Delegation to a Group*

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Abstract

We study the choice of a principal to either delegate a decision to a group of careerist experts, or to consult them individually and keep the decision-making power. The experts have access to information of different levels of competence-dependent accuracy, at cost $C \geq 0$, and benefit from being perceived as competent. Our model predicts a trade-off between *information acquisition* and *information aggregation*. On the one hand, the expected benefit from being informed is larger in case the experts are consulted individually, so the experts, depending on C, either acquire the same or a larger amount of information than in case of delegation of decision-making. On the other hand, any acquired information is better aggregated in case of delegation, where experts can deliberate secretly. To test the key predictions, we run an experiment, varying C across treatments. The results confirm the predicted trade-off. However, we find that many experts overinvest in information, which makes delegation optimal even where theory predicts better outcomes in case the experts are consulted individually. Nevertheless, the principals in our experiment are very reluctant to delegate decisions.

Keywords: delegation, decision rights, committees, group decision-making, expert advice, strategic communication.

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1 Introduction

Careful management of decision rights and the flow of information is crucial for organizational success. Principals often have to choose whether to delegate a decision or to seek advice and decide by themselves. As they lack the time to become informed about every issue that lands on their table, they typically have to rely on experts to gather relevant information. Consider a manager, for example, who faces the decision whether or not to invest in the development of a new product but lacks the technical knowledge to make the decision. She could ask the engineers in her company for advice or delegate the decision to them. Whether or not delegation of decision-making is a good idea depends on the effects on information acquisition and on how acquired information is used in the decision-making process. We study these effects theoretically and experimentally, focusing on delegation to a group of experts rather than to a single agent. As we will see, quite different effects are at play in this scenario, which has, so far, largely been neglected in the literature.

Delegation of decision-making by a single principal to a single expert has been studied extensively for various set-ups (e.g., Aghion and Tirole, 1997; Dessein, 2002; Prat, 2005; Fox and Van Weelden, 2012; Argenziano et al., 2016).[1] However, many decisions are delegated to groups of experts rather than to a single agent, and if a decision is not delegated, often more than one expert is consulted. Studying this set-up, we link the previous delegation literature to the literature on decision making in committees of careerist experts. Most of the papers in this literature consider the case of costless information (e.g., Levy, 2007a,b; Visser and Swank, 2007; Gersbach and Hahn, 2008; Mattozzi and Nakaguma, 2017; Fehrler and Hughes, 2018) with two exceptions (Gersbach and Hahn, 2012; Swank and Visser, 2018). None of them studies the decision to delegate a task to the committee, which is the focus of our study. We will see that the case of costly information is of particular interest as it gives rise to a trade-off between information acquisition and aggregation.

The experts in our model differ in their level of competence: that is, in the accuracy of the information they can acquire. More specifically, the level of competence determines the probability that they will be informed about the state of the world after investing the costs to acquire information. The experts' types are private information and they care about being perceived as competent – the standard assumption in many career concerns models (e.g., in Levy, 2007a,b; Visser and Swank, 2007; Gersbach and Hahn, 2008; Mattozzi and Nakaguma, 2017; Fehrler and Hughes, 2018). The principal, on the other hand, is interested in reaching the optimal decision for the organization. To arrive at a decision, the principal can consult each expert individually and then decide herself. Alternatively, she can delegate the whole decision-making process to the experts. In this case, the experts form an ad-hoc committee, discuss the information they might have acquired, and decide collectively on behalf of the principal.

Considering delegation to a group instead of to an individual expert turns the spotlight

[1] In some of these set-ups, conflicts of interests arise from different preferences regarding the decision (e.g., Aghion and Tirole, 1997; Dessein, 2002; Argenziano et al., 2016) in others, conflicts of interest arise from career concerns (e.g., Prat, 2005; Fox and Van Weelden, 2012).

on two aspects that become crucial in this context. On the one hand, careerist experts can aggregate information better among themselves because incompetent members can admit their lack of information to other group members, whereas they cannot admit this to the principal as it would reveal their incompetence.[2] As a consequence, the principal is better off delegating the decision if agents can acquire information at no cost. On the other hand, it is less beneficial for an expert to acquire information in case of delegation of decision-making to the group, as opposed to the case of consulting the experts individually, because the accuracy of the group decision has a smaller effect on the principal's assessment of their competence. Moreover, in case of consulting the experts individually, the effect of getting informed about the state of the world on the probability that the expert's advice is correct is greater than the effect of getting informed on the probability that the group decision is correct in case of delegation. If other experts also bought information, this could make any expert's own acquired information redundant. This leads to lower incentives to acquire information in case of delegation.[3] Hence, if information is costly (but not excessively costly), there is a trade-off between the effect of delegation on information aggregation (positive) and on information acquisition (negative). Which of the two effects dominates, and hence whether the decision should be delegated or not, depends on the level of the costs of information.

These predictions depend on a number of assumptions regarding the equilibria that will be played – the results sketched above hold if the most informative equilibrium is played – and the degree of strategic behavior by the agents. It is, therefore, not obvious that the model will predict behavior accurately. Moreover, recent experimental studies have shown that principals are very reluctant to delegate decisions even when it is beneficial to do so (Fehr et al., 2013; Bartling et al., 2014). To investigate the predictive power of our theoretical model, we conduct a laboratory experiment in which the costs of information are varied between three treatments. In each treatment, subjects play a number of rounds under either regime (consulting all experts individually or delegation of decision-making to the group of experts). These two parts are followed by a final part, in which the principal can decide whether to delegate the decision or not. This allows us to study whether principals delegate whenever our model says they would.

Our experimental results confirm that information is better aggregated under delegation. As predicted, communication of uninformed experts is more honest than in case experts are consulted individually. It is also the case that under delegation less information is acquired than if the experts are consulted individually in our high-cost treatment. However, this difference is much smaller than predicted. As a consequence, the positive effect through improved aggregation still outweighs the negative effect of fewer information acquisitions. Despite the fact that delegation leads to more correct decisions in all our treatments, more than 60% of the principals in each of the treatments chose to consult the experts individually instead. A potential explana-

[2] This effect is similar to the effect of secret decision making as compared to transparency in committees of careerist experts (see Fehrler and Hughes, 2018).

[3] The incentive to free-ride on others' information acquisition, of course, also exists in common-value situations in committees without career concerns (see, e.g., Elbittar et al., 2016; Großer and Seebauer, 2016; Bhattacharya et al., 2017).

tion is that they value being in charge *per se*, as suggested by Bartling et al. (2014) as the main reason for the reluctance to delegate in their experiment. Consistent with this hypothesis, the share of choices to consult individually shrinks in another, subsequently developed treatment, in which the role of the committee is reduced to that of an advisory board and the decision right stays with the principal in both regimes. However, even in this modified setting, a majority of principals prefer to consult the experts individually. Hence, a non-instrumental value that they might attach to the decision right cannot fully explain the low number of delegation decisions in our main treatments. To shed more light on this puzzling behavior, we analyze our subjects' answers to open questions about their behavior in the post-experimental questionnaire. These answers reveal a variety of reasons – simple curiosity in the individual experts' messages being one of them.

We review the related literature in the next section. We set up the model and derive theoretical results in Section 3. In Sections 4 and 5, we describe our experimental design, state our hypotheses and present our experimental results, before discussing them and concluding in Section 6.

2 Related Literature

Delegation The rise of the delegation literature, which focuses on set-ups with a single principal and a single agent, starts with the seminal work of Aghion and Tirole (1997). They stress the trade-off between saving the costs of information acquisition and the loss of control of the principal whose agent has different preferences regarding the final decision. Dessein (2002) also considers an environment with different preferences but without costly information acquisition and shows that delegation, instead of communication, gives rise to a trade-off between loss of control and loss of information. A similar set-up, but now again with costly information, is studied in Argenziano et al. (2016) and Lai and Lim (2012). All of the aforementioned papers find, among other things, that whether to delegate or not depends on the size of the conflict of interest between principal and agent. The studies with costly information find that delegation increases the effort that agents invest in acquiring information. In line with this latter finding, Liberti (2018) present evidence from an empirical investigation of the effects of delegation, which shows that delegation leads to more effort provision of loan-officers (the agents) in a banking environment. Note that our predicted effect of delegation on information acquisition goes in the opposite direction. We predict fewer information acquisitions under delegation because of the free-riding incentive that arises in the group.

Prat (2005) and Fox and Van Weelden (2012) study the optimal level of transparency between a principal and an agent in a delegation set-up. The misalignment of incentives for the agent and the preferences of the principal in their models stems from career-concerns (Holmström, 1999). The agent is not (only) interested in the decision outcome *per se*, but cares about signaling his ability level. Hence, it matters what part of the decision process the principal can observe, which also plays a key role in our set-up.

Fehr et al. (2013) studied Aghion and Tirol's (1997) set-up experimentally and found a suboptimal level of delegation by the principals – a finding that spurred a string of further investigations and explanations for under-delegation. Bartling et al. (2014) argue that the reason for suboptimal delegation is an intrinsic utility from having the decision power. Neri and Rommeswinkel (2017) suggest that it is not only utility derived from power, but the disutility of letting others interfere in a decision that leads to a suboptimal level of delegation. Danz et al. (2015) explain suboptimal delegation by reference to hindsight bias of principals, which makes them overconfident with respect to their ability to decide correctly by themselves. Taking these considerations into account, we design an additional treatment in which the decision right stays with the principal also in the alternative case to consulting the experts individually.

Committee Decision-Making Career concerns in committee decision-making with costless information has been studied in a growing string of recent theoretical models (Visser and Swank, 2007; Levy, 2007b,a; Gersbach and Hahn, 2008; Mattozzi and Nakaguma, 2017; Fehrler and Hughes, 2018) and experiments (Mattozzi and Nakaguma, 2017; Fehrler and Hughes, 2018; Renes and Visser, 2018), which mainly focus on the optimal level of transparency of the decision-making process. The effect of transparency is also studied in Gradwohl (2018), where committee members are not career concerned but have a preference for strategic ambiguity, and in Gradwohl and Feddersen (2018) and Feddersen and Gradwohl (2019), where the committee takes the role of an advisory board and the focus lies on communication between the committee members and a principal who does not share their preferences. Unlike the above-mentioned papers, in which information is costless, Gersbach and Hahn (2012) and Swank and Visser (2018) study information acquisition in committees of careerist experts – the former focusing on the role of transparency, the latter on the interplay of external and internal reputation concerns (that is, reputation concerns toward other committee members). Using data from the Federal Open Market Committee, Meade and Stasavage (2008) and Hansen et al. (2018) study empirically how a change in this monetary policy board's transparency rules affected the way committee members deliberate. What is common to all these papers is that what other players observe about the committee members' behavior matters to them and hence affects their choices in the information acquisition, deliberation or voting stages of the different models, experiments or monetary policy decision-making processes. This is also the case in our set-up.

Another string of papers in the committee decision-making literature studies information acquisition, in the absence of career concerns, in common-value committees theoretically (Persico, 2004) and experimentally (Elbittar et al., 2016; Großer and Seebauer, 2016, 2017; Bhattacharya et al., 2017). In the set-ups of these studies, the committee members face a public goods problem, as they have an incentive to free-ride on the information acquisition of others, as is the case in Gersbach and Hahn (2012) and also in our model under delegation.

As we will formally derive next, delegation to a group (or committee) gives rise to a trade-off between information acquisition and information aggregation, and the optimal choice of the principal will crucially depend on how costly information is.

3 The Model

3.1 Set-Up

Nature determines the state of the world $S \in \{A, B\}$ (such as, promising product–not promising product, talented candidate–untalented candidate) and a binary decision $D \in \{A, B\}$ (such as, invest–do not invest, hire–do not hire) has to be made. The principal is interested in matching the decision D to the state of the world S, receiving a payoff of 1 in case of success and 0 otherwise. Both states of the world are equally likely and the realization of S is *a priori* unknown. The principal herself cannot obtain any signal about the state of the world but there are $n \in \mathbb{N}$ experts, indexed by $j \in [1, ..., n]$, who can. Obtaining a signal $s_j \in \{A, B, \emptyset\}$ comes at cost $C \in [0, \infty)$. The experts can be of two different competence types $t_j \in \{i, c\}$. Their type determines the probability of being informed about the state of the world after obtaining a signal. While a competent expert k ($t_k = c$) will always receive a perfectly informative signal ($s_k = S$) if he chooses to pay the information cost C, an incompetent expert l ($t_l = i$) will receive a perfectly informative signal ($s_l = S$) with probability $p \in (0, 1)$ and an uninformative signal ($s_l = \emptyset$) with probability $(1 - p)$.[4]

The experts are driven by career concerns and their utility does not depend on the decision about the project D *per se*. Instead, they only care about being perceived as competent in the eyes of the principal. As is standard in career concern models, their utility equals the posterior probability that the principal attaches to them being competent at the end of their interaction. The prior probability of an expert being competent is publicly known to be λ, and their type, their acquiring decision, as well as their acquired signal (if one is acquired) are private information of each expert.

The principal has two options: Consulting the Experts Individually (CI) and Delegating the Decision to the Group (DG). The experts learn the principal's choice before deciding whether or not to acquire a signal at cost C. Under CI, after possibly acquiring a signal and observing it, each expert j submits a costless message $M_j \in \{A, B, \emptyset\}$ to the principal, who then makes the decision D. The messages are sent simultaneously.[5] After the decision is implemented, the true state of the world S is revealed and the principal uses all available information to update her belief about the type of each expert using Bayes' rule.

The other option, DG, shifts the decision power to the experts. Under DG, as under CI, after knowing what option the principal chose, each expert can first decide on whether or not to acquire a costly signal. Then the experts form a committee, simultaneously submit a costless

[4] Competence can, thus, be interpreted as knowing where to look for information. While a competent expert knows where he can find the answer to his question, an incompetent experts looks at the wrong place with positive probability and might thus stay uninformed despite investing the (effort) cost of looking for information.

[5] Equivalently, we could assume sequentially sent messages that are unobservable to the other experts.

message $M_j \in \{A, B, \emptyset\}$ to all other experts, and afterwards decide on D via majority rule. In case of a tie, the committee decision is made by a coin flip.[6] Neither the messages nor the votes (and potentially the coin flip) within the committee are observed by the principal. After learning the true state of the world, the principal updates her beliefs about the experts' competence types, as under CI, but this time she has to rely on less information. While the message of each expert can be used for updating under CI, only the decision of the whole committee can be used under DG.

3.2 Timeline

Stage 0

Nature determines the state of the world $S \in \{A, B\}$ and draws types. Each expert j privately learns his type $t_j \in \{i, c\}$.

Stage 1

The principal decides whether to consult individually or to delegate the decision. The experts observe her choice.

Stage 2

Each expert decides whether or not to acquire a signal s_j at cost C. Those who acquire a signal observe it privately.

Stage 3

CI Each expert sends a message $M_j \in \{A, B, \emptyset\}$ to the principal.

DG Each expert sends a message $M_j \in \{A, B, \emptyset\}$ to the other expert(s).

Stage 4

CI The principal observes messages and decides on $D \in \{A, B\}$.

DG The experts observe messages and decide on $D \in \{A, B\}$ by voting under majority rule. Ties are resolved by the flip of a fair coin.

Stage 5

CI The true state of the world $S \in \{A, B\}$ is revealed and the principal updates her belief about each expert based on the message and the true state. Each expert j's utility realizes as $U_j = Pr(t_j = c|S, M_j)$. The principal's utility realizes as $U_P = 1$ if $S = D$ and $U_P = 0$ if $S \neq D$.

DG The principal learns the decision of the committee, and the true state of the world $S \in \{A, B\}$ is revealed. She updates her belief about each expert's type based on the group decision and the true state. Each expert j's utility realizes as $U_j = Pr(t_j = c|S, D)$. The principal's utility realizes as $U_P = 1$ if $S = D$ and $U_P = 0$ if $S \neq D$.

[6] Alternatively, we could assume that committee members can coordinate their votes via a public randomization device to avoid a tie, which would reveal their disagreement.

3.3 Equilibrium Predictions

The solution concept we use is Perfect Bayesian Equilibrium (PBE). We focus on type-symmetric PBEs and ignore equilibria with inverted language. Even with these restrictions there are multiple equilibria, which is typically the case in cheap talk games. We restrict the set of equilibria further by focusing on the most informative equilibria: that is, the equilibria in which the final decision is based on the greatest amount of information possible. This is a standard refinement in cheap talk games (e.g., Crawford and Sobel, 1982; Chen et al., 2008) and allows us to ignore unintuitive babbling equilibria and equilibria in which nobody is ever pivotal in the voting stage under delegation.

With these restrictions, the principal's posterior belief about the experts' competence increases in the case of a correct decision (a correct individual advice) under DG (CI) unless the cost of information is too high to allow for information acquisition at least of the competent experts. Under CI, informed experts will, therefore, truthfully communicate their signal, while uninformed experts will try to conceal their ignorance by communicating A or B randomly with equal probability. Truthfully communicating $\emptyset$ would reveal their incompetence.[7]

Under DG, the experts are in a common-value situation and our equilibrium prediction is that they will share any information among themselves truthfully and decide unanimously on the decision that is more likely to match the true state of the world (as in Coughlan, 2000; Guarnaschelli et al., 2000; Goeree and Yariv, 2011) and collectively decide on A or B with equal probability in case both states of the world appear equally likely to them, which can only occur in case no expert is informed (as in Fehrler and Hughes, 2018).[8]

Depending on the magnitude of the costs C, equilibrium decisions in the two regimes differ in their accuracy. Proposition 1 summarizes our main results in this respect. In Appendix A, we characterize the equilibria of both regimes for the whole range of C.

Proposition 1

For all numbers of experts $n \geq 2$, all prior probabilities of competence $\lambda \in (0,1)$ and all levels of incompetence $p \in (0,1)$, there always exist cost levels $C'(n,\lambda,p) < C''(n,\lambda,p) < C'''(n,\lambda,p)$, such that

1. *delegation to the group of experts leads to a higher decision accuracy than consulting the experts individually if $C \leq C'$,*

2. *consulting the experts individually leads to a higher decision accuracy than delegation to the group of experts if $C'' < C \leq C'''$,*

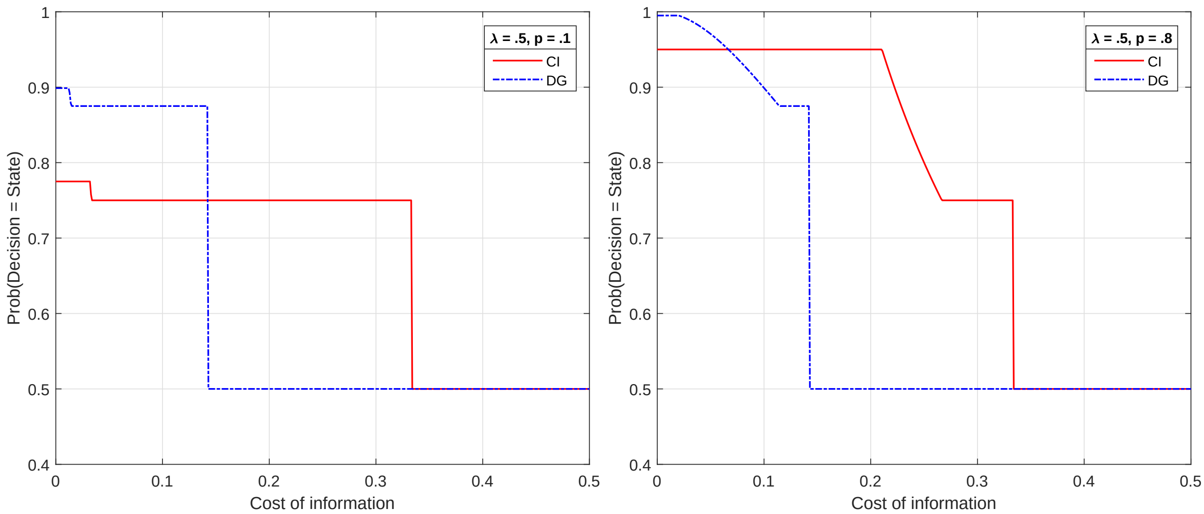
[7] This behavior is supported as an equilibrium action by the principal's out-of-equilibrium belief that the message $\emptyset$ could only stem from an incompetent expert. This could be micro-founded by a tremble of the experts between truth-telling and strategic communication in the messaging stage.

[8] The 50-50 mixing stems from the fact that any other mixing probability would lead to a lower expected posterior belief of the principal following the decision that is chosen with higher probability. Hence, any expert could benefit from deviating by voting for the other option. Only when either group decision is made with equal probability no such profitable deviation exists.

3. *and both regimes lead to the same decision accuracy if $C''' < C$.*

Proof. See Appendix A. $\square$

To illustrate, Figure 1 plots the different decision accuracies for a committee of two experts under CI and DG for $\lambda = 0.5$ and different cost levels. Panel (a) plots the success probability for $p = 0.1$, indicating that incompetent experts who acquire information receive an informative signal with probability 0.1, while panel (b) shows the plot for a lower discrepancy between competence levels of the two types with $p = 0.8$. For both parameter settings, the graph shows that for low (medium) costs of information DG (CI) outperforms CI (DG). For high costs, the only sustainable equilibrium is when no information is acquired and all decisions are made without any information.



(a) $p = 0.1$, high difference in competence

(b) $p = 0.8$, low difference in competence

Figure 1: Decision Accuracies of the Most Informative Equilibrium for $n = 2$ Experts.

The intuition underlying these results rests on a trade-off of information acquisition and information aggregation.

Why Delegation Improves Information Aggregation The dominance of DG in the low range of C stems from superior information aggregation and the fact that similar amounts of information are acquired under both regimes. The main difference compared to CI is that the experts could truthfully reveal to the other experts if they were uninformed under DG. Under CI, on the contrary, it would never be optimal to reveal ignorance about the state of the world if the principal believed that competent experts acquire a signal. Hence, uninformed experts are predicted to strategically pretend they have received an informative signal, and doing so, they will sometimes contradict the correct messages of other, informed, experts. This can lead to wrong decisions being made by the principal. Under DG, this cannot happen as the committee would always implement the correct decision if at least one expert knew the true state of the world.

Why Consulting the Experts Individually Increases the Incentive to Acquire Information Under CI, the principal updates her beliefs about the competence of an expert based on the true state and the message she received from the expert. Hence, an expert's incentive to acquire information is independent of the other experts' behavior. Under DG, however, the whole committee benefits from the information acquired by any expert. Moreover, after the acquisition stage, the preferences for every expert in the committee are aligned and any information will be truthfully shared. Thus, information acquisition has the typical structure of a public goods game and the incentive to pay C in order to receive a signal becomes weaker with a higher number of experts in the committee. As a consequence, the threshold cost level above which it is no longer beneficial for an expert to acquire information in order to increase the chance of a correct message (CI) or decision (DG) is lower for DG than for CI. Hence, there is always a range of costs where no information is acquired under DG, but competent experts still acquire information under CI. In this cost range, the success probability is lower under DG than under CI.

4 Experimental Design, Hypotheses, and Procedure

4.1 Design

For all treatments, we set $\lambda = 0.5$ and $p = 0.1$. Our main treatment variable is the cost of information which takes values of 0, 10, and 30 in the three different main treatments (corresponding to 0, 0.1, and 0.3 in Figure 1 (a)) and 0 in the extra treatment. The experiment consists of 23 rounds. For rounds 1-20, the regime under which subjects play is exogenously given. Half the sessions start with 10 rounds of CI (DG), followed by 10 rounds of DG (CI). For the remaining three rounds, principals can choose whether to play DG or CI. Table 1 gives an overview of the treatments, number of subjects and number of matching groups. Figure 1 (a) displays the theoretical predictions regarding the decision accuracy for DG and CI for all cost levels.

For the $C = 0$ treatment, theory predicts DG will outperform CI, and our theory consequently predicts that principals will delegate. However, in case they derive utility from keeping the decision right this latter prediction might not hold. To address this issue we designed the extra treatment, also with $C = 0$, in which the principal stays in charge even when experts form a committee. The DG option is replaced. There is still a committee and the acquisition, deliberation and voting procedures are unchanged, but the committee only votes on a recommendation that the principal is free to follow or not. Hence, the committee's role is reduced to that of an advisory board. The equilibrium predictions regarding experts' behavior are unaffected by this mere shift of the decision right and the principal is always better off if she follows the committee's recommendation.

For the $C = 10$ treatment, theory predicts competent experts will acquire information and incompetent experts will refrain from information acquisition. As the amount of information that is bought is the same for both regimes, DG is again predicted to outperform CI due to improved information aggregation.

For the $C = 30$ treatment, the information acquisition predictions differ between the regimes. Under DG, our theory predicts that no information will be acquired, while competent experts will still acquire information under CI. Consequently, CI is now predicted to outperform DG.

Table 1: Overview of Treatments, Sessions and Matching Groups (MG)

	Costs			Order		Decision power
Subjects (Sessions, MG)	0	10	30	CI - DG	DG - CI	under DG
36 (2,4)	✓			✓		Experts
36 (2,4)	✓				✓	Experts
36 (2,4)	✓			✓		Principal
36 (2,4)	✓				✓	Principal
36 (2,4)		✓		✓		Experts
36 (2,4)		✓			✓	Experts
36 (3,4)			✓	✓		Experts
36 (2,4)			✓		✓	Experts

4.2 Hypotheses

Our experimental design allows us to test the following hypotheses, which arise from the solution of the model (Hypothesis 1 - 3), and from the addition of a potential intrinsic value of keeping the decision right (Hypothesis 4).

Hypothesis 1 (Information Acquisition) The share of competent experts that acquire information in the high cost ($C = 30$) treatment is higher under CI than under DG, while it is the same in all other treatments.

Hypothesis 2 (Information Aggregation) The share of messages honestly revealing a lack of information is higher under DG than under CI in all treatments.

Hypothesis 3 (Decision Accuracy) DG outperforms CI in the $C = 0$ and $C = 10$ treatments, but not in the $C = 30$ treatment.

Hypothesis 4 (Delegation) CI is chosen less often when delegation leads to a higher decision accuracy (that is, in the $C = 0$ and $C = 10$ treatments as compared to the $C = 30$ treatment), and, comparing the two $C = 0$ treatments, CI is chosen less often in the extra treatment where the decision power stays with the principal.

As there are multiple equilibria under both regimes, it is *a priori* unclear whether the predicted most informative equilibrium will be played. Moreover, the predicted behavior of the experts involves some depth of strategic reasoning and it is unclear whether these predictions are accurate descriptions of actual behavior. Under CI, we predict incompetent experts to lie about their competence by recommending a decision even if they did not acquire a signal or if they received an uninformative one (Hypothesis 2). In DG with high costs, our model predicts no acquisitions because the positive externalities of information (information being a public good in the committee) are not internalized (Hypothesis 1). This is at odds with findings of over-acquisition of signals in recent experimental studies on information acquisition in committees (Großer and Seebauer, 2016, 2017; Bhattacharya et al., 2017). It can also not be taken for granted that the belief-updating of principals will be well approximated by Bayesian updating. Finally, while previous studies (e.g., Fehr et al., 2013; Bartling et al., 2014) found clear evidence for under-delegation, whether or not an intrinsic utility derived from keeping the decision right is the driving force behind this phenomenon is less clear. Hence, none of our hypotheses is obvious to hold in the laboratory.

4.3 Procedural Details

Before the first round, each subject is randomly assigned the role of principal or expert and keeps this role for the entire session.[9] At the beginning of each round, groups of three, including one principal and two experts, are randomly formed out of matching groups of nine subjects. In round 11, an exogenous regime change from CI to DG (or vice versa) takes place. In the beginning of round 21, principals can decide the regime that is played within their group for the last three rounds.

The state of the world is represented as a colored jar (blue or red). The competent experts can choose to pay C to receive a ball that has the same color as the jar (a perfectly informative signal). Incompetent experts, who chose to pay C, receive a gray ball with probability $\frac{9}{10}$, which leaves them ignorant about the state of the world. With probability $\frac{1}{10}$ they receive a ball that has the same color as the jar. If an expert chooses not to pay, he does not get to see any ball.

In the next stage, an expert can choose to send one of three pre-specified messages: 'I recommend red'/'I recommend blue'/'I do not have any information'. The recipient of these messages is either the principal of their own group (under CI) or the other expert in their group (under DG). In the CI rounds, the principal can then, after observing the messages of both experts of her group, choose which decision to implement. In the DG rounds, each expert votes for either blue or red after receiving the message of the other expert in the group, and the decision is implemented using majority rule. In the case of a tie, one decision is randomly implemented with equal probabilities and the principal is not informed about the tie. In the treatment where the principal keeps the decision right, the experts do not vote on the decision itself but on a group-recommendation to the principal who then implements the decision herself.

After the decision is implemented, a principal of a different group (but from the same matching group), whom we call the observer, sees the true state of the world as well as the messages (CI) or the group decision (DG) and has to enter a percentage probability $x_j \in [0, 100]$ for every expert $j \in \{1, 2\}$, which refers to how probable she thinks it is that this expert is competent. This evaluation determines the payoff of expert j as x_j, and the observers themselves

[9]See Appendix C for screen-shots and Appendix D for the instructions.

are incentivized to report their true belief with a quadratic scoring rule.[10] We cannot let the principals do the evaluation of the experts in their own group as they would then (in round 21) have another reason to choose CI, where they learn more about the experts, in order to get a higher payoff from more accurate evaluations. This would be at odds with the model.

Additionally, the payoff of the decision is 50 points for the principal if it is correct, and 0 points otherwise. After every round, each expert receives feedback about the true state, the decision, and their own payoff from the evaluation of the observer. The principal receives feedback about whether the correct decision is implemented, and the competence levels of the observed subjects. The competence level and the signal acquisition decision of an expert is neither revealed to the principal of the own group, nor to the other expert. At the end of the experiment, three of the first 10 rounds, three of rounds 11–20, and one of rounds 21–23 are randomly selected as payoff-relevant. To avoid hedging incentives for the principals, only one randomly determined evaluation of an expert within a selected round is payoff relevant but never two evaluations from the same round. Each point is converted into 2.5 Euro cents.

Printouts of the instructions for the first 10 rounds are distributed at the beginning of the experiment. The instructions for each following part are distributed after the end of the preceding part. Before the experiment starts, the subjects answer an unincentivized quiz on their screens. The experiment was conducted in 2017 and 2018 in the LakeLab of University of Konstanz using z-tree (Fischbacher, 2007) for the treatment and ORSEE (Greiner, 2015) for the recruitment of the subjects. The average earnings in 17 sessions with 288 participants (average age: 22.39 years, female: 58.3%) were 17.61 Euro (sd = 2.16) including a show-up fee of 3 Euro. Each session lasted around 80 minutes, including a post-experimental questionnaire and the payment.[11]

5 Experimental Results

We present our experimental findings in the following order: (i) results regarding the experts' behavior with respect to information acquisition and communication, (ii) results regarding the decision accuracies, (iii) results regarding the principals' choice between CI and DG, (iv) results regarding the observers' evaluation behavior, and (v) results regarding changes in behavior over time and potential reasons for deviations from our predictions.

We test for treatment differences with tests based on clustered standard-errors at the matching-group level. For comparisons within treatments, we also take the paired structure of the data into account, which stems from the fact that all subjects play under both regimes. For this purpose, we run regressions with subject fixed-effects. Furthermore, due to the limited number of matching groups (and hence potentially rather imprecisely estimated standard er-

[10] If the evaluated expert j is competent, the observer's payoff is $\Pi_c = \frac{1}{2} \cdot (100 - \frac{1}{100} \cdot x_j^2)$, while it is $\Pi_i = \frac{1}{2} \cdot (100 - \frac{1}{100} \cdot (100 - x_j)^2)$ in case the expert is incompetent.

[11] The unincentivized post-experimental questionnaire included questions on sociodemographic characteristics and open questions about the reasons underlying the behavior in the experiment.

rors; see, e.g., Cameron and Miller, 2015), we also report the results of non-parametric Wilcoxon signed-rank tests.

5.1 Experts' Behavior

Information Acquisition Table 2 shows the relative frequencies of signal acquisitions of experts in the laboratory, as well as the theoretically predicted frequencies. The acquisition behavior matches the prediction well in most cases. The competent experts in the $C = 30$ treatment are the exception with 60% information acquisition under DG and 70% under CI, where theory predicts 0% and 100%, respectively.

Appendix B provides regression analyses for every treatment and for competent and incompetent experts separately (Tables B1 and B2). These regressions, as well as the Wilcoxon signed-rank test for matched pairs of differences within matching groups, reveal that incompetent experts differ in their acquisition behavior between DG and CI only in the $C = 10$ treatment, and competent experts only in the $C = 30$ treatment. In both cases, DG leads to fewer information acquisitions.

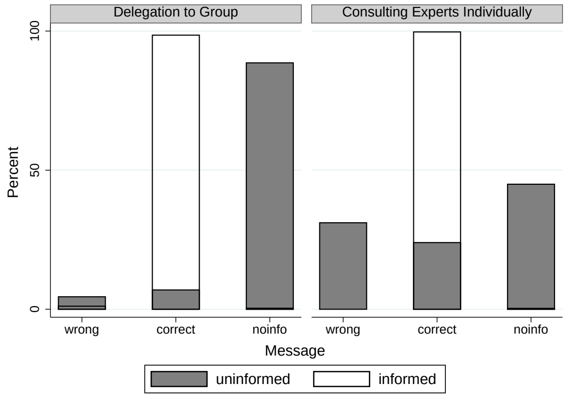
Table 2: Relative Frequencies of Information Acquisitions

	CI				DG			
	incompetent		competent		incompetent		competent	
	Actual	Pred.	Actual	Pred.	Actual	Pred.	Actual	Pred.
C = 0	92 %	(100)	100 %	(100)	89 %,89 %	(100)	100 %, 100 %	(100)
C = 10	17 % **	(0)	91 %	(100)	7 % **	(0)	89 %	(100)
C = 30	3 %	(0)	70 % **	(100)	1 %	(0)	60 % **	(0)

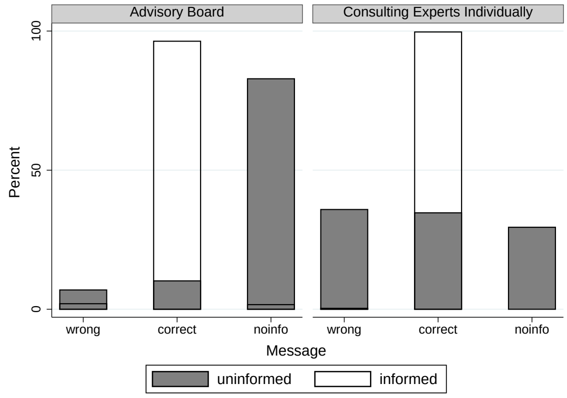
Notes: The first numbers in the cells of the $C = 0$ row and Delegation columns correspond to the relative frequencies of information acquisition in case the group has the decision power, and the second number represents the share for the case that the principal has the decision power. All numbers are rounded to an integer. $^{**}p < 0.05$ denotes the significance of the difference between DG and CI of a Wilcoxon signed-rank test of the equality of the median shares of acquisitions under both regimes within a matching group.

Experimental Result 1 (Information Acquisition): *Hypothesis 1 is confirmed. However, in the $C = 30$ treatment, we observe over-acquisition by competent experts compared to theory. Apart from that, information acquisitions are well predicted.*

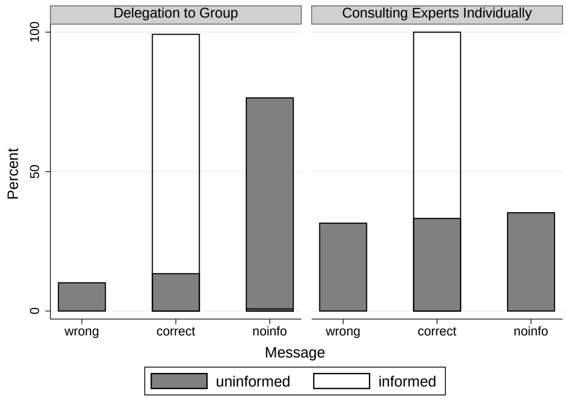
Information Aggregation Figure 2 gives an overview of the messaging behavior in the experiment. The prediction that the informed experts honestly reveal the signal turns out to be almost wholly correct in the lab. Table 3 reports the result of OLS regressions for the probability of honestly reporting being uninformed with and without subject fixed-effects for each treatment. Under DG, the share of honest revelations of uninformed experts is significantly higher than under CI in all treatments. A Wilcoxon signed-rank test for the difference between



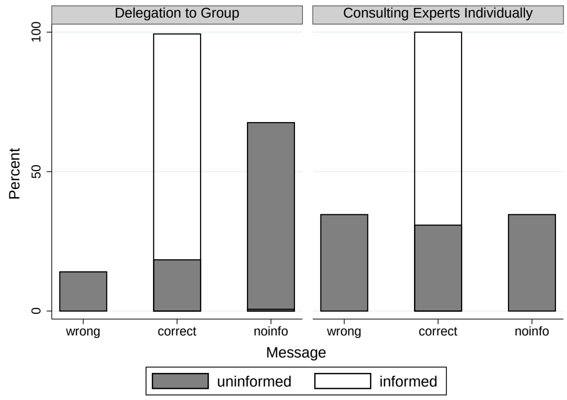
(a) $C = 0$, Group Decision Power



(b) $C = 0$, Principal Decision Power



(c) $C = 10$



(d) $C = 30$

Figure 2: Shares of Different Messages Submitted to Principal (CI) or other Expert (DG)

the median shares under CI and DG of honest messages of incompetent experts within matching groups over all treatments also shows a highly significant difference ($p < 0.01$).

Experimental Result 2 (Information Aggregation): *Hypothesis 2 is confirmed. The share of messages honestly revealing the lack of information is significantly higher under DG than under CI.*

Under DG, information aggregation does not only depend on the messages sent, but also on the votes cast. Our theory predicts that informed experts should always vote for the correct state; uninformed experts who receive a meaningful message from the other expert should follow this message; and uninformed experts who do not receive an informative message should vote randomly. These predictions describe the subjects behavior accurately with 99.6% correct informed votes, 95.5% of the uninformed votes following an informative message of the other, and uninformed votes of experts who also receive a 'no information' message turn out to be 56.3% for blue and 43.7 % for red.

Table 3: Honest Revelations of Ignorance

	Cost = 0, Gr. Dec.		Cost = 0, Prin. Dec.		Cost = 10		Cost = 30	
	(1)	(2)	(3)	(4)	(5)	(6)	(9)	(10)
Delegation	0.436***	0.448***	0.537***	0.536***	0.416***	0.429***	0.341***	0.325***
	(0.041)	(0.042)	(0.088)	(0.086)	(0.038)	(0.051)	(0.066)	(0.066)
Competent	0.115*	-0.024	-0.832***	-0.698***	-0.167	-0.109	-0.254***	-0.107**
	(0.055)	(0.021)	(0.037)	(0.039)	(0.123)	(0.071)	(0.036)	(0.031)
const.	0.450***		0.295***		0.368***		0.407***	
	(0.054)		(0.079)		(0.031)		(0.048)	
Obs.	512	512	496	496	571	571	740	740
Clusters	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG
Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES
R^2	0.211	0.5341	0.2944	0.525	0.182	0.556	0.159	0.463

Notes: OLS regressions of indicator variable that is equal to 1 if the *"I do not have information"* message is sent. Informed experts are not included in the regression. *Delegation* represents the coefficient of rounds where delegation is played and the message is sent to the other expert instead of to the principal. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5.2 Decision Accuracy

Figure 3 plots the share of correct decisions for each cost treatment and regime (DG or CI). As the theoretical predictions differ for different group compositions, the graphs also display the accuracy of decision in all possible group compositions separately. The markers in the graph represent our theoretical predictions.

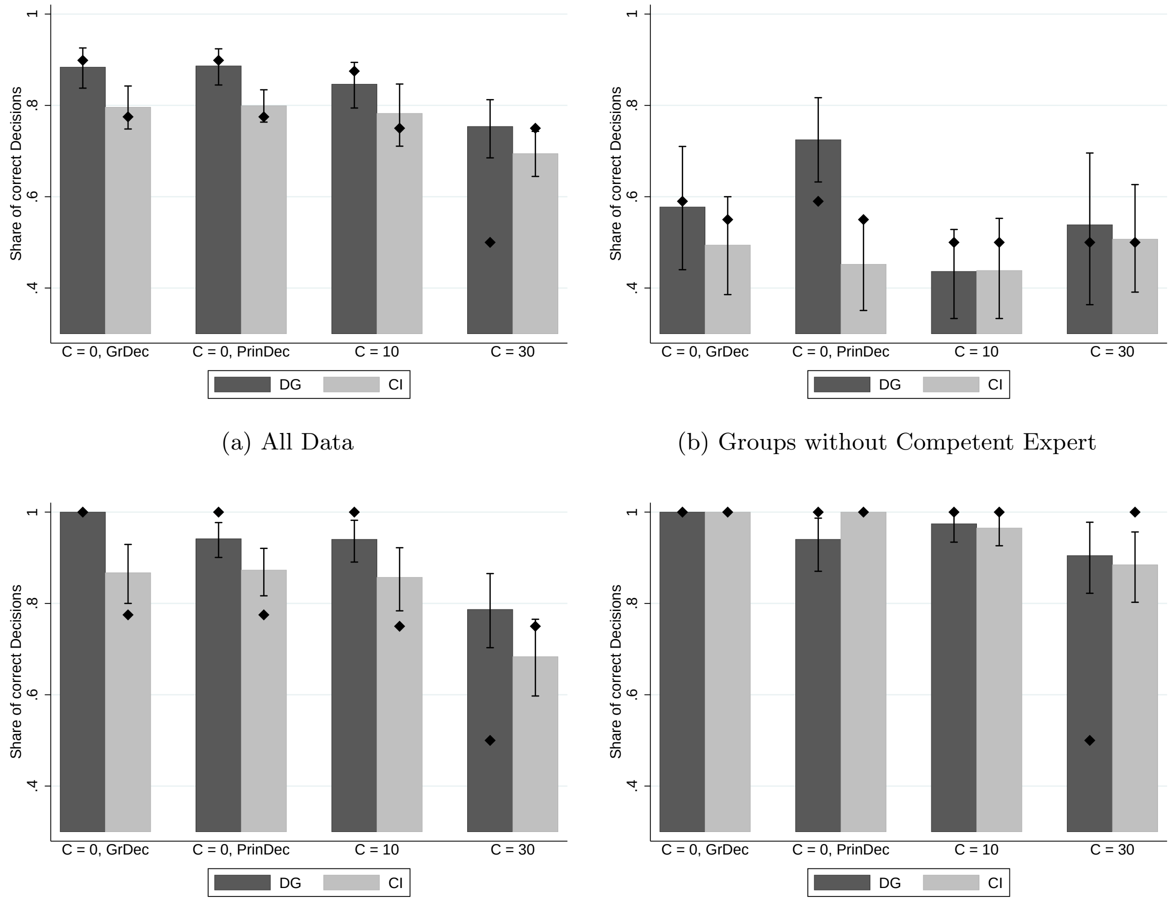
In the $C = 0$ treatments, without competent experts, as well as with one competent expert in a group, DG leads to a significantly higher median success rate than CI ($p = 0.02$ and $p < 0.01$). With two competent experts, CI leads to a weakly higher median success probability than DG ($p = 0.08$).[12] Weighting the outcomes of the group compositions with the respective probabilities of their occurrence, performing the Wilcoxon signed-rank test for the overall decision accuracy shows that DG significantly outperforms CI ($p < 0.01$).[13]

For the $C = 10$ treatment, we find no significant differences in the median shares of correct decisions between the regimes for rounds with two incompetent or two competent experts ($p = 0.89$ and $p = 0.93$), as predicted. We find a weakly significantly higher decision accuracy under DG than CI for rounds with one incompetent and one competent expert ($p = 0.09$). Weighting all accuracies under different group compositions with their probability of occurrence and performing the test reveals no significant difference between CI and DG ($p = 0.125$).

For the $C = 30$ treatment, our Wilcoxon signed-rank test between the accuracy rates in a matching group under the two regimes shows no significant difference in groups with no or with two competent experts ($p = 0.23$ and $p = 0.36$) and a weakly significantly higher decision accu-

[12]This result stems from principals who do not follow the group recommendation in the treatment where the principals keep the decision power (as can also be seen in Figure 3).

[13]We refer the reader to Table B3, in Appendix B, for parametric, regression-based tests of the equality of the means, which lead to qualitatively the same picture as the Wilcoxon signed-rank test results that we report in the text.



(a) All Data

(b) Groups without Competent Expert

(c) Groups with one Competent Expert

(d) Groups with two Competent Experts

Figure 3: Share of Correct Decisions under DG and CI in the Different Treatments

Notes: Markers depict theoretical PBE predictions. Whiskers represent 95% confidence intervals based on bootstrapped standard-errors (10000 repetitions) at the group level.

racy under DG than under CI in case of one competent expert in a group ($p = 0.08$). Weighting the decision accuracies in a matching group with the different group composition probabilities and performing the test shows that the accuracy rate under DG is, overall, significantly higher than under CI ($p = 0.011$).

Experimental Result 3 (Decision Accuracy): *DG leads to more correct decisions for the $C = 0$ and $C = 30$ treatments, while there is no significant difference in the $C = 10$ treatment. Hypothesis 3 is therefore only confirmed for the $C = 0$ treatment.*

5.3 Principals' Behavior

In the treatments where the principal has decision power under DG, she follows the suggestion of the committee in 98.5% of the cases. In the CI regimes, the principals follow one informative message in 97% of the cases, and two informative messages in 100% of the cases.

Table 4: Decision to Delegate

	(1)	(2)	(3)	(4)
Cost $= 0$	-0.0833	-0.0833	-0.126	-0.126*
	(0.0805)	(0.0845)	(0.0818)	(0.0681)
Cost $= 10$	0.0417	0.0417	0.0287	0.0348
	(0.113)	(0.111)	(0.108)	(0.0842)
Cost $= 0\times$	0.208	0.208*	0.204*	0.198**
Principal Power	(0.132)	(0.111)	(0.107)	(0.0934)
order: CI first		0.208**	0.178**	0.213***
		(0.0784)	(0.0766)	(0.0611)
Decision-Payoff			0.021***	0.020***
DG - CI			(0.004)	(0.004)
Evaluation-Payoff				0.013***
DG-CI				(0.003)
constant	0.3333	0.2292	0.1882	0.2781
	(0.0698)	(0.0591)	(0.108)	(0.0544)
Observations	96	96	96	96
N clusters	32	32	32	32
R^2	0.0247	0.0721	0.216	0.305

Notes: OLS regression with the decision to delegate (have the experts form an advisory board in the extra treatment) in Period 21, with standard-errors clustered at the matching-group level. Decision- and Evaluation-Payoff denote the principals' payoff difference in experimental points between DG and CI of the first 20 rounds, divided by the number of rounds per regime (10). All other variables are treatment dummies.
***(**/*) Significant at the 1 (5/10) percent level.

Preferences over Regimes In the 21^{st} round, each principal determines which regime is played in the remaining three rounds. 25% (37%, 33%) of the principals choose DG in the treatment with 0 (10, 30) cost of information when delegation comes with the loss of the decision right. In the treatment in which the decision power stays with the principal, a majority of 54% of the principals still choose CI. These decisions might be driven by different experiences of the principal with respect to different payoffs between the regimes, which might result from the randomly determined group compositions. Table 4 reports results from an OLS regression where we control for this. Furthermore, we control for the order of regimes, and the evaluation payoff difference. These regressions reveal that keeping the decision right (weakly) significantly increases the number of delegation decisions.[14] Other significant predictors for choosing DG with a higher probability are starting with CI and playing DG afterwards, and more positive experiences with DG than with CI in the first 20 rounds.

[14]A Wilcoxon rank-sum test shows no significant difference between the two $C = 0$ treatments in the share of Delegation decisions within a matching group ($p = 0.17$).

Experimental Result 4 (Delegation Decisions): *Hypothesis 4 can only be partly confirmed. More expert groups are formed when the principals keep the decision right but the number of delegation decisions is (statistically insignificantly) greater with $C = 30$ than with $C = 0$, while we predicted the opposite.*

The share of principals who chose CI in the extra treatment is still quite high, at 54%. The most prominent explanation for too few delegation choices – an intrinsic utility of having the right to decide – can therefore only offer a partial explanation of our findings.

5.4 Observers' Evaluations

Figure 4 plots the distribution of evaluations. The theoretical PBE prediction as well as the optimal (best response) evaluation given experts' actual behavior is plotted as vertical, dashed lines.

The distribution of evaluations between correct and incorrect messages is significantly different throughout all three CI treatments (Kolmogorov-Smirnov tests, $p < 0.01$). The difference between evaluations after a 'no information' message and a wrong message is significantly different for the no-cost and the $C = 10$ treatment (Kolmogorov-Smirnov test, $p < 0.01$) but insignificant in the $C = 30$ treatment (Kolmogorov-Smirnov test, $p = 0.14$). In the DG treatments, the difference between the distribution of evaluations following a wrong and a correct group-decision (group-message) is significant for all three treatments (Kolmogorov-Smirnov tests, $p < 0.01$).

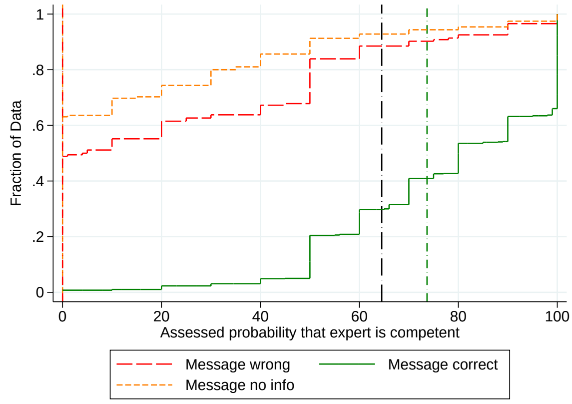
We see that the correctness of an individual advice or a group decision has a substantial effect on the average observer's evaluation, which provides the incentives for information acquisitions.

5.5 Potential Reasons for Deviations from Hypothesized Behavior

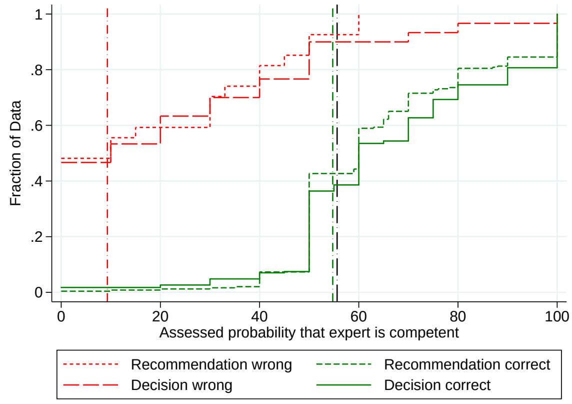
Our analysis has revealed a couple of deviations from our theoretical predictions; the over-acquisition of signals by competent experts in the $C = 30$ treatment under DG and the under-delegation of principals are the most striking. In the following, we shed some light on potential reasons for these deviations. For this purpose, we first analyze how far the observed information acquisitions might be a best response to the incentives that result from the behavior of other subjects, which might differ from the incentives in the theoretically predicted equilibrium. Second, we will look at changes in behavior over time, which might hint at learning. Finally, we will present the reasons subjects themselves gave for information acquisition and delegation in the post-experimental questionnaire.

5.5.1 Best Responses to the Behavior of other Subjects

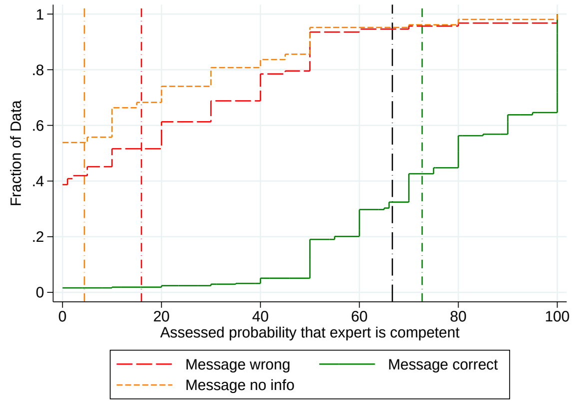
As neither principals nor experts behaved perfectly in line with equilibrium predictions, we check next to what extent the acquiring behavior of the experts is a best response to the actual



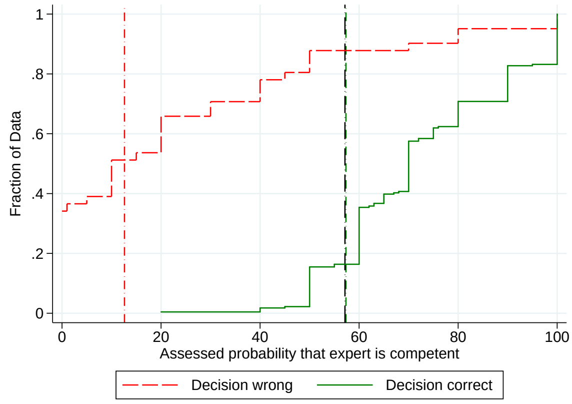
(a) CI, $C = 0$



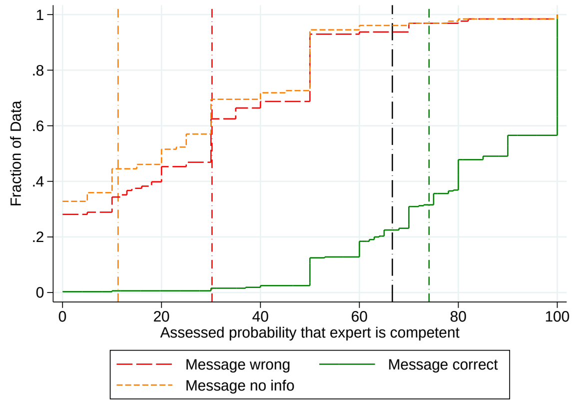
(b) DG, $C = 0$



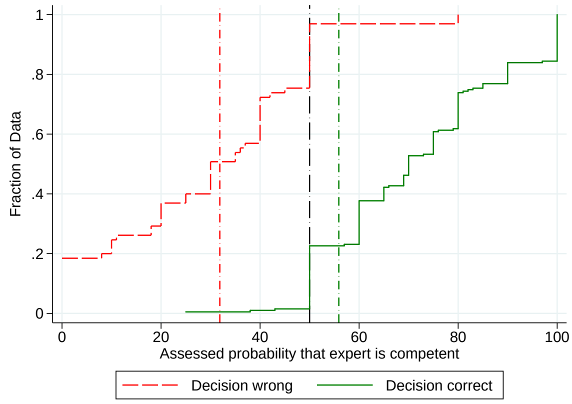
(c) CI, $C = 10$



(d) DG, $C = 10$



(e) CI, $C = 30$



(f) DG, $C = 30$

Figure 4: CDF of Observers' Evaluations

Notes: Vertical dashed lines correspond to the empirical best response evaluation. The black long-dashed vertical line depicts the theoretical prediction after a correct message (CI) or decision (DG).

evaluations of the observers. Taken the (average) evaluation of observers for each case as given, we calculate whether it is optimal to acquire information for the different types.

Consulting the Experts Individually In the $C = 0$ treatment, the difference of the average assessment regarding being competent between sending a correct message and an incorrect message equals $77.76 - 24.90 = 52.86$ percentage points. As there are no costs, it is always optimal to acquire information. Incompetent experts can expect to submit a correct message with probability 0.55 if they acquire information, and with probability 0.5 if they do not. The (net) benefit of drawing a signal is $(0.55-0.5)\cdot 77.76+(0.45-0.5)\cdot 24.90 = 2.64$. For competent experts there is no uncertainty if they acquire information, and the (net) benefit of drawing a signal is therefore $\frac{1}{2}\cdot(77.76 - 24.90) = 26.43$.

Repeating this exercise for the $C = 10$ treatment leads to a benefit of $0.05 \cdot (77.10 - 21.87) = 2.76 < C = 10$ for the incompetent experts, which is smaller than the costs of 10, and $\frac{1}{2}\cdot(77.10- 21.87) = 27.62 > C = 10$ for the competent experts. In the $C = 30$ treatment, the evaluation behavior of the principals leads to a benefit of $0.05 \cdot (82.19 - 27.47) = 2.74 < C = 30$ for the incompetent experts and $\frac{1}{2} \cdot (82.19 - 27.47) = 27.36 < C = 30$ for the competent experts.

In the $C = 30$ treatment with high costs, it is thus not optimal for competent experts to acquire information, which is against our predictions and might explain why the relative frequency of acquisitions is, indeed, lower than the theoretical prediction of 100%. However, at 70% it is also much higher than the best response would have been in the experiment (0%). Nevertheless, the incentive not to acquire a signal is weak.

Delegation to the Group To calculate the value of receiving a signal under DG, we have to take into account the probability of being matched with a competent expert, 0.5, as well as the average acquiring probabilities of these experts.[15] In the $C = 0$ treatment, the (net) benefit of receiving a signal – that is, the expected increase in evaluation – for an incompetent (competent) expert is 1.03 (10.33).

In the $C = 10$ treatment, the benefit of drawing a signal for incompetent experts is $1.35 < C = 10$, and $13.54 > C = 10$ for competent experts, which shows that it is indeed optimal to acquire information for competent experts only, as predicted. For the $C = 30$ treatment, the benefit of receiving a signal is $1.47 < C = 30$ for incompetent experts, and $14.68 < C = 30$ for competent experts. This shows, that the competent experts under DG in the $C = 30$ treatment could have increased their expected payoff substantially by not acquiring a signal, which is also what our theory predicts.

5.5.2 Learning

Given the more or less costly deviations from best-response behavior that we observe in the data, we next analyze if subjects adapt their behavior over time. For this purpose, we split

[15] The share of informed experts that submit the correct message exceeds 99%, and 99.6% of the informed experts also vote for the correct state irrespective of the other's message.

our observational sample of periods 1–20 into two groups per regime: the first five rounds of a regime and the last five.[16] In all cases we compare the relative frequency of choices within a matching group in the two halves with a Wilcoxon signed-rank test.

First, we note that the accuracy of the observers' evaluations does not increase over time. Their payoffs for the accuracy of their stated beliefs do not significantly differ between the first five rounds and the subsequent five rounds, either under CI, or under DG.[17]

Next, we turn to information acquisition. In the $C = 30$ we saw that many competent experts do not play a best response under CI and buy information even if it does not pay off to do so. The relative frequency of information acquisitions is 76% in the first half of the CI rounds and decreases to 67% in the second half of the CI rounds. However, we do not find a statistically significant difference between the distributions ($p = 0.26$).[18] Under DG, where we also observed an over-acquisition of information of competent experts, the acquisition rate again declines over time, but again not statistically significantly so: 69% in the first half of the periods and 55% in the second half.[19]

With respect to the information aggregation, we saw that the share of uninformed experts who honestly reveal their ignorance under DG is 78%. As theory predicts every uninformed expert will send the 'no information' message, we now check whether this share increases over time. Comparing again the first five rounds to the subsequent five rounds under DG, no significant difference is detected: 78% vs. 79% ($p = 0.58$). Under CI, where theory predicts that no uninformed expert would honestly reveal their ignorance to the principal, 36% of their messages are the honest 'no information' message. This high share might result from either a preference for honesty or from not understanding the incentive to lie properly. While 44% of the messages are honest revelations of ignorance in the first five rounds, this number decreases to 30% in the subsequent five rounds and our test indicates a statistically significant difference ($p < 0.01$). This finding suggests that at least some experts adapt their behavior over time in the direction of best-response behavior.

5.5.3 Self-Stated Reasons

After the experiment, the subjects were asked to fill out a non-incentivized questionnaire with questions investigating socio-demographics and open questions about the underlying behavior of the game. The answers to two open questions can potentially give some hints for the reasoning behind the observed over-acquisition of information and the under-delegation of decisions.

[16] As the regime played in round 21–23 is endogenously determined and therefore not played by every subject, we exclude these last three rounds in the analysis of behavior over time.

[17] The Wilcoxon signed-rank test between the average evaluation payoff within the matching groups remains insignificant between the two halves under CI ($p = 0.81$) and DG ($p = 0.36$).

[18] Repeating the Wilcoxon signed-rank test on subject level instead of matching group level also shows an insignificant difference ($p = 0.12$).

[19] $p = 0.11$ for comparison of shares within a matching group, and $p = 0.18$ for comparisons on the subject level.

Stated Reasons for Information Acquisition Subjects who played the role of an expert were asked *'What influenced your decision to draw a ball?'* and could answer in their own words. We categorized the answers to check how many experts mentioned the difference between being competent or incompetent (category 'Competence'), and how many answers relate to playing under CI or DG (category 'Regime').[20] Table 5 gives an overview of the categorized answers. While 88% (87%) of the given answers in the $C = 10$ ($C = 30$) treatment mention the competence in their answer, only 9% (3%) of the answers mention the regime they were in. These answers suggest that the free-riding incentive under DG is not very salient, which might to some extent explain the over-acquisition of information in the $C = 30$ treatment.

Table 5: Self-Reported Reasons for Information Acquisition

	Cost = 0	Cost = 10	Cost = 30
Always Draw	60	0	0
Costs	0	5	4
Competence	16	38	33
Regime	2	4	1
Other	9	4	4
Num. of Answers	84	43	38
Num. of Subjects	96	48	48

Notes: Categorization of answers to question: 'What influenced your decision to draw a ball?'. Answers can fall into multiple categories.

Stated Reasons for (not) Delegating More than half of the principals in every treatment choose CI. One of the post-experimental questions for the principals read *'What influenced your decision about the regime (at the beginning of part 3)?'*, and subjects could answer it in free form. The range of different answers was broad, but some categories stand out. Table 6 gives an overview. Having the right to decide or not having another party interfere is often mentioned by principals choosing CI (category 'Decision Power & Interference of Others'); the exception is our extra treatment, in which they always keep the decision power anyway. Reassuringly, from a theoretical point of view, the second most often chosen category is 'Higher Payoff'. Other stated reasons are greater entertainment/ fun during the experiment (category 'Fun'), and curiosity about the expert's messages (category 'Curiosity'). Some principals also stated the easier evaluation in their role as observer (category 'Evaluation'), although we made it very clear in the instructions and on the screen that the decision counts for the individual's own group only, while the observation is done for a different group. Four principals in our extra treatment reported seeing more signals to be superior to seeing only one signal (category 'More Signals Better') without further explanation.

[20] Further categories are 'Always Draw', which is a frequent answer in the $C = 0$ treatments, and 'Costs'. Other answers are subsumed under the category 'Other'.

Table 6: Self-Reported Reasons for Choice of DG/CI

	Choice: CI				Choice: DG			
	Gr. Dec.	Prin. Dec.			Gr. Dec.	Prin. Dec.		
	C=0	C=0	C=10	C=30	C=0	C=0	C=10	C=30
Decision Power & Interference of Others	10	1	6	9	1	-	-	-
Fun	1	1	1	2	-	1	-	-
Higher Payoff	3	2	3	2	1	5	6	1
Evaluation	2	2	1	-	1	1	-	-
Curiosity	1	2	1	-	-	2	-	-
More Signals Better	-	4	-	-	-	-	-	-
Other	-	1	1	2	3	1	2	3
Num. of Answers	15	12	12	15	5	10	8	4
Num. of Subjects	18	13	15	16	6	11	9	8

Notes: Categorization of answers to question: 'What influenced your decision about the regime?'. Every subject can give up to one answer, but answers can fall into multiple categories.

6 Discussion and Conclusion

Our investigation of delegation of decision-making to a group brings together two strands of literature – the delegation and the committee decision-making literatures – and points to a number of aspects that arise in this novel setting. Our theoretical analysis highlights an important trade-off between information acquisition and information aggregation, which depends on the cost of information. The key results in this respect is Proposition 1, which states that there always exists (1) a low cost range in which delegation of decision-making to the group of experts leads to better results than consulting the experts individually, (2) a middle cost range in which consulting individually outperforms delegation, and (3) a cost threshold above which both regimes lead to the same outcome. Confirming theoretical predictions, we find in the laboratory that information aggregation works better under delegation, whereas more information is acquired in case experts are consulted individually when the cost of information is sufficiently high. However, our experimental results also deviate from the models' predictions in some respects.

First of all, we find that under delegation and high costs of information the positive effect of better information aggregation still outweighs the negative effect of lower information acquisition. The main reason for this is that more experts buy information than predicted. Our analysis in Section 5.5 reveals that this is quite costly for the experts and clearly not a best response to the behavior of the other subjects. Over-acquisition of information has also been observed in a number of other studies, suggesting that subjects might in fact have a positive willingness to pay for information even if it has low instrumental value (e.g., Großer and Seebauer, 2016, 2017; Bhattacharya et al., 2017). The answers that subjects gave in our post-experimental questionnaire (Table 5) suggest that many subjects did not take the regime, and thus a potential free-riding incentive under delegation, into account but only focused on their own competence level and the cost of information.

The second important deviation from our theoretical predictions is the low number of decisions to delegate, by the principals. This might have been expected given similar findings from experiments on delegation to a single agent (e.g., Fehr et al., 2013; Bartling et al., 2014). To dig deeper, we designed an extra treatment, in which the decision right is not transferred to the experts but the principal can decide to either consult them individually or to have them form an advisory board. While fewer principals choose to consult individually in the new treatment, which is consistent with the idea that they value the decision right *per se* (Bartling et al., 2014), more than half of them still prefer to do so, thereby forgoing the benefit of improved information aggregation and more accurate decisions. While the answers to our post-experimental questionnaire (Table 6) quite clearly show that keeping the decision power or avoiding interference from others is an important reason to choose to consult individually in our main treatments, they are less clear about the reasons in our extra treatment. Half of the principals who chose to consult individually there, stated that seeing more signals was better or gave curiosity as a reason.

Despite these deviations from our theoretical predictions, we see important differences in experts' behavior and the resulting decision accuracies between the two regimes. Hence, the choice whether or not to delegate decisions to groups of experts appears to be important for organizational success and thus deserves more attention. Future studies could shed more light on this: for example, by studying different scenarios with respect to the nature of the friction between the principals' and the agents' objectives. They could also seek new insights into the reasons behind, and the consequences of, the apparently very robust reluctance of principals to delegate decisions, and the tendency of experts to overinvest in information – both of which have now been observed in a number of different experimental settings.

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A Theoretical Appendix

To prove proposition 1, we construct the most informative equilibria for CI and DG. These are the equilibria in which the final decision is based on the greatest amount of information possible. It is easy to see that it can never be optimal to buy information and then not communicate it, neither under CI nor under DG (where the experts are in a common value situation after the information acquisition stage and truthful communication is possible in equilibrium). Hence, under DG the most-informative equilibria will be the equilibria in which the greatest amount of information is acquired. Under CI, this is also true but the result is less obvious as the acquired and communicated information of informed experts can be diluted by random messages of uninformed experts trying to mimic informed experts. As long as there can be informed experts in equilibrium (that is, when C is not too high), these will more likely be the competent experts and the incentive to mimic cannot be avoided. However, the principal's decision will still be based on more information than in an equilibrium without any information acquisition, and the amount of information that is available to the principal will increase in the number of acquisitions. In the following, we can therefore focus on the equilibria in which most information is acquired. Under DG, the information acquisition stage is followed by truthful communication, and a group decision for the decision that is more likely to match the state of the world or a 50-50 random decision in case the committee is uninformed. Under CI, the information acquisition stage is followed by truthful communication of informed experts and 50-50 random messages $M_j \in \{A, B\}$ of uninformed experts, and a principal's decision for the decision recommended by the majority of messages, or a random decision in case of a tie.[21]

A.1 Most-Informative Equilibria under CI

The first-most-informative equilibrium occurs in the cost range in which both types of experts acquire information with certainty.

CI all buy equilibrium $(\hat{\pi}_i, \hat{\pi}_c) = (1, 1)$**:** If every informed expert i sends $M_i = S$, and uninformed experts u send $M_u = S$ and $M_u \neq S$ with equal probability, it is optimal for the principal to take the decision recommended by the most messages. In case the messages contradict each other and there is a tie, the principal is indifferent between the options and cannot do better than choosing $D \in \{A, B\}$ randomly. As ties can only occur in case of an even number of experts n, the *ex ante* probability of $D = S$ differs for even and uneven number of experts. In the equilibrium where both types of experts acquire information with certainty, the resulting (expected) decision accuracy is:

[21] The 50-50 mixing probabilities of uninformed experts stem from the fact that any other mixing probability would lead to a lower expected posterior belief of the principal (regarding the expert's competence) following the decision that is chosen with higher probability. Hence, any expert could benefit from deviating by voting for the other option. Only when either the individual decision which message to send (under CI) or the group decision (under DG) is made with equal probability no such profitable deviation exists. An uninformed principal can, of course, decide randomly with arbitrary probabilities.

$Pr(D = S|\pi_i = \pi_c = 1, CI) =$

$$\begin{cases} \sum_{k=0}^{n} \binom{n}{k} \lambda^{n-k}(1-\lambda)^k (\sum_{i=0}^{k} \binom{k}{k-i} p^{k-i}(1-p)^i (\frac{\sum_{j=0}^{\frac{n}{2}-1} \binom{i}{i-j} + \frac{1}{2}\binom{i}{i-\frac{n}{2}}}{2^i})) & \text{for } n \text{ even} \\ \sum_{k=0}^{n} \binom{n}{k} \lambda^{n-k}(1-\lambda)^k (\sum_{i=0}^{k} \binom{k}{k-i} p^{k-i}(1-p)^i (\frac{\sum_{j=0}^{\frac{n-1}{2}} \binom{i}{i-j}}{2^i})) & \text{for } n \text{ odd.} \end{cases} \tag{A.1}$$

The posterior probabilitiy of competence depends on the message and the true state, but not on the other experts' behavior. Expecting uninformed experts to randomly submit $M \in \{A, B\}$, the probability is $Pr(t = c|M = S) = \frac{2\lambda}{1+\lambda+p-\lambda p}$ and $Pr(t = c|M \neq S) = 0$. Incompetent experts acquire information as long as the expected utility from doing so exceeds that from not buying and still sending the correct message with probability 0.5. Hence, information is acquired as long as $\frac{1}{2}(p + 1)Pr(t = c|M = S) - C \geq \frac{1}{2}Pr(t = c|M = S)$. Solving for C results in

$$C \leq \frac{p\lambda}{1 + \lambda + p(1 - \lambda)}. \tag{A.2}$$

In case C is lower than this threshold, there is a perfect Bayesian equilibrium in which both types of experts acquire information with certainty. For $C > \frac{p\lambda}{1+\lambda+p(1-\lambda)}$, however, the equilibrium cannot be maintained, as incompetent experts would benefit from deviating and not buying.[22]

The second-most-informative equilibrium is the equilibrium in which competent experts acquire information with certainty, and incompetent experts mix their acquisition choices by acquiring information with a positive probability.

CI mixed strategy equilibrium $(\hat{\pi_i}, \hat{\pi_c}) = (\pi_i^{MSE,CI}, 1)$**:** The equilibrium behavior of informed experts i is again to send $M_i = S$, of uninformed experts u to randomly send $M_u \in \{A, B\}$, and of principals to take the decision that equals the highest number of messages (or take a random decision in case of a tie). The resulting success probability are: $Pr(D = S|\pi_i = \pi_i, \pi_c = 1, CI) = \sum_{k=0}^{n} \binom{n}{k} \lambda^{n-k}(1-\lambda)^k (\sum_{i=0}^{k} \binom{k}{k-i} \pi^{k-i}(1-\pi)^i (\sum_{j=0}^{k-i} \binom{k-i}{k-i-j} p^{k-j}(1-p)^j (\frac{\sum_{t=0}^{\frac{n}{2}-1} \binom{j}{j-t} + \frac{1}{2}\binom{j}{j-\frac{n}{2}}}{2^j})))$ for n even, and $Pr(D = S|\pi_i = \pi_i^{MSE,CI}, \pi_c = 1, CI) = \sum_{k=0}^{n} \binom{n}{k} \lambda^{n-k}(1-\lambda)^k (\sum_{i=0}^{k} \binom{k}{k-i} \pi^{k-i}(1-\pi)^i (\sum_{j=0}^{k-i} \binom{k-i}{k-i-j} p^{k-j}(1-p)^j (\frac{\sum_{t=0}^{\frac{n-1}{2}} \binom{j}{j-t}}{2^j})))$ for n odd. To calculate the equilibrium acquisition probability of the incompetent experts $\pi_i^{MSE,CI}$, we again have to analyze the Bayesian updating of the principal. Knowing the dominant strategies and the equilibrium acquisition probabilities, the ex post probability to observe a competent expert is $Pr(t = c|M = S) = \frac{2\lambda}{1+\lambda+p\pi-\lambda p\pi}$ and $Pr(t = c|M \neq S) = 0$. Given this belief updating, incompetent experts are indifferent between acquiring or not if $\pi_i^{MSE,CI}(C, \lambda, p) = \frac{C+C\lambda-\lambda p}{Cp(\lambda-1)}$. Since, $0 \overset{!}{<} \pi_i^{MSE,CI} \overset{!}{<} 1$ the described mixed-strategy equilibrium exists if $\frac{p\lambda}{1+\lambda+p(1-\lambda)} < C < \frac{p\lambda}{1+\lambda}$. For costs exceeding this threshold, there can be no equilibrium where incompetent experts acquire information with a positive probability.

[22] Note that the competent experts' best response follow immediately from that of the incompetent experts in this case, as the competent experts face the same information acquisition costs as the incompetent but benefit more from it (as $p < 1$ by assumption). Thus, if it is optimal for the incompetent experts to acquire a signal, competent experts will do the same.

The third-most-informative equilibrium is an equilibrium in pure strategies, where competent experts acquire information with certainty, while incompetent experts do not acquire information.

CI competent experts buy equilibrium $(\hat{\pi_i}, \hat{\pi_c}) = (0, 1)$**:** Following the same logic as in the previous cases, the expected decision accuracy is:

$$Pr(D = S|\pi_i = 0, \pi_c = 1, CI) = \begin{cases} \sum_{k=0}^{n} \binom{n}{k} \lambda^{n-k}(1-\lambda)^k \frac{\sum_{i=0}^{\frac{n}{2}-1} \binom{k}{k-i} + \frac{1}{2}\binom{k}{k-\frac{n}{2}}}{2^k} & \text{for } n \text{ even} \\ \sum_{k=0}^{n} \binom{n}{k} \lambda^{n-k}(1-\lambda)^k \frac{\sum_{i=0}^{\frac{n-1}{2}} \binom{k}{k-i}}{2^k} & \text{for } n \text{ odd.} \end{cases} \tag{A.3}$$

The principal updates her beliefs as follows: $Pr(t = c|M = S) = \frac{2\lambda}{\lambda+1}$ and $Pr(t = c|M \neq S) = 0$. For competent experts information acquisition is a best response as long as:

$$C \leq \frac{\lambda}{\lambda + 1} =: C'''. \tag{A.4}$$

For cost levels above C''', the decision accuracy will necessarily equal the prior probability of 50% and the posterior probability of competence will equal the prior probability of λ.[23]

A.2 Most-Informative Equilibria under DG

The first-most-informative equilibrium occurs in the cost range in which both types of experts acquire information with certainty.

DG all buy equilibrium $(\hat{\pi_i}, \hat{\pi_c}) = (1, 1)$**:** Without truthful communication in the group, having one informed expert in a group is enough to arrive at a correct decision with certainty. Thus the resulting expected decision accuracy is:

$$Pr(D = S|\pi_i = \pi_c = 1, DG) = 1 - \frac{1}{2}(1-\lambda)^n(1-p)^n. \tag{A.5}$$

The principal updates her beliefs about the competence of every expert in the group as follows: $Pr(t = c|D = S) = \frac{\lambda}{1-\frac{1}{2}(1-\lambda)^n(1-p)^n}$ and $Pr(t = c|D \neq S) = 0$. Incompetent experts acquire information as long as the expected utility from doing so exceeds that from not buying. As the utility of information does not depend on the identity of the expert who paid the costs for it, $EU_i(buy) = Pr(t = c|D = S)(1 - \frac{1}{2}(1-\lambda)^{n-1}(1-p)^n) - C$ and $EU_i(not\ buy) = Pr(t = c|D = S)(1 - \frac{1}{2}(1-\lambda)^{n-1}(1-p)^{n-1})$. Plugging in $Pr(t = c|D = S)$ and rearranging for C yields the following condition:

$$C \leq \frac{\lambda p(1-\lambda)^{n-1}(1-p)^{n-1}}{2 - (1-\lambda)^n(1-p)^n} =: C'(n, \lambda, p). \tag{A.6}$$

[23] A mixed-strategy equilibrium where incompetent experts do not acquire information and competent experts do so with positive probability (which is increasing in C) cannot exist above the same threshold C''' for which competent experts stop acquiring information. Such an equilibrium, however, can never be more informative than the one where at least competent experts acquire information with certainty.

For costs exceeding $C'(n, \lambda, p)$, there cannot be an equilibrium where incompetent experts acquire information with certainty.

The second-most-informative equilibrium occurs in the cost range where competent experts acquire information with certainty, and incompetent experts play a mixed strategy in their acquisition behavior.

DG mixed strategy equilibrium $(\hat{\pi_i}, \hat{\pi_c}) = (\pi_i, 1)$**:** If an incompetent expert acquires information with probability π_i, the decision accuracy is given by $Pr(D = S|\pi_i = \pi, \pi_c = 1, DG) = 1 - \frac{1}{2}(1-\lambda)^n(1-\pi p)^n$. Principals update their beliefs about the competence as follows: $Pr(t = c|D = S) = \frac{\lambda}{1-\frac{1}{2}(1-\lambda)^n(1-\pi p)^n}$ and $Pr(t = c|D \neq S) = 0$. The equilibrium acquiring probability is decreasing in C and becomes zero when $C = \frac{p\lambda(1-\lambda)^n}{((1-\lambda)^n-2)(\lambda-1)}$. For costs exceeding this threshold, there cannot be an equilibrium where incompetent experts acquire information with positive probability.

The third-most-informative equilibrium occurs in the cost range where all competent experts acquire information, but incompetent experts do not.

DG competent experts buy equilibrium $(\hat{\pi_i}, \hat{\pi_c}) = (0, 1)$**:** The expected decision accuracy is: $Pr(D = S|\pi_i = 0, \pi_c = 1, DG) = 1 - \frac{1}{2}(1-\lambda)^n$. The posterior probability of an individual group member being competent is: $Pr(t = c|D = S) = \frac{\lambda}{1-\frac{1}{2}(1-\lambda)^n}$ and $Pr(t = c|D \neq S) = 0$. Competent experts acquire information as long as the expected utility from doing so exceeds that from not buying.For the competent experts, which is the case as long as:

$$C \leq \frac{\lambda(1-\lambda)^{n-1}}{2-(1-\lambda)^n} =: C''. \tag{A.7}$$

For $C > C''$, there is no equilibrium where any expert acquires information. Hence, the decision accuracy will equal the prior probability of 50% and the posterior probability of competence will equal the prior probability of λ.

A.3 Proof of Proposition 1

After characterizing the most informative equilibrium for the whole range of C under CI (Section A.1) and DG (Section A.2), we are now ready to prove Proposition 1.

Proposition 1

For all numbers of experts $n \geq 2$, all prior probabilities of competence $\lambda \in (0, 1)$ and all levels of incompetence $p \in (0, 1)$, there always exist cost levels $C'(n, \lambda, p) < C''(n, \lambda, p) < C'''(n, \lambda, p)$, such that

1. *delegation to the group of experts leads to a higher decision accuracy than consulting the experts individually if $C \leq C'$,*
2. *consulting the experts individually leads to a higher decision accuracy than delegation to the group of experts if $C'' < C \leq C'''$,*

3. *and both regimes lead to the same decision accuracy if* $C''' < C$.

Proof. **(1) DG outperforming CI if $C \leq C'$:** In the most informative equilibrium for low level of costs, both types of experts acquire information under CI as well as under DG. Equations A.1 and A.5 represent the decision accuracies for this type of equilibrium under CI and DG respectively. For all $n \geq 2$ and any λ and p, $Pr(D = S|\pi_i = \pi_c = 1, CI) < Pr(D = S|\pi_i = \pi_c = 1, DG)$. Further, equation A.6 represents the threshold costs C' up to which this equilibrium exists under DG. As $C' > 0$ for all $0 < \lambda < 1$, $0 < p < 1$ this equilibrium always exists. Thus, for $C \leq C'$, DG always leads to a higher decision accuracy than CI.

(2) CI outperforming DG if $C'' \leq C'''$: Equations A.4 and A.7 represent the cost thresholds up to where information is acquired in the most informative equilibrium. As the threshold under DG, $C'' = \frac{\lambda(1-\lambda)^{n-1}}{2-(1-\lambda)^n}$, is strictly lower than the threshold under CI, $C''' = \frac{\lambda}{\lambda+1}$, for all $\lambda < 1$ and $n \geq 2$, there always is a range of costs where information is acquired under CI but not under DG. The decision accuracy of the CI equilibrium where competent experts acquire information is shown in equation A.3, and we see that $Pr(D = S|\pi_i = 0, \pi_c = 1, CI) > 0.5 = Pr(D = S|\pi_i = \pi_c = 0, DG)$ for all $n \geq 2$ and $0 < \lambda < 1$. Thus, for $C'' \leq C'''$, CI always leads to a higher decision accuracy than DG.

(3) Both regimes lead to the same decision accuracy if $C > C'''$: Above C''', no expert will buy a signal under either regime. Hence, the decision accuracy will be $\frac{1}{2}$ under either regime. □

B Further Experimental Results

Table B1: Information Acquisition, Incompetent Experts

	Cost = 0, Gr. Dec.		Cost = 0, Prin. Dec.		Cost = 10		Cost = 30	
	(1)	(2)	(3)	(4)	(5)	(6)	(9)	(10)
Delegation	-0.026	-0.039	-0.043	-0.048	-0.092**	-0.076**	-0.017	-0.015
	(0.037)	(0.029)	(0.037)	(0.040)	(0.033)	(0.032)	(0.018)	(0.017)
const.	0.913***		0.930***		0.165***		0.028*	
	(0.034)		(0.032)		(0.041)		(0.012)	
Obs.	571	571	547	547	516	516	547	547
Clusters	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG
Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES
(Adj.) R^2	0.002	0.507	0.006	0.608	0.020	0.449	0.004	0.114

Notes: OLS regressions of expert's buying decisions. *Delegation* represents the coefficient of rounds where delegation is played. Only decisions of incompetent experts are included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B2: Information Acquisition, Competent Experts

	Cost = 0, Gr. Dec.		Cost = 0, Prin. Dec.		Cost = 10		Cost = 30	
	(1)	(2)	(3)	(4)	(5)	(6)	(9)	(10)
Delegation	-0.004	-0.004	-0.004	-0.006	-0.020	-0.040	-0.103**	-0.084*
	(0.004)	(0.004)	(0.004)	(0.007)	(0.042)	(0.043)	(0.040)	(0.044)
const.	1***		1***		0.906***		0.698***	
	(0)		(0)		(0.028)		(0.080)	
Obs.	533	533	557	557	588	588	557	557
Clusters	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG
Fixed Effects	NO	YES	NO	YES	NO	YES	NO	YES
(Adj.) R^2	0.002	0.078	0.002	0.103	0.001	0.549	0.012	0.586

Notes: OLS regressions of expert's buying decisions. *Delegation* represents the coefficient of rounds where delegation is played. Only decisions of competent experts are included. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table B3: Decision Accuracy

	Cost = 0, Gr. Dec.		Cost = 0, Prin. Dec.		Cost = 10		Cost = 30	
	(1)	(2)	(3)	(4)	(5)	(6)	(9)	(10)
Delegation	0.088**		0.087***		0.064*		0.059***	
	(0.043)		(0.019)		(0.032)		(0.020)	
0 comp. Exp.		0.494***		0.452***		0.438***		0.507***
		(0.042)		(0.052)		(0.048)		(0.068)
1 comp. Exp.		0.867***		0.873***		0.857***		0.683***
		(0.032)		(0.028)		(0.022)		(0.051)
2 comp. Exp.		1		1		0.965***		0.885***
		(.)		(.)		(0.022)		(0.044)
0 comp. Exp.$\times$*DG*		0.083		0.273***		-0.002		0.031
		(0.108)		(0.055)		(0.075)		(0.079)
1 comp. Exp.$\times$*DG*		0.133***		0.069**		0.083**		0.103*
		(0.032)		(0.029)		(0.033)		(0.056)
2 comp. Exp.$\times$*DG*		0		-0.060*		0.009		0.020
		(.)		(0.036)		(0.027)		(0.029)
const.	0.796***		0.799***		0.782***		0.694***	
	(0.026)		(0.022)		(0.012)		(0.029)	
Obs.	552	552	552	552	552	552	552	552
Clusters	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG	8 MG
(Adj.) R^2	0.012	0.883	0.0143	0.876	0.005	0.867	0.003	0.746

Notes: OLS regressions of decision accuracy. *Delegation* (*DG*) represents the coefficient of rounds where delegation is played. Standard errors clustered at the matching group level and bootstrapped with 10000 repetitions. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

C Decision Screens

Translations of the German texts (from top to bottom of each screen) are provided in the figure notes.

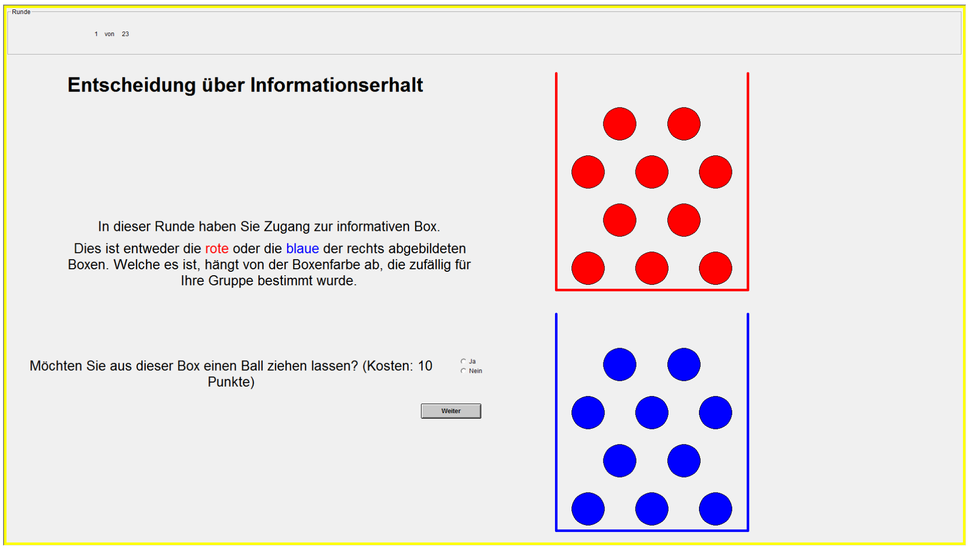


Figure C1: Decision Screen. $C = 10$, CI and DG, Competent Expert.

Notes: "Decision on information receipt. In this round you have access to the informative box. That's either the red or the blue box shown on the right. Which one it is depends on the boxcolor, that has randomly been determined for your group. Do you want to draw a ball out of this box? (Cost: 10 Points). Yes/No." (Different cost treatments accordingly.)

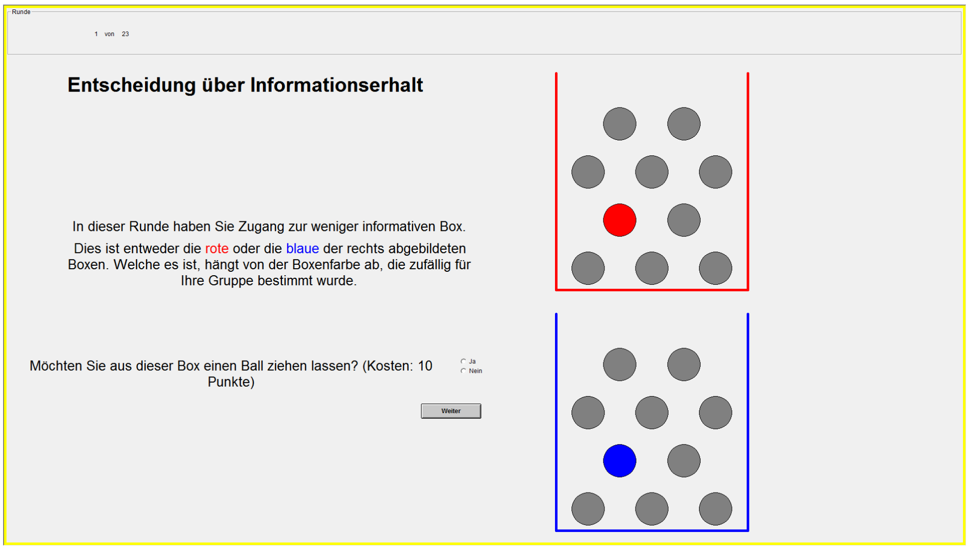


Figure C2: Decision Screen. $C = 10$, CI and DG, Incompetent Expert.

Notes: "Decision on information receipt. In this round you have access to the informative box. That's either the red or the blue box shown on the right. Which one it is depends on the boxcolor, that has randomly been determined for your group. Do you want to draw a ball out of this box? (Cost: 10 Points). Yes/No." (Different cost treatments accordingly.)

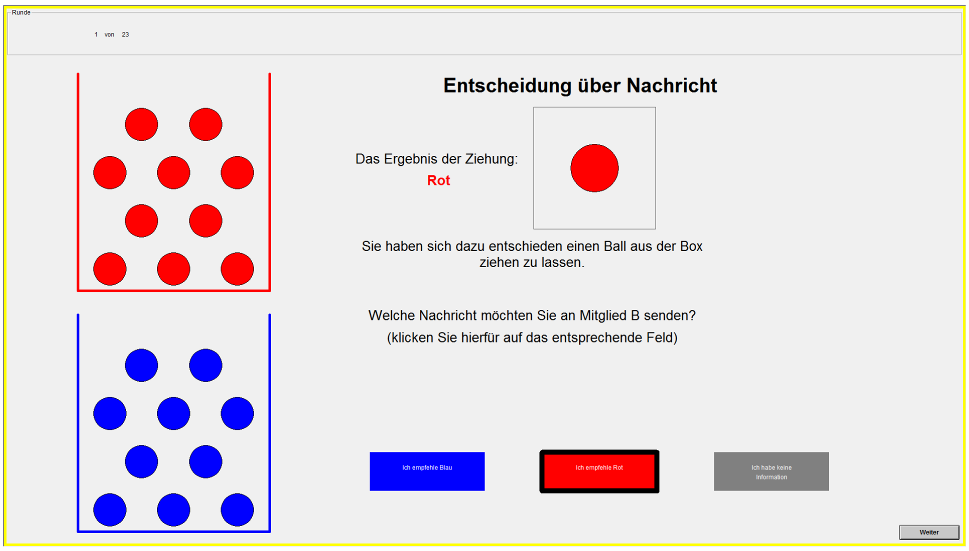


Figure C3: Decision Screen. CI, Competent Expert.

Notes: "Decision on message. The result of the draw: Red. You've decided to draw a ball from the box. What message do you want to send to Member B? (click on the respective field) I recommend Blue / I recommend Red / I do not have any information." (DG treatment replaces *Member B* with *the other Member A of your group.*)

Figure C4: Decision Screen. CI, Principal.

Notes: "Decision on boxcolor of the group. Member A1 sent: I recommend blue. Member A2 sent: I do not have any information. What color do you decide for? Red / Blue."

Figure C5: Decision Screen. DG, Expert.

Notes: "Poll on group decision. The other Member A of your group sent the following to you: I recommend Red. You have sent to the other Member A the following: I do not have any information. You and the other Member A can vote on the groupdecision. Member B and the observer only learn the group decision. What do you vote for? Red / Blue."

Figure C6: Decision Screen. CI, Principal / Observer.

Notes: "Probability assessment for other group. The boxcolor of the other group has been blue in this round. Member A1 of the other group sent the following message: I recommend Blue. Member A2 of the other group sent the following message: I do not have any information. In percent enter the probability with which you think that Member A1(A2) has had access to the informative box (a number between 0 and 100)."

Figure C7: Decision Screen. DG, Principal / Observer.

Notes: "Probability assessment for the other group. The boxcolor of the other group was blue in this round. The decision of the Member As of the other group has been blue. Enter your assessment with respect to the randomly determined Member A of the other group. In percent enter the probability with which you think that the randomly determined member A of the other group has had access to the informative box (a number between 0 and 100)."

D Instructions

An English translation of the original German instructions for the C=10 treatment that starts with CI is presented below. The instructions of each of the two subsequent parts were handed out after the previous part was finished. Instructions to the other treatments were very similar and are, therefore, omitted here. The original German instructions can be obtained from the authors upon request.

Experiment description rounds 1 - 10

Overview

Welcome to the experiment. We ask you not to talk to the other participants and to turn off your mobile phones and other mobile electronic devices.

For your participation in today's session, you will be paid in cash at the end of the experiment. The size of the payoff partially depends on your own decisions and the decisions of others, but is also random to an extent. It is therefore important that you carefully read and understand the instructions prior to the start of the experiment.

In the experiment, every interaction between (you and the other) participants is mediated through the computers in front of you. You will interact with each other anonymously and your decisions will be stored together with your random ID number only. Neither your name, nor the names of other participants will be made public; neither today nor in future written analyses.

Today's session consists of multiple rounds. At the end, 7 rounds are randomly selected and paid out. Any unselected rounds will not be paid out. The size of the payoff is determined by the points earned in the selected rounds, converted to euro, as well as your show-up fee of 3 Euro. The conversion of the points in euro proceeds as follows: Every point is worth 2.5 cents, such that:

$$40\ Points\ =\ 1\ Euro$$

Every participant is paid in private, such that the other participants cannot see how much you earned.

Experiment

The experiment consists of three parts and has 23 rounds in total. Each round within parts 1 (round $1-10$), 2 $(11-20)$ and 3 $(21-23)$ is identical in terms of structure. You will receive the instructions to the consecutive parts after finishing the previous one.

At the beginning of the experiment you will be assigned a role, which is either **Member A** or **Member B / Observer**. You will retain your assigned role throughout the entire experiment.

The Group

In the first round you are assigned to a meta-group of 9 members. At the beginning of each trial, three members of your meta-group are randomly assigned to form a group for the duration of the round. Every group consists of one Member B and two Members A. Thus the members of a group are randomly reassigned in every round.

General Trial Structure

There are differently colored boxes, from which balls can be drawn. For every group and round the color of these boxes will be randomly determined. They can be either Red or Blue. Both boxcolors are equally likely for every group and do not depend on the boxcolors of other groups. All boxes within one group have the same color, which is unbeknownst to the members of the group. Members A can, however, receive an information about the boxes' color by the drawing a ball from one of the boxes. Member B has no direct access to information concerning the boxcolor of his group, but receives messages from the Members A. After receiving these messages, Member B has to decide on a color. His payoff depends on whether the decision is correct, i.e. whether or not the chosen color equals the color of the box it was drawn from.

The drawing of a ball from the box by Member A costs 10 points. The probability to discover the color of the box by drawing a ball from it depends on the degree of informativity of the box Member A has access to. The boxes' degree of informativity is randomly determined at the beginning of a round when every Member A receives access to an informative or to a less informative box with $50\ \%$ probability, independently of the other Member A. Only the Member A himself is informed about the kind of box he has access to. Irrespective of the degree of informativity of either box, every box Member As have access to have the same color (Red or Blue) within one group and within the every round.

Having made the decision on whether or not to draw a ball, a Member A can recommend a color to Member B, upon which he has to decide on a color.

A member of another group, who takes the place of an observer, views both the recommendations made by Member As and the group's actual boxcolor at the end of the round. Thereupon he estimates the probability for either Member A of having had access to an informative box. The estimated probability consequently determines Member As' payoff for the round. The higher the probability, the higher the payoff.

Member A

Member A begins each round with a budget of 30 points. In each round he has to make two decisions:

1. Whether he pays 10 points to draw a ball from his box (whose color is randomly determined and unbeknownst)
2. Which message he sends to Member B.

At the beginning of a round Member A is informed about the degree of informativity of his box. As mentioned before, this is randomly determined with 50 % probability. For each group, the color of the box is randomly determined at the beginning of the round as well and it is either Red or Blue (with 50 % probability, respectively).

If the box-color of the group is red, then an informative (red) box contains 10 red balls and a less informative (red) box one red ball and 9 grey balls. If the box-color of the group is blue, then an informative (blue) box contains 10 blue balls and a less informative (blue) box one blue ball and 9 grey balls (see figure 1 and 2).

If Member A has access to an informative box and decides to draw a ball, he learns the round's color with certainty.

If Member A has access to a less informative box and decides to draw a ball, he learns round's color with 10 % probability, but remains oblivious with 90 % probability.

If Member A decides to pay 10 points to draw a ball from the box, he can see the color of the drawn ball. Else he cannot see any drawn ball. Regardless of the decision and the color of the ball, Member A can send one of three possible messages to Member B of the same group:

I recommend Blue / I recommend Red / I do not have any information

After receiving messages from both Members A of his group, Member B has to decide whether he believes the box' color of the group in this round to be either Red or Blue.

The messages from Members A in one round and the correct color of the group will be seen by an observer, who is not part of the same group. Based on this information he guesses the probability of each Member A having had access to an informative box in current round (see figure 5). This estimate (in percent) determines the round-payoff of the Member A.

The Round-payoff of a Member A is:

- $30\ (starting\ points)\ +\ estimation\ by\ the\ observer$, if Member A did not decide to draw a ball from the box.
- $30 - 10\ (costs\ of\ drawing\ a\ ball) +\ estimation\ by\ the\ observer$, if Member A decided to draw a ball from the box.

Example: Member A draws a ball and an observer estimates the probability of Member A having access to an informative box to be 40 %. In this case Member A's payoff is 60 points in this round.

Figure 1: Decision about information acquisition by Member A, who has access to a less informative box in this round. The two possible boxes he may be faced with are shown on the right part of the screen. He will be able to draw a ball from one of them. At least until the point of drawing, he will not know which of the boxes he has been allocated.

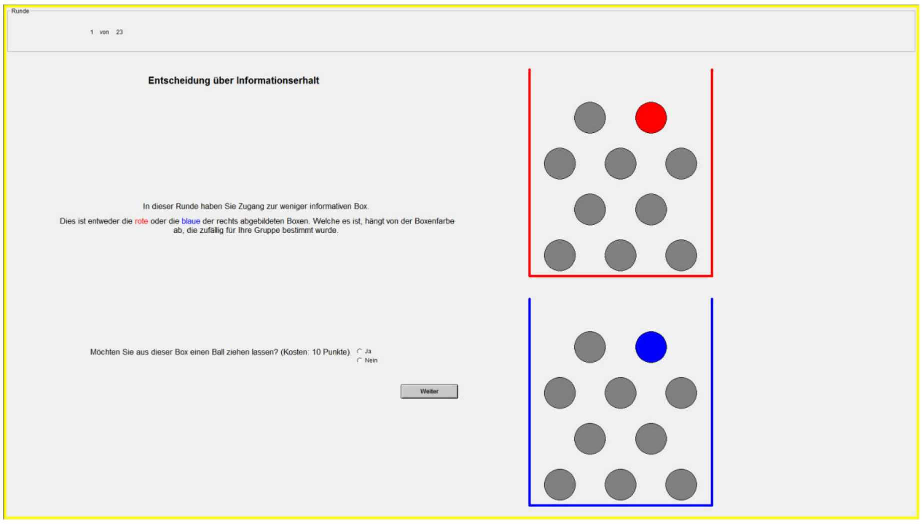


Figure 2: Decision about Information acquisition by Member A, who has access to an informative box in this round.

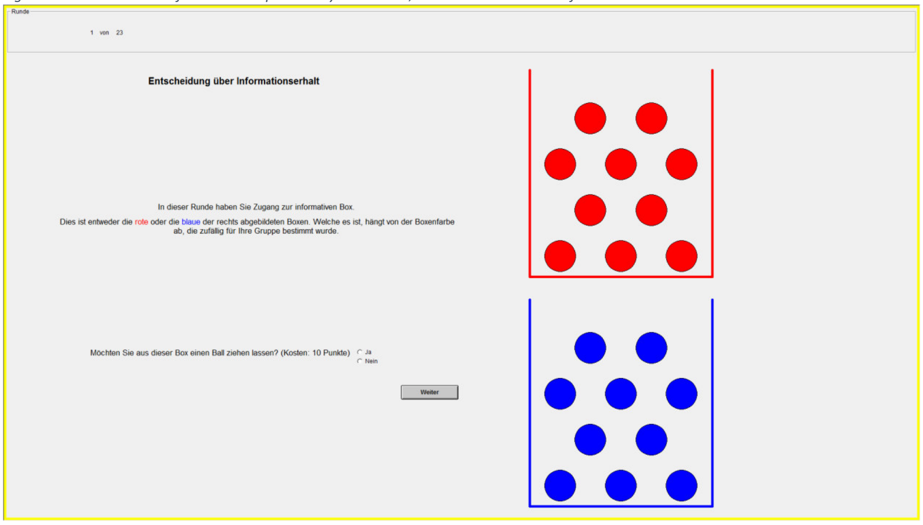
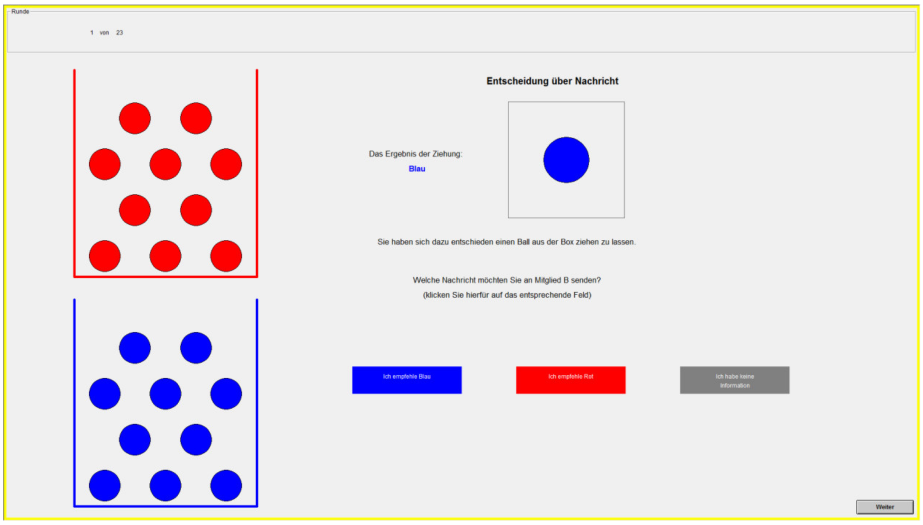


Figure 3: Example of a screen displaying information on the second decision concerning the recommendation of a Member A, that has access to an informative box in this round and decided to draw a ball from the box (which is blue in this case).



Member B / Observer of the other group

As mentioned before, Member B can see the messages from both Member As of his group (Member A1 and Member A2) in each round. Based on this information, he can choose Red or Blue (see figure 4).

If Member B chooses the correct color, i.e. the decision equals the actual boxcolor, he receives 50 points. Else he receives 0 points. Reminder: the color of the group is randomly determined at the beginning of the round (50 % probability for both Red and Blue, respectively).

In addition to deciding about the color in the own group, every Member B also acts as an observer in a group other than his own. As an observer, Member B views the messages and the boxcolor of this group (picture 5).

Based on this information, the observer provides an estimate as to how likely he thinks a respective Member A (of the other group) is to have had access to an informative box.

Attention: The observer does not estimate the probability of respective Member A drawing a ball, but rather the probability of having access to an informative box. In other words: he guesses, if Member A had the possibility to draw a ball from an informative box.

Figure 4: Example of a screen displaying information on the decision of a Member B concerning the boxcolor in the own group.

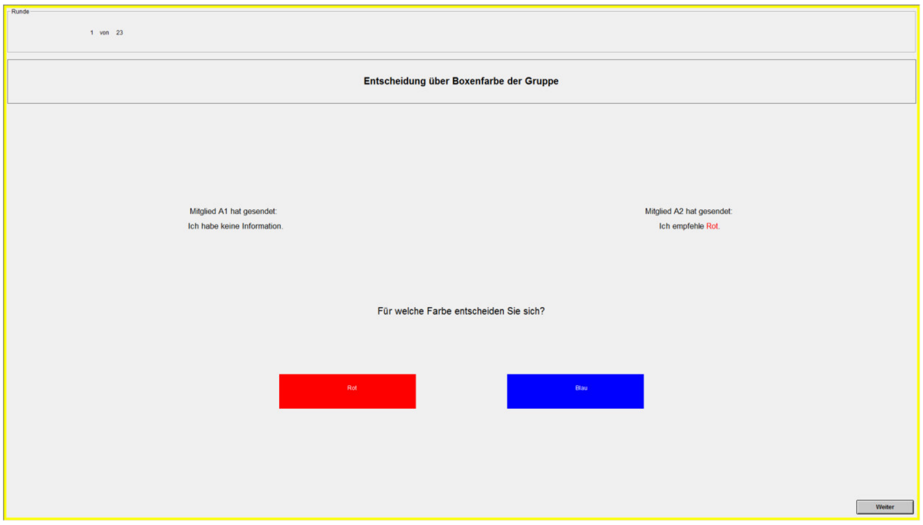


Figure 5: Example of a screen displaying the probability assessment of an observer about the Member As of a different group.

The formula determining the observer's payoff following his estimate is slightly complicated. In simple terms, **it ensures the highest expected payoff of an observer, if he truthfully entered his actual estimate (in percent).** Example: If an observer assumes some Member A's probability of having access to an informative box to be 60% in the current round, then it is also the best option for the observer to enter an estimate of exactly 60%. Every other estimate reduces the expected payoff.

The exact equation to compute the number of points for accuracy of respective estimate, which lies between 0 and 50, is:

- $\frac{1}{2} * (100 - \frac{1}{100} * (Prob(Access\_informative))^2)$ if Member A had access to a less informative box.
- $\frac{1}{2} * (100 - \frac{1}{100} * (100 - Prob(Access\_informative))^2)$ if Member A had access to an informative box.

Where $Prob(Access\_informative)$ is the entered probability in percent (a number between 0 and 100).

In the end only one estimate, either the one of Member A1 or A2 (of the other group), is relevant for the round payoff of the observer. It is randomly determined, whether the estimate of Member A1 or Member A2 of the other group will be payoff relevant in the current round. This will be communicated at the end of the experiment.

The **Round-payoff of a Member B / Observer** is:

- $50 + Payoff\ from\ assessmentaccuracy$, if the decision about the box-color of the own group was correct.
- $0 + Payoff\ from\ assessmentaccuracy$, if the decision about the box-color of the own group was incorrect.

Total Payoff

The payoff at the end of the experiment consists of:

- Round payoff of 7 randomly determined rounds.
  - From part 1 and 2 (round 1-10 and 11-20) three rounds are randomly determined to be payoff-relevant respectively.
  - From part 3 (round 21 -23) one round will randomly be determined to be payoff-relevant.
- 3 Euro for showing up in time.

Questions?

Please take the time to read the instructions one more time. If you have a question, please give a hand gesture. An experimenter will come to you and answer your question in person. If you believe that you have understood everything, please click “Start” on the screen. Control-questions on the desktop will follow. Control-questions should ensure, that each participant has understood the instructions. The answers do not influence your payoff. After answering the control-questions, you can see and compare your answers to the correct solution by clicking on “next”. If every participant has answered the control-questions and all confusions were made clear, a short summary will be read out aloud. Thereafter, the experiment starts.

Experimental description rounds 11 - 20

Rounds 11 – 20

In the second part of the experiment, it is no longer Member B that decides on the color. Instead, the decision will be made by the Members A. After the decision of a member A, whether the costs of 10 will be paid in order to draw a ball, it submits, as in the first part, a message. The recipient of this message is the other Member A of the same group in the second part. After receiving the message of the other Member A, every member A can now vote on a groupdecision.

If both Member As vote for red, the groupdecision is red. If both Member As vote for blue, the groupdecision is blue. If one Member A votes for red, and the other Member A votes for blue, the computer randomly decides (with 50 % probability red or blue respectively).

The observer, who still is a member of another group, now observes next to the correct box-color also the group-decision of the Member As. The individual recommendations, as well as the votes of the member As are not visible to the observer. On the basis of this information, the observer can now estimate, how likely he thinks a randomly chosen Member A from the observed group to have had access to the informative box.

This estimation still determines the payoff of a member A. Also the formula for the round payoff of an observer remains unchanged.

The round payoff of a Member B also stays unchanged and depends on whether the correct decision has been taken, with the difference that this decision is now taken by the Members A. Member B still receives 50 points for the correct decision, and 0 points in case the group-decision is incorrect.

All formulas to calculate the payoff remain therefore unchanged.

Experimental description rounds 21 - 23

Rounds 21 – 23

You now played 10 rounds in **scenario 1** (Members A send messages to Member B, where after Member B decides on the color), and 10 rounds in **scenario 2** (Members A send messages to each other and decide about the color thereafter). For the last three rounds of the experiment, Member B can now decide, whether in his group scenario 1 or scenario 2 will be played. This decision has no influence on the scenario that is played in the other group, where, as before, assessments have to be done.

Which scenario is played in a round, is shown at the first screen of each round.