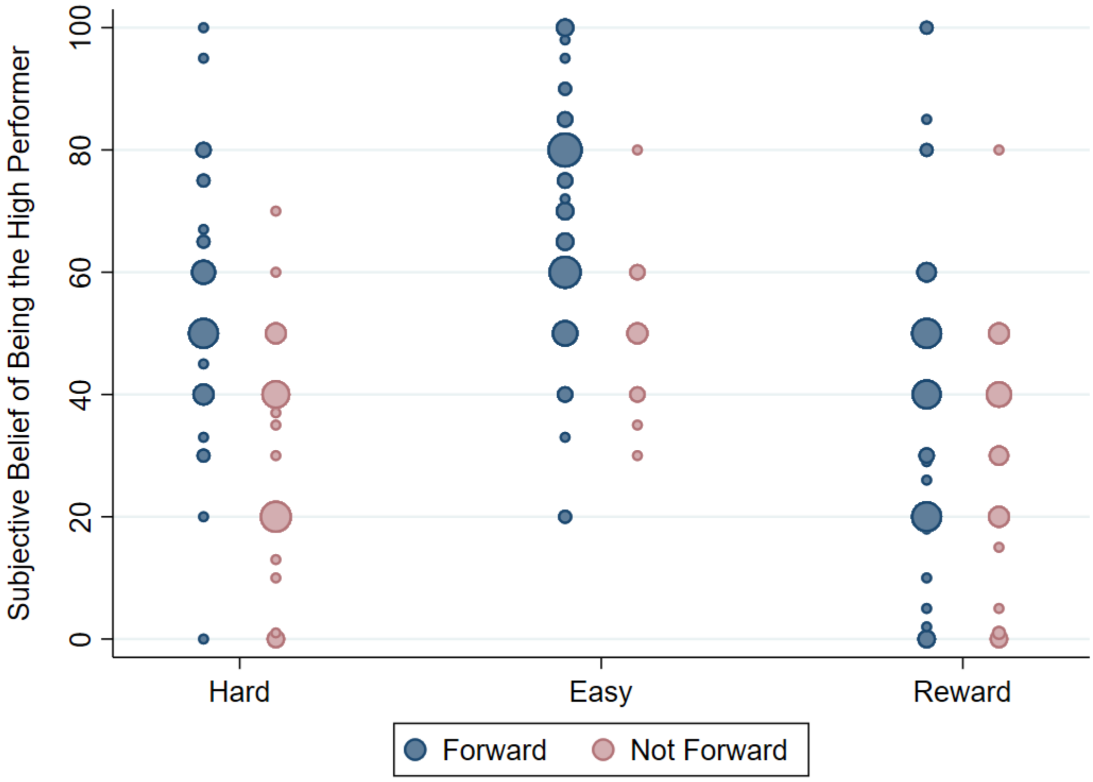

Figure 7: Choices of experts according to their subjective beliefs.

Note: The size of the circle corresponds to the number of experts with the same subjective belief.

In the Reward treatment where experts earn additional reward for being visible, $Y = 2$, the model predicts multiple equilibria. If an expert's subjective belief is lower than 19 %[26], the decision to forward his signal depends on the expert's belief about what other participants will do. Thus, both pooling and separating equilibrium is possible. Figure 7 shows that in the Reward treatment, experts' choices depend to a lower extent on experts' subjective beliefs compared to those in the other two treatments. Thus, the presence of multiple equilibria enhances the coordination problem.

Decision makers perform relatively well in assessing the informativeness of experts' advice. Figure 8 shows the average advice informativeness by treatments. Decision makers' beliefs about advice informativeness are close to the actual advice informativeness in the Hard, the Easy and the Rewards treatments on average. In the Feedback treatment, decision makers expect higher advice informativeness; however, they underestimate it compared to the actual one (diff. = 7.7 pp; t-test, p = 0.08).

[26]This number stems from the equilibrium analysis in the Appendix B.5

Results 5-7. On average, decision makers expect lower advice informativeness in the Hard treatment compared to that in three other treatments.[27]

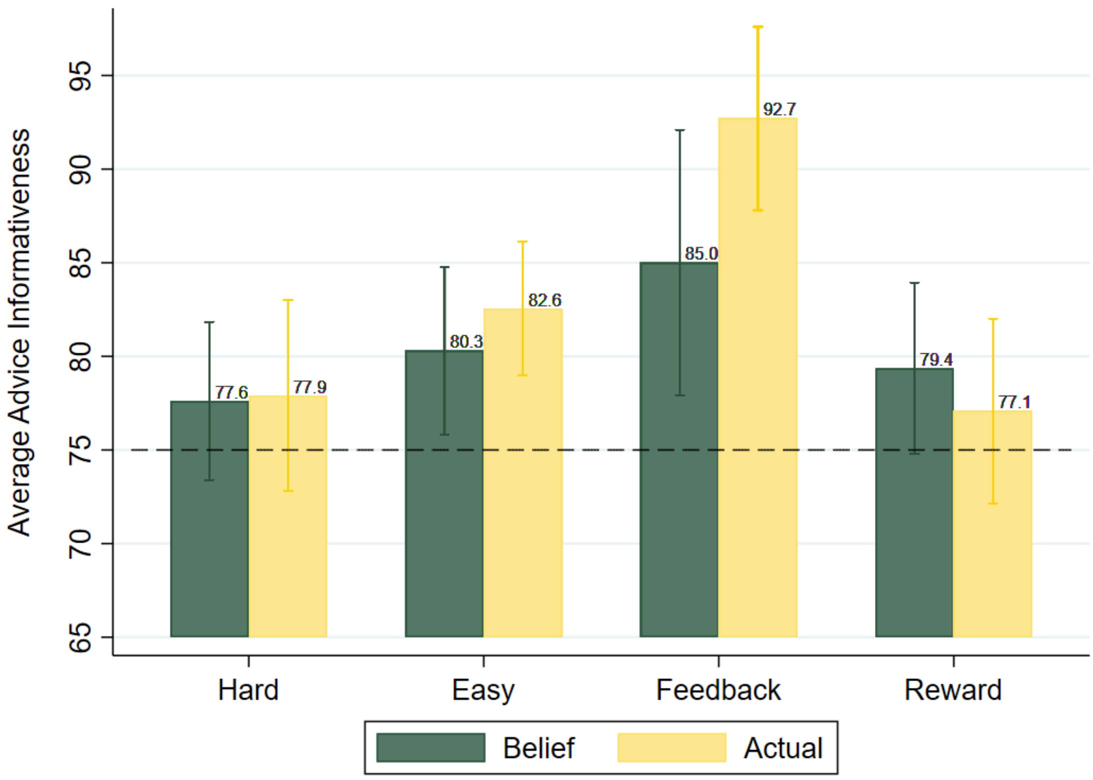

Figure 8: Advice informativeness.

Note: The horizontal dashed line stands for the advice informativeness of 75 %, reflecting the belief report of decision makers when they believe that the observed advice has an equal chance of coming from either High or Low Performer.

5 Conclusion

In this paper, I show that the exogenous shift in confidence about one's own relative skill causally influences the decision to talk. The upward shift in confidence results in higher average accuracy of the delivered information. This is due to individuals with high competence but lower confidence in their relative skills, who start engaging in conversations more often.

Competition for attention motive increases participation in conversations, but it does not improve the coordination between individuals: high-skilled and low-skilled individuals

[27]The difference is statistically significant only when comparing the Hard and the Feedback treatments (diff. = 7.4 pp; t-test, p = 0.06).

self-select into talking in a similar way. The average accuracy of the delivered information remains relatively low.

Feedback about one's own relative skill improves coordination of talkers which leads to a significant increase in the average accuracy of the delivered information. However, listeners' beliefs regarding the accuracy of the information adjust to a lesser degree.

This study helps us understand what kind of people engage in conversations and how they coordinate in delivering messages, and gives some directions on how to design environments that support fruitful conversations.

If talkers and listeners have aligned incentives – they want to deliver and consume accurate information – it might be beneficial to induce the optimal level of confidence among talkers. This could involve boosting the confidence of highly skilled individuals while maintaining lower confidence levels for those with lower skills. Providing information about one's own relative skill leads to almost optimal coordination. Fellner-Röhling et al. (2023) show that providing social information can serve as an effective tool for correcting biased self-assessments. Moreover, excluding competition for attention motive could also lead to an increase in accuracy of the delivered information.

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A Appendix: Instructions

The instructions below are translated from German. The treatment-specific text is shown in square brackets: [**H**: ...] - the Hard treatment, [**E**: ...] - the Easy treatment, [**F**: ...] - the Feedback treatment, [**R**: ...] - the Reward treatment. The text of the Hard treatment is also relevant for the Feedback and the Reward treatment. Comments are shown as [Comment: ...].

General Instructions

Welcome

Thank you for participating in our experiment.

In this experiment you have the opportunity to earn money. Your payoff may depend on your answers, choices and luck. Therefore, it is in your interest to pay attention to the instructions and make careful choices.

The experiment will last up to 60 minutes and consists of three parts: Part 1, Part 2 and Questionnaire.

When all participants have completed the experiment, your payment will be calculated and displayed to you. In addition to a show-up fee of 7 euro, you can earn more for your choices during the experiment. You will be paid directly after the experiment. We ask you to remain seated until you are invited to receive the payment.

Anonymity

Your answers and choices are anonymous and will be kept confidential and used for scientific purposes only.

Rules of conduct

In order for the data of the experiment to be reliable, certain rules must be adhered to during the experiment. Thus, we would like to ask you to switch your mobile phone on completely silent and put them out of reach. In addition, during the experiment, we ask you to use only the computer functions necessary for the experiment and otherwise refrain from using other electronic devices.

Please limit your communication to questions about the experiment and direct these questions to the experimenters only. If you have any questions after you have read the instructions, please communicate quietly by raising your hand. Your questions will then be answered personally and quietly. If a question is relevant to all participants, the question will be repeated loudly and answered by the experimenter.

Anyone disrupting the experiment or violating the above rules may be excluded from the experiment. In this case the participant will forfeit any earnings.

Good luck with this experiment!

Set-up of the experiment

The experiment consists of three parts.

In the first part, all participants will work on a computer task.

In the second part, participants will interact in groups of three people. Before making their decisions in this part, some of the participants will get additional information. The accuracy of this information is related to the first part of the experiment.

The third part is a questionnaire.

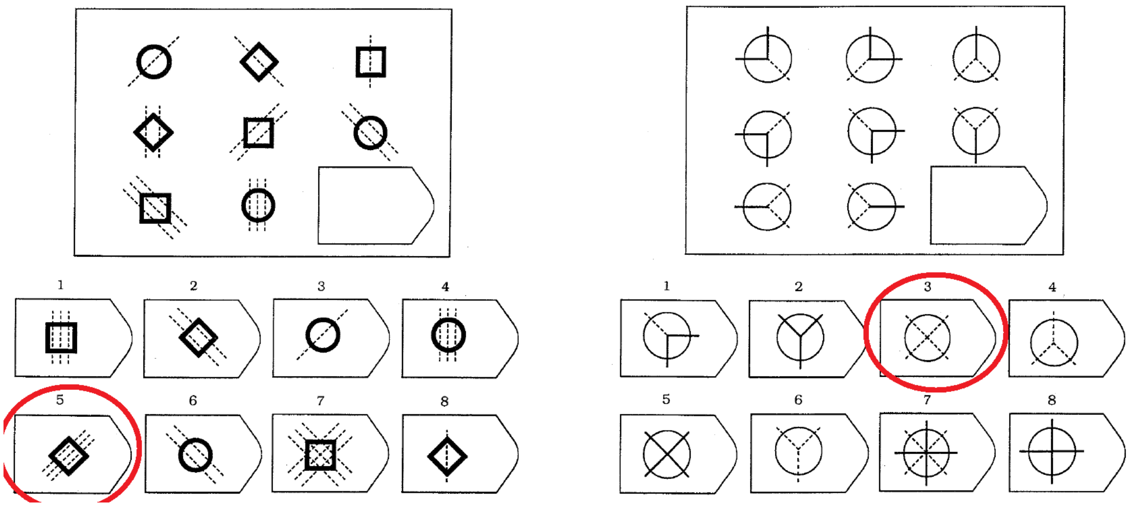
At the beginning of each part you will receive further instructions about your tasks. You will get paid after you have completed all three parts of the experiment.

Part 1: Instructions

In the first part of the experiment, you are asked to complete a short reasoning task consisting of 14 questions. Questions like these are sometimes used to measure a person's intelligence quotient (IQ). The 14 questions for this experiment were chosen from the [**E:** easy and moderate] [**H:** moderate and hard] difficulty levels of such a test.

You have 7 minutes to answer as many of the questions numbered 1 to 14 as possible. Each correct answer is worth 0.20 euro and each incorrect or incomplete question is worth 0.00 euro.

For each question, there is a pattern with a piece missing. Below the pattern, there are eight options to replace the missing piece. You have to choose which of the pieces below is the correct one to complete the pattern. In each case, one and only one of these pieces is the correct one. Figure A1 shows an example question and its answer.



[E] [H]

Figure A1: Example question.

Once you start the reasoning task, you can enter your answers on the right side of your computer screen. You can switch back and forth between the 14 questions and change your previous answers. Your respective answer will be saved only when you click on the "Next" or "Back" button. In the upper right corner of the screen, the remaining time (in seconds) is displayed.

Before we start Part 1, please raise your hand if you have any questions.

[Comment: the reasoning task takes place. The questions are displayed in the same order for all participants.]

Part 1: Estimates

Thank you for completing the reasoning task.

From now on, all participants will be randomly assigned to groups of three people. You will only interact with the participants in your group. Your group will remain for the rest of the experiment.

Before you begin the second part of the experiment, we ask you to make some estimates about how you and another randomly selected participant in your group performed on the reasoning task in Part 1.

More precisely, the computer will now randomly match you with one of the other two participants in your group. Your score in the reasoning task of Part 1 will be compared with the score of this other person. If you scored higher than the other person, you are the High Performer. If you scored less than the other person, you are the Low Performer. If your score is the same, the computer flips a coin to randomly determine if you are the High Performer or the Low Performer.

Estimate 1: What do you think is the probability that you are the High Performer in the sense of the previous paragraph?

You can use the following rough guideline to answer this question, but any number between 0 and 100 is possible.

- 100 - I am sure that I scored better than the other person
- 80 - It is very likely that I have scored better than the other person
- 60 - It is somewhat likely that I have scored better than the other person
- 50 - It is equally likely that I scored better or worse than the other person
- 40 - It is somewhat likely that I have scored worse than the other person
- 20 - It is very likely that I have scored worse than the other person
- 0 - I am sure that I scored worse than the other person

The accuracy of your answer contributes to your earnings. Your payment for the estimate is calculated using a rule called the Binarized Scoring Rule. According to this rule, you can receive 2 euro. The probability of earning this payment of 2 euro increases depending on how close your estimate is to your actual relative performance. If you are actually the High Performer, you should report a high number as your estimate in order to have a higher probability of receiving the payment. On the other hand, if you are the Low Performer, you should report a low number.

Although you don't need to understand the exact mechanism of the "Binarized Scoring Rule", you can find the full description below in the section "Part 1: BSR". All you need to know is that the rule makes it optimal for all participants to to state their true beliefs in response to this question.

The following estimate has no direct impact on your payout. Nevertheless, please provide it as best as you can.

Estimate 2: What is your best estimate for how many points you scored in the reasoning task? Please enter a score between 0 and 14.

Part 1: Binarized Scoring Rule

This section describes the payment rule for the question about your relative performance in the reasoning task. In this question, as described, you indicate the probability that you scored higher than another person on a scale from 0 to 100.

The expected payment increases with the accuracy of your answer. The measure of the realized error in the reported answer (hereafter called l) is calculated as follows: $l = ((x - t)/100)^2$, where x is your estimate, and t is the actual relative performance. In particular, t can take one of two values: $t = 100$ if you are the High Performer or $t = 0$ if you are the Low Performer.

The payment is calculated as follows. For each participant, the computer draws a random integer z between 0 and 100, with equal probability for each integer. If the error measure l is strictly smaller than $z/100$ ($l < z/100$), participant receives 2 euro. If l is greater than or equal to $z/100$ ($l \geq z/100$), the participant receives nothing. This mechanism ensures that the probability of getting a payment is strictly proportional to the accuracy of the estimate.

It follows from this rule that it is optimal for you to enter a relatively high number x (close to 100) if you think that your relative performance t is high. Conversely, it is optimal to enter a relatively small number if you think that your relative performance is low. In this way, you maximize the probability of receiving 2 euro for every possible realization of the integer z. Please note: how large or small the optimal x is, depends on your precise assessment of how likely you think it is that you are the High Performer.

With this in mind, the Binarized Scoring Rule implies that it is always optimal for the participants to truthfully state their own belief. This has been demonstrated by Hossain and Okui (2013) in a formal analysis and under very general conditions.[28]

Part 2: Instructions

Please read the instructions carefully so that you fully understand all tasks and questions.

[28]Tanjim Hossain, Ryo Okui; The Binarized Scoring Rule, *The Review of Economic Studies*, Volume 80, Issue 3, 1 July 2013, Pages 984â1001.

At the end of the instructions you will be asked a few questions to make sure you understand the experiment. If you answer a question incorrectly, the relevant text passages from the instructions will appear in a separate window. Please read these passages again carefully and try to answer the question again.

Introduction

In the second part of the experiment, you will continue to interact with participants in your group.

Each group of participants consists of two experts and one decision maker. Your role (Expert A, Expert B or Decision Maker)[29] will be randomly assigned and announced to you at the beginning of the payoff-relevant stage of Part 2. Your role remains the same for the rest of the experiment.

Short summary of the interaction

The Decision Maker would like to answer a question. The question has two possible answers (a or b), one of which is correct. The Decision Maker does not know the correct answer, but can get advice from an expert.

Each of the two experts receives a signal (a or b) â a suggested answer to the question that the Decision Maker is interested in. One of the two experts receives the correct signal, i.e., the correct answer to the question. The other expert receives a random signal, i.e., it is equally likely that the answer is correct or incorrect.

The quality of experts' signals depends on their performance in the Part 1 of the experiment. Whether Expert A or Expert B receives the correct signal (rather than the random signal) depends on their performance in Part 1. The High Performer with the higher number of correctly answered questions receives the correct signal, the Low Performer receives the random signal.

Each expert has to decide whether to forward his signal to the Decision Maker and thereby advise the decision maker. [**F:** Before he has to decide, he receives feedback as to whether he is the High Performer or the Low Performer in his group.]

Upon observing the advice from *one* expert, the Decision Maker has to evaluate its reli-

[29]For the sake of simplicity the masculine form is used throughout this document, but should be taken to refer to persons of both genders.

ability. The Decision Maker needs to assess how likely it is that the advice is the correct answer to his question.

The answer of the Decision Maker determines the payment in Part 2. All three participants receive the same payment which increases with the accuracy of the Decision Maker's assessment. Thus, in order to earn the highest possible payment, (1) experts should inform the Decision Maker as best they can, (2) the Decision Maker should be able to correctly assess how well advised he is.

What comes next?

Below are the detailed instructions of the interaction. The average reading time for these instructions is 6 minutes.

After everyone has read the instructions, you will answer a questionnaire with several comprehension questions to test your knowledge of the instructions.

After filling out the questionnaire, the payoff-relevant stage of Part 2 begins.

Initialization of the interaction

Before the interaction begins, your role (Expert A, Expert B or Decision Maker) will be randomly assigned and announced to you.

Next, the computer determines the correct answer to the question that the Decision Maker has to answer. Each possible answer (a or b) is equally likely to be correct.

To illustrate this step, imagine that there is a Question 15 in the reasoning task, with two possible answers (a and b), both equally likely as shown in Figure A2. The computer considers this question and finds the correct answer. The Decision Maker does not know the answer and waits for an expert's advice.

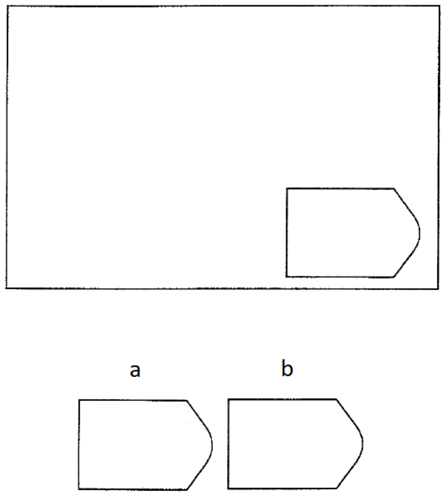


Figure A2: Question 15

Task of the experts

Each expert receives one signal (a or b) that can be either the correct or the random answer to the Question 15 described above.

The experts cannot know the accuracy of their signals with certainty. This accuracy depends on who is the High Performer in the reasoning task of Part 1.

Among the two experts, the expert who answered more questions correctly observes the correct signal. Thus, if the correct answer to Question 15 is a, the expert observes the signal a, and if the correct answer is b, the expert observes the signal b.

The other expert, who answered fewer quiz questions correctly, receives a signal that is selected at random, i.e., the signal shown to the expert is determined by a (computerized) coin flip. If the coin lands on heads, the expert receives the signal a, whereas if the coin lands on tails, the expert receives the signal b.

Remember that if both experts have answered the same number of questions correctly, the High Performer is also determined by a coin toss. The expert selected as the High Performer will then also receive the correct signal in part 2. The other expert receives a random signal.

Table 1 summarizes the accuracy of an expert's signal depending on the performance in the reasoning task in Part 1. The table illustrates: providing more correct answers for the 14 questions in Part 1 increases probability of answering the 15th question correctly.

Table A1: Accuracy of signal depending on experts' performance in Part 1

Expert	Signal	Accuracy
scored HIGHER in the reasoning task	correct	100 %
scored LOWER in the reasoning task	random	50 %
scored SAME in the reasoning task	correct or random	100 % or 50 %

[**F:** Before deciding whether to forward the signal, each expert receives feedback on whether he is the High Performer or the Low Performer.] After both experts observe their signals [**F**: and feedback], each of them decides whether to forward the signal to the decision maker.

If none of the experts or both of the experts decide to forward their signals, one of the two experts is randomly selected by the computer and his signal is forwarded to the decision maker.

In all cases, the Decision Maker receives exactly one signal: either Expert A or Expert B (but not the other expert) forwards his signal, or one signal is selected at random.

The signal that the Decision Maker receives is called the advice.

Task of the Decision Maker

The Decision Maker observes the advice (a or b) and reports a number between 50 and 100 that indicates how likely it is that the observed advice is the correct answer to the Question 15.

Remember that the accuracy of the advice depends on the relative performance in Part 1 of the expert who forwarded it. Thus, the advice coincides with the true answer with a probability between 50 and 100 percent. Although the Decision Maker knows that the advice is more likely to be true than false (at least somewhat more likely), he should know as precisely as possible how likely the advice is true. This feature is implemented by the payment rule described next.

Payment

The number between 50 and 100 reported by the Decision Maker hereafter referred to as the the Decision Maker's belief determines the payment for all three participants: all three receive the same payment.

The payment is calculated using the "Binarized Scoring Rule" that has been explained to you in Part 1. However, here in Part 2 you can earn a reward of **8 euro**.

The logic of the rule is simple: the probability of earning 8 euro increases the more accurate the decision maker's expectation is about how likely the advisor's advice is true.

Note: knowing how likely the advice is true is the same as knowing how likely the true answer to question 15 a or b is. This yields another simple property of the "Binarized Scoring Rule": the payoff is higher when experts pass on the correct signal with higher probability. Just like the other properties of the "Binarized Scoring Rule", you do not need to check this property, you can just trust us. A full description of the rule can be found below in the section "Part 2: BSR".

In summary, the payoff in this experiment is higher when (1) the experts inform the decision maker as good as possible and (2) the Decision Maker shares an expectation that is the best estimate of how well informed he is.

[**R:** Forwarding the signal contributes to the expert's remuneration as well. The expert whose signal is shown to the Decision Maker receives an additional **2 euro**. For example, if Expert A forwards his signal to the Decision Maker and Expert B does not, Expert A receives 2 euro in addition. If none of the experts or both experts forward their signals, the experts whose signal is shown to the Decision Maker receives the 2 euro.]

Part 2: Binarized Scoring Rule

This section describes the payment rule for the communicated belief of the Decision Maker. This rule determines the payoff for all participants: all participants earn 8 euro or they earn nothing. The probability of each of these two possible outcomes depends on the Decision Maker's belief.

The expected payoff increases with the accuracy of the communicated belief. The measure of the realized error in the communicated belief (hereafter called l) is calculated as follows: $l = ((x - t)/100)^2$, where x is the belief of the Decision Maker about the accuracy of the advice, and t is the actual accuracy of the advice. In particular, t can take one of two values: $t = 100$ if the advice coincides with the correct answer to the Question 15 and $t = 0$ otherwise. Thus, l measures the distance between the belief of the decision maker and the actual accuracy of the advice.

The payment of all three group members is calculated as follows. For each group, the computer randomly draws an integer between 0 and 100 (hereafter called z). Each integer between 0 and 100 has the same probability of being drawn as the value of z. If the error measure l is strictly smaller than $z/100$ ($l < z/100$), participants get 8 euro. If l is greater than or equal to $z/100$ ($l \geq z/100$), participants get nothing in this part of the experiment.

It follows from this rule that it is optimal for the Decision Maker to enter a relatively high number x (close to 100) if he thinks that the actual accuracy of the advice t is high. Conversely, it is optimal for the Decision Maker to enter a relatively small number if he thinks that the actual accuracy of the advice is low. Overall, it is always optimal for decision makers to truthfully state their own expectation. This has been demonstrated by Hossain and Okui (2013).[30]

The other property mentioned in the payment section is that it is optimal if the advice is correct with the highest possible probability. It can be demonstrated using the expression for l mentioned above as follows. Since the accuracy of the advice can be either $t = 100$ or $t = 0$, it is relatively easy to calculate the expected payment for a given t. You do not need to check the formula, but the expected payment is proportional to

$$1 - Pr\big(t = 100\big)(100 - x)^2 - (1 - Pr\big(t = 100\big))x^2$$

where $Pr\big(t = 100\big)$ is the probability that t has the value 100. One can also verify that for any number x between 50 and 100, this expected payoff increases as long as $Pr\big(t = 100\big)$ increases. This means that increasing the probability $Pr\big(t = 100\big)$, i.e., the accuracy of the advice, increases the expected payoff of all participants.

Part 2: Comprehension questions

Please answer the following questions to test your understanding of the instructions. Your answers to these questions will not affect your payment.

Please note: Some of the questions describe specific situations. This is for illustration purposes only and does not indicate what will happen or be chosen in the course of the

[30] Tanjim Hossain, Ryo Okui; The Binarized Scoring Rule, *The Review of Economic Studies*, Volume 80, Issue 3, 1 July 2013, Pages 984â1001.

experiment.

[Comment: questions are displayed one by one. If a participant answers a question correctly, the next question appears. If the answer is wrong, then the participant gets to read a relevant section of instructions, and has a chance to answer again. If the second answer is wrong, the correct answer is displayed.]

1. How many experts are in your group?
    - Options: 0, 1, 2 [Correct: 2]
    - Help: "Each group of participants consists of two experts and one decision maker. Your role (Expert A, Expert B or Decision Maker) will be randomly assigned and announced to you at the beginning of the payoff-relevant stage of Part 2. Your role remains the same for the rest of the experiment."
2. How many signals can be observed by the Decision Maker?
    - Options: 0, 1, 2 [Correct: 1]
    - Help: "After both experts observe their signals, each of them decides whether to forward the signal to the decision maker. If none of the experts or both of the experts decide to forward their signals, one of the two experts is randomly selected by the computer and his signal is forwarded to the decision maker."
3. What is the accuracy of the High Performer's signal?
    - Options: 0 %, 50 %, 100 % [Correct: 100 %]
    - Help: Table A1.
4. What is the accuracy of the Low Performer's signal?
    - Options: 0 %, 50 %, 100 % [Correct: 50 %]
    - Help: Table A1.
5. Suppose the Decision Maker is sure that the advice comes from an expert who scored significantly *worse* in Part 1 than the other expert. How likely is it that this advice is the correct answer to Question 15?
    - Options: 0 %, 50 %, 100 % [Correct: 50 %]

- Help: Table A1.

6. Suppose the Decision Maker is sure that the advice comes from an expert who scored significantly *better* in Part 1 than the other expert. How likely is it that this advice is the correct answer to Question 15?
   - Options: 0 %, 50 %, 100 % [Correct: 100 %]
   - Help: Table A1.
7. Suppose the Decision Maker has revised his belief after a moment's thought and now reports a belief that is closer to the true value. Has the probability of getting a higher payoff for his group decreased, increased, or remained constant?
   - Options: decreased, increased, remained constant [Correct: increased]
   - Help: "Your answer was not correct. Please recall:" Last section in **Payment**.

Part 2: Expert

You are Expert A [B].

Your signal is a [b].

[**F:** You are the High [Low] Performer]

Would you like to forward this signal to the Decision Maker?

[FORWARD] [NOT FORWARD]

Part 2: Decision Maker

You are Decision Maker.

The advice forwarded to you is a [b].

Please indicate how likely it is that this advice is the correct answer to the Question 15.

You may wish to use the following rough guideline for answering this question, but any number between 50 and 100 is possible.

- 100 - I am certain that the advice is the right answer
- 80 - It is very likely that the advice is the right answer

- 70 - It is relatively likely that the advice is the correct answer
- 50 - It is equally likely that the advice is the right or wrong answer

Questionnaire

[Comment: gender, age, experience in economic experiments, highest degree obtainied, student status, area of studies, employment status, knowledge of German.]

Payment

Thank you for participating in this experiment!

Your payment consists of the following parts:

1. [?] euro for answering [?] questions in Part 1.
2. [0/2] euro for estimating your relative performance in the reasoning task.
3. [0 /8] euro for the accuracy of the Decision Maker's belief.

Your complete payment is therefore [?] euro including the show-up fee of 7 euro.

B Appendix: Equilibrium Strategies

B.1 Equilibrium Strategy of the Receiver

Receiver reports her belief μ that the observed signal s, $s \in \{a, b\}$, coincides with the true state of the world θ, $\theta \in \{a, b\}$: $\mu = P(\theta = s)$.

Without loss of generality, assume that the Receiver observes the advice $s = a$. If she follows the Bayes rule, she reports her belief as follows:

$$\begin{aligned}
\mu = P(\theta = s) &\overset{wlog}{=} P(\theta = a|s = a) \\
&= \frac{P(\theta = a) \cdot P(s = a|\theta = a)}{P(\theta = b) \cdot P(s = a|\theta = b) + P(\theta = a) \cdot P(s = a|\theta = a)} \\
&= \frac{P(s = a|\theta = a)}{P(s = a|\theta = b) + P(s = a|\theta = a)}
\end{aligned}$$

since $P(\theta = a) = P(\theta = b) = 0.5$.

The numerator becomes

$$\begin{aligned}
&P(s = a|\theta = a) \\
&= \underbrace{P(s = a|\theta = a, \eta = \overline{\eta})}_{=1} \cdot \underbrace{P(\eta = \overline{\eta}|\theta = a)}_{=P(\eta=\overline{\eta})} + \underbrace{P(s = a|\theta = a, \eta = \underline{\eta})}_{=0.5} \cdot \underbrace{P(\eta = \underline{\eta}|\theta = a)}_{=P(\eta=\underline{\eta})} \\
&= P(\eta = \overline{\eta}) + 0.5 \cdot P(\eta = \underline{\eta})
\end{aligned}$$

where $P(s = a|\theta = a, \eta = \overline{\eta})$ is the probability that the observed signal is forwarded by the High Performer (HP) and $P(s = a|\theta = a, \eta = \underline{\eta})$ is the probability that the observed signal is forwarded by the Low Performer (LP). Moreover, $P(\eta = \overline{\eta}|\theta) = P(\eta = \overline{\eta})$ and $P(\eta = \underline{\eta}|\theta) = P(\eta = \underline{\eta})$, since probabilities that the HP and the LP forward their signals are independent of the true state of the world.

The denominator becomes

$$
\begin{aligned}
&P(s=a|\theta=b)+P(s=a|\theta=a)\\
&=\underbrace{P(s=a|\theta=b,\eta=\overline{\eta})}_{=0}\cdot\underbrace{P(\eta=\overline{\eta}|\theta=b)}_{=P(\eta=\overline{\eta})}+\underbrace{P(s=a|\theta=b,\eta=\underline{\eta})}_{=0.5}\cdot\underbrace{P(\eta=\underline{\eta}|\theta=a)}_{=P(\eta=\underline{\eta})}\\
&+\underbrace{P(s=a|\theta=a,\eta=\overline{\eta})}_{=1}\cdot\underbrace{P(\eta=\overline{\eta}|\theta=a)}_{=P(\eta=\overline{\eta})}+\underbrace{P(s=a|\theta=a,\eta=\underline{\eta})}_{=0.5}\cdot\underbrace{P(\eta=\underline{\eta}|\theta=a)}_{=P(\eta=\underline{\eta})}\\
&=0.5\cdot P(\eta=\underline{\eta})+P(\eta=\overline{\eta})+0.5\cdot P(\eta=\underline{\eta})\\
&=P(\eta=\underline{\eta})+P(\eta=\overline{\eta})\\
&=1
\end{aligned}
$$

Therefore, the report of the Receiver can be expressed as

$$
\begin{aligned}
\mu=P(\theta=s)&\overset{wlog}{=}P(\theta=a|s=a)\\
&=P(\eta=\overline{\eta})+0.5\cdot P(\eta=\underline{\eta})\\
&=P(\eta=\overline{\eta})+0.5\cdot(1-P(\eta=\overline{\eta}))\\
&=0.5\cdot P(\eta=\overline{\eta})+0.5
\end{aligned}
$$

where $P(\eta=\overline{\eta})$ is the probability that the advice is forwarded by the HP or the probability that the accuracy of the advice is high.

In words, probability that the advice coincides with the true state is equal to the probability weighted sum of the accuracy of the advice times the probability of observing the advice with a given accuracy.

B.2 Properties of the BSR

Given the true belief $p=P(\theta=s)$ of the Receiver, the probability of receiving the reward X is given by:

$$\pi(p,\mu)=p\cdot(1-(1-\mu)^2)+(1-p)\cdot(1-\mu^2)$$

The Receiver chooses to report μ that maximizes the probability of receiving the reward X. Thus, the Receiver reports her true belief:

$$\pi'_\mu(p,\mu) = 2p(1-\mu) + (1-p)\cdot(-2\mu) = 2p - 2\mu \equiv 0 \Rightarrow \mu(p) = p$$

Moreover, the following holds:

$$\begin{aligned}
\pi'_p(p,\mu) &= (1-(1-\mu)^2) - (1-\mu^2) \\
&= 1 - (1 - 2\mu + \mu^2) - 1 + \mu^2 \\
&= 1 - 1 + 2\mu - \mu^2 - 1 + \mu^2 \\
&= 2\mu - 1 > 0 \text{ if } \mu > 0.5
\end{aligned}$$

If the report of the Receiver is restricted to $\mu > 0.5$, it holds that the probability of the receiving the reward X increases with actual probability that the advice coincides with the true state of the world. Consequently, it is always optimal for senders to provide the most accurate information to the Receiver.

B.3 Equilibrium Strategy of the Sender

Sender i forwards the signal if his expected payoff from forwarding it is larger than his expected payoff from not forwarding it.

If Sender i forwards his signal, his expected payoff is $XE[\pi_{s_i}]$, where $E[\pi_{s_i}]$ is:

$$\begin{aligned}
E[\pi_{s_i}] =& P(\theta = s_i|s_i)\cdot\big(1-(1-\mu)^2\big) + P(\theta \neq s_i|s_i)\cdot\big(1-\mu^2\big) \\
=& \big(\hat{\eta}_i + 0.5(1-\hat{\eta}_i)\big)\cdot\big(1-(1-\mu)^2\big) + \big(1-(\hat{\eta}_i + 0.5(1-\hat{\eta}_i))\big)\cdot\big(1-\mu^2\big) \\
=& (0.5\hat{\eta}_i + 0.5)(1-(1-2\mu+\mu^2)) + (1-(0.5\hat{\eta}_i+0.5))(1-\mu^2) \\
=& (0.5\hat{\eta}_i + 0.5)(2\mu - \mu^2) + (0.5 - 0.5\hat{\eta}_i)(1-\mu^2) \\
=& \mu\hat{\eta}_i - 0.5\mu^2\hat{\eta}_i + \mu - 0.5\mu^2 + 0.5 - 0.5\hat{\eta}_i - 0.5\mu^2 + 0.5\mu^2\hat{\eta}_i \\
=& \mu\hat{\eta}_i + \mu + 0.5 - 0.5\hat{\eta}_i - \mu^2
\end{aligned}$$

If Sender i does not forward his signal, his expected payoff is as if $\hat{\eta}_i = 0.5$, s.t.:

$$E[\pi_{s_i}|\hat{\eta}_i = 0.5] = 1.5\mu + 0.25 - \mu^2$$

Therefore, Sender i forwards s_i if his belief about being the HP is larger than 0.5.

$$\begin{aligned} X\big(E[\pi_{s_i}] - E[\pi_{s_i}|\hat{\eta}_i = 0.5]\big) &> 0 \\ \mu(\hat{\eta}_i - 0.5) - 0.5(\hat{\eta}_i - 0.5) &> 0 \\ (\mu - 0.5)(\hat{\eta}_i - 0.5) &> 0 \\ \hat{\eta}_i &> 0.5 \end{aligned}$$

B.4 Equilibria

Assuming that every participant plays an intrapersonal game with beliefs $\hat{\eta}_i$, $\hat{\eta}_{-i} = 1 - \hat{\eta}_i$, and μ, and that these believes are seen as common knowledge by all participants, there exist two candidate equilibria.

Separating equilibrium. Without loss of generality, let us assume that Sender i believes that he is the High Performer with probability $\hat{\eta}_i > 0.5$. Then, according to his equilibrium strategy, he forwards his signal. The other Sender believes that he is the High Performer with probability $\hat{\eta}_{-i} = 1 - \hat{\eta}_i < 0.5$ and does not forward his signal. The Receiver observes the advice $s = s_i$ and believes that it coincides with the true state with probability $\mu = 0.5 \cdot P(\eta = \overline{\eta}) + 0.5 = 0.5\hat{\eta}_i + 0.5$.

Pooling equilibrium. Both senders with beliefs $\hat{\eta}_i = \hat{\eta}_{-i} = 0.5$ are indifferent between forwarding their signals or not. The Receiver believes that the randomly selected signal that she observes coincides with the true state with probability $\mu = 0.75$.

B.5 Competition for Attention

Assuming that every participant plays an intrapersonal game with beliefs $\hat{\eta}_i$, $\hat{\eta}_{-i} = 1 - \hat{\eta}_i$, and μ, and that these believes are seen as common knowledge by all participants, there exist two candidate equilibria.

Separating equilibrium. Without loss of generality, let us assume that Sender i believes that he is the High Performer with probability $\hat{\eta}_i > 0.5$. Then his equilibrium strategy is to forward the signal if his expected payoff from forwarding it is larger than his expected payoff from not forwarding it, given that Sender $-i$ does not forward his signal.

If Sender i forwards his signal and Sender $-i$ does not, the expected payoff of Sender i is $XE[\pi_{s_i}] + Y$, where Y is the reward for competition for attention. If Sender i does not forward his signal and Sender $-i$ does not forward his signal as well, one of the two signals is randomly transmitted to the Receiver, and the expected payoff of Sender i is $\frac{1}{2}X\big(E[\pi_{s_i}] + E[\pi_{s_{-i}}]\big) + \frac{Y}{2}$, where $E[\pi_{s_{-i}}]$ is the expected payoff that realizes if Sender $-i$'s signal is transmitted to the Receiver.

Thus, Sender i should forward his signal if the following holds:

$$
\begin{aligned}
&XE[\pi_{s_i}] + Y > \frac{1}{2}X\big(E[\pi_{s_i}] + E[\pi_{s_{-i}}]\big) + \frac{Y}{2} \\
&\Leftrightarrow \frac{1}{2}X\big(E[\pi_{s_i}] - E[\pi_{s_{-i}}]\big) + \frac{Y}{2} > 0 \\
&\Leftrightarrow X\big(E[\pi_{s_i}] - E[\pi_{s_{-i}}]\big) + Y > 0
\end{aligned}
$$

where $E[\pi_{s_{-i}}]$ is expressed as:

$$
\begin{aligned}
E[\pi_{s_{-i}}] =& P(\theta = s_{-i}|s_i) \cdot \big(1 - (1-\mu)^2\big) + P(\theta \neq s_{-i}|s_i) \cdot \big(1 - \mu^2\big) \\
=& \big(0.5\hat{\eta}_i + (1-\hat{\eta}_i)\big) \cdot \big(1 - (1-\mu)^2\big) + \big(1 - (0.5\hat{\eta}_i + (1-\hat{\eta}_i))\big) \cdot \big(1 - \mu^2\big) \\
=& (1 - 0.5\hat{\eta}_i)(2\mu - \mu^2) + 0.5\hat{\eta}_i(1 - \mu^2) \\
=& 2\mu - \mu^2 - \mu\hat{\eta}_i + 0.5\mu^2\hat{\eta}_i + 0.5\hat{\eta}_i - 0.5\mu^2\hat{\eta}_i \\
=& 2\mu - \mu^2 - \mu\hat{\eta}_i + 0.5\hat{\eta}_i
\end{aligned}
$$

and the difference between the two expected payoffs is:

$$
\begin{aligned}
E[\pi_{s_i}] - E[\pi_{s_{-i}}] =& \Big(\mu\hat{\eta}_i + \mu + 0.5 - 0.5\hat{\eta}_i - \mu^2\Big) - \Big(2\mu - \mu^2 - \mu\hat{\eta}_i + 0.5\hat{\eta}_i\Big) \\
=& 2\mu\hat{\eta}_i - \mu + 0.5 - \hat{\eta}_i \\
=& 2(\mu - 0.5)(\hat{\eta}_i - 0.5)
\end{aligned}
$$

Substituting this result, Sender i should forward his signal if his belief about being the High Performer is larger than the threshold N_c.

$$
\begin{aligned}
&X\big(E[\pi_{s_i}] - E[\pi_{s_{-i}}]\big) + Y > 0 \\
&\Leftrightarrow 2X(\mu - 0.5)(\hat{\eta}_i - 0.5) + Y > 0 \\
&\Leftrightarrow \hat{\eta}_i > 0.5 - \frac{Y}{2X(\mu - 0.5)} \equiv N_c
\end{aligned}
$$

The equilibrium strategy of the Receiver is to report $\mu = 0.5\hat{\eta}_i + 0.5$. Substituting this strategy into the strategy of the Sender i, the following should hold:

$$
\begin{aligned}
&\hat{\eta}_i > 0.5 - \frac{Y}{2X(\mu - 0.5)} \\
&\Leftrightarrow \hat{\eta}_i > 0.5 - \frac{Y}{X\hat{\eta}_i} \\
&\Leftrightarrow \hat{\eta}_i^2 - 0.5\hat{\eta}_i + \frac{Y}{X} > 0
\end{aligned}
$$

The solutions of the quadratic equation are:

$$
\hat{\eta}_i = \frac{1}{4} \pm \sqrt{\frac{1}{16} - \frac{Y}{X}}
$$

which given the ratio of the rewards used in the experiment $\frac{Y}{X} = \frac{2}{8} = \frac{1}{4}$ are two complex roots. To determine whether the inequality holds, we can test any value of $\hat{\eta}_i$. Substituting, for example, $\hat{\eta}_i = 0$, we get $\frac{1}{4} > 0$ which is positive, meaning that inequality is satisfied for any real number $\hat{\eta}_i$.

Now, let us assume that Sender $-i$ believes that he is the High Performer with probability $\hat{\eta}_{-i} < 0.5$. Then his equilibrium strategy is to forward the signal if his expected payoff from forwarding it is larger than his expected payoff from not forwarding it, given that Sender i forwards his signal.

If Sender $-i$ forwards his signal and Sender i also forwards his signal, one of the two signals is randomly transmitted to the Receiver, and the expected payoff of Sender $-i$ is $\frac{1}{2}X\big(E[\pi_{s_i}] + E[\pi_{s_{-i}}]\big) + \frac{Y}{2}$. If Sender $-i$ does not forward his signal and Sender i forwards his signal, the expected payoff of Sender $-i$ is $XE[\pi_{s_i}]$.

Thus, Sender $-i$ should forward his signal if the following holds:

$$\begin{aligned}
&\frac{1}{2}X\big(E[\pi_{s_i}] + E[\pi_{s_{-i}}]\big) + \frac{Y}{2} > XE[\pi_{s_i}] \\
&\Leftrightarrow \frac{1}{2}X\big(E[\pi_{s_{-i}}] - E[\pi_{s_i}]\big) + \frac{Y}{2} > 0 \\
&\Leftrightarrow X\big(E[\pi_{s_{-i}}] - E[\pi_{s_i}]\big) + Y > 0
\end{aligned}$$

where $E[\pi_{s_{-i}}] - E[\pi_{s_i}] = 2(\mu - 0.5)(\hat{\eta}_{-i} - 0.5)$.

Substituting this result, Sender $-i$ should forward his signal if his belief about being the High Performer is larger than the threshold N_c.

$$\hat{\eta}_{-i} > 0.5 - \frac{Y}{2X(\mu - 0.5)} \equiv N_c$$

Substituting the equilibrium strategy of the Receiver $\mu = 0.5\hat{\eta}_i + 0.5$ into the Sender $-i$'s strategy, the following should hold:

$$\hat{\eta}_{-i}^2 - 1.5\hat{\eta}_{-i} + 0.5 - \frac{Y}{X} < 0$$

The solutions of the quadratic equation are:

$$\hat{\eta}_{-i} = \frac{3}{4} \pm \sqrt{\frac{1}{16} + \frac{Y}{X}}$$

and the inequality is satisfied for the values $\hat{\eta}_{-i} \in \Big(\frac{3}{4} - \sqrt{\frac{1}{16} + \frac{Y}{X}}, \frac{3}{4} + \sqrt{\frac{1}{16} + \frac{Y}{X}}\Big)$, which given the ratio of the rewards used in the experiment and the probability property simplifies to $\hat{\eta}_{-i} \in (0.19, 1)$. Thus, if Sender $-i$ believes that he is the High Performer with probability $\hat{\eta}_{-i} < 0.19$, he is better of by not forwarding his signal to the Receiver.

Pooling equilibrium. Both senders with beliefs $\hat{\eta}_i = 1 - \hat{\eta}_{-i} \in \Big[0.5 - \frac{Y}{0.5X}, 0.5 + \frac{Y}{0.5X}\Big]$ are indifferent between forwarding their signals or not. The Receiver believes that the randomly selected signal that she observes coincides with the true state with probability $\mu = 0.75$.

C Appendix: Analysis of Experimental Results

Figure C1 shows median subjective beliefs of experts in the Hard and Easy treatments.

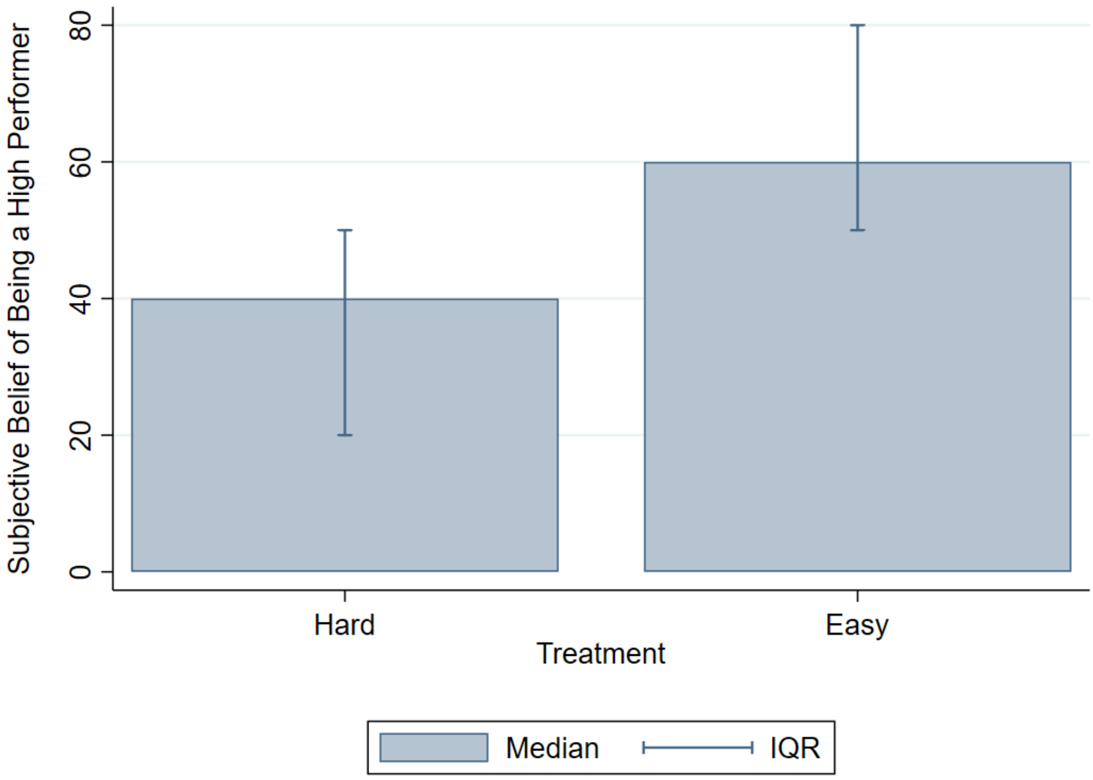


Figure C1: Median subjective beliefs of experts by treatment.

Figure C2 shows the cumulative distribution functions for the Hard and Easy treatments. The vertical dashed line indicates the subjective belief of being a High Performer, which is set at 50 %. Based on the theoretical framework outlined in Section 3, experts with a subjective belief above 50 % should forward the signal, while those with a belief below 50 % should not. Therefore, applying this framework to the experimental data suggests that approximately 30 % of experts in the Hard treatment and 60 % in the Easy treatment should forward their signals.

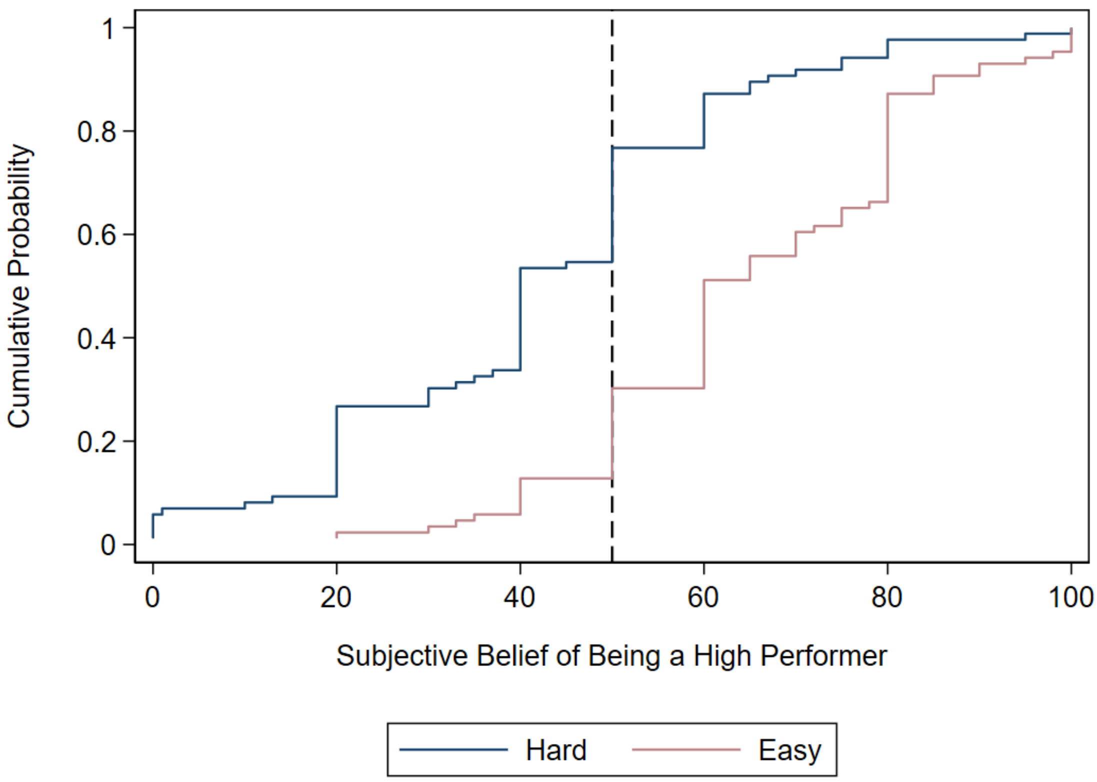


Figure C2: Cumulative distribution functions.

An exogenous increase in confidence translates into a higher fraction of experts who forward their signals. The first column of Table C1 shows that there are significantly more signals forwarded in the Easy Treatment compared to the Hard treatment. The second column implies that there are no statistically significant differences between males and females. The third column indicates that the result is slightly affected by the coefficient of risk aversion. Less risk-averse experts forward their signals significantly more often.

Table C1: Propensity to forward a signal.

	OLS		
	(1)	(2)	(3)
Treatment (Easy = 1)	0.3256***	0.3270***	0.2970***
	(0.0681)	(0.0680)	(0.0690)
Female		0.0307	
		(0.0689)	
Risk aversion			0.0512***
			(0.0180)
Constant	0.5000***	0.4878***	0.2268**
	(0.0542)	(0.0609)	(0.1087)
N	172	172	172
R-squared	0.1186	0.1196	0.1571

Note: $^{*}\,p < 0.1$; $^{**}\,p < 0.05$; $^{***}\,p < 0.01$

Table C2 shows the results of the Probit regression model for the determinants of forwarding a signal. The Probit analysis yielded results that closely resembled those obtained from the OLS regression analysis presented in Tables C1 and 2.

Table C2: Propensity to forward a signal.

	Probit	Marginal Effects	Probit	Marginal Effects	IV Probit	Marginal Effects
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment (Easy = 1)	0.9368***	0.3074***				
	(0.2093)	(0.0562)				
Subjective belief			4.4168***	1.1078***	5.0149***	1.2712***
			(0.7097)	(0.0993)	(0.9102)	(0.2089)
Constant	−0.0000		−1.7556***		−2.0836***	
	(0.1355)		(0.3687)		(0.4859)	
N	172	172	172	172	172	172
Pseudo R-squared	0.0957		0.3025			

Note: $^{*}\,p < 0.1$; $^{**}\,p < 0.05$; $^{***}\,p < 0.01$

Table C3 shows subjective beliefs of experts by treatment and decision to forward the signal. There are large and significant mean differences in subjective beliefs between the experts who forward and the experts who do not forward their signals in the Hard and the Easy treatments. In the Reward treatment, the mean difference becomes smaller and is only significant at the 10 % level. This provides further evidence for a prevalence of separating equilibrium in the Hard and the Easy treatments and pooling equilibrium in the Reward treatment.

Table C3: Subjective beliefs of experts by treatment and decision to forward the signal.

	Forward		Not Forward		t-test	
Treatment	Mean	S.D.	Mean	S.D.	Diff.	p
Hard	53.72	18.60	29.67	17.32	24.04	0.000
Easy	68.25	17.88	49.67	12.32	18.59	0.000
Reward	37.95	23.00	29.49	19.19	8.47	0.069

Note: The last column shows the two-tailed p-values of the two-sample t-test.