How do Groups Speak and How are They Understood?*

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Abstract

We experimentally study an environment where a group of senders communicates with a receiver by disclosing or not disclosing a realized outcome. Group members have distinct preferences over disclosure/non-disclosure, and aggregate their interests into a collective disclosure decision via a given deliberation procedure. In line with theoretical results, our experimental evidence establishes a relationship between the procedure used by the group and the receiver's interpretation of the group's "no disclosure messages:" group members who have more power over the group's disclosure decision are regarded with more skepticism when the group fails to disclose. We further document that in a group disclosure setting, the observer is typically not as skeptical about group members' values upon seeing no disclosure, relative to theoretical predictions; and that the interpretation of communication from a group differs from that of individual communication, even when the two are theoretically equivalent. We argue that these observations are consistent with group members having social preferences; and contrast them with previous literature on the "romance of leadership."

1 Introduction

In many economic circumstances in which people communicate, communication decisions are made by organizations composed of groups of people, rather than by individual actors. Political parties collectively agree on "stances" their members should publicly hold regarding politically

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relevant issues. Decisions on what reporting to include in a magazine or newspaper's next issue are normally made by editorial boards. Teams of startup founders jointly decide when and how to pitch startup ideas to potential investors.[1] Cyert and March (1963) make an observation, seminal to the field of organizational economics, that "People (i.e., individuals) have goals; collectivities of people do not." Their point is that, if one wants to understand economic decisions made by organizations, it is not sufficient to impute "preferences" on them and expect rational decision making. Rather, it is important to view them as a collective of individuals, each of whom has their own preferences, who aggregate these interests through some process of conflict resolution, perhaps described by some (formal or informal) power structure within the organization.

In this paper, we study how groups/organizations *communicate*, taking Cyert and March's perspective of an organization as a collective of individuals who reach communication decisions via the (perhaps uneven) aggregation of their often-conflicting interests. Our main results establish experimentally that the balance of power between individuals in an organization plays a dual role in group communication: it directly affects the aggregation of individual interests, and it indirectly determines the way the group's communication is interpreted by their audience.

A Theory of Group Communication. Our experimental design is based on a basic environment of *group disclosure* first introduced by Onuchic and Ramos (2023). This environment extends the disclosure models of Grossman (1981) and Milgrom (1981) to a context in which a group of agents makes a collective decision regarding the disclosure of a piece of evidence. Different members of the group often have conflicting preferences regarding the disclosure/non-disclosure of the realized evidence, and the group's disclosure decision summarizes these different interests through some pre-determined aggregation procedure. We believe this disclosure communication protocol to be a good description of many applied settings, but the main reason we choose to study group communication first in a disclosure environment is its simplicity. The group disclosure environment allows us to cleanly study the new mechanisms introduced by group communication, and is easily adaptable to an experimental setting.

In our version of the group disclosure model, a group of two individuals (A and B) draws an observable outcome, described by its value to each of the two group members. After seeing the outcome, the group decides whether to disclose it to an outside observer. To that end, each group member makes a recommendation, suggesting that the outcome be disclosed or that it not

[1] In each of these situations, collective communication decisions are reached via the (perhaps uneven) aggregation of the interests of individuals who have (perhaps uneven) power in the organization's decision-making process. See, for example, Egerod et al. (2024) who study communication decisions made by trade associations, influential lobbying organizations that provide a crucial channel for the transmission of elite public opinion about the advisability of certain policies. The paper argues that stances taken by a trade association more closely reflect the interests of more powerful individual actors within the association.

be disclosed. In making their recommendations, each of the group members aims to maximize the observer's belief about their own drawn value. The two individual recommendations then get aggregated into a group disclosure decision via an aggregator function that we denote the *deliberation procedure*. The deliberation procedure is the main primitive of the model and it describes each group member's power to impose their preferred action as the group's disclosure decision.

While the theoretical model permits a more general class of deliberation rules, our experimental design focuses on three possible procedures: a *unilateral* deliberation procedure, according to which disclosure happens if at least one of the group members recommends it (so that both group members can unilaterally enforce the outcome's disclosure); a *consensus* procedure, according to which the group discloses the outcome only if both group members recommend the outcome's disclosure (neither group member has full disclosure power); and a *leader* procedure, according to which the group's decision always equals group member A's recommended action (so that group member A has full disclosure power, but group member B does not).

Once the decision is made, the observer sees (or does not see) the (non-)disclosed evidence and forms a belief about the value of the outcome to each of the two group members. The observer perfectly observes these values if the outcome is disclosed, and otherwise makes inferences about them based on the group's decision not to disclose the outcome. As in classic individual disclosure games, the observer's belief of no disclosure reflects their skepticism about group members' values, from the inference that "they must have chosen not to disclose because the outcome was bad news." Specifically in the group disclosure environment, this skepticism is targeted at one or both group members' values, depending on who the observer perceives to be "to blame" for the decision to not disclose. This perception of blame, and therefore the skepticism reflected in the observer's "no disclosure beliefs," vary with the group's deliberation procedure.

If the group uses the unilateral deliberation procedure, then the observer infers from no disclosure that both group members recommended no disclosure, and therefore is very skeptical (in equilibrium) about both group members' values upon seeing no disclosure. Under the consensus procedure, no disclosure implies that at least one group member recommended no disclosure, but the blame cannot be fully attributed to either of them; correspondingly, the observer's equilibrium "no disclosure beliefs" are less skeptical about each of the group members than in the unilateral procedure. Finally, with the leader procedure, the observer knows that blame for no disclosure is due to group member A (the leader), and their equilibrium no disclosure beliefs are very skeptical about group member A and not skeptical about group member B. Proposition 1 formally states this theoretical result, establishing an ordering on the observer's skepticism about group members' values across the different deliberation procedures.

Group Disclosure in the Lab. The ordering of the observer's skepticism about group members' values across deliberation procedures, and parallel predictions regarding group member's disclosure recommendation strategies under different procedures, are the main hypotheses we wish to validate empirically in the lab. To do so, we propose an experimental design that closely parallels the group disclosure model. In the lab, subjects are grouped into units of three, and in each unit one subject is assigned the role of group member A, one is assigned the role of group member B, and one is assigned the role of the evaluator. Group members draw a pair of cards that describe their respective values and make recommendations, suggesting to report or not to report the drawn cards to the evaluator. After seeing/not seeing the cards, the evaluator is asked to guess each group member's value. The evaluator is incentivized to make accurate guesses, and each group member's payoff is increasing in the evaluator's guess of their own value.

In line with the theory, our three main treatments, which vary the deliberation procedure used to aggregate the group members' recommendations into a group disclosure decision, are the *unilateral treatment*, the *consensus treatment*, and the *leader treatment*. Importantly, all participants know the deliberation procedure used, that is, group members know how their recommendations map into group decisions and the evaluator knows how group members' recommendations were aggregated (but does not see group members' recommendations themselves). As a baseline, we also consider a comparable *individual treatment*, in which a single individual makes disclosure decisions (regarding an outcome conveying only their own individual value).

Our model predictions regarding the ordering of the observer's skepticism in the different treatments are confirmed by our experimental data, indicating that, in practice, evaluators understand and take into account the process used by the group to reach a "no disclosure" decision when they are asked to interpret that decision by guessing group members' values. In a first instance, we confirm these predictions using data from the observer's guesses during the game play. We additionally confirm them using data from an incentivized post-play questionnaire, in which all participants (regardless of their played role) are asked what their guess would be about each group member's value if they were the evaluator and saw no disclosure.

While our hypothesized ordering on the evaluator's skepticism across treatments are confirmed in the experiment, we find that the exact skepticism numbers differ significantly in theory (equilibrium no disclosure beliefs are stated in Proposition 1) and in practice. Similar to previous experimental literature on games of individual disclosure (discussed in our related literature section), we find that the evaluator tends to be less skeptical than predicted by the theory, both in treatments where theory predicts full unravelling and in treatments in which equilibria do not feature "maximal skepticism." In the leader treatment, our finding that the observer has "too little skepticism" with respect to the leader's value (compared to the "true procedure" according to which the leader has full control over the group's decision) stands in contrast with previous literature that documents the *romance of leadership*, the idea that responsibility for group outcomes is over-attributed to individuals in leadership roles. (The term "romance of leadership" is introduced by Meindl et al. (1985), who conduct a series of experimental exercises and document an over-attribution of organizational outcomes to a role of "leadership.")

By comparing the experimental data in the various group treatments to the baseline individual disclosure treatment, we show that communication coming from a group is interpreted fundamentally different from communication coming from an individual, even in circumstances where theory predicts group and individual communication equilibria to be comparable. For example, we find that the observer is less skeptical about each group member in the unilateral treatment than about the individual in the individual treatment. In contrast, our theory predicts "maximal skepticism" in both these cases. We interpret this observation as indicating that the evaluator's perception of "social blame" in the unilateral treatment erodes each group member's "individual blame" for the collective decision to not disclose; while this blame erosion cannot happen in the individual treatment. In section 5, we argue that the erosion of individual blame under the unilateral procedure can be reconciled with equilibrium behavior in an environment in which individuals have social preferences, as in Fehr and Schmidt (1999).

Our final set of experimental results compares subjects' reporting recommendation strategies across our four treatments. Although comparisons are less sharp than those regarding the evaluator's skepticism across treatments, there is evidence linking group members' reporting behavior to that predicted in the theory. Specifically, we first compare the average reporting recommendation rate for group members, for each draw of their own outcome value, across treatments. We find, for example, that group member A's tend to recommend the reporting of the group's cards more often in the leader treatment than in the consensus treatment, which is consistent with our theoretical prediction.

Additionally, we assess whether group members use "threshold recommendation strategies," recommending that the group's cards be reported if and only if their own value is above a certain threshold. We find that most group members use threshold strategies, across all treatments, and that group members' threshold strategies vary across treatments, roughly in line with our theory. Further, we compare the thresholds used by group members to their belief about the observer's guess of their own value if the group does not disclose, as elicited in the questionnaire.[2] We find that the thresholds used in group members' disclosure recommendation strategies often correspond to these reported beliefs in the individual disclosure treatment (as would be expected in our theoretical setting), but less often in the group disclosure treatments. We further document that, where these thresholds differ from the reported beliefs, the deviations indicate behavior expected from

[2] These beliefs are the responses of individuals who played group member roles to the question "Suppose you are an evaluator, and the group hand is not reported to you by the group. What would be your guess A and guess B for group member A's value and group member B's value, respectively?"

individuals with altruistic social preferences as in Fehr and Schmidt (1999).

1.1 Related Literature

The theoretical portion of our paper contributes to the large literature on disclosure games — surveyed, for example, by Milgrom (2008). For a complete review on the connection between these stated results and previous theoretical literature, please refer to Onuchic and Ramos (2023).

The main focus of this paper is experimental. To the best of our knowledge, this is the first paper to experimentally study a group communication game, in which a group of senders with distinct interests collectively communicate with a receiver through the disclosure of verifiable information. This focus mainly connects our work to the experimental literature on disclosure games (and communication experiments more broadly) and to the experimental literature on games played by groups or games of collective decision. We comment on each of these connections below.

Communication Experiments. There is a significant literature that experimentally test predictions of theoretical models of disclosure in the tradition of Grossman (1981) and Milgrom (1981). Some experiments, including those in Forsythe et al. (1989), Li and Schipper (2020), Jin et al. (2021), and Deversi et al. (2021), consider environments in which theoretical analysis predicts that skepticism on the part of the receiver leads to the "unravelling" of equilibria in which not all information is disclosed by the sender. These experiments find evidence of unravelling to different degrees, and scrutinize the mechanisms behind the discrepancy between theoretical and experimental findings.[3]

In the repeated feedback treatment of Jin et al. (2021), in which they find the strongest evidence of unravelling, the observer's "no disclosure skepticism" about the sender's secret number is about 0.552.[4] This repeated feedback treatment is similar to our benchmark individual disclosure treatment, and their skepticism number is comparable to what we find in our individual treatment, in which the observer's no disclosure skepticism is 0.317 on average. For reference, full unravelling corresponds to a maximally skeptical observer (skepticism$=1$). In our group disclosure setting, one novel observation is that the evaluator is (depending on the treatment) either "not sufficiently skeptical," as found in this previous literature, or "too skeptical," relative to skepticism predicted by our accompanying theory.

[3] For instance, Li and Schipper (2020) use an iterated admissibility criterion to generate theoretical predictions for finite levels of reasoning about rationality.

[4] To calculate a skepticism value using the data from Jin et al. (2021) that is comparable to skepticism estimates in our environment, we use the expression

$$\sigma = \frac{\mathbb{E}(\text{secret number}) - \text{Guess}(\text{no disclosure})}{\mathbb{E}(\text{secret number}) - \min(\text{secret number})} = \frac{3 - 1.897}{3 - 1} = 0.552.$$

There is also a set of experimental papers that consider individual disclosure environments in which full disclosure is not a necessary prediction. For example, King and Wallin (1991) runs an experiment akin to the model in Dye (1985), according to which the sender with some probability does not have access to verifiable information; Dickhaut et al. (2003) consider the possibility that disclosure is costly; Hagenbach and Perez-Richet (2018) study an environment in which the sender does not have monotonic preferences; and Hagenbach and Saucet (2024) run an experiment in which information receivers have preferences over the information they learn, as in the literature on motivated beliefs. Adding to these contributions, our paper provides a new environment that is adapted to an experimental setting and in which "full disclosure" is not a necessary theoretical prediction. Our new mechanism behind the failure of unravelling is the observer's inability to attribute blame for a "no disclosure" decision across individuals in a group.

Similarly to Hagenbach and Saucet (2024), our paper proposes a theoretical environment in which the degree of predicted skepticism varies across the different treatments considered; and, like them, we assess whether the predicted ordering on skepticism is confirmed experimentally. In their setting, treatments vary whether the state that senders communicate about is ego-relevant or neutral for receivers, and whether skeptical beliefs are aligned or not with what Receivers prefer believing. Compared to neutral settings, they find that the receiver's skepticism is significantly lower when it is self-threatening, and not enhanced when it is self-serving. In our experiment, different treatments vary the aggregation procedure used by the group to reach disclosure decisions; and we show that the evaluator is consistently more skeptical about individuals who have more power over the group's disclosure decision.

There are a few experimental papers that study communication with multiple senders. For example, Lai et al. (2015) and Vespa and Wilson (2016) consider experiments in which multiple senders communicate with a single receiver via cheap talk. Our setup differs from that both because the group communicates through a different protocol (information disclosure rather than cheap talk), and because we consider communication by a group as a single coordinated entity, rather than independent communication from multiple sources.

Experiments Played by Groups. There are two main types of experiments that consider games played by groups of subjects. The first set of papers includes studies that compare group and individual behavior in various games and individual decision problems where all members of the group share the same payoffs. These studies typically find that team play more closely resembles the standard predictions of game theory. Charness and Sutter (2012) and Kugler et al. (2012) are surveys that cover that experimental literature; and Kim et al. (2022) is a theoretical paper that proposes a general framework, easily mappable to the usual experimental setting of "games played by groups," for analyzing games where each player is a team and members of the same team all receive the same payoff.

The second type of group experiments consider games of collective decision in which group members have different and private information about a state that is relevant to determine the group's ideal action. This literature, surveyed by Martinelli and Palfrey (2018), includes experiments on voting games, on information aggregation in committees, and on legislative bargaining. Our paper resembles some of this work — for example, Goeree and Yariv (2011) — in that our different treatments vary the institutions by which decisions are reached by the group.

Our paper distinguishes itself from both these strands of the literature in that we consider a game of group communication. In our game, group members have distinct preferences over communication decisions (unlike in the first literature strand), and have access to all the information relevant to make their own optimal disclosure recommendation (unlike the second strand of the literature, in which information aggregation plays a big role). Our main experimental objects of interest are Bayesian beliefs formed by the evaluator who sees group communication decisions.

2 Model and Theoretical Results

The following model and results are simplified versions, adapted for fitness to an experimental setting, of those proposed in Onuchic and Ramos (2023).

2.1 Environment

There is a group, composed of two group members $i = A, B$. The group draws an observable outcome ω, described by its value to each group member i, $\omega_i \in [0, 1]$. The outcome values ω_A and ω_B are independently drawn, each distributed according to the uniform distribution over the interval $[0, 1]$. The group makes a single decision, of whether to disclose the realized outcome, thereby revealing it to some outside third-party, or to conceal it. Before providing further details on the group's decision making, we discuss possible interpretations of this simple environment.

Interpretation. A possible scenario is one of a team in a tech company that is assigned the project of designing a new tool. The team is made up various professionals, including an engineer and a marketer. After working on this project for a while, the team produces an initial prototype (the observable outcome), which is very well done in terms of its technical aspects, but poorly "packaged." At this point, the team is approached by a higher-up manager (the outside third-party) who asks them to report on their progress. The team must decide whether to reveal the prototype to the manager or not to do so (maybe claiming that they need more time, or that no prototype has yet been produced). If the team reveals the prototype, the manager will be positively impressed by the engineer, who contributed the technical aspects, but negatively impressed by the marketer, who is responsible for the below-par packaging. In this case, even though the team produced a single observed outcome, its disclosure yields a different value to each team member — a high $\omega_{engineer}$ and a low $\omega_{marketer}$.

Alternatively, think of a meeting of the editorial board of a magazine, where various editors need to decide whether to include an inflammatory piece (the observable outcome) in the upcoming publication (in which case the outcome will be seen by the outside third-party, the potential readers of the magazine). The editors have different views on the ideal editorial leaning for the magazine, maybe relating to their own political views, and therefore assign different value to the inclusion of this piece in the magazine's new issue. Again, even though there is a single observable outcome in hand, the publishable piece, its publication yields a different value to each member of the editorial board — so that $\omega_{editorA} \neq \omega_{editorB}$.

Group Decision-Making. We assume that each group member i sees only their own outcome value ω_i before the group decides on the outcome's disclosure.[5] To reach a group decision, each group member makes an individual disclosure recommendation $x_i(\omega_i) \in \{0, 1\}$ — $x_i = 1$ indicates that i favors the outcome's disclosure. The individual recommendations are then aggregated into a group disclosure decision according to some deliberation procedure $D : \{0, 1\}^2 \to [0, 1]$, so that

$$d(\omega) = D\left(x_A(\omega_A), x_B(\omega_B)\right)$$

is the probability that the group discloses outcome ω to the outside third-party.

The aggregator function D provides a reduced-form description of the "deliberation procedure" used by the team to reach a collective decision: it describes the disclosure decision that is reached after each possible combination of individual disclosure recommendations made by the group members. We assume that this aggregation respects unanimity, that is, it follows disclosure recommendations that are unanimous across the two group members; so that $D(0, 0) = 0$ and $D(1, 1) = 1$. Because these values are fixed by assumption, a group's deliberation procedure can be described by the values $D(1, 0) \in [0, 1]$ and $D(0, 1) \in [0, 1]$, the disclosure probabilities attained when the two group members make conflicting recommendations.

The different treatments we consider in our experiment consider groups that use different deliberation procedures to aggregate individual recommendations. Specifically, we consider three treatments: the *unilateral* deliberation procedure, the *consensus* deliberation procedure, and the

[5] In our model, each group member's possible payoffs are entirely determined by their own outcome value ω_i and the observer's equilibrium "beliefs of no disclosure." This implies that there is no additional information relevant to group member i that is conveyed by group member j's outcome value; and our assumption that each group member sees only their own value is of very little consequence. We make this assumption mainly so that the model exactly parallels our experimental design.

leader deliberation procedure. In the unilateral procedure, both group members can unilaterally enforce the disclosure of the group outcome; this corresponds to $D(1,0) = D(0,1) = 1$, indicating that disclosure occurs for sure if at least one group member recommends it. In the consensus procedure, disclosure must be a consensual decision among group members; in this case, $D(1,0) = D(0,1) = 0$, indicating that disclosure does not happen unless both group members recommend it. Finally, in the leader deliberation procedure, group member A is a dictator, and the group almost always directly follows their recommendation; this corresponds to $D(1,0) = 1 - \epsilon$ and $D(0,1) = \epsilon$, for some small $\epsilon > 0$.

Payoffs. If the group chooses to disclose the outcome ω, the outside third-party perfectly observes it, and each group member i receives a payoff equal to their own respective value of the outcome, ω_i. If instead the group chooses to not disclose the outcome, then the outside observer does not see the outcome, but sees that the group chose "no disclosure." In that case, the observer forms a Bayesian posterior belief about the value of ω_i for each group member i, given by

$$\omega_i^{ND} = \mathbb{E}(\omega_i | \text{ no disclosure}). \tag{1}$$

Group member i's payoff is then equal to the observer's posterior belief about their own outcome.

Equilibrium. Given a deliberation procedure D, individual disclosure strategies x_i for $i \in \{A, B\}$, the group's disclosure decision d, and no-disclosure posteriors ω_i^{ND} for $i \in \{A, B\}$ constitute an equilibrium if

1. Group members make disclosure recommendations as if they are pivotal:

$$\omega_i > \omega_i^{ND} \Rightarrow x_i(\omega) = 1 \text{ and } \omega_i < \omega_i^{ND} \Rightarrow x_i(\omega) = 0.$$

2. The group's disclosure decision aggregates individual disclosure strategies x:

$$d(\omega) = D(x_1(\omega_1), x_2(\omega_2)) \text{ for every } \omega \in [0,1]^2.$$

3. No-disclosure posteriors are Bayes-consistent: for each $i \in N$, ω_i^{ND} satisfies (1).

The equilibrium notion is close to a weak PBE, with a small variation requiring that group members make recommendations as if they are pivotal (condition 1 in the equilibrium definition). This condition refines out potential equilibria in which group members make a recommendation solely because they believe themselves not to be pivotal. For example, suppose the group uses the consensus deliberation procedure. And suppose group member A always recommends that the outcome not be disclosed (regardless of their own value). In that case, group member B understands that, regardless of their own recommendation, the outcome will not be disclosed; and therefore group member B is willing to always recommend no disclosure. By this logic, there exists a weak Perfect Bayesian Equilibrium in which every group member always recommends no disclosure. Such an equilibrium is not plausible, because there are instances in which both group members would prefer to collectively deviate to disclosing the outcome, but don't do so because they are stuck in a "no pivotality trap." Such implausible equilibria are refined out by condition 1.[6]

2.2 Group Disclosure and "Unravelling"

Our first result characterizes the equilibrium set under different deliberation procedures.

Theorem 1. *Fix a deliberation procedure, defined by $D(1,0)$ and $D(0,1)$. The following statements are true about the equilibrium set:*

- *There exists a full-disclosure equilibrium.*
- *Full disclosure is the unique equilibrium if $D(1,0) = 1$ or $D(0,1) = 1$.*
- *If $D(1,0) < 1$ and $D(0,1) < 1$, there exists a unique equilibrium without full disclosure.*

Theorem 1 first shows that a full-disclosure equilibrium always exists in this environment, regardless of the deliberation procedure used by the group to make communication decisions. To see that, note that if the observer's beliefs of no disclosure are $\omega_A^{ND} = \omega_B^{ND} = 0$, then every group member is always willing to recommend that the outcome be disclosed, regardless of their outcome value. In that case, every outcome is necessarily disclosed to the observer; and therefore "no disclosure" only happens off path. Because our equilibrium condition makes no consistency requirements for off-path beliefs, the initial conjectured beliefs $\omega_A^{ND} = \omega_B^{ND} = 0$ do constitute an equilibrium, along with the always-disclose individual recommendation strategies.[7]

The theorem further states that, if at least one group member can individually enforce the disclosure of the outcome — that is, if either $D(1,0)$ or $D(0,1)$ is equal to 1 — then full disclosure is the unique equilibrium of the disclosure game. If an individual has the power to enforce disclosure,

[6] If the deliberation procedure is such that $0 < D(1,0), D(0,1) < 1$, then condition 1 is equivalent to requiring that group members do not play weakly dominated strategies.

[7] The no disclosure beliefs $\omega_A^{ND} = \omega_B^{ND} = 0$ can sustain a full disclosure equilibrium, as they induce both group members to always recommend disclosure. However, if $D(1,0) = 1$ (meaning that group member A can unilaterally enforce the outcome's disclosure), full disclosure can also be supported by beliefs $\omega_A^{ND} = 0$ and $\omega_B^{ND} > 0$, as it is sufficient for group member A to always recommend disclosure in order to ensure that the outcome is always disclosed by the group. Similarly, if $D(0,1) = 1$, then full disclosure can also be supported by beliefs $\omega_A^{ND} > 0$ and $\omega_B^{ND} = 0$.

we show that the standard "unravelling logic," proposed by Grossman (1981) and Milgrom (1981) for individual disclosure games, precludes the existence of equilibria without full disclosure. To understand that logic, conjecture an equilibrium in which not all outcomes are disclosed by the group. If the observer "sees no disclosure," they understand that some "bad news" must have occurred for an individual who has the power to enforce disclosure (for otherwise they would have chosen to disclose the outcome). Consequently, they form "no disclosure" beliefs that are skeptical about such an individual's value, to the extent that it must incentivize that individual to deviate to disclosing at least some of the conjectured not disclosed outcomes.

Perhaps more interestingly, the third statement in the theorem provides a converse to the second: we show that if neither group member can individually enforce disclosure, then there exists an equilibrium without full disclosure.[8] The main lesson of Theorem 1 is that the standard "unravelling logic" does not apply when disclosure is a decision that requires some degree of consensus between multiple parties. Specifically, the logic fails because, upon "seeing no disclosure," the observer is unable to attribute the decision to not disclose to a specific group member (since neither group member has the power to enforce disclosure individually). Consequently, the observer forms "no disclosure beliefs" that are not-too-skeptical about either group member's value; and such beliefs are consistent with the group members' recommendations not to disclose some outcomes.

"Unravelling" as an Experimental Hypothesis. We can apply Theorem 1 to the deliberation procedures that we use in our experimental treatments. It implies that full disclosure is the unique equilibrium in the *unilateral* deliberation treatment. For the *consensus* deliberation treatment, there exists an equilibrium without full disclosure. The same is true for the *leader* treatment; but, in that case, full disclosure is approached as $\epsilon \to 0$. These predictions regarding the existence/non-existence of equilibria without full disclosure can be tested in our experiment, to potentially establish a link between the necessity of full disclosure and the deliberation procedure used by the group. However, we know from previous experimental work on disclosure games — for example, Jin et al. (2021) — that full disclosure typically does not arise in the lab as predicted in the theory, even in individual disclosure games. Jin et al. (2021) show that information receivers in the lab form beliefs that are insufficiently skeptical about nondisclosed information, and information senders react to these not-so-skeptical beliefs by concealing some unfavorable outcome realizations.

This previous work discourages us from directly testing the effect of different deliberation treatments on the existence/non-existence of full disclosure equilibria. Instead, we try to establish a relationship between the observer's ability to attribute group decisions to specific individuals (as

[8]We can further show that, in case $D(1,0) < 1$ and $D(0,1) < 1$, the equilibrium without full disclosure is the unique sequential equilibrium. That is, if we impose a consistency requirement on off-path beliefs, "full disclosure" is refined out of the equilibrium set.

determined by the deliberation procedure) and the observer's no disclosure beliefs about each individual's value, as well as the individuals' disclosure recommendations. The next section provides the main theoretical results on which we base our experimental hypotheses.

2.3 Disclosure Power and Individual Skepticism

For any deliberation procedure, any equilibrium can be fully described by the observer's beliefs of no disclosure. Given beliefs ω_A^{ND} and ω_B^{ND}, we can back out the equilibrium strategy for both group members: each group member recommends disclosure if and only if their own drawn outcome value is larger than the observer's no disclosure belief about their value. This is formally stated in Observation 1 below. Moreover, from the recommendation strategies and the deliberation procedure, we can infer the group's disclosure strategy.

Observation 1. *In any equilibrium, for each $i \in \{A, B\}$, $x_i(\omega_i)$ is a step function, satisfying*

$$x_i(\omega_i) = \begin{cases} 0, \textit{ if } \omega_i < \omega_i^{ND} \\ 1, \textit{ if } \omega_i > \omega_i^{ND}. \end{cases}$$

Because no disclosure beliefs provide full descriptions of equilibrium behavior, these will be essential objects in our analysis. As an interpretation, the observer's beliefs ω_A^{ND} and ω_B^{ND} describe their skepticism about each individual upon seeing that they chose not to disclose the group outcome. Specifically, note that if the observer sees no information about the outcome of an individual i, the unconditional posterior is that $\mathbb{E}(\omega_i) = 1/2$. Therefore, in equilibrium, the measure

$$\sigma_i = \frac{1/2 - \omega_i^{ND}}{1/2}$$

reflects how much more skeptical the observer is about i's outcome than if they were to see no information at all about it. We thus denote σ_i the observer's *skepticism about individual i*. Proposition 1 evaluates how this skepticism depends on the deliberation procedure, specifically considering the three treatments we use in our experimental exercise.

Proposition 1.

1. *If the group uses the unilateral deliberation procedure, there is a unique symmetric equilibrium with full disclosure, in which*

$$\omega_A^{ND} = \omega_B^{ND} = 0.$$

Therefore, $\sigma_A = \sigma_B = 1$.

2. *If the group uses the consensus deliberation procedure, there is a unique equilibrium without full disclosure, in which*
$$\omega_A^{ND} = \omega_B^{ND} = 0.38.$$
Therefore, $\sigma_A = \sigma_B = 0.24$.

3. *If the group uses the leader deliberation procedure, in which* $D(1,0) = 1-\epsilon$ *and* $D(0,1) = \epsilon$ *for some small* $\epsilon > 0$*, then there is a unique equilibrium without full disclosure, in which*
$$\lim_{\epsilon\to 0} \omega_A^{ND} = 0 \textit{ and } \lim_{\epsilon \to 0} \omega_B^{ND} = 0.5.$$
Therefore, as $\epsilon \to 0$*,* $\sigma_A \to 1$ *and* $\sigma_B \to 0$.

Before providing an interpretation of Proposition 1, we make two technical comments. First, we know from Theorem 1 that full disclosure is the unique equilibrium when the group uses the unilateral deliberation procedure. However, full disclosure can be attained in equilibrium for various no disclosure beliefs on the part of the observer. So long as the observer is "fully skeptical" about one of the team members — $\omega_i^{ND} = 0$ for some i — that team member is willing to recommend that every outcome be disclosed, which is sufficient to enforce the disclosure of every outcome. A necessary and sufficient condition for full disclosure is to have $\omega_i^{ND} = 0$ for some i. With an eye to our experimental design, in the first statement of Proposition 1, we highlight the unique pair of equilibrium beliefs which is symmetric. Second, for the second and third statements in Proposition 1, we focus on the unique equilibrium without full disclosure given the consensus and leader deliberation procedures. As previously remarked, these are the unique equilibria that survive a variety of refinements that impose consistency on off path beliefs; specifically, the equilibria without full disclosure are the unique sequential equilibria in each case.

Proposition 1 establishes a relationship between an individual's power to enforce the disclosure of the group's outcome and the observer's skepticism about their own value upon seeing that the outcome was not disclosed. Specifically, in the unilateral procedure, both group members can enforce disclosure; and in the leader procedure, group member A can (close to) enforce disclosure. In each of those cases, this power implies observer is (close to) "maximally skeptical" about the individual's value upon seeing no disclosure. Contrastingly, neither individual has power to individually enforce disclosure in the consensus procedure; and in the leader treatment, team member 2 has (close to) no power to disclose. A consequence is that the observer's skepticism about each of these individuals is much weaker in equilibrium.

Although Proposition 1 provides exact numbers that correspond to equilibrium skepticism about each individual's value under each deliberation procedure, our experimental hypothesis solely concerns the ordering of these values. Group member A in the leader procedure, along with each group member in the unilateral procedure, are more powerful than each group member in the consensus procedure; and in turn each group member in the consensus procedure is more powerful than group member B in the leader procedure. Based on Proposition 1, we expect that same ordering to apply when we evaluate the observer's equilibrium skepticism.

A More General Principle. The relation between an individual's power to enforce the disclosure of the group's outcome and the observer's no-disclosure skepticism about that individual's value is more general than the comparisons established by Proposition 1. Proposition 4 stated in Appendix B fleshes out a more general principle: the observer's no-disclosure skepticism about an individual's value is larger when that individual has relatively more disclosure power, or when disclosure is "proportionally easier" for the group. (These notions are formally stated in Appendix B.)

3 Experimental Design and Experimental Hypotheses

3.1 Basic Experimental Design

We first describe one round of the basic game played in the lab, which is designed to match the environment described in the group disclosure model. The game involves 3 players: group member A, group member B, and an evaluator. The 3 players constitute a unit and play a game consisting of 4 stages: information, reporting, guessing, and feedback.

In the **information stage**, the computer program randomly and uniformly chooses one card from each of two decks, deck A and deck B. Each deck has 11 cards, with numbers $0, 1, ..., 9, 10$. The pair of cards constitutes the group's hand; the value on card A denotes the value of the group's hand for group member A, and the value on card B denotes the value of the group's hand for group member B. At this stage, each group member sees the card representing their respective value, but not the card referring to their partner's value. Additionally, neither card is seen by the evaluator.

The next stage is the **reporting stage**, in which the group chooses whether to disclose the group hand to the evaluator. Towards reaching a decision, each group member makes a recommendation, by clicking one of two buttons: "report" or "not report." The two group members' recommendations are then aggregated into a group disclosure decision through a deliberation procedure.

The deliberation procedure is the object we vary in the different treatments in our experiment. We consider 3 deliberation procedures, following the variations introduced in our theory section: *consensus* procedure, *unilateral* procedure, and *leader* procedure.

- In the consensus treatment, the group hand is reported to the evaluator if and only if both group members recommend reporting it. That is, if both group members recommend reporting, both cards in the group hand are revealed to the evaluator. Otherwise, neither card is revealed to the evaluator.

- In unilateral treatment, if group member A, group member B, or both group members recommend reporting, then both cards in the group hand are revealed to the evaluator. If instead neither group member recommends reporting, the group hand is not revealed to the evaluator.
- In the leader treatment, group member A is the "leader," and the group's reporting decision follows A's recommendation with high probability. Specifically, with 99% chance, group member A's recommendation is followed by the group and with 1% chance, group member B's recommendation is followed by the group.

After the group makes their reporting decision, the evaluator is informed whether the group hand was reported or not. If the group hand is reported, the evaluator sees both cards in the group hand. If the group hand is not reported, the evaluator does not see the group hand, and is alerted of the fact that the group chose not to report the hand.[9]

After the evaluator sees the reported/not reported group hand, the game moves to the **guessing stage**, in which the evaluator is asked to make two guesses: to guess group member A's value, and to guess group member B's value. Each of the evaluator's guesses is a number between 0 and 10. We allow for guess increases of 0.5.

The final stage in a round is the **feedback stage**, in which every participant is shown a screen containing the group hand, whether the group hand was reported or not, and the pair of evaluator guesses made in the current round.

Incentive Implementation. The evaluator is paid for the accuracy of one of the guesses. The evaluator gets paid the points earned from either guess A or from guess B, with equal probability. Specifically, the evaluator earns either $110 - 20(.34|\text{Value A} - \text{Guess A}|)^{1.4}$ points or $110-20(.34|\text{Value B}-\text{Guess B}|)^{1.4}$ points. As for the group members, their payment is increasing in the evaluator's guess of their own value. Specifically, group member A earns $110 - 20[.34(10 - \text{Guess A})]^{1.4}$ points, and group member B earns $110 - 20[.34|10 - \text{Guess B})]^{1.4}$ points.[10] In line with the literature, the payment scheme is communicated to the subjects using a table. The table

[9]If the group chooses not to report its hand to the evaluator, we remind the evaluator of the procedure used by the group to reach that decision. In the unilateral treatment, the evaluator sees a message saying "The group hand in this round was NOT reported. That is, both group members recommended not to report the group hand." In the consensus treatment, the message reads "The group hand in this round was NOT reported. That is, group member A, group member B, or both group members recommended not to report the group hand." Finally, in the leader treatment, the message reads "The group hand in this round was NOT reported. That almost certainly means that group member A recommended not to report the group hand."

[10]The incentives we provide are similar to that in Jin et al. (2021) and Deversi et al. (2021), with an adjustment of a constant to ensure all possible payoffs are positive.

provides the amount of points to be received by each subject for each possible combination of the drawn value i and the evaluator's guess of i's value.

3.2 Questionnaire

In addition to the main experimental setting described above, we ask that the participants complete a short questionnaire. The same questionnaire is presented to every participant, regardless of the role they played during the main portion of the experiment. Participants' answers to parts 1 and 2 of the questionnaire are incentivized;[11] other responses are not incentivized.

In the first part of the questionnaire, we elicit each participant's "belief of no disclosure." To that end, we ask: " Suppose you are an evaluator, and the group hand is not reported to you by the group. What would be your guess A and guess B for group member A's value and group member B's value, respectively?" In the second part, looking to elicit subject's reporting strategies, we ask: "Suppose you are group member A, and a group hand is drawn in which value A is x. Would you recommend to report that group hand?" We ask this question 11 times, one for each value of $x \in \{0, 1, ..., 10\}$. In the leader treatment, which is asymmetric, we also ask 11 analogous questions, regarding how the subject would report if they were group member B.

Finally, we complete the questionnaire with a standard set of questions regarding the participants demographics. These include the participant's major, their gender, their GPA, and whether they have taken a game theory class.

3.3 Individual Disclosure Treatment

As a further benchmark, we also run a version of our experiment in which a single individual (rather than a group) makes reporting decisions.[12] This treatment is made up of the same stages as described in section 3.1, with the following changes. First, in the information stage, only one card is drawn (rather than one per group member), and the single individual sees the drawn card. Second, at the reporting stage, the single individual makes a reporting recommendation, and their recommendation is followed. Third, at the guessing stage, the evaluator makes a single guess about the individual's value (rather than two guesses, one per group member).

[11] To do so, we communicate to participants at the beginning of the questionnaire, saying: "Please answer the following questions. You can earn additional money with your answers. Your responses will be compared to a randomly chosen participant's behavior in this experiment. To assess your answers, we randomly choose a participant from the main part of this study, and compare your answer to their behavior in one round. Specifically, we will select one of your answers below, and you will receive a $3 bonus for correctly predicting the answer of the randomly chosen participant."

[12] Theoretically, individual behavior and observer skepticism in this individual disclosure treatment should be akin to the behavior and skepticism observed in the unilateral treatment. By making that comparison, we aim to assess whether there is any effect inherent to the fact that our game is played by a group rather than by an individual, even if the strategic incentives present in the interaction are unchanged.

3.4 Implementation

Subject Pool and Experimental Details. This experiment was conducted at Interdisciplinary Experimental Laboratory (IELab) at Indiana University (IU) during the Spring of 2024, using software z-Tree (Fischbacher (2007)). Subjects were recruited from the general student population via ORSEE recruitment system (Greiner 2015). We conducted 4 sessions for each treatment (unilateral, consensus, leader, and individual treatments). Most sessions had 5 units (one unit is made up of 3 subjects for the unilateral, consensus, and leader treatments, and of 2 subjects in the individual treatment); one session of the individual treatment had 7 units. In total, there were 224 subjects.

The instructions were read aloud, with paper copies distributed to all subjects (see Appendix C for instructions). After reading the instructions, the subjects first engaged in 2 practice rounds before moving onto 30 actual rounds. The experiment lasted around 60 minutes, and subjects earned an average payoff of \$20, which included a \$8 show-up fee. In the experiment, the payoffs in the game were denominated in points. Each point was converted to US dollars at the rate of 10 points to \$1.

We implemented a between subjects design for the consensus, unilateral, leader, and individual disclosure treatments. In each treatment, each subject is assigned one of the three roles, and they keep their role for 30 rounds. While roles are fixed, the units are re-matched every round to avoid reputation building issues or reciprocity between group members. For instance, group member A, stays as group member A in the next round, but is randomly re-matched with another pair of participants playing the roles of group member B and evaluator.

Preregistration. Our experiment was registered using the AEA RCT Registry, under ID 0013276. Our preregistration includes two main sets of hypotheses, in line with the theory developed in section 2. The first set of hypotheses regards the evaluator's beliefs about each group member's value upon seeing no disclosure; that is, they compare the evaluator's skepticisim about each individual in the different treatments. The second set of hypotheses refers to the group members' reporting recommendation behavior across the different treatments.

3.5 Preregistered Hypotheses Regarding Skepticism

These hypotheses follow directly from Proposition 1. To state them in our empirical environment, we first define measures of the evaluator's skepticism. In a round in which the group's decision is to *not report* their group hand, we measure the evaluator's skepticism about group member A and group member B, respectively, as

$$\text{A-skepticism} = \sigma_A = \frac{5 - \text{Guess A}}{5}$$

$$\text{B-skepticism} = \sigma_B = \frac{5 - \text{Guess B}}{5}$$

We also refer to the average of A-skepticism and B-skepticism as aggregate skepticism:

$$\text{Aggregate skepticism} = \Sigma = \frac{\sigma_A + \sigma_B}{2}$$

The following are our hypotheses regarding skepticism in our different treatments:

Hypothesis 1. *Agg. skepticism in the consensus treatment is smaller than in unilateral treatment.*

Hypothesis 2. *A-skepticism in the consensus treatment is smaller than in the leader treatment.*

Hypothesis 3. *B-skepticism in the consensus treatment is larger than in the leader treatment.*

3.6 Preregistered Hypotheses Regarding Reporting Behavior

A set of three hypotheses regarding group members' reporting behavior mirrors Hypotheses 1-3 about the observer's no-disclosure skepticism. We refer to group members' by their role $i \in \{A, B\}$, and to their drawn values as v_i for $i \in \{A, B\}$. The main hypotheses are as follows:

Hypothesis 4. *Following each realization of own value v_i, group member i recommends reporting the group hand* weakly less *in the Consensus treatment than in the Unilateral treatment. Moreover, for some intermediate realizations of own value v_i, group member i recommends reporting the group hand* strictly less *in the Consensus treatment than in the Unilateral treatment.*

Hypothesis 5. *Following each realization of own value v_A, group member A recommends reporting the group hand* weakly less *in the Consensus treatment than in the Leader treatment. Moreover, for some intermediate realizations of own value v_A, group member A recommends reporting the group hand* strictly less *in the Consensus treatment than in the Leader treatment.*

Hypothesis 6. *Following each realization of own value v_B, group member B recommends reporting the group hand* weakly more *in the Consensus treatment than in the Leader treatment. Moreover, for some intermediate realizations of own value v_B, group member B recommends reporting the group hand* strictly more *in the Consensus treatment than in the Leader treatment.*

Threshold Strategies and Beliefs. According to our theory, as stated in Observation 1, a group member should use a threshold individual reporting strategy, recommending that the group not report when their own value is low and that the group report otherwise. The threshold dividing the decision to not report or report should coincide with the group member's belief about the evaluator's guess of their own value in case the team's hand is not reported.

Our preregistration also includes an analysis of individual threshold reporting strategies. It first proposes an assessment of whether individuals use threshold reporting strategies, and an empirical method to estimate their used thresholds. Next, our proposed analysis compares these estimated thresholds to (1) the observer's beliefs of no disclosure during the game, and to (2) the beliefs of no disclosure elicited from all participants by the questionnaire.

Finally — although this step has not been preregistered — we compare the estimated individual thresholds across the different treatments. Our theory predicts a clear ordering on these thresholds, in line with Hypotheses 4-6 stated above and Hypotheses 1-3 below.

4 Results

4.1 Disclosure Power and Individual Skepticism in the Lab

Table 1: Average Skepticism by Treatment

Treatment	A Skepticism	B Skepticism	Agg. Skepticism
Consensus	0.147	0.136	0.141
Leader	0.286	-0.041	0.123
Unilateral	0.297	0.230	0.263
Individual	0.317	—	0.317

Our first set of results concerns the evaluator's skepticism about group members' values in the different treatments. Table 1 provides numbers for A skepticism, B skepticism, and aggregate skepticism, across all four treatments. These numbers are averages across all participants and all rounds played in each of these treatments.

Test of Main Hypotheses. Observe that the evaluator's skepticism varies sizably across treatments, and across roles within the asymmetric leader treatment; thereby indicating that the evaluator's perception of each individual's power to enforce disclosure on behalf of the group indeed impacts their formed belief about their respective values. In line with our hypotheses 1-3, aggregate skepticism is smaller in the consensus treatment than in the unilateral treatment, A-skepticism is smaller in the consensus treatment than in the leader treatment, and B-skepticism is larger in the consensus treatment than in the leader treatment. A consequence of these three hypotheses is that B-skepticism should be smaller in the leader treatment than in the unilateral treatment; this also holds in our data.

We test the statistical significance of each of these statements using a non-parametric test (Mann Whitney U Test), and find that skepticism is significantly different across treatments in every case. The statistical tests are reported in Table 2.[13]

Table 2: Summary of Hypotheses Testing Results

Comparison	Avg. Comp. 1	Avg. Comp. 2	p-value
Consensus vs. Unilateral	0.141	0.263	0.000
Consensus A vs. Leader A	0.147	0.286	0.000
Consensus B vs. Leader B	0.136	-0.041	0.000
Individual vs. Leader A	0.317	0.286	0.794
Individual vs. Unilateral	0.317	0.263	0.044

These tests establish the empirical validity of the main mechanism proposed in our model of group communication: the power structure used to make communication decisions in a group (as given by the deliberation procedure) significantly determines the interpretation of equilibrium messages used by the group. Specifically, the "no disclosure" message is interpreted as a less favorable indication of a particular individual's value whenever that individual has more power to enforce disclosure decisions in the group. There is a clear link between disclosure power and individual skepticism.

Skepticism in Theory and in Practice. Beyond validating our hypotheses that compare skepticism values across treatments, we can also compare the skepticism values in each of the treatments to those predicted by our theory, as stated in Proposition 1. In each treatment, the skepticism values found in practice are smaller than those predicted by the proposition: (a) in the consensus treatment, the average A-skepticism and B-skepticism are 0.147 and 0.136, compared to $\sigma_A = \sigma_B = 0.24$ in the theoretical result; (b) Proposition 1 posits that skepticism should be equal to 1 for both group members in the unilateral treatment, close to 1 for group member A in the leader treatment, and equal to 1 in the individual disclosure treatment. In all these cases, skepticism in practice is significantly lower than 1; (c) Our theoretical prediction is that skepticism about group member B's value should be close to 0 in the leader treatment; this value is close to confirmed in practice, where we find the average B-skepticism to be equal to -0.041.

Each of these findings add to a wealth of observations in the experimental literature on games of individual disclosure — for example, Jin et al. (2021) — which finds that the observer's "no disclosure beliefs" are typically less skeptical than the maximal skepticism/full unravelling predicted theoretically. Our findings expand on that statement by documenting that "too little skepticism" relative to theoretical predictions arises also in group disclosure contexts, even in contexts where the theory does not predict full unravelling.

[13] While one might be concerned about multiple-hypotheses testing, the results stay the same when we use the Bonferroni correction, which is a conservative test.

Individual vs. Group Communication. Table 2 also displays comparisons between skepticism values in the unilateral and leader treatments to that in the individual disclosure baseline. Our theoretical results predicted that the evaluator's skepticism (about either group member) in the unilateral treatment should not differ from skepticism in the individual treatment, which in turn should not differ from skepticism about group member A in the leader treatment. In all three cases, the theory predicts the unravelling of any equilibrium without full disclosure, and establishes that the evaluator should be "maximally skeptical" in equilibrium.

Our results in Table 2 instead show that, although skepticism in the individual treatment is similar to A-skepticism in the leader treatment, this value is significantly different from skepticism about either group member in the unilateral treatment. In the unilateral treatment, observing "no disclosure" means that "both group member A and group member B recommended no disclosure," and therefore both group members should be equally and fully held to blame for that decision. In practice, our results indicate that the evaluator's perception of "social blame" after seeing no disclosure erodes each group member's "individual blame" for the collective no disclosure decision. We see this as evidence that the mechanism behind skepticism in a group setting — the attribution of blame across members of a group — is in its essence different from the skepticism mechanism in a one person setting.

Finally, our observation that A-skepticism in the leader treatment is similar to skepticism in the individual treatment is in contrast with findings in the literature on managerial psychology, which document in various contexts a phenomenon denoted the *romance of leadership*. The term "romance of leadership" was introduced by Meindl et al. (1985) to denote the idea that responsibility for group outcomes is over-attributed to individuals in leadership roles. Meindl et al. (1985) conduct a series of experimental exercises and document an over-attribution of organizational outcomes that are random or outside of an organization's control to someone in a role of "leadership." In our group disclosure experimental setting, blame for "no disclosure" is under-attributed to the leader, if we take the theoretical prediction of skepticism equal to 1 as the benchmark; or correctly attributed to the leader, if we take skepticism in the individual treatment to be the benchmark.[14]

[14] One way of understanding over- or under- attribution of responsibility for a group's decision across the group members is to consider an evaluator with a "mis-specified model" of the deliberation procedure. That is, the evaluator's understanding of the deliberation procedure is given by some $\hat{D} : \{0,1\}^2 \to [0,1]$ which differs from the "true deliberation procedure" given by $D : \{0,1\}^2 \to [0,1]$. We can introduce over-attribution of responsibility to one group member (say group member A) relative to the true procedure D by considering $\hat{D}$ that attributes "more power" to A: $\hat{D}(1,0) > D(1,0)$, so that the $\hat{D}$ sees A as more able to impose their recommendation to disclose than D does; and $\hat{D}(0,1) < D(0,1)$, so that $\hat{D}$ sees A as more able to impose their recommendation to *not* disclose than D does. The introduction of an evaluator with a mis-specified model of the group's deliberation procedure is one possible way to theoretically reconcile our observation of the "non-romance" of leadership, and we aim to pursue this theoretical thread further in future work.

Skepticism Elicited via Questionnaire. We repeat our analysis using the data elicited via our post-experiment questionnaire. Beyond the different elicitation method, this data differs also because no disclosure beliefs are reported not only by evaluators but also by subjects who play the roles of group members. Table 3 displays skepticism values, as reported in the questionnaire, across all treatments, and separated by the subjects' roles. These values are averaged over all subjects in each of the treatments.

Table 3: Average Skepticism by Treatment and Role (Questionnaire Data)

Treatment	**Group Member A or B**		**Evaluator**		**Combined Roles**	
	A-Skept.	**B-Skept.**	**A-Skept.**	**B-Skept.**	**A-Skept.**	**B-Skept.**
Consensus	0.207	0.165	0.100	0.160	0.172	0.163
Leader	0.372	-0.072	0.365	-0.170	0.370	-0.105
Unilateral	0.362	0.312	0.280	0.270	0.335	0.298
Individual	0.309	—	0.477	—	0.393	—

Again, we test each of our hypotheses 1-3 using the elicited skepticism data from the questionnaire. As before, our hypotheses are confirmed, with statistically significant differences. The results are reported in Table 4.

Table 4: Hypotheses Testing Results (Questionnaire Data)

Comparison	Avg. Comp. 1	Avg. Comp. 2	p-value
Consensus vs. Unilateral	0.168	0.317	0.006
Consensus A vs. Leader A	0.172	0.370	0.000
Consensus B vs. Leader B	0.163	-0.105	0.000

Some other insights emerge from the questionnaire data. First, when looking at the skepticism elicited from the evaluator subjects, we see that their reports are often closer to the skepticism predicted in the theory than the skepticism played in the duration of the experiment. Specifically, skepticism about both group members in the unilateral treatment, skepticism in the individual treatment, and A-skepticism in the leader treatment, are larger than the values reported in Table 1.

Second, we see a significant difference between the skepticism elicited from evaluators and that elicited from group members. Differences in elicited skepticism are particularly large when we compare evaluators to individuals who played the role of group member B. Our current conjecture is that these differences are due to small sample bias (as we only observe one questionnaire answer per participant). The empirical distribution of drawn values specifically for participants who played the roles of group member B was sizably distinct from the uniform, and we believe this distortion may have affected the questionnaire answers of subjects who played that role. We are in the process of gathering more data which will allow us to either rule out or further understand discrepancies in questionnaire answers across different roles.

4.2 Individual Reporting Behavior

Next, we analyze the individual disclosure recommendation strategies in the different treatments. Our preregistered hypotheses propose the comparison of individual disclosure recommendations conditional on their drawn value. For example, Hypothesis 5 posits that, for every drawn value, group member A in the leader treatment recommends disclosure more often than each group member in the consensus treatment. This comparison is displayed in Figure 1. Analogous figures can be found in Appendix A, displaying reporting rates in other treatments.

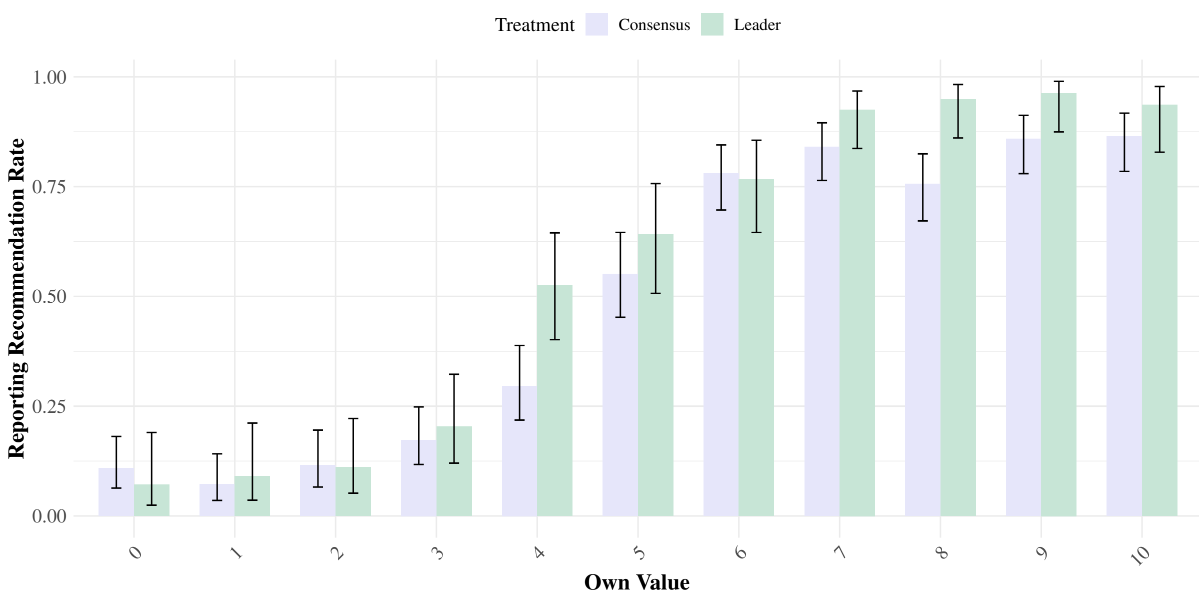


Figure 1: Reporting recommendation rates conditional on an individual's drawn value; all group members are considered in the consensus treatment (in purple), and group member A is considered in the leader treatment (in green). The plot includes confidence intervals for the reporting recommendation rates in each instance.

In Figure 1, we see that group member A in the leader treatment — who has close to full power over the group's decision — typically recommends to disclose an outcome more often than group members in the consensus treatment. The difference is especially stark, and statistically significant, when comparing realizations where a group member's own value is 4. This observation exactly confirms our Hypothesis 5, which posits that there is a weak ranking in reporting rate across these two treatments, and that the ranking is strict for some realizations of the group member's value (in this case, the realization of the own value equal to 4). Figure 6 in Appendix A shows a version of Figure 1 considering only a selected subsample of subjects, those who use "threshold reporting strategies" (as defined later in this section). The evidenced difference in group member As behavior across the consensus and leader treatments is even more clear in the restricted subsample.

Figures 3-5 in Appendix A display reporting recommendation rates in other treatments and show that reporting rates are roughly in line with our hypotheses. However, differences in group members' recommendation behavior (conditional on their own realized values) are not statistically different across treatments. Despite the lack of sufficient data to establish significant differences in group members' behavior, we attempt to further document the effect of our different treatments on individual recommendation strategies by assessing whether subjects use "threshold recommendation strategies" and how these thresholds vary across treatments.

Threshold Reporting Recommendation Strategies. According to our theory, each group member should use equilibrium individual disclosure recommendation strategies that favor an outcome's recommendation if and only if their own outcome value is larger than some threshold. Moreover, this threshold should coincide with that group member's belief of their payoff of no disclosure, which in turn coincides in equilibrium with the observer's no disclosure belief about that individual's value.

To evaluate whether a subject played according to a threshold strategy, we take the following steps. For each subject s, we consider their individual recommendations only in the last 20 rounds of play. Suppose subject s recommended that the group outcome be concealed from the evaluator in rounds $\{c_1, c_2, ..., c_k\} \subseteq \{11, 12, ..., 30\}$ and that the group outcome be disclosed to the observer in rounds $\{d_1, d_2, ..., d_{k'}\} \subseteq \{11, 12, ..., 30\}$. We create the set $\hat{\Phi}_0^s = \{v_{c_1}^s, v_{c_2}^s, ..., v_{c_k}^s\}$, which records every realization of subject s's own value for which they recommended that the outcome not be disclosed. Analogously, the set $\hat{\Phi}_1^s = \{v_{d_1}^s, v_{d_2}^s, ..., v_{d_{k'}}^s\}$ records every realization of subject s's own value for which they recommended that the outcome be disclosed. (Note that if there were two instances in which subject s drew value 7 and recommended disclosure, then both those instances are separately recorded in set $\hat{\Phi}_1^s$.)

We say there is overlap between sets $\hat{\Phi}_0^s$ and $\hat{\Phi}_1^s$ if their intersection is nonempty; and we say the *size of the overlap* is equal to $|\hat{\Phi}_0^s \cap \hat{\Phi}_1^s|$.[15] We say subject s uses a threshold strategy if the size of the overlap for subject s is at most 2, and if, after removing the overlaps, we find that the maximal element in the "no reporting" set is lower than the minimal element in the "reporting" set.

Table 5 displays statistics on the size of overlaps in recommendation strategies used by subjects in group member roles in each of our treatments. It shows that, in all treatments, a significant portion of subjects are classified as having used threshold recommendation strategies: 82.5% in the consensus treatment, 80% in the leader treatment, 85% in the unilateral treatment, and 81.8%

[15] If $\hat{\Phi}_0^s = \{0, 1, 1, 1, 2, 2, 3, 3, 3, 4, 4, 5, 7\}$ and $\hat{\Phi}_1^s = \{4, 7, 7, 7, 8, 9, 10\}$, then $\hat{\Phi}_0^s \cap \hat{\Phi}_1^s = \{4, 7\}$ and the size of the overlap for subject s is 2.

in the individual treatment.

Table 5: Statistics on "Overlap Sizes" and Use of Threshold Strategies

Treatment	Average Overlap	Median Overlap	% Threshold Strategy
Consensus	1.18	1	82.5
Leader	0.78	0	80.0
Unilateral	1.02	1	85.0
Individual	1.32	1	81.8

Individually Rational Thresholds. Using the subsample of subjects who use threshold strategies, we evaluate whether group members make reporting recommendations that are consistent with individual rationality. In this context, individual rationality implies that an individual uses a threshold in their reporting strategy that is equal to what they think the evaluator would guess about their own value if the group chose no disclosure.

For subjects who are classified as using threshold strategies, we ascertain their used threshold as follows. First, we remove any overlap from their sets $\hat{\Phi}_0^s$ and $\hat{\Phi}_1^s$, generating sets $\Phi_s^0 = \hat{\Phi}_s^0 \setminus \hat{\Phi}_s^1$ and $\Phi_s^1 = \hat{\Phi}_s^1 \setminus \hat{\Phi}_s^0$. Next, we define the threshold used by subject s as

$$t_s = \max \Phi_s^0.$$

That is, the largest realization of their own outcome value for which subject s recommended that the group's outcome be concealed from the evaluator. Alternatively, we can define the threshold for subject s as $t'_s = \min \Phi_s^1$, the smallest realization of their own value for which s recommends that the outcome be revealed to the observer. The comparison of thresholds across treatments remains largely unchanged when we use this alternative specification.

We wish to compare these estimated thresholds to group members' beliefs about the evaluator's no disclosure guesses. For subjects who play the group member roles, we elicit these "no disclosure beliefs" through the post-play questionnaire. Tables 7 and 6 display results from two comparisons of subjects' thresholds used during the game and their no disclosure beliefs elicited by the questionnaire.

First, Table 6 presents the results of a regression, relating a subject's played threshold to their no disclosure belief elicited by the questionnaire. Remember, for a subject who played the role of group member i, this belief is their answer to the question "if you were the evaluator and saw that the group chose not to disclose their outcome, what would be your guess of group member i's value?" We can see from the regression result that there is a high correlation between played thresholds and reported beliefs: subjects who believe the evaluator would make a higher guess of their value upon seeing no disclosure are also subjects who recommend that outcomes with higher values be concealed.

Table 6: Regression Output: Played Threshold and Elicited No Disclosure Belief

	Coefficient	Std. Error	p-Value
No Disclosure Belief	0.2547	0.0677	< 0.001
Constant	3.4527	0.3003	< 0.001

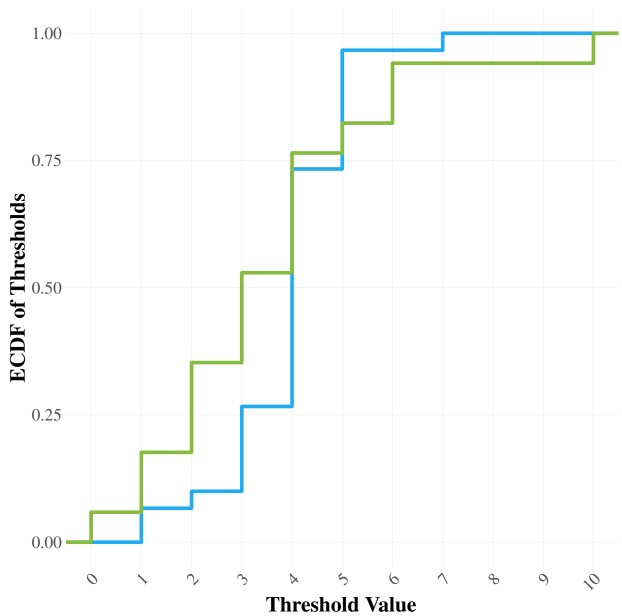
Our post-play questionnaire also asks group members to declare what reporting recommendation they would make after each possible realization of their own value. As a final check on the robustness of our estimated threshold strategies, we compare the estimated thresholds to the thresholds in the strategies declared by the subjects in the questionnaire. Table 7 shows that for 38.4% of our subjects, the estimated threshold coincides with the declared threshold; for 70.4% of our subjects, the difference between these values is at most 1, and for 92.8% of subjects, these values differ by at most 3.

Table 7: Difference between reporting thresholds and elicited threshold

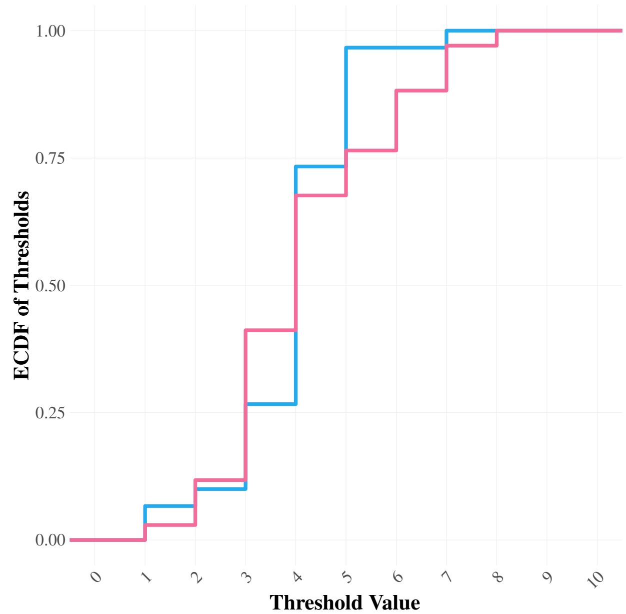
$\lvert\Delta\rvert = 0$	$\lvert\Delta\rvert \leq 1$	$\lvert\Delta\rvert \leq 3$
38.4%	70.4%	92.8%

Comparing Thresholds across Treatments. In Figure 2, we display the distributions of thresholds across subjects in different treatments. We make four main observations. First, panel (2a) shows that subjects playing the role of group member A in the leader treatment (those with close to total power in their group) typically use threshold strategies with a lower threshold than subjects who play either group member role in the consensus treatment. Specifically, over 50% of "leaders" use a threshold lower or equal to 4, while close to 50% of subjects in the consensus treatment use a threshold of 5. This observation is consistent with our model predictions, and with the evidence on skepticism reviewed in section 4.1: group members in the consensus treatment should anticipate less skepticism than leaders, and therefore recommend that outcomes with higher values be concealed.

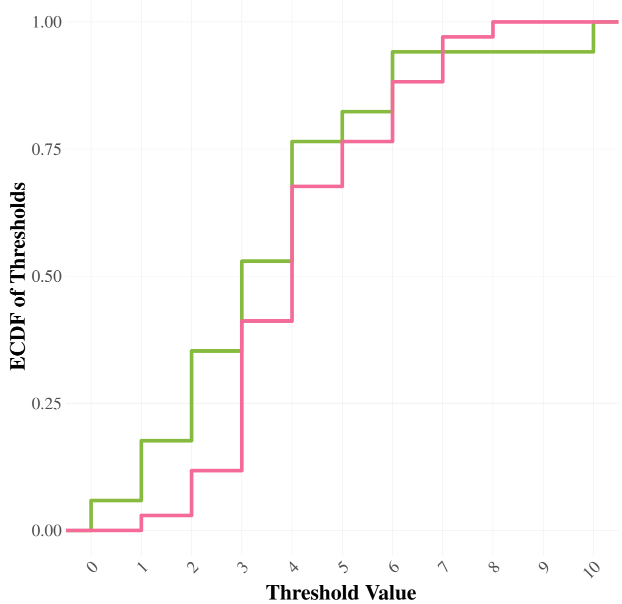
Similarly, panel (2c) shows that group member A's in the leader treatment typically use lower thresholds than group members in the unilateral treatment. And panel (2d) displays a large discrepancy in the distribution of thresholds used by group member As (leaders) and group member Bs (nonleaders) in the leader treatment. This latter observation is the most striking evidence that individual disclosure recommendation behavior is affected by an individual's disclosure power, as predicted by our theory.



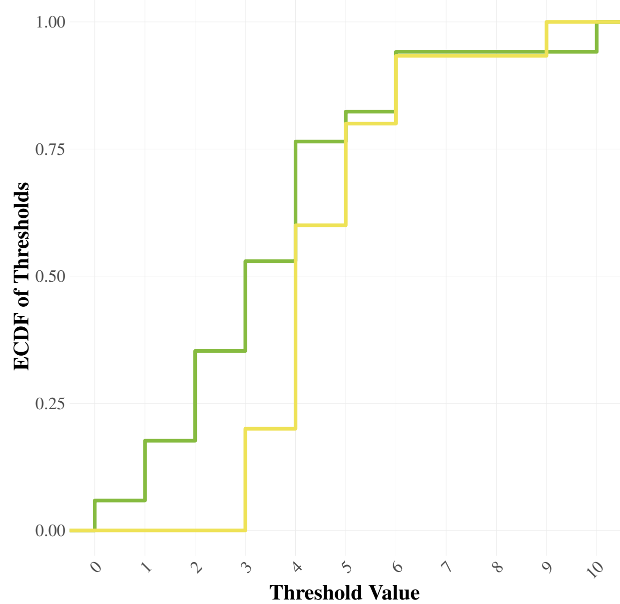
(a) Threshold distributions for all group members in the **consensus treatment** (blue line), and for **group member A's in the leader treatment** (green line).



(b) Threshold distributions for all group members in the **consensus treatment** (blue line), and for all group members in the **unilateral treatment** (pink line).



(c) Threshold distributions for all group members in the **unilateral treatment** (pink line), and for **group member A's in the leader treatment** (green line).



(d) Threshold distributions for **group member A's in the leader treatment** (green line), and for **group member B's in the leader treatment** (yellow line).

Figure 2: Comparison of subjects' thresholds across treatments.

For completeness, in panel (2b), we plot the cdf of thresholds used by group members in the consensus and unilateral treatments. Our theory predicts that group members in the consensus treatment should face less skepticism from the observer if they choose to not disclose than group members in the unilateral treatment (this prediction is confirmed by our data); and should therefore be more willing to conceal group outcomes, consequently using a higher threshold in their recommendation strategies. Panel (2b) does show that "low thresholds" (smaller than 4) are used more often in the unilateral treatment than in the consensus treatment; however the ordering reverses if we think of "low thresholds" as those smaller than 5. We regard the comparison between individual disclosure recommendation behavior across these two treatments as inconclusive, given the currently available data.

5 The Role of Social Preferences

A large theoretical and experimental literature has explored the role of social preferences in various games and economic contexts. According to Fehr and Charness (2023), "the key characteristic of social preferences is that individuals are willing to sacrifice money or other material resources to help or hurt other people, to establish fairness and justice, or to increase groups' joint payoff." One common formulation of social preferences is due to Fehr and Schmidt (1999) and states that in a group of two individuals, i and j, i's preferences are given by

$$U_i = (1-\alpha)\pi_i + \alpha\pi_j, \text{ if } \pi_i < \pi_j \; U_i = (1-\beta)\pi_i + \beta\pi_j, \text{ if } \pi_i \geqslant \pi_j,$$

where π_i and π_j are the payoffs to each individual in the base game, and $\alpha, \beta \in [-1, 1]$. This flexible formulation can express a variety of social preferences, from inequality aversion to envy, depending on the signs of the parameters α and β. Previous literature has established in various experiments that, at least among populations of university students, two types of social preferences make up the vast majority of the population: selfish types ($\alpha = 0$ and $\beta = 0$) and altruistic types ($\alpha > 0$ and $\beta > 0$) — see Table 1 in Fehr and Charness (2023), which shows that each of these types is estimated to make up at least 28% of the population, and the sum of both types is estimated to make up at least 73% of the population, in different samples.

The theory of group communication we state in this paper is based solely on selfish types, and our experiment was designed to most closely reflect these selfish preferences. To do so, we make sure that each group member sees only their own card in the group hand before making a recommendation, so that they are unaware of the payoff implications of their recommendation to their fellow group member. We also impose that each group member receives payments based only on the evaluator's guess of their own value, and not that of their partner's value. Despite this modelling and implementation decisions, we find that social preferences (and specifically altruistic preferences) can play a role in determining features of equilibrium play in our group disclosure game. Some of these are important in reconciling our theoretical predictions to the observed play in the lab, and we state them as propositions below.

Proposition 2. *Suppose a group uses the* ***unilateral*** *deliberation procedure. If both group members have altruistic preferences with $\alpha > 1/2$, there exists an equilibrium in which*

$$\omega_A^{ND} = \omega_B^{ND} > 0, \text{ and therefore } \sigma_A = \sigma_B < 1.$$

Moreover, in an equilibrium with $\omega_A^{ND} = \omega_B^{ND} > 0$, for each $i \in \{A, B\}$, $x_i(\omega_i)$ is a step function in which, for some $t > \omega_i^{ND}$,

$$x_i(\omega_i) = \begin{cases} 0, \text{ if } \omega_i < t \\ 1, \text{ if } \omega_i > t. \end{cases}$$

Proposition 3. *Suppose a group uses the* ***consensus*** *deliberation procedure. In an equilibrium with $\omega_A^{ND} = \omega_B^{ND} > 0$, for each $i \in \{A, B\}$, if i is altruistic, then $x_i(\omega_i)$ is a step function in which, for some $t < \omega_i^{ND}$,*

$$x_i(\omega_i) = \begin{cases} 0, \text{ if } \omega_i < t \\ 1, \text{ if } \omega_i > t. \end{cases}$$

Proofs of Propositions 2 and 3 are available in Appendix B, and they are based on the idea that, even without seeing their partner's outcome value (the value of their card in the experiment), a group member can choose actions that provide *option value* to their partner.

Specifically, under the unilateral protocol, if a group member recommends that the outcome be concealed, then they effectively give the decision power to their partner, who can unilaterally enforce disclosure by recommending disclosure or ensure the outcome is concealed by recommending concealment. By effectively delegating the decision to their partner via recommending concealment, a group member can provide option value to that partner. If the group member is altruistic, then providing such option value is desirable whenever they are close to indifferent between disclosure and concealment in terms of their own direct payoff (when their drawn outcome ω_i is sufficiently close to the equilibrium belief ω_i^{ND}). This logic ensures two things: First, that under the unilateral protocol, an altruistic group member uses a threshold disclosure recommendation strategy in which the threshold is *larger* than the equilibrium belief ω_i^{ND}. Second, that under the unilateral protocol, if the two group members are altruistic, there exists an equilibrium without unravelling, in which the observer is not maximally skeptical about either group member.

In turn, under the consensus protocol considered in Proposition 3, an altruistic group member can provide option value to their partner by recommending the disclosure of the group's outcome.

In that case, their partner can enforce disclosure by recommending disclosure or unilaterally impose concealment by recommending so. Consequently, if such an altruistic group member is close to indifferent between disclosure and concealment in terms of their own direct payoff, they will choose to recommend the disclosure of the outcome. We conclude that under the consensus protocol, an altruistic group member uses a threshold disclosure recommendation strategy in which the threshold is *smaller* than the equilibrium belief ω_i^{ND}.

Each of the three theoretical observations stated in Propositions 2 and 3 have some support in our experimental data. First, as already mentioned, skepticism in the unilateral treatment differs significantly from skepticism in the individual treatment. While full unravelling and maximal skepticism (which corresponds to a skepticism of 1) do not arise in either treatment, we find significantly less skepticism in the group treatment. In line with this "erosion of individual blame" in the group setting, Proposition 2 finds that lack of unravelling under the unilateral procedure can arise if the group disclosure game is played by individuals who have (and are perceived to have) altruistic preferences.

Next, Table 8 displays data on how, for subjects in the group member roles who use threshold disclosure rules (as defined in section 4.2), the threshold values at which they switch from recommending concealment to recommending disclosure differ from the "no disclosure beliefs" we elicited from them in the questionnaire. Remember that these "no disclosure beliefs" correspond to these individuals' answers to the question "if you were the evaluator and saw that the group chose not to disclose their outcome, what would be your guess of group member i's value?" We interpret this answer as the subject's perception of the evaluator's "no disclosure belief," and interpret differences between them and their played thresholds as deviations from "individual rationality" for a fully selfish player. To build Table 8, we classify elicited no disclosure beliefs which differ from the played threshold by at most 0.5 in the category "$\text{thr} - \text{blf} = 0$;" for larger differences, we categorize them as $\text{thr} - \text{blf} < 0$ or $\text{thr} - \text{blf} > 0$, accordingly.

Table 8: Difference Between Played Threshold and Elicited No Disclosure Belief

	$\text{thr} - \text{blf} < 0$	$\text{thr} - \text{blf} = 0$	$\text{thr} - \text{blf} > 0$
Consensus	47%	12%	41%
Unilateral	19%	24%	57%
Individual	17%	44%	39%

First note that, in the individual treatment, the modal subject who uses a threshold strategy (44% of them) uses a threshold that is equal to the no disclosure belief elicited from them in the questionnaire. This is no longer the case in the group treatments: only 12% of such subjects use thresholds equal to the no disclosure belief in the consensus treatment, and only 24% of them do so in the unilateral treatment. This is in line with the notion that, in group treatments, group members use recommendation strategies different from those that are "individually rational" to an individual with selfish preferences.

From Table 8, we further observe that in the unilateral treatment, the modal subject plays using a threshold larger than their reported belief, and subjects are 16 and 18 percentage points more likely to use thresholds larger than their reported belief than in the consensus and individual treatments, respectively. In turn, in the consensus treatment, the modal subject uses a threshold smaller than their belief elicited by the questionnaire, and using a belief smaller than this elicited belief is 28 and 30 percentage points more likely than in the unilateral and individual treatments, respectively. All these observations are consistent with the presence of some subjects with altruistic preferences in the population, as per Propositions 2 and 3.

6 Conclusion

In this paper, we experimentally studied a game of group communication. In this game, group members have distinct preferences over disclosure/non-disclosure of a group outcome, and must aggregate their interests into a single group disclosure decision. Our analysis establishes a relationship between the aggregation procedure used by the group and the receiver's interpretation of the group's "no disclosure messages."

The interpretation of no disclosure messages, as measured by the skepticism of the observer about each group member's value after seeing no disclosure, is an empirical object that ascertains the observer's perception of who, amongst the individuals in the group, is responsible for the decision to not disclose the verifiable outcome. Because the evaluator in our experiment understands the deliberation procedure used by the group, it is natural that they attribute more blame for that decision to individuals who indeed have more power over the group's disclosure decision; who are consequently regarded with more skepticism.

One of the contributions of our paper is to the literature on experiments played by groups of players — refer, for example, to the following surveys: Charness and Sutter (2012), Kugler et al. (2012), and Martinelli and Palfrey (2018). An innovation of our experiment is that the communication game played by a group is a Bayesian game, and in fact our main objects of interest are elicited beliefs that hint at an observer's perception of each individual's role in decisions reached by the group. Our results establish several differences between observed outcomes in a "game played by a group" in comparison to a parallel Bayesian game played by an individual.

We see this paper as an initial foray into understanding the relationship between individual power and blame attribution in an experimental setting. A likely next step will be to understand this relationship when aggregation procedures are not exogenous features of the environment: for example, how is blame perceived if group members informally communicate before coming to a collective decision? Another avenue for further exploration is to understand how making certain demographic characteristics salient can affect the perception of blame and responsibility. In this exact setting, we could ask, for example, how the evaluator's skepticism would respond to us making group members' genders salient. Would male group members be perceived as more responsible? Would female group members face larger blame?

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A Appendix: Additional Figures and Tables

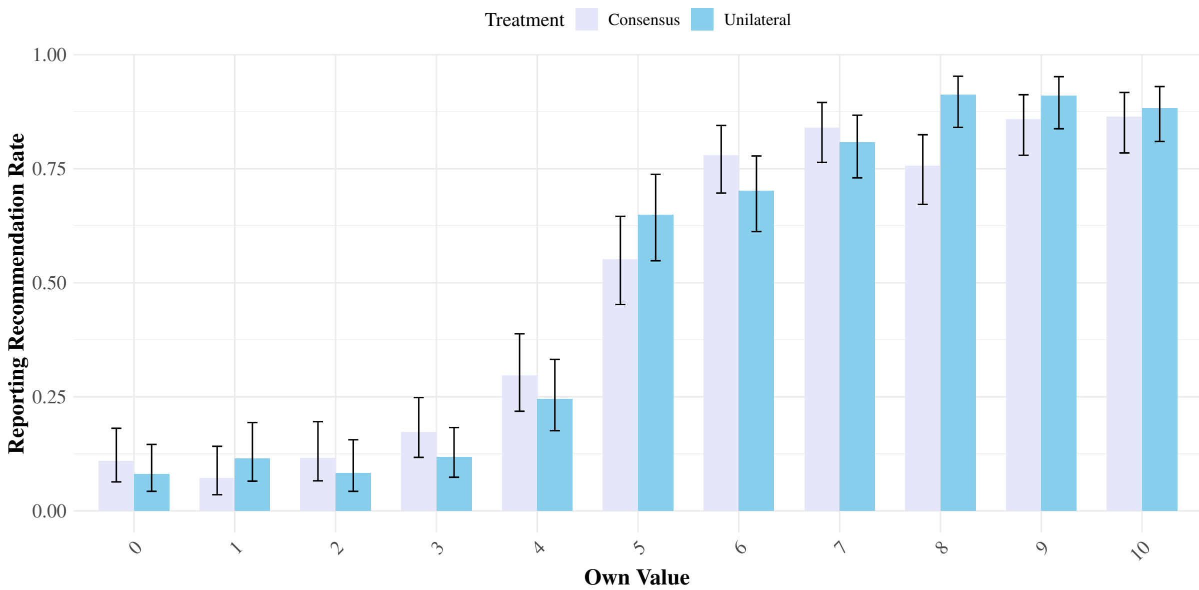

Figure 3: Reporting recommendation rates conditional on an individual's drawn value; all group members are considered in both the consensus treatment (in purple) and the unilateral treatment (in blue). The plot includes confidence intervals for the reporting recommendation rates in each instance.

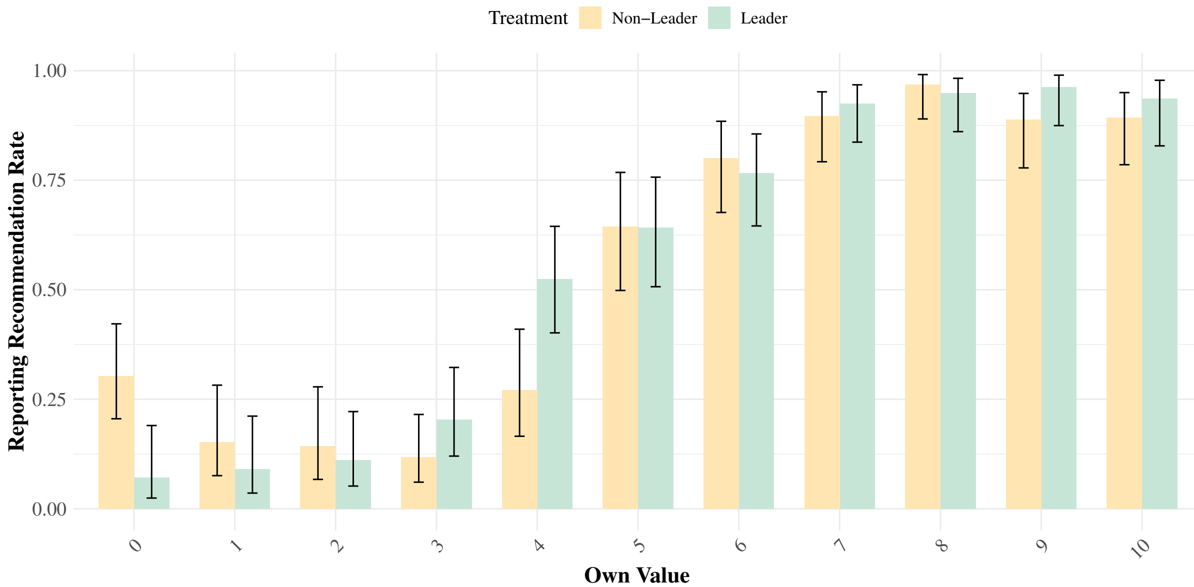

Figure 4: Reporting recommendation rates conditional on an individual's drawn value; 'Non-Leader' refers to subjects assigned "group member B" roles in the leader treatment (in yellow), and 'Leader' refers to subjects assigned "group member A" roles in the leader treatment (in green). The plot includes confidence intervals for the reporting recommendation rates in each instance.

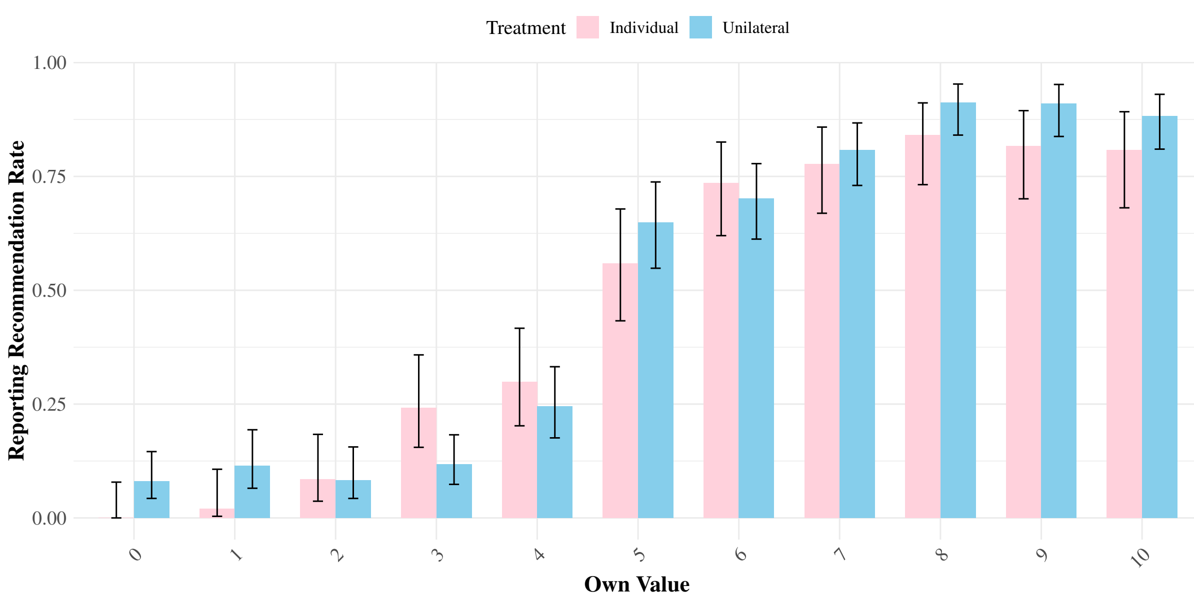

Figure 5: Reporting recommendation rates conditional on an individual's drawn value; all group members are considered in both the consensus treatment and the individual treatment. The plot includes confidence intervals for the reporting recommendation rates in each instance.

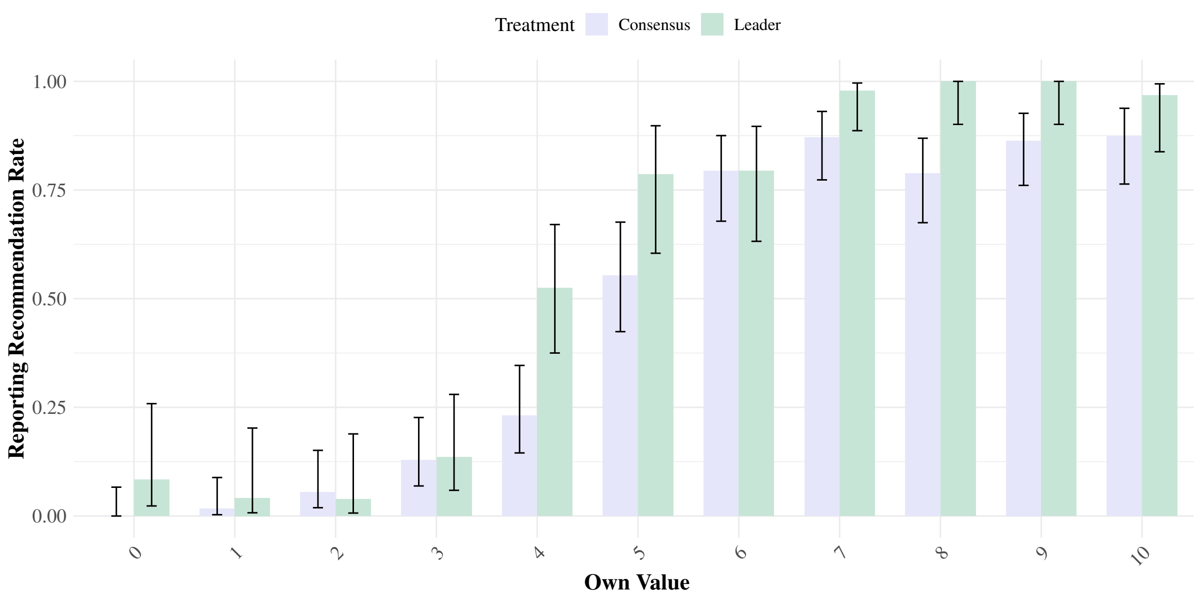

Figure 6: (Restricted Sample) Reporting recommendation rates conditional on an individual's drawn value; all group members who use "threshold reporting strategies" are considered in the consensus treatment (in purple), and group member As who use "threshold reporting strategies" are considered in the leader treatment (in green). The plot includes confidence intervals for the reporting recommendation rates in each instance.

B Appendix: Proofs and Additional Theoretical Results

B.1 Proof of Theorem 1

It is easy to see that a full-disclosure equilibrium as described always exists. It is supported by the observer's *off-path* maximally skeptical beliefs about both group members, $\omega_A^{ND} = \omega_B^{ND} = 0$. Given these beliefs, both group members are willing to always recommend that all outcomes be disclosed, which ensures that all outcomes are indeed disclosed. And therefore non-disclosure happens only off path, in which case we do not impose any equilibrium restriction on the observer's beliefs.

In the next part of the proof, we use notation $C_A = 1 - D(1,0)$ and $C_B = 1 - D(0,1)$. A partial-disclosure equilibrium exists if and only if there exist $v, w \in (0,1)$ such that individual A recommends disclosure if and only if $\omega_A \geqslant v$ and individual 2 recommends disclosure if and only if $\omega_B \geqslant w$; and such that the Bayesian no-disclosure beliefs ω^{ND} implied by the aggregated group-disclosure decisions given the individual recommendations satisfy $\omega_A^{ND} = v$ and $\omega_B^{ND} = w$. These conditions hold if and only if there exists $v, w \in (0,1)$ such that the following two conditions hold:

$$v = \frac{[(1-w)C_B v + wv]\frac{v}{2} + [(1-v)wC_A]\frac{1+v}{2}}{(1-w)C_B v + wv + (1-v)wC_A}, \tag{2}$$

$$w = \frac{[(1-v)C_A w + wv]\frac{w}{2} + [(1-w)vC_B]\frac{1+w}{2}}{(1-v)C_A w + wv + (1-w)vC_B}. \tag{3}$$

Manipulating equation (1), we have

$$[(1-w)vC_B + vw]v = (1-v)wC_A(1-v) \Rightarrow [(1-w)C_B + w]v^2 = wC_A(1-v)^2$$

$$\Rightarrow (1-w)C_B + w = wC_A\left(\frac{1-v}{v}\right)^2 \Rightarrow (1-w)C_B = \left[C_A\left(\frac{1-v}{v}\right)^2 - 1\right]w$$

$$\Rightarrow C_B\frac{1-w}{w} = C_A\left(\frac{1-v}{v}\right)^2 - 1.$$

$$\Rightarrow C_A\hat{v}^2 - C_B\hat{w} - 1 = 0, \tag{4}$$

where we let $\hat{v} = (1-v)/v$ and $\hat{w} = (1-w)/w$. Using the same steps, we can rewrite (3) as

$$\Rightarrow C_B\hat{w}^2 - C_A\hat{v} - 1 = 0. \tag{5}$$

Partial-disclosure equilibria are given by solutions to the system defined by (10) and (5), with

$\hat{v} \geqslant 0$ and $\hat{w} \geqslant 0$. From (10), write

$$\hat{v} = \sqrt{\frac{C_B \hat{w} + 1}{C_A}}. \tag{6}$$

Plugging this into equation (5), we have

$$C_B \hat{w}^2 - C_A \sqrt{\frac{C_B \hat{w} + 1}{C_A}} - 1 = 0$$

$$\Rightarrow \frac{C_B \hat{w}^2 - 1}{C_A} = \sqrt{\frac{C_B \hat{w} + 1}{C_A}}. \tag{7}$$

Now note that the left-hand side of equation (7) is a strictly convex function of $\hat{w}$), and the right-hand side of (7) is a strictly concave function of $\hat{w}$). Moreover, it is easy to see that, at $\hat{w} = 0$, the left-hand side is strictly smaller than the right-hand side; and there exists some $\hat{w} > 0$ such that the left-hand side is strictly larger than the right-hand side. Combining all these facts, we know that there exists a unique $\hat{w} \geqslant 0$ that satisfies (7).

And so we know that there is exactly one solution to the system defined by (10) and (5), which implies that exactly one partial-disclosure equilibrium exists. □

B.2 Proof of Proposition 1

Part 1 follows directly from Theorem 1. For part 2, note that $v = w = 0.38$ is a solution to (10) and (5) when $C_A = C_B = 1$, and $\omega_A^{ND} = \omega_B^{ND} = 0.38$ thus determines the unique interior equilibrium under the consensus deliberation procedure. For part 3, note that $C_A = \epsilon$ and $C_B = 1 - \epsilon$. The solutions to (10) and (5) thus satisfy $\lim_{\epsilon \to 0} v = 0$ and $\lim_{\epsilon \to 0} w = 1/2$. □

B.3 Proof of Proposition 2

Suppose a group uses the unilateral protocol and consider an equilibrium in which $\omega_A^{ND} = \omega_B^{ND} > 0$ (first assume such an equilibrium exists). It is clear that each individual i uses a recommendation strategy $x_i(\omega_i)$ which is a step function. Let t be the threshold ω_i for which i switches from recommending no disclosure to recommending disclosure.

The payoff to i from recommending disclosure is:

$$\omega_i + \alpha \omega_{-i}.$$

And their payoff from recommending no disclosure is:

$$(1-t)\omega_i + t\omega_i^{ND} + \alpha \left[\int_0^t \omega_{-i}^{ND} d\omega_{-i} + \int_t^1 \omega_{-i} d\omega_{-i} \right].$$

The difference between the two payoffs is:

$$t(\omega_i - \omega_i^{ND}) + \alpha \int_0^t (\omega_{-i} - \omega_{-i}^{ND}) d\omega_{-i}. \tag{8}$$

Suppose by contradiction that $t \leqslant \omega_i^{ND} = \omega_{-i}^{ND}$. Then the second term in (8) is strictly negative, which implies that (8) is strictly negative for all $\omega_i < \hat{\omega}_i$, where $\hat{\omega}_i > \omega_i^{ND}$. This means that group member i optimally recommends no disclosure for all $\omega_i < \hat{\omega}_i$, which contradicts the assumption that $t \leqslant \omega_i^{ND}$.

Now we wish to prove that an equilibrium exists in which $\omega_A^{ND} = \omega_B^{ND} > 0$. To that end, first note that under the unilateral procedure, if both group members use the threshold reporting strategy with threshold t, then the Bayes-posterior beliefs of the observer satisfy

$$\omega_A^{ND} = \omega_B^{ND} = \frac{t}{2}. \tag{9}$$

An equilibrium in which $\omega_A^{ND} = \omega_B^{ND} > 0$ is then defined by t such that the value of (8) is 0 for $\omega_i = t$ and (9) is satisfied. Putting these together, we have

$$t\left(t - \frac{t}{2}\right) + \alpha \int_t^1 (\omega_{-i} - t) d\omega_{-i} = 0 \Leftrightarrow \alpha(1 - t^2) = \left(\alpha - \frac{1}{2}\right) t^2. \tag{10}$$

It is easy to see that, if $\alpha \in (1/2, 1)$, there is exactly one t that satisfies (**??**), which defines an equilibrium with $\omega_A^{ND} = \omega_B^{ND} > 0$. □

B.4 Proof of Proposition 3

Suppose a group uses the consensus protocol and consider an equilibrium in which $\omega_A^{ND} = \omega_B^{ND} > 0$. It is clear that each individual i uses a recommendation strategy $x_i(\omega_i)$ which is a step function. Let t be the threshold ω_i for which i switches from recommending no disclosure to recommending disclosure.

The payoff to i from recommending disclosure is:

$$(1 - t)\omega_i + t\omega_i^{ND} + \alpha \left[\int_0^t \omega_{-i}^{ND} d\omega_{-i} + \int_t^1 \omega_{-i} d\omega_{-i} \right].$$

And their payoff from recommending no disclosure is:

$$\omega_i^{ND} + \alpha \omega_{-i}^{ND}.$$

The difference between the two payoffs is:

$$(1-t)(\omega_i - \omega_i^{ND}) + \alpha \int_t^1 (\omega_{-i} - \omega_{-i}^{ND}) d\omega_{-i}. \tag{11}$$

Suppose by contradiction that $t \geqslant \omega_i^{ND} = \omega_{-i}^{ND}$. Then the second term in (11) is strictly positive, which implies that (11) is strictly positive for all $\omega_i > \hat{\omega}_i$, where $\hat{\omega}_i < \omega_i^{ND}$. This means that group member i optimally recommends disclosure for all $\omega_i > \hat{\omega}_i$, which contradicts the assumption that $t \geqslant \omega_i^{ND}$. □

B.5 A More General Principle (Proposition 4)

To state a more general principle relating the group's deliberation procedure and the observer's no-disclosure skepticism, consider two deliberation procedures D and D'. We say group member A is *relatively more powerful* in procedure D than in procedure D' if $D(1,0) \geqslant D'(1,0)$ and $D(0,1) \leqslant D(1,0)$. It is clear that, in that case, under procedure D group member A is more able to enforce disclosure than in procedure D', while group member B is less able to enforce disclosure; and therefore group member A is relatively more powerful than group member B in procedure D than in procedure D'. Analogously, we say group member B is relatively more powerful in procedure D than in procedure D' if $D(1,0) \leqslant D'(1,0)$ and $D(0,1) \geqslant D(1,0)$. Finally, we say *disclosure is proportionally easier* in procedure D than in procedure D' if

$$\frac{D(1,0) - D'(1,0)}{1 - D'(1,0)} = \frac{D(0,1) - D'(0,1)}{1 - D'(0,1)} \geqslant 0.$$

Proposition 4. *Consider two deliberation procedures, D and D', such that $0 < D(1,0), D(0,1) < 1$ and $0 < D'(1,0), D'(0,1) < 1$. Let ω_i^{ND} and $\omega_i'^{ND}$ be the beliefs of no disclosure about group member i's value in the unique equilibrium without full disclosure under procedure D and D' respectively.*

1. *If group member i is relatively more powerful in procedure D' than in procedure D,*

$$\omega_i^{ND} \leqslant \omega_i'^{ND} \text{ and } \omega_{-i}^{ND} \geqslant \omega_{-i}'^{ND}.$$

2. *If disclosure is proportionally easier in procedure D than in procedure D',*

$$\omega_i^{ND} \leqslant \omega_i'^{ND} \text{ and } \omega_{-i}^{ND} \leqslant \omega_{-i}'^{ND}.$$

Proposition 4 clarifies that there are two forces at play when we vary the deliberation procedure used by the group. On the one hand, one procedure might make disclosure easier for the group, in a proportional way, so that the balance of power between the two group members does not change. In that case, the observer must become more skeptical about both group members upon seeing no disclosure. This result is reminiscent of a similar comparative statics performed in Dye (1985), which states, in an individual disclosure model, that if the individual is more able to disclose their outcome, then the observer must be more skeptical about their outcome upon seeing no disclosure. The second force at play concerns a relative change in the balance of power in the group. If $D(1,0)$ increases and $D(0,1)$ decreases, this means that the group is more likely to act in accordance to group member A's recommendation. In that case, we say that group member A becomes relatively more powerful; and Proposition 4 states that the observer must accordingly become more skeptical about group member A's value, and less skeptical about group member B's value.

Proof of Proposition 4. Let v and w be the unique solution to the system defined by equations (10) and (5).

Step 1. Showing that $dw/dD(0,1) \leqslant 0$ and $dv/dD(1,0) \leqslant 0$ (where remember that $C_A = 1 - D(1,0)$ and $C_B = 1 - D(0,1)$).

We can calculate the implicit derivative $d\hat{w}/dC_B$ from equation (7). We have:

$$\left[\frac{\hat{w}^2}{C_A} - \frac{1}{2}\left(\frac{C_B\hat{w}+1}{C_A}\right)^{-1/2}\frac{w}{C_A}\right]dC_B + \left[2\frac{C_B}{C_A}\hat{w} - \frac{1}{2}\left(\frac{C_B\hat{w}+1}{C_A}\right)^{-1/2}\frac{C_B}{C_A}\right]d\hat{w} = 0 \qquad (12)$$

We want to evaluate the signs of the two terms in brackets. To that end, we denote by $L(\cdot)$ the function on the left-hand side of equation (7) and by $R(\cdot)$ the function on its right-hand side. We have that $L(0) = -1/C_A$ and $R(0) = \sqrt{1/(C_A}$. Moreover, because L is convex and R is concave, we have

$$L(\hat{w}) \leqslant L(0) + L'(\hat{w})\hat{w}, \text{ and } R(\hat{w}) \geqslant R(0) + R'(\hat{w})\hat{w}.$$

And therefore, using the fact that $L(\hat{w}) = R(\hat{w})$, we know that

$$[L'(\hat{w}) - R'(\hat{w})]w \geqslant \frac{1}{C_A} + \sqrt{\frac{1}{C_A}}.$$

Substituting in the derivatives of L and R, we have

$$\left[2\frac{C_B}{C_A}\hat{w} - \frac{1}{2}\left(\frac{C_B\hat{w}+1}{C_A}\right)^{-1/2}\frac{C_B}{C_A}\right]\hat{w} \geqslant \frac{1}{C_A} + \sqrt{\frac{1}{C_A}}$$

$$\Rightarrow \left[2\hat{w} - \frac{1}{2}\left(\frac{C_A}{wC_B+1}\right)^{1/2}\right]\hat{w} \geqslant \frac{1}{C_B} + \sqrt{\frac{C_A}{C_B^2}}. \tag{13}$$

We know that for any C_A and C_B, it must be that $\hat{w} \geqslant 1$ — because we know that in equilibrium, $w \leqslant 1/2$, which is the unconstrained expected value of w. But we consider two cases. First, suppose $C_B\hat{w} \leqslant 1$; then (13) implies

$$2\hat{w} \geqslant \sqrt{\frac{C_A}{C_B^2\hat{w}^2}} \geqslant \sqrt{\frac{C_A}{C_B\hat{w}+1}}.$$

Now suppose instead that $C_B\hat{w} > 1$; then (13) implies

$$2\hat{w} \geqslant \frac{1}{C_B}\hat{w} \geqslant \frac{1}{C_B\hat{w}^2-1} \geqslant \frac{C_A}{C_B\hat{w}^2-1} = \sqrt{\frac{C_A}{C_B\hat{w}+1}},$$

where the last equality used the fact that $L(\hat{w}) = R(\hat{w})$. In each case, we have $2\hat{w} \geqslant \sqrt{\frac{C_A}{C_B\hat{w}+1}}$. It is easy to see that this implies that both terms in brackets in equation (12) are positive.

And therefore, $d\hat{w}/dC_B \leqslant 0$. But because $\hat{w} = (1-w)/w$, this means that $dw/dC_B \geqslant 0$. Equivalently, $dw/dD(0,1) \leqslant 0$. And by symmetry, $dv/dD(1,0) \leqslant 0$.

Step 2. Showing that $dv/dD(0,1) \geqslant 0$ and $dw/dD(1,0) \geqslant 0$.

We can rewrite equation (7) as

$$\frac{1}{C_B}\frac{W^2-1}{C_A} - \sqrt{\frac{W+1}{C_A}} = 0, \tag{14}$$

where we set $W = C_B\hat{w}$. Taking an implicit derivative of W with respect to C_B, we have

$$\left[-\frac{W^2-1}{C_A}\frac{1}{C_B^2}\right]dC_B + \left[\frac{2W}{C_A} - \frac{1}{2}\sqrt{\frac{C_A}{W+1}}\frac{1}{C_A}\right]dW = 0.$$

At the W that satisfies (14), it must be that the first term in square brackets is negative and the second term in square brackets is positive. And therefore $dW/dC_B \geqslant 0$. Now combining this with equation (6), we have that $d\hat{v}/dC_B \geqslant 0$. And because $\hat{v} = 1 - v/v$, this means that $dv/dC_B \leqslant 0$, or equivalently $dv/dD(0,1) \geqslant 0$. And by symmetry we know that $dw/dD(1,0) \geqslant 0$.

Steps 1 and 2 imply the first statement in the proposition.

Step 3. Showing that both v and w decrease after a proportional increase in D.

A proportional increase in D implies a decrease in both C_A and C_B, while maintaining the ratio

$C_A/C_B =: \alpha$. Rewrite equation (7) as

$$\alpha\hat{w}^2 - \frac{1}{C_A} - \sqrt{\alpha\hat{w} + \frac{1}{C_A}} = 0.$$

A proportional increase in D thus corresponds to an increase in $1/C_A$, while maintaining the value of α. We can implicitly sign the effect of this change on $\hat{w}$:

$$\left[-1 - \frac{1}{2}\left(\alpha\hat{w} + \frac{1}{C_A}\right)^{-1/2}\right] d\frac{1}{C_A} + \left[2\alpha\hat{w} - \frac{\alpha}{2}\left(\alpha\hat{w} + \frac{1}{C_A}\right)^{-1/2}\right] d\hat{w} = 0.$$

The first term in square brackets is clearly negative; and at the $\hat{w}$ that satisfies (7), it must be that the second term in square brackets is positive. And so we conclude that $\hat{w}$ increases after a proportional increase in D. By symmetry, we know that $\hat{v}$ also increases after the same change in the protocol. And consequently, both w and v decrease after such a change.

Step 3 implies the second statement in the proposition. □

C Appendix: Instructions

The following instructions correspond to the *consensus* treatment.

Instructions

This is an experiment in economic decision making. What you earn in this experiment depends partly on your decisions, partly on the decisions of others and partly on chance. The amount of money you earn will be paid to you privately, in cash, at the end of the experiment.

The entire session will take place through computer terminals, and all interactions between you and the other participants will be done through the computers. Please do not talk, communicate in any way, or use your electronic devices during the session. If you have any questions during the entire session, raise your hand and your question will be answered privately.

Role assignment

You will be randomly assigned to one of three possible roles: you could be a *group member A*, a *group member B* or an *evaluator*. You will keep the same role for all 30 rounds. In each round, you will be randomly matched with two other participants in this room who have been assigned the other two roles. There will be a new random matching at the beginning of each round, so it is unlikely that you will be matched with the same two participants in consecutive rounds.

Round description

Each round consists of four stages:

1. Card-drawing stage; 2. Reporting stage; 3. Guessing stage; 4. Feedback stage.

1. *Card-drawing stage (only group members participate)* There are two decks of cards, deck A and deck B. Each deck has 11 cards labeled 0,1,2,...,9, and 10. The computer program will randomly pick one card from deck A and one card from deck B. The pair of cards drawn by the computer is referred to as the *group's hand*.

The number on the card drawn from deck A is called Value A; it represents the value of the group's hand to group member A. Similarly, the number on the card drawn from deck B is called Value B, representing the value of the group's hand to group member B. Within each deck a card is picked at random with equal chance. Note that the computer separately picks the card from each deck, so that group member A's value is not related to group member B's value.

At the card-drawing stage, each group member sees the card representing their respective value, but not the card representing the value of the group's hand to the other group member. Moreover, at this stage, neither card is seen by the evaluator.

2. ***Reporting stage (only group members participate)*** After observing their respective values, group member A and group member B decide whether to report the group hand to the evaluator. Group members can choose to report the entire group hand, or to not report it; reporting each card separately is not possible.

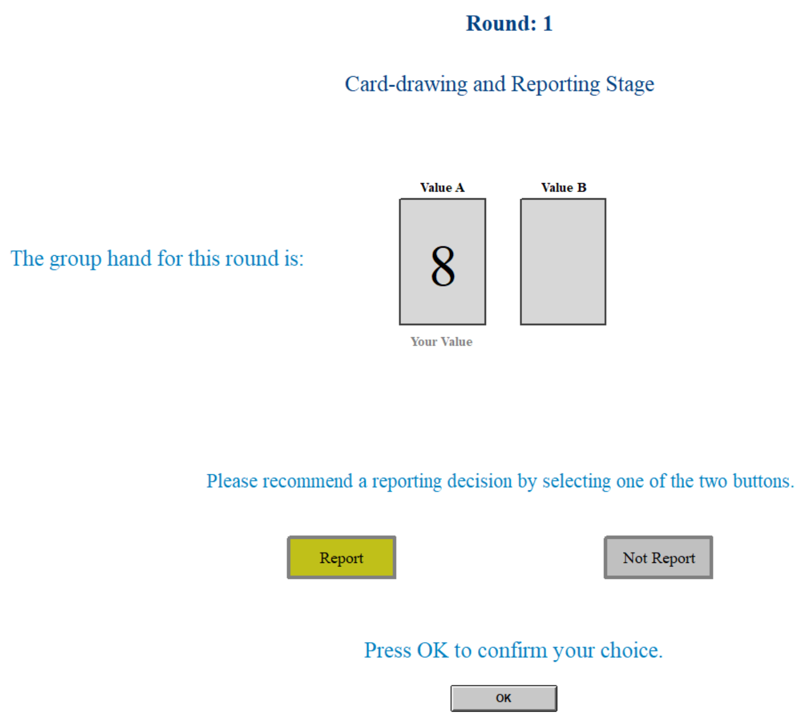

Figure 7: Sample Screen - Group Member A

Figure 7 presents a sample screen for a group member A. There are two buttons on the screen labeled 'Report' and 'Not Report' corresponding to two choices. The group member can move the cursor over one of these buttons and that button will light up, as button 'Report' is in Figure 7. After deciding on the selection, group member presses the "OK" button to confirm the recommendation. Each group member makes their own recommendation without observing that of the other group member.

- If *both* group members choose the 'Report' button then the evaluator **will see** both cards in the group hand, thereby revealing Value A and Value B.

- If neither group member A nor group member B choose the ‘Report’ button or if only one group member chooses the ‘Report’ button, the evaluator **will not see** the group hand. In that case, the evaluator will be informed that the group chose not to report the group’s hand.

3. ***Guessing stage (only evaluator participates)*** The evaluator is informed whether the group hand was reported or not.

- If the group hand was reported, the evaluator sees both cards in the group hand, thereby revealing Value A and Value B (as in Figure 8).

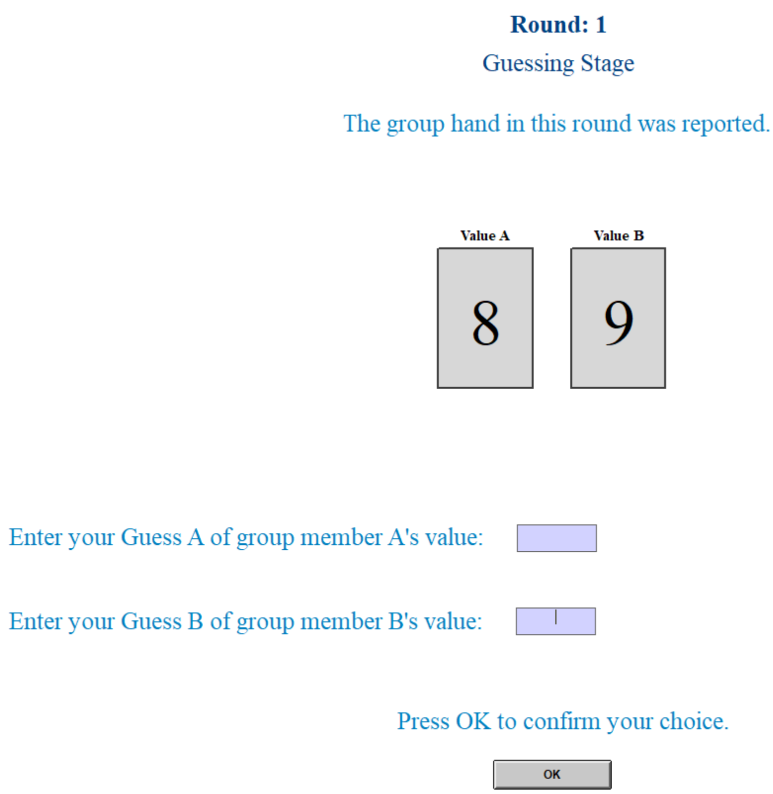

Figure 8: Sample Screen - Reported

- If the group hand is **not** reported, the evaluator does not see the group hand, and is instead informed that the group chose not to report the group’s hand (as in Figure 9).

After seeing the reported/not reported group hand, the evaluator is asked to make two guesses: to guess group member A’s value (Guess A), and to guess group member B’s value (Guess B). Each guess is entered as a number between 0 and 10, and increments of 0.5 are allowed. For instance, if the evaluator thinks 3 and 4 are equally likely, they can insert a guess of 3.5. Instead, an evaluator who, for instance, would like to make a guess of 6.7 needs to “settle” for a guess of 6.5 or 7.

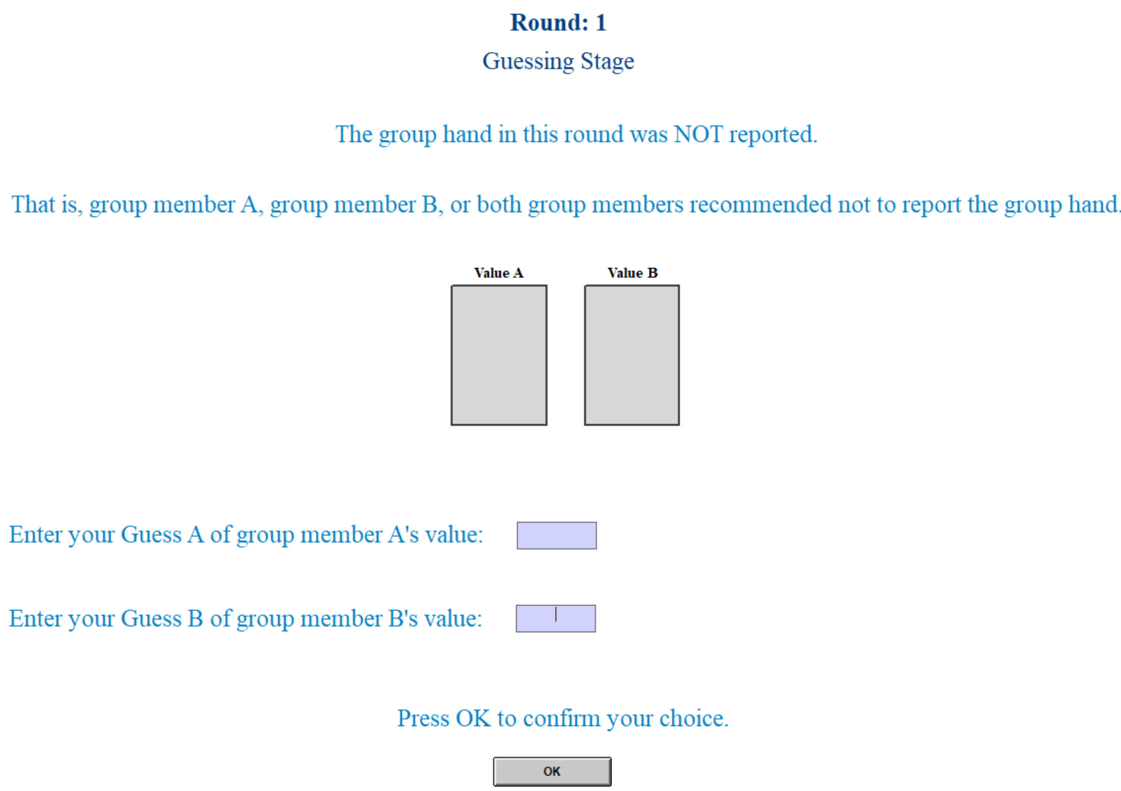

Figure 9: Sample Screen - Not Reported

Once the evaluator makes their guesses (Guess A and Guess B) and confirms, every participant in the unit moves to the feedback stage.

4. ***Feedback stage (everyone participates)*** Every participant will see a feedback screen. The screen will show both cards in the group hand, whether the group hand was reported or not, and the evaluator's guesses. After everyone is done observing the screen, the round is over and a new round begins.

Evaluator's payoff

The evaluator is paid for the **accuracy** of their guesses. The evaluator gets paid for either the accuracy of Guess A or for the accuracy of Guess B, *with equal chance*. **The evaluator earns more when the guess is closer to the value in the drawn card.** Specifically, Table 9a presents the evaluator's payoffs in all possible scenarios.

Group members' payoffs

Each group member is rewarded based on the evaluator's guess of their own respective value. The higher the evaluator's guess of a group member's value, the more that group member earns. **The group member earns more when the evaluator's guess of their value is higher, regardless of the value in the drawn card.** Specifically, Table 9b presents the group member's payoffs in all possible scenarios.

Additional information about payoffs

Regardless of your role, you will be paid according to your points in 1 round chosen at random, in addition to a show-up fee. Points will be exchanged to US dollars at a rate of 10 points to 1 dollar.

Practice rounds

Before the beginning of the experiment, you will play 2 practice rounds. These rounds are meant for you to familiarize yourselves with the screens. All the choices made in the practice rounds are unpaid and have no relation to the paid 30 rounds. These are for illustrative purposes only and they do not affect the actual experiment.

(a) Evaluator's payoff

	Guess 0	Guess 0.5	Guess 1	Guess 1.5	Guess 2	Guess 2.5	Guess 3	Guess 3.5	Guess 4	Guess 4.5	Guess 5	Guess 5.5	Guess 6	Guess 6.5	Guess 7	Guess 7.5	Guess 8	Guess 8.5	Guess 9	Guess 9.5	Guess 10
Value 0	110	109	106	103	99	95	90	85	80	74	68	62	56	50	43	36	29	22	15	7	0
Value 1	106	109	110	109	106	103	99	95	90	85	80	74	68	62	56	50	43	36	29	22	15
Value 2	99	103	106	109	110	109	106	103	99	95	90	85	80	74	68	62	56	50	43	36	29
Value 3	90	95	99	103	106	109	110	109	106	103	99	95	90	85	80	74	68	62	56	50	43
Value 4	80	85	90	95	99	103	106	109	110	109	106	103	99	95	90	85	80	74	68	62	56
Value 5	68	74	80	85	90	95	99	103	106	109	110	109	106	103	99	95	90	85	80	74	68
Value 6	56	62	68	74	80	85	90	95	99	103	106	109	110	109	106	103	99	95	90	85	80
Value 7	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110	109	106	103	99	95	90
Value 8	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110	109	106	103	99
Value 9	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110	109	106
Value 10	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110

(b) Group member's payoff

	Guess 0	Guess 0.5	Guess 1	Guess 1.5	Guess 2	Guess 2.5	Guess 3	Guess 3.5	Guess 4	Guess 4.5	Guess 5	Guess 5.5	Guess 6	Guess 6.5	Guess 7	Guess 7.5	Guess 8	Guess 8.5	Guess 9	Guess 9.5	Guess 10
Value 0	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 1	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 2	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 3	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 4	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 5	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 6	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 7	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 8	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 9	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110
Value 10	0	7	15	22	29	36	43	50	56	62	68	74	80	85	90	95	99	103	106	109	110

Table 9