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Team Governance: Empowerment or Hierarchical Control

Guido Friebel and
Wendelin Schnedler

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Guido Friebel* Wendelin Schnedler**

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Abstract

We investigate a team setting in which workers have different degrees of commitment to the outcome of their work. We show that if there are complementarities in production and if the team manager has some information about team members, interventions that the manager undertakes in order to assure certain efforts may have destructive effects: they can distort the way workers perceive their fellow workers and they may also lead to a reduction of effort by those workers that care most about output. Moreover, interventions may hinder the development of a cooperative organizational culture in which workers trust each other. Thus, our framework provides some first insights into the costs and benefits of interventions in teams. It identifies that team governance is driven by the importance of tasks that cannot be monitored. The more important these tasks, the more likely it is that teams are empowered.

Keywords: team work, incentives, informed principal, intrinsic motivation

JEL-Codes: M54, D86

*friebel@cict.fr, Toulouse School of Economics, CEPR and IZA

**wendelin.schnedler@awi.uni-heidelberg.de, University of Heidelberg and IZA

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1 Introduction

What is the smallest unit in an organization? Following the philosophy of Taylor's scientific management, Ford and many other industrialists in the early twentieth century studied and dissected work processes. They assigned elementary tasks to individual workers and designed elaborate systems to manage individuals through time studies, conveyor belts and intensive monitoring by supervisors, and they incentivized them through piece-rate compensation. The Taylorist view of how organizations operate or should operate seems outdated for most modern production processes. The classical case of Taylorist production, car-building, started to move from conveyor belts to team-based structures in the early 1970s; the Volvo plant in Kalmar became one of the showcases of team production (see for instance Ellegard, 1996). Complex production processes, frequent innovation, and concerns for quality have made it increasingly difficult to measure precisely what an individual contributes to the output of an organization. Moreover, even if such measurement were feasible, standardization and specialization have their costs: industrial psychologists have shown that excessively narrow tasks lead to fatigue and de-motivation (Hancock and Desmond, 2001). Hence, in many circumstances, work teams have replaced the individual as the essential unit in organizational design.

Recognizing the importance of teams is, however, not necessarily tantamount to leaving teams entirely to their own devices. The management of an organization may decide to give a work team different degrees of autonomy. The costs and benefits of intervening in teams are of great interest for the management and industrial psychology literature (as the survey of 93 studies by Stewart, 2006, shows). In economics the topic has received much less attention.

We here suggest a simple incentive theoretical framework to investigate some of the determinants of what we call team governance: What induces an organization to empower teams to manage themselves, or, conversely, when does an organization decide to subject teams to some hierarchical control?

We investigate a multi-agent situation in which workers have different degrees of commitment to the outcome of their work. We show that if there are complementarities in production and if the team manager has some information about team members, interventions that the manager undertakes in order to assure certain efforts may have destructive effects: they can distort the way workers perceive their fellow workers and they may also lead to a reduction of effort by those workers that care most about output. Moreover, interventions may hinder the development of a cooperative organizational culture in which workers trust each other's commitment. Thus, our framework provides some first insights into the costs and benefits of interventions in teams. It identifies that team governance depends on how important non-measurable tasks are. The more important these tasks, the more likely it is that teams are empowered, that is, unfettered by managerial interventions.

Our model looks at a production process with several tasks, some of which are easier to monitor than others. Team members can differ in their commitment to the mission of the team: some may care more about the outcome of their work then others —in the sense of Besley and Ghatak's (2005) "motivated agents" who "pursue goals because they perceive intrinsic benefits from doing so". Those who do care would be willing to exert effort in order to achieve quality. However, because of the complementarity between workers' efforts, it is only optimal for them to do so, if they expect the other team members to do the same. The manager responsible for a team may have some pieces of information about the commitment of some or all of the team members, for instance, from a worker's personnel file that team members have no access to. This information need not be better than that of the team members; an informed principal problem in the sense of Maskin and Tirole (1992) emerges whenever the manager has some private information. The manager can choose whether to intervene or to empower.

The main purpose of the model is to investigate the determinants of empowerment vs. hierarchical control and to identify the consequences of managerial interventions in teams. Consider a team that consists of two members, A and B. If all tasks can be perfectly monitored, managerial intervention is (trivially) good for the productivity of the team. However, if some of the tasks are too complex to be monitored, there are costs associated with the intervention. We first assume that everybody knows that A is committed to the team goals, while B's commitment is only known to the manager. To simplify, the manager's information is perfect and efforts of A and B are sequentially chosen. In this simple setting, managerial interventions signal to team member A that the manager believes B not to be committed. Team member A then updates his belief about the probability that B will put effort into the task that cannot be monitored. As a result, A does not exert effort even though he is committed. The reason is that under complementarity, such effort would be wasted unless team member B also exerts effort.

Intervention thus has two effects: it increases effort on tasks that can be monitored easily and lowers effort on tasks that cannot be monitored. This trade-off is essential for our results. Whether or not the manager intervenes depends on the importance of the tasks that cannot be monitored. If they are not very important, there is a signaling equilibrium in which empowerment signals that the manager believes B to be committed. If they are important, a manager who believes in B's commitment always empowers, while a manager who does not believe in B's commitment empowers at least with some probability (Proposition 1). The latter implies that two inefficiencies occur with positive probability (Corollary 1): first, uncommitted workers work too little, second, committed workers waste their effort.

In a next step, we maintain the assumption that A is known to be committed and that the manager has perfect information, but we consider simultaneous moves of A and B. We show that interventions then affect the image that worker A has about worker B and that, in turn, B will behave according to this image (Corollary 2). This has no effect on the equilibrium, if the manager has perfect information. If, however, her information is imperfect, additional problems arise: the manager may wrongly signal that B is not committed (Proposition 2). The consequence may be that team members' initial trust is undermined and less effort is exerted (Corollary 3).

Finally, we look at a dynamic version of the model to investigate how interventions may affect the build-up of trust in a team. Worker B may use effort as a device to signal commitment. This, however, requires that he is sufficiently patient (Propostion 3). If neither worker knows his co-worker's commitment, they will only be able to use effort as a signal and coordinate on an equilibrium in which they cooperate if their initial belief that their co-worker is committed is particularly strong (Corollary 4). Otherwise, the negative effect of intervention is lasting and the team takes an entirely different path compared to the path it would have taken had the manager empowered the team. Intervention may thus determine the culture of a team and induce seemingly selfish behavior, where otherwise an atmosphere of trust would have emerged.

The remainder of the paper is organized as follows. Section 2 relates our findings to the literature. Section 3 introduces the model, which is then analyzed in Section 4. Section 5 reconsiders the problem in a dynamic context and Section 6 concludes.

2 Literature

In the tradition of Alchian and Demsetz (1972), economists have argued that teams are crucial for modern production and that they blur individual contributions by melting them into one joint output.[1] In our model, some tasks can be monitored, while others cannot. We then examine how the importance of the tasks that cannot be monitored affects team governance. We hence follow the multi-task approach of Holmström and Milgrom (1991) in assuming that some tasks are easier to observe than others and blend this with a small body of recent literature that has more closely investigates the costs and benefits of team work (Itoh 1991, 1992) and the organization of team work (Auriol et al.,

[1]Holmström (1982) has shown that introducing a principal who is the residual claimant can solve the free-riding problem that is present in such teams.

2002).

In terms of the informed-principal approach of the paper we are close to Bénabou and Tirole (2003) who show that a principal who intervenes, for instance, by providing incentives, may reveal information to a worker, which can crowd out intrinsic motivation. The difference is that our model considers a multi-agent situation, in which interventions are a signal about the commitment of the other team member rather than the worker's own preferences.

Even closer to our paper is the one by Sliwka (2007) where actions by the principal also inform the agent about preferences of others. There are, however, important differences. First, Sliwka does not explicitly model the strategic interactions between agents. His story is one in which agents may be of different types: some always stick to promises, others never. A third undecided type adapts their preferences to the prevailing social norm. These agents interpret an intervention by the principal as a sign that it is unusual to stick to promises. As a result, they do not exert promised effort. This mechanism is quite different from ours, where a worker cares about his co-worker's preference because it matters for team production and not because of social norms. In our model it does not change A's preferences, if he learns that B is not committed. Worker A simply realizes that his effort will be wasted because B is not going to contribute, which leads him to work less. Crowding out effort is hence present even if people do not consider social norms but are simply interested in delivering a decent output. Second, and potentially more important, is that in our model hierarchical control distorts the build-up of trust in a team, an effect that is neither present in Bénabou and Tirole (2003), nor in the paper by Sliwka.

Our paper adds to a large body of literature that examines the potentially detrimental effects of explicit incentives. Such detrimental effects have been observed experimentally (see e.g. Gneezy and Rustichini 2000, Falk and Kosfeld 2006) as well as in field data (see the survey by Frey and Jegen 2001). Seabright (2004) suggests that agents signal their type through certain actions and can no longer use this signal once these actions are paid for. Alternatively, explicit incentives may be a signal themselves and inform the agent in a principal-agent relationship about the character (Ellingsen and Johannesson 2007), the expectations (Schnedler and Vadovic 2007), or the trust of the principal (Herold 2004).[2] Here, we suggest an alternative explanation for interference to have detrimental effects: it signals the low commitment of co-workers.

We take the team and the preferences of its workers as given to study the effect of interference on motivation. We thus abstract from the possibility that the composition of the team and hence the preferences of its members may be influenced. This complementary question, namely, how firm policies influence the composition of the work force, is studied by Besley and Ghatak (2005) as well as Kosfeld and von Siemens (2007).

For most economists, teams are formed to exploit technological complementarities rather than for motivational reasons. Che and Yoo (2001) are an interesting exception. They argue that repeated interactions and peer monitoring associated with teams simplify the provision of incentives even in the absence of technological advantages of team production. Ichniowski et al. (1997) provide empirical evidence that teams indeed have motivational effects. They show that team work helps steel mills to improve their productivity independently of the used technology, and that there are important complementarities between team work and other innovative human resource practices.

Keeping in mind these exceptions, worker motivation is regarded rather secondary for team formation in economics. In the literature in industrial psychology, however, the idea of multi-dimensional sources of motivation has always been accepted; the starting point of most of the work in this field is that self-governed teams have great motivational advantages. Evidence for the positive effects of empowered and self-managed teams abound. Kirkman and Rosen (1999) summarize a large body of literature on the benefit of self-

[2] Herold independently developed a model that in many ways is similar to ours. However, he focuses on interaction between the manager and a single worker rather than on the more involved team setting and has no comparative statics with respect to the importance of the extra task.

governed teams and present an analysis of survey data from more than 100 teams surveyed in four firms. They find a strong correlation between team empowerment and performance measures.

But if self-governed teams increase efficiency, then what limits their use in firms? The dominant explanation is that teams involve difficult governance issues. In particular, managers find it hard to commit themselves not to intervene. There are two central questions posed in this literature. First, what determines managerial intervention, and second, what are the consequences of excessive intervention? Our model provides answers to both questions and we can compare them to the empirical findings.

With respect to the first question, Kirkman and Rosen (1999) find that teams receive more autonomy from their management when team members work on a contained product or service, that is, if complementarities between team members are important and contributions are difficult to identify. This finding thus meshes well with our result that empowerment is more likely if tasks that are hard to measure are important.

Concerning the consequences of managerial intervention, Gerwin and Moffat (1997) provide interesting evidence. They look at a sample of 14 firms and 53 teams in "concurrent engineering" (the parallel development of a technical innovation such as an integrated design system for a new airplane). The authors find that withdrawing the autonomy of concurrent engineering teams—for instance by introducing evaluation and monitoring schemes—lowers the performance of teams measured in task performance. It also obstructs decision-making and reduces cohesion within the team. This finding corresponds with our result that intervention leads to a lower provision of effort on tasks where complementarities matter and to "distrust" amongst team members—in the sense that team members believe that their colleagues are not committed.

Crozier (1964) gives a by now classical example of the effects of interventionist policies in a public organization. In Chapter 2 of his book, he describes a highly interdependent work organization with a strict hierarchy that comprises supervision in case of problems and very little workplace autonomy. Crozier quotes workers: "We are obliged not to care about the work, although we would like to" and "Where I was before, it was sometimes possible to be proud of one's work, but here I do not see any possibility." This notion is captured in what we call the "tragedy of unempowered but committed workers" (Corollary 3). Finally, workers learn very little about each other in the organization described by Crozier. They cannot develop the "psychological safety" that is a prerequisite for learning about each other and the success of teams (Edmondson, 1999). In terms of our dynamical model, intervention prevents workers from learning about each others' commitment and jeopardizes effort exertion in later stages.

3 Model

The team and its task. We consider a team that consists of two workers, A and B. The team is supervised by a manager and produces a value v through workers' efforts. The job of workers comprises two different types of tasks. First, for some tasks, the manager can assure effort. The effort choice of worker i with respect to these verifiable tasks is called e_i^N, where the N stands for "normal". We will not specify how the manager assures this effort,[3] rather we are interested in how interventions affects the interaction between team members. Second, there are tasks that are not verifiable, and here interventions of the manager are impossible. The respective effort will be called e_i^E, where the E stands for "extra".

As an example, consider a large private or public organization that employs its own experts in various areas and puts together a team of a programmer and a tax expert to produce a tax software. While it is possible to check whether the tax expert has produced a list of program functionalities or whether the software runs, the complementarities and

[3]The intervention could, for example, be the result of monitoring combined with an implicit understanding that the worker is fired in case of shirking. Alternatively, it may be achieved by explicit performance pay.

hence the reason for team production occurs at the interface. This part is notoriously difficult to verify and depends crucially on the willingness of the team members to exert extra effort.

For simplicity and to isolate the effect of interventions on the interactions between workers, we suppose that the effort decision of individual i at task k are dichotomous: $e_i^k \in \{0, 1\}$, where high effort entails costs c^k and the produced value is increasing in effort. We also assume that the value of production is additive in the two tasks and symmetric in the efforts: $v = v^N(e_1^N, e_2^N) + \alpha v^E(e_1^E, e_2^E)$, where α is the importance of the extra effort for the product. The additive structure of output and the fact that efforts do not interact in the cost function imply that the decision to provide normal effort and the decision to provide extra effort are technologically independent. In particular, there is no reason for a worker to withdraw extra effort in order to increase normal effort. We impose this structure precisely to eliminate any technological interdependence so that any interdependency must be created by the information structure. Note that the produced value may well be verifiable (see Appendix D) but to keep the paper tractable, we assume that is is not.

Motivation of workers. Some of the workers are interested in the team product, which reflects "public service mentality" or "public mindedness" for the public sector and "professional attitude" in the private sector.[4] We will call such workers *committed (to the results of production)*. This commitment may, for example, arise from reputational concerns. However, not everybody is equally committed; some workers may not have reputational concerns (or a very high discount factor). We reflect this by introducing workers who only care about money and the disutility of effort and receive no utility from the production result. Hence, the utility of a worker takes the form: $\theta v - c^N e_i^N - c^E e_i^E$. where $\theta = 1$ if worker i is committed and zero if he is not committed.

Efficiency. The extra effort is efficient, because the gains from joint production exceed

[4] The terminology is from Francois (2000) and Besley and Ghatak (2005) who use a similar assumption.

the costs:

$$v^E(1,1) - v^E(0,0) > 2c^E. \tag{1}$$

To represent the complementarity between the inputs on the extra task, extra effort of one worker only pays if the co-worker also puts in extra effort:

$$v^E(1,0) - v^E(0,0) < c^E \quad \text{and} \quad v^E(0,1) - v^E(0,0) < c^E \tag{2}$$

Together these two assumptions reflect that team production is only advantageous if all members of the team put in effort.

Normal effort is efficient, irrespective of the behavior of the other worker:

$$v^N(\cdot,1) - v^N(\cdot,0) > c^N \quad \text{and} \quad v^N(1,\cdot) - v^N(0,\cdot) > c^N. \tag{3}$$

The condition holds if effort on the normal task is less complementary or even independent from the effort of the co-worker. Together these assumptions reflect the idea that the gains of team production are strongest, where it is most difficult to identify individual efforts. Under the assumption that normal effort is efficient, committed workers are always willing to put in normal effort, which distinguishes them from uncommitted workers. In our example, a committed tax expert would take pride in delivering a list of functionalities and a committed programmer delivers a nice program. However, substantial complementary gains are realized if both the programmer and the tax expert extend their thinking beyond their field of expertise and put in the extra effort required to do so.

As pointed out before the manager's intervention (or "interference") is modeled in a reduced form. The manager is left with the choice to interfere or to "empower" the team. If the manager interferes he can obtain $e^N = 1$ at a price of k by some mechanism, for instance by monitoring or incentives. The manager will never interfere when the costs of interference are too high. To make things interesting, costs must be sufficiently small for interference to improve efficiency:

$$v^N(1,\cdot) - v^N(0,\cdot) > k \quad \text{and} \quad v^N(\cdot,1) - v^N(\cdot,0) > k. \tag{4}$$

Information. Worker A is not sure whether worker B is committed. The manager has some independent information about the commitment of worker B. It is not important that the manager has better information. For instance, in our tax software example, the team of the programmer and the tax expert is created for a specific purpose. They may both be long-term employees of the organization and may have been members of different working groups before. The records of these earlier activities give the manager some idea about their commitment, an information that is inaccessible to the workers who may have other sources (for example conversations with colleagues).

In most of the article, we look at the situation where only the commitment of worker B is in question. Worker A is committed and this is assumed to be common knowledge. This assumption is a simplification; in reality the preferences of worker A are likely to be unknown as well. By having only one informational asymmetry, the model becomes more tractable. We briefly discuss the implications of relaxing this assumption at the end of the analysis.

We will vary the quality of the manager's information. Formally, we suppose that there is a common a-priori probability λ that B is committed. In order to model the independent information of the manager, we assume that she receives a signal θ about the type of worker B which is correct with probability p^P. The manager then uses this signal to update her beliefs:

$$\lambda^P = \begin{cases} \bar{\lambda}^P := \frac{\lambda}{p^P\lambda+(1-p^P)(1-\lambda)} & \text{if} \quad \text{signal indicates } \theta = 1, \\ \underline{\lambda}^P := 1 - \frac{1-\lambda}{p^P(1-\lambda)+(1-p^P)\lambda} & \text{if} \quad \text{signal indicates } \theta = 0. \end{cases}$$

Depending on the received information, we distinguish two types of managers: those with *weak beliefs* $\underline{\lambda}^P$ that worker B is committed and those with *strong beliefs* $\overline{\lambda}^P$.

Timing.

1. Nature determines the commitment of worker B.

2. The manager receives information about this commitment.

3. The manager decides whether to interfere.

4. Workers decide about effort provision for the two tasks.

5. Payoffs accrue.

Concluding the model description, we want to summarize the essential assumptions.

First, we are looking at a production process in which the efforts for some of the tasks can be controlled while the efforts of other tasks cannot be controlled. There are complementarities between the efforts of different team members and these complementarities are stronger for the task that cannot be monitored. Second team members may differ in their commitment for the result of their work. Third, the manager has some pieces of information about the commitment of some team member to which other team members have no access to. Fourth, the manager can choose whether or not to intervene with the team. We will use the word empowerment in the latter case. The manager's decisions will be guided by the benefits and costs of the intervention.

Equilibrium concept. Throughout the text, we consider Perfect Bayesian Nash equilibria which fulfill the intuitive criterion. We will show that it is the best response of a committed worker to choose the same extra effort as his colleague (see Lemma 1). Consequently, two committed workers who simultaneously decide on extra effort may in equilibrium either both exert extra effort or both exert no extra effort. Equilibria of the former type pareto-dominate the latter type. In order to overcome the multiplicity, we limit attention to equilibria where the behavior of the workers is pareto-optimal. Apart from being pareto-optimal, equilibria in which workers exert extra effort are more interesting. If no workers ever exert extra effort, the managers decision to empower is trivial as it only depends on the direct costs and benefits of the intervention on normal effort. If extra effort is at least sometimes exerted, there may also be an indirect effect of the intervention on extra effort.

4 Analysis

We begin the analysis with some observations about the effort of committed and uncommitted workers. Given our assumptions it is obvious that an uncommitted worker only exerts effort if he is forced to by the intervention of the manager. The behavior of committed workers is described in the following Lemma.

Lemma 1 (Best response of a committed worker)**.** *(i) A committed worker always exerts normal effort. (ii) Extra effort: a committed worker's best response is extra effort if and only if the other worker also exerts extra effort.*

Proof. Claim (i) follows directly from (3). Claim (ii), if-part: recall that extra effort is efficient by Equation (1): $v^E(1,1) - v^E(0,0) > 2c^E$. This is equivalent to $v^E(1,1) - v^E(1,0) + v^E(0,1) - v^E(0,0) > 2c^E$ or $v^E(1,1) - v^E(1,0) > c^E + (c^E - (v^E(0,1) - v^E(0,0)))$ and because of (2), we get $v^E(1,1) - v^E(1,0) > c^E$ and it is optimal for a committed workers to put in effort. Claim (ii), only-if part: this part follows directly from Equation (2). $\square$

In other words, in equilibrium, a committed worker exerts extra effort whenever his colleague does so.

Consider now a benchmark in which by intervening the manager can assure both normal and extra effort. A committed worker can then count on his colleague spending extra effort; likewise he will exert effort by the preceding lemma. This leads to a utility of $v^E(1,1) - c^E$, for the committed worker. In the absence of the intervention, worker B will have a payoff of either $v^E(1,1) - c^E$ or $v^E(0,0)$. All other effort combinations can be ruled out because committed workers match extra effort by Lemma 1. By an argument similar to the one used in the proof of that lemma, it can be shown that $v^E(1,1) - c^E > v^E(0,0)$. Hence, the committed worker is weakly better off when his colleague is controlled.

Thus, managerial interventions *increase* the voluntary supply of effort by a committed worker. Committed workers welcome hierarchical control because it ensures that their effort is not wasted. So, perfect interference works as a guarantee for effort provision;

directly on uncommitted workers and indirectly on committed ones. As this perfect control is not very realistic, we assume for the remainder of the paper that the manager can assure only normal effort but not extra effort.

4.1 Interference as a signal about co-worker's type

In order to investigate the potential cost of intervention, we consider first a simple setting in which the manager knows the type of worker B, i.e. $p^P = 1$, the committed worker A chooses his effort first, B observes this choice and then decides about his own effort.

As the next lemma shows, worker A's beliefs about B, λ^{A}, play a crucial rule.

Lemma 2. *If worker B can observe the extra effort of worker A before deciding on his extra effort, there is some threshold such that worker A exerts extra effort if and only if his belief is above this threshold:*

$$\lambda^E = \frac{c^E - (v^E(1,0) - v^E(0,0))}{v^E(1,1) - v^E(0,0) - (v^E(1,0) - v^E(0,0))}.$$

Proof. If worker A exerts no extra effort, worker B (who observes this choice) will not exert extra effort—either because he is uncommitted or because of Lemma 1. Hence, the value from extra effort becomes $v^E(0,0)$ in this case. If worker A exerts extra effort, the response by B depends on his type. Thus worker A's extra effort depends on his belief about worker B. With probability λ^{A}, B is a committed worker, who exerts effort by Lemma 1 and with probability $(1 - \lambda^{\mathrm{A}})$ an uncommitted one, who exerts no effort. Accordingly, the payoff is: $\lambda^{\mathrm{A}} v^E(1,1) + (1 - \lambda^{\mathrm{A}})v^E(1,0) - c^E$. Comparing the two payoffs, we get that the first worker exerts effort if and only if $\lambda^{\mathrm{A}} v^E(1,1) + (1 - \lambda^{\mathrm{A}})v^E(1,0) - c^E \geq v^E(0,0)$. Solving for λ^{A} yields the threshold λ^E. □

Having established how A's effort choice depends on his beliefs about B, we now turn to the manager's intervention, which occurs before the effort choice of worker A.

Three elements determine the intervention decision of the manager: (i) the direct costs of interference k, (ii) the direct gains of interference in terms of normal effort, and (iii) the indirect effect of signaling on extra effort.

We have not yet shown that the third effect exists, and how exactly it plays out is stated in Proposition 1. Lemma 2 shows that the extra effort of a committed worker A depends on his beliefs. These beliefs, however, are influenced by the manager's action that conveys to worker A some information about the manager's beliefs about worker B. Consequently, worker A updates his belief about B: if the updated belief is then below the level defined by Lemma 2, he exerts no extra effort, otherwise he does.

This effect of signaling on extra effort is the same for managers with weak and strong beliefs. The same is true for the direct cost of intervention. However, managers with weak beliefs have higher direct gains from interference as they believe that B will not exert normal effort. The last point establishes that there cannot be "inverted signaling" in which a manager with strong beliefs would intervene while a manager with weak beliefs would not (this is formally shown in Lemma 7 in the Appendix).

Whether or not a manager wants to intervene depends on the importance of extra effort and her beliefs. We define the following bound on the importance of the extra task α in dependence of the belief λ.

$$\alpha(\lambda) := \frac{(1-\lambda)(v^N(1,1) - v^N(1,0)) - k}{\lambda(v^E(1,1) - v^E(0,0)) + (1-\lambda)(v^E(1,0) - v^E(0,0))}. \tag{5}$$

Using this definition, we can formalize the link between the importance of the extra task and the behavior of managers with different information (the respective proof is in Appendix B).

Proposition 1. *In equilibrium, the following holds.*

1. *Managers with strong beliefs always empower.*

2. *The behavior of managers with weak beliefs depends on the importance of the extra task:*

(a) If the extra task is not important, $\alpha < \alpha(0)$, a manager with weak beliefs interferes (separating equilibrium).

(b) If the extra task is important, $\alpha > \alpha(0)$, the behavior depends on the initial beliefs of workers.

i. If worker A has sufficiently weak initial beliefs about B being committed ($\lambda < \lambda^E$), a manager with weak beliefs empowers the team with some probability (partially separating equilibrium).

ii. If worker A has strong initial beliefs about worker B being committed, ($\lambda > \lambda^E$) a manager with weak belief empowers the team regardless of her information (pooling equilibrium).

The central message of this proposition, namely, how the manager responds to the importance of extra effort, is summarized in Figure 1. Observe that managers with weak beliefs under some circumstances empower. This leads to the following inefficiency.

Corollary 1 (Behavior of workers)**.** *If the importance of the extra task is large, $\alpha > \alpha(0)$, managers with weak beliefs empower (at least with some probability) and the following inefficiencies arise:*

1. *worker B exerts no normal effort and*

2. *worker A wastes extra effort.*

Summarizing this section, we find that worker A can learn about the worker B's type from the interference of the manager. The manager may then rationally respond by not interfering if the value of extra effort is high enough and the beliefs of workers about their colleagues are sufficiently strong.

4.2 Interference as a signal about one's image

For the sake of clarity about the fundamental effects, we have assumed above that worker B observes the effort of worker A before deciding. We now relax this assumption: both

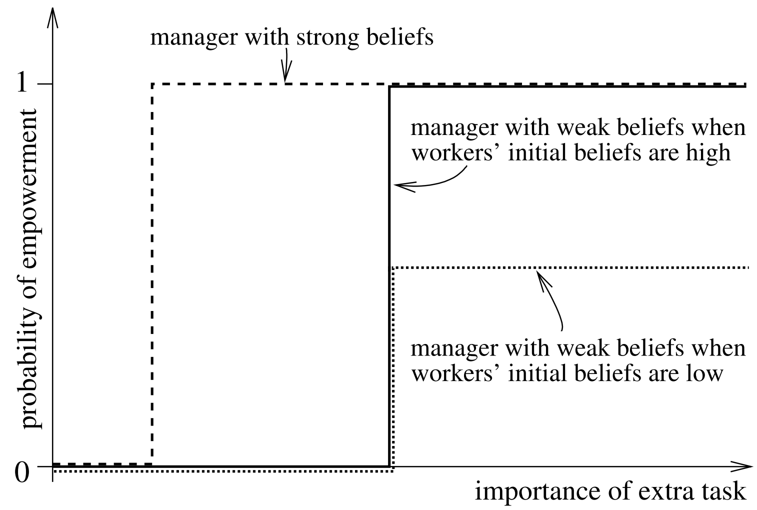

Figure 1: Effect of extra effort on equilibrium behavior of manager

workers simultaneously decide on effort. For the moment, we maintain the assumption that the manager is perfectly informed ($p^P = 1$) and that it is common knowledge that worker A is committed. In this setting, we derive the following analogue to Lemma 2.

Lemma 3. *If worker A and B simultaneously decide on effort, committed workers exert effort if and only if A's belief that B is committed is above the threshold λ^E.*

Proof. A committed worker exerts extra effort if and only if $\lambda v^E(1, e)) + (1 - \lambda)v^E(1, 0) - c^E \geq \lambda v^E(0, e) + (1 - \lambda)v^E(0, 0)$, where e is the behavior of another committed worker. This is equivalent to $\lambda \geq \frac{c^E - (v^E(1,0) - v^E(0,0))}{v^E(1,e) - v^E(0,e) - (v^E(1,0) - v^E(0,0))}$. Suppose $e = 1$. If in addition $\lambda \geq \lambda^E$, the worker has an incentive to exert extra effort. Extra effort is thus an equilibrium for $\lambda \geq \lambda^E$. Notice that exerting no effort when the other worker exerts no effort $e = 0$ is also a Nash equilibrium. This second Nash equilibrium, however, is pareto-dominated and hence ruled out by our equilibrium notion. If the condition is not met and $\lambda < \lambda^E$, worker A exerts no extra effort and the other worker had no reason to choose $e = 1$ in the first place. Thus, given that $\lambda < \lambda^E$, extra effort is not an equilibrium. $\square$

An immediate consequence of this lemma is the following corollary.

Corollary 2. *Under the assumption that the manager is perfectly informed and with simultaneous effort choice, equilibrium behavior of the manager is the same as described in Proposition 1.*

The corollary is proven exactly like Proposition 1 with the exception that Lemma 3 takes the role of Lemma 2 in the respective proof. The only difference between this corollary and the preceding proposition is the following. Before, only worker A drew inferences from the behavior of the manager and worker B decided on the basis of the observed effort of worker A. Now, worker B also draws inferences from the manager's action. If worker B finds that the manager interferes with him, he correctly infers that his co-worker will not trust him and hence his extra effort would be wasted. Whereas before worker A only withdrew extra effort when the manager interfered with his co-worker, worker B is now withdrawing effort when the manager interferes with him. Interference works like a self-fulfilling prophecy and a committed worker with a bad image behaves in accordance with this image. In other words, worker B acts to confirm the beliefs of worker A. For the moment, this effect does not have any negative consequences because in equilibrium the manager never interferes with a committed worker B. If, however, the manager is imperfectly informed, an interesting dilemma arises—as we will see in the next section.

4.3 Un-empowered but committed workers

We now assume that the manager is imperfectly but still relatively well informed about B's preference, i.e., $p^P < 1$ with p^P relatively large.[5] We maintain the assumption that A is committed and that this is common knowledge.

As the manager is no longer certain about the preferences of worker B, even a manager

[5] Most results of this section are robust even if the manager is not very well informed, i.e. p^P is small. Even little knowledge of the manager may be helpful to workers (see Lemma 24 in the appendix). Moreover, the behavior described in the central proposition of this section, Proposition 2, still occurs in equilibrium (see Appendix C.3). However, the equilibrium is no longer unique.

with strong beliefs finds it expedient to interfere if the extra task produces relatively little value. This idea is formalized in the following analogue to Proposition 1 (the proof is in Appendix C.2).

Proposition 2. *If the manager is sufficiently well-informed, the following holds in equilibrium.*

1. *Managers with strong beliefs empower if the extra task is somewhat important* ($\alpha > \alpha(\bar{\lambda}^P)$).
2. *The behavior of managers with weak beliefs depends on the importance of the extra task:*
   (a) *If the extra task is of not too important,* $\alpha < \alpha(\underline{\lambda}^P)$, *a manager with weak beliefs interferes.*
   (b) *If the extra task is important,* $\alpha > \alpha(\underline{\lambda}^P)$, *the behavior depends on the initial beliefs of workers.*
      i. *If worker A has sufficiently weak initial beliefs about B being committed,* $\lambda < \lambda^E$, *a manager with weak beliefs empowers the team with some probability.*
      ii. *If worker A has strong initial beliefs about worker B being committed,* $\lambda > \lambda^E$, *a manager with weak beliefs empowers the team regardless of her information.*

Compared to Proposition 1, there are two additional inefficiencies which arise when the manager is imperfectly but well informed. First, since the manager with strong beliefs is no longer empowering if extra effort is of low importance ($\alpha < \alpha(\bar{\lambda}^P)$), the information of the manager is no longer revealed to worker A. Accordingly, worker A may never learn that his co-worker is committed. Then, committed workers, who otherwise would have exerted extra effort, refrain from doing so. Second, as the manager is not perfectly informed, she will occasionally interfere although worker B is committed.

Corollary 3 (Tragedy of un-empowered but committed workers)**.** *For very low and very high importance of the extra task, i.e., $\alpha > \alpha(\underline{\lambda}^P)$ or $\alpha < \alpha(\overline{\lambda}^P)$, the manager interferes with some probability with a committed worker B and hence (weakly) reduces the supply of extra effort by committed workers.*

Previously, all inefficiencies where due to uncommitted workers who did not exert effort or committed workers who exerted too much effort. This corollary shows that committed workers may exert less effort as a result of interference.

An un-empowered and committed worker B is, of course, painfully aware of the fact that he and his team mate are committed and that they could both improve their situation by exerting extra effort. This improvement could be achieved if worker B tells worker A that he is committed. In a richer setting, in which uncommitted workers have an incentive to pretend that they are committed because they benefit from extra effort,[6] it is not credible if worker B claims to be committed. This leaves the question whether there is a channel for worker B to credibly convince worker A that he is committed. In the next section, we introduce such a channel.

5 Dynamic considerations

Workers in teams observe the behavior of their co-workers and if the team remains together, future effort decisions can be made contingent on the observed earlier effort. A committed worker who wants to convince his co-worker of his character may choose to exert effort for this reason. In this section, we study how repetition and the possibility to signal one's type by effort affects the behavior of committed workers. In contrast to the preceding section, we now assume that after effort is exerted by both workers, the effort choices are revealed and the team meets again for a second round of effort exertion. In order to simplify matters, the manager only decides on empowerment in the first round

[6] An example for such a setting can be found in Appendix D.

while interference is effective and costs k in both rounds. The value of payoffs from the second round are discounted with a common discount factor of δ. The repeated nature evokes the idea that effort may be sustained using peer pressure, for example, in a self-enforcing equilibrium. But even in an infinitely repeated game, an uncommitted worker cannot be forced to exert effort: "no effort" is a strictly dominant strategy irrespective of the future effort choices of the colleagues precisely because the uncommitted worker does not care about output. With two committed workers, the issue at hand is not an enforcement but rather an information problem. It is this information problem that we are addressing in this section. First, we deal with a situation where worker A is committed and this is common knowledge. Then, we move on to a case where the preferences of worker A are not known.

5.1 Extra effort as a trust-building measure

In this section, we assume that worker A is known to be committed. A committed worker B can then exert extra effort to convince worker A that it is worth putting in extra effort in the second round. To understand the consequences, we examine the belief λ_2^A of worker A at the beginning of the second round, i.e., before exerting effort for a second time.

Lemma 4. *Worker A's belief to face a committed worker B, λ_2^A, increases in unsolicited earlier effort of worker B.*

Proof. Assume that there is an equilibrium in which worker A's belief stays the same or decreases when observing unsolicited extra effort. An uncommitted worker receives a lower payoff under all possible actions that may follow extra effort than when he sticks to no extra effort. By evoking the intuitive criterion, worker A thus believes to face a committed worker if he sees unsolicited extra effort (off the equilibrium path) which contradicts the assumption that worker A's belief does not increase. □

This lemma ensures that unsolicited effort can be employed as a signal. In principle, there are two ways to exert unsolicited effort: normal effort if the manager has not interfered and extra effort if the manager has interfered. The former is completely costless for a committed worker. Accordingly, the worker is always going to use this signal. However, normal effort can only be used as a signal when the manager does not interfere with the worker. But then, there is no need for worker B to signal his type. Signaling the type only has value if the manager interfered, created an inefficiency, and a committed worker B tries to eliminate this inefficiency. The following proposition deals with this problem.

Proposition 3. *If the manager has interfered with worker B and worker A does not believe worker B to be committed in the first round, worker B will exert extra effort in the first round to signal commitment if and only if he is sufficiently patient ($\delta > \delta^*$).*

Proof. Because the manager has interfered, worker B can only signal that he is committed by using extra effort. If worker B exerts no extra effort in the first round, worker A has no reason to update beliefs ($\lambda_2^A < \lambda^E$) and will not exert extra effort in the second round either. In the last round, worker B has thus no incentive to exert extra effort. Hence, payoffs in the second round when worker B exerts no extra effort in the first round will be $v^E(0,0) + \delta v^E(0,0)$. If worker B exerts extra effort in the first round, worker A believes that B is committed by Lemma 4. Accordingly, extra effort will be exerted by both in the second round. Note that worker A never exerts extra effort in the first round, because his beliefs are weak. The payoff to worker B from extra effort in the first round is thus: $v^E(0,1) - c^E + \delta(v^E(1,1) - c^E)$. Summarizing, worker B exerts extra effort in the first round whenever $v^E(0,1) - c^E + \delta(v^E(1,1) - c^E) \geq v^E(0,0) + \delta v^E(0,0)$. Solving for δ yields: $\delta \geq \frac{c^E - (v^E(0,1) - v^E(0,0))}{v^E(1,1) - v^E(0,0) - c^E} =: \delta^*$, where the right-hand side is strictly positive by Equations (1) and (2). It is also strictly below one because Equation (1) together with the assumption that the value derived from the extra task increases in extra effort yields: $v^E(1,1) - v^E(0,1) - (v^E(0,0) - v^E(0,0)) > 2 \cdot c^E$, which in turn is equivalent to $c^E - (v^E(0,1) - v^E(0,0)) < v^E(1,1) - v^E(0,0) - c^E$. □

The possibility to use extra effort as a signal for one's preference partially alleviates the inefficiency because worker B exerts extra effort even when the manager interferes. Only the extra effort of worker A in the first round is lost. This efficiency loss ($v^E(0,1) - v^E(0,0) - c^E$) is smaller than the gains of future effort exertion ($v^E(1,1) - v^E(0,0) - 2c^E$) whenever the worker is sufficiently patient ($\delta > \delta^*$). Extra effort can thus be a trust-building measure which improves efficiency. It can, however, not eliminate the inefficiency completely. The first round extra effort from worker B is not met by extra effort from worker A and hence partially wasted.

If worker B is impatient, he will not try to signal commitment. Still, empowerment becomes less attractive to the manager: if an empowered worker A wrongly believes B to be committed and exerts extra effort in the first round, he will correct this mistake in the second round. This affects the manager's trade-off. In order to be able to capture the new situation, we define a new benchmark for the relative importance of the extra task when worker B is impatient:

$$\tilde{\alpha}^0(\lambda) := \frac{(1+\delta)[(1-\lambda)(v^N(1,1) - v^N(1,0)) - k]}{(1+\delta)[\lambda(v^E(1,1) - v^E(0,0))] + (1-\lambda)(v^E(1,0) - v^E(0,0))}. \tag{6}$$

If worker B is patient, empowerment becomes even less attractive to the manager: the manager can rely on worker B to correct the negative signal of interference by exerting extra effort. For the case of a patient worker B, we define the benchmark:

$$\tilde{\alpha}^1(\lambda) := \frac{(1+\delta)[(1-\lambda)(v^N(1,1) - v^N(1,0)) - k]}{\lambda(v^E(1,1) - v^E(1,0))] + (1-\lambda)(v^E(1,0) - v^E(0,0))}. \tag{7}$$

Comparing the three benchmarks for a task to be considered important, we find: $\alpha(\lambda) < \tilde{\alpha}^0(\lambda) < \tilde{\alpha}^1(\lambda)$. In words, given the same belief λ, the threshold for an extra task to be considered important is higher when there is a second round and worker B is impatient and even higher when worker B is patient. We can use this new benchmark to describe the behavior of the manager in dependence of the importance of the extra task.

Corollary 4. *Suppose the team remains together for a second round of effort exertion while first round efforts are observable for team members. If worker B is impatient* , $\delta <$

δ^*, the manager's behavior is described by Proposition 2, where $\tilde{\alpha}^0(\lambda)$ replaces $\alpha(\lambda)$. If worker B is patient , $\delta > \delta^*$, it is described by Proposition 2, where $\tilde{\alpha}^1(\lambda)$ replaces $\alpha(\lambda)$.

Proof. Under the assumption that worker B is impatient and that interference signals weak beliefs, the payoffs to a manager who interferes are:

$$(1+\delta)(v^N(1,1)-k)+\alpha(\lambda^P v^E(0,0)+(1-\lambda^P)v^E(0,0))+\delta\alpha(\lambda^P v^E(0,0)+(1-\lambda^P)v^E(0,0)),$$

While the payoffs to a manager who empowers are:

$$(1+\delta)(\lambda^P v^N(1,1)+(1-\lambda^P)v^N(1,0))+\alpha(\lambda^P v^E(1,1)+(1-\lambda^P)v^E(1,0)) \\ +\delta\alpha(\lambda^P v^E(1,1)+(1-\lambda^P)v^E(0,0)). \quad (8)$$

Comparing these two payoffs yields the threshold $\tilde{\alpha}^0(\lambda)$. The proof then follows from replacing the threshold used in the proof of Proposition 2 by the new threshold.

If we compute the same payoffs if worker B is patient, the payoff from empowerment is the same, while interference yields

$$(1+\delta)(v^N(1,1)-k)+\alpha(\lambda^P v^E(1,0)+(1-\lambda^P)v^E(0,0))+\delta\alpha(\lambda^P v^E(1,1)+(1-\lambda^P)v^E(0,0)).$$

The threshold that keeps the manager indifferent is then $\tilde{\alpha}^1(\lambda)$ and the proof follows from using this new threshold in the proof of Proposition 2. □

The key insight from this proposition is that extra effort needs to be more important for the manager to empower in the dynamic setting and even higher if worker B is patient. The reason is that the costs of signaling drop because worker A can learn from the first round and because worker B can correct the bad impression following interference by exerting extra effort.

5.2 Lasting destructive effects of interference

Extra effort is a valuable signal for worker B because worker A is known to be committed. In this section, we relax the assumption that worker A's type is known. Instead, there is a commonly known prior λ that this worker is committed. How does this influence the behavior of worker B?

Most importantly, extra effort is now only used as a signal of commitment, if worker B's beliefs about worker A's commitment are sufficiently strong.

Proposition 4. *If the manager interferes with a committed worker B, this worker B exerts extra effort and signals to be committed if and only if he has sufficiently strong beliefs $\lambda > 2\lambda^E$ and is sufficiently patient $\delta > \delta(\lambda) > \delta^*$.*

Proof. Initially, the belief of worker B to face a committed worker A (now and in the next round) is λ. If $\lambda < \lambda^E$, worker B has no reason to exert extra effort either now or in the future and signaling his commitment is not optimal for worker B. If on the other hand, the beliefs of worker B about worker A are sufficiently large ($\lambda > \lambda^E$), he believes that A exerts effort in the second round and will do the same. Then, extra effort in the first round leads to an expected payoff of $v^E(0,1) - c^E + \delta(\lambda v^E(1,1) + (1-\lambda)v^E(1,0) - c^E)$. Comparing this payoff with the payoff of no extra effort ($v^E(0,0) + \delta v^E(0,0)$) yields that extra effort is efficient whenever $\delta > \frac{c^E + v^E(0,0) - v^E(1,0)}{\lambda v^E(1,1) + (1-\lambda)v^E(1,0) - v^E(0,0) - c^E} =: \delta(\lambda)$. In order for $\delta(\lambda)$ to be below one, it is necessary that $\lambda > \frac{c^E - (v^E(0,1) - v^E(0,0))}{v^E(1,1) - v^E(1,0)} \cdot 2 = \lambda^E \cdot 2$. □

This proposition shows that uncertainty about the type of worker A weakens the possibility to overcome inefficiency by exerting extra effort. Worker B must be more patient ($\delta > \delta(\lambda) > \delta^*$) than when he knows that worker A is committed. Moreover, worker B needs to have very strong beliefs that worker A is committed ($\lambda > 2 \cdot \lambda^E$). Again, the change in the signaling behavior will influence the empowerment decision of the manager. Relative to the previous situation, the worker signals less and hence the manager empowers more (i.e. for lower α) than before.

We focused the analysis on the empowerment of worker B. Now, as worker A's commitment is unknown and he might not be committed, it seems reasonable to also consider the problem of interfering with this worker. The respective analysis is completely symmetric.

However, the decision to interfere is not independent for the following reason. Suppose that the manager interferes with worker B. We have seen that under appropriate conditions this implies that committed workers are not exerting extra effort. Consequently, the indirect costs of interference are already incurred and any decision whether to empower or interfere with worker A only depends on the direct benefits and costs of interference. In other words, interfering with worker A is cheaper when the manager is already interfering with B. Managers are more inclined to interfere with worker A if they intend to interfere with worker B.

This section has shown that the behavior of the manager can have lasting effect on beliefs and hence on effort provision by workers. Intrinsic motivation will be "crowded out" and even committed team members cannot re-establish an atmosphere which is conducive to voluntary effort, again. According to Tuckman and Jensen (1977) groups go through a number of ideal-type phases: forming - storming - norming - performing - adjourning. The decisive phase for the success of a team is the norming phase. Here, team-members develop common performance standards. If they do not, there is no success. In our dynamic model, managerial interventions may have precisely that effect, because they can distort the process through which team-members learn about the composition of the team. Consequently, an otherwise well performing team settles on just providing the "normal"—in the sense of monitorable— effort.

6 Concluding remarks

We have presented a first step towards an economic theory of team governance. A manager, who decides whether to empower the team or to intervene, faces a simple tradeoff. While intervening increases effort for tasks that can be monitored easily, it may distort the effort incentives for tasks that cannot be monitored. The reason is that they affect the beliefs of members of the team about the commitment of their team-mates to the joint production result. It follows that the optimality of intervention vs. empowerment depends on both prior beliefs about the commitment of team-members and the importance of tasks that cannot be monitored. In a dynamic perspective, interventions may destroy the trusting atmosphere that is required for voluntary effort.

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Appendix

A Preliminaries

We structure the analysis according to the importance of the extra task. This importance, as defined in equation (5), decreases in the belief of the manager.

Lemma 5. *$\alpha(\lambda)$ decreases in λ.*

Proof. Note that $\alpha(\lambda)$ is the ratio $\frac{(1-\lambda)(v^N(1,1)-v^N(1,0)-k)}{\lambda(v^E(1,1)-v^E(0,0))+(1-\lambda)(v^E(1,0)-v^E(0,0))} = \frac{g(\lambda)}{h(\lambda)}$. The sign of the derivative is hence determined by $g'(\lambda)h(\lambda) - g(\lambda)h'(\lambda)$. Note that $h(\lambda)$, $g(\lambda)$, and $h'(\lambda) = v^E(1,1) - v^E(1,0)$ are positive while $g'(\lambda) = -(v^N(1,1) - v^N(1,0)$ is negative. So, overall the derivative is negative and $\alpha(\lambda)$ decreases in λ $\square$

We can thus distinguish three cases:

- no manager finds the extra task important: $\alpha(\underline{\lambda}^P) < \alpha$,
- only managers with strong beliefs find the extra task important: $\alpha(\bar{\lambda}^P) < \alpha < \alpha(\underline{\lambda}^P)$, and
- all managers find the extra task important: $\alpha(\underline{\lambda}^P) < \alpha$.

Most of the following results require that the manager's information would affect the committed workers if they had this information. Formally, we define the following monotonicity condition.

Definition 1 (Monotonicity condition)**.** *The monotonicity condition is met if and only if there is a threshold λ^E such that committed workers exert effort if they share the belief with an manager with strong beliefs $\bar{\lambda}^P > \lambda^E$ and they do not exert effort if they share the belief with a manager with weak beliefs $\underline{\lambda}^P < \lambda^E$.*

For several results, we need the following threshold: $\hat{\lambda} := 1 - \frac{k}{v^N(1,1)-v^N(1,0)}$. This parameter can be regarded as an indicator how effective the interference of the manager is, i.e. how the direct costs of interference k relate to its direct benefit of higher normal effort.

In principle, there are three types of equilibria:

- signaling equilibria, where interference reveals the information of the manager,
- pooled empowerment, where all managers empower, and
- pooled interference, where all managers interfere.

In the following, we examine under which conditions these three types of behavior occur in equilibrium. The notion of equilibrium used will be the Perfect Bayesian Nash equilibrium. Occasionally, we appeal to the intuitive criterion by Cho and Kreps (1987).

A.1 Signaling in Equilibrium

This section lists conditions when to expect signaling to occur in equilibrium. We distinguish two types of signaling.

Definition 2 (Normal and inverted signaling)**.** *Signaling is normal if and only if interference signals that the manager has weak beliefs. Signaling is inverted if and only if interference signals that the manager has strong beliefs.*

Lemma 6. *A manager with weak beliefs has a larger payoff from interfering than an manager with strong beliefs.*

Proof. In terms of the gains from interference, a manager with strong beliefs differs from a manager with weak beliefs only with respect to the benefits from normal effort on the first task. Direct costs and signaling costs are identical. As the manager with strong beliefs expects higher normal effort, the gains from control are smaller. □

Lemma 7 (Interference cannot signal optimism)**.** *In equilibrium, there is no inverted signaling.*

Proof. Suppose intervention signals that the manager has strong beliefs. Then, the manager with strong beliefs prefers intervention to empowerment while managers with weak beliefs empower. However, intervention yields higher gains to managers with weak rather than strong beliefs by the preceding lemma and intervention is thus a profitable deviation for managers with weak beliefs. □

Lemma 8. *Suppose $\alpha < \alpha(\bar{\lambda}^P)$. Then, there is no normal signaling in equilibrium.*

Proof. Suppose normal signaling is an equilibrium. Then, empowerment is used only by managers with strong beliefs. Consequently, a deviation yields $\bar{\lambda}^P v^N(1,1) + (1-\bar{\lambda}^P)v^N(1,1) + \alpha(\bar{\lambda}^P v^E(0,0) + (1-\bar{\lambda}^P)v^E(0,0)) - k$ which is larger than the equilibrium payoff $\bar{\lambda}^P v^N(1,1) + (1-\bar{\lambda}^P)v^N(1,0) + \alpha(\bar{\lambda}^P v^E(1,1) + (1-\bar{\lambda}^P)v^E(1,0))$ because $\alpha < \alpha(\bar{\lambda}^P)$. □

Lemma 9. *Suppose that $\alpha(\bar{\lambda}^P) < \alpha < \alpha(\underline{\lambda}^P)$ and that the monotonicity condition holds. Then, normal signaling occurs in equilibrium. Beliefs in this equilibrium satisfy the intuitive criterion.*

Proof. The equilibrium payoff to an manager with strong beliefs is $\bar{\lambda}^P v^N(1,1)+(1-\bar{\lambda}^P)v^N(1,0)+\alpha(\bar{\lambda}^P v^E(1,1)+(1-\bar{\lambda}^P)v^E(1,0))$, while deviation means that workers thinks she has weak beliefs and don't put in extra effort. Accordingly, the deviation yields $\bar{\lambda}^P v^N(1,1) + (1-\bar{\lambda}^P)v^N(1,1) + \alpha(\bar{\lambda}^P v^E(0,0) + (1-\bar{\lambda}^P)v^E(0,0)) - k$, which is smaller because $\alpha(\bar{\lambda}^P) < \alpha$. The equilibrium payoff to a manager with weak beliefs is $\underline{\lambda}^P v^N(1,1) + (1-\underline{\lambda}^P)v^N(1,1) + \alpha(\underline{\lambda}^P v^E(0,0) + (1-\underline{\lambda}^P)v^E(0,0)) - k$. When deviating and empowering, the manager with weak beliefs is taken to have strong beliefs and has a payoff of $\underline{\lambda}^P v^N(1,1)+(1-\underline{\lambda}^P)v^N(1,0)+\alpha(\underline{\lambda}^P v^E(1,1)+(1-\underline{\lambda}^P)v^E(1,0))$, which is smaller because $\alpha < \alpha(\underline{\lambda}^P)$. □

Lemma 10. *Suppose $\alpha > \alpha(\underline{\lambda}^P)$ and that the monotonicity condition holds. Then, there is no normal signaling in equilibrium.*

Proof. Suppose empowerment is used only by managers with strong beliefs. Then, the payoff to a manager with weak beliefs is

$$\underline{\lambda}^P v^N(1,1) + (1-\underline{\lambda}^P)v^N(1,1) + \alpha(\underline{\lambda}^P v^E(0,0) + (1-\underline{\lambda}^P)v^E(0,0)) - k.$$

When deviating and empowering, the manager with weak beliefs gets $\underline{\lambda}^P v^N(1,1)+(1-\underline{\lambda}^P)v^N(1,0)+\alpha(\underline{\lambda}^P v^E(1,1) + (1-\underline{\lambda}^P)v^E(1,0))$. This deviation is profitable because $\alpha > \alpha(\underline{\lambda}^P)$. □

A.2 Pooled Empowerment in Equilibrium

This section lists conditions when to expect pooled empowerment in equilibrium. We distinguish three types of results: (i) general results, (ii) results which are valid if the manager is well informed, (iii) results when the manager is badly informed.

Definition 3 (Pooled and mixed empowerment)**.** *Pooled empowerment is present if managers with strong and weak beliefs empower. Mixed empowerment is present if the manager with strong beliefs always empowers and the manager with weak beliefs empowers with some probability.*

A.2.1 General results

Lemma 11. *Suppose $\alpha < \alpha(\underline{\lambda}^P)$. Then, there is no pooled empowerment in equilibrium.*

Proof. If all managers empower, the equilibrium payoff to a manager with weak beliefs is at most $\underline{\lambda}^P v^N(1,1) + (1-\underline{\lambda}^P)v^N(1,0) + \alpha(\underline{\lambda}^P v^E(1,1) + (1-\underline{\lambda}^P)v^E(1,0))$. The payoff when deviating is at least

$$\underline{\lambda}^P v^N(1,1) + (1-\underline{\lambda}^P)v^N(1,1) + \alpha(\underline{\lambda}^P v^E(0,0) + (1-\underline{\lambda}^P)v^E(0,0)) - k.$$

Because $\alpha < \alpha(\underline{\lambda}^P)$, this deviation is profitable and empowerment by all managers cannot be an equilibrium. □

Lemma 12. *Suppose $\alpha(\underline{\lambda}^P) < \alpha$, initial beliefs are weak ($\lambda < \lambda^E$), and the monotonicity condition holds. Then, empowerment by managers with strong beliefs and occasional empowerment by managers with weak beliefs occurs in equilibrium. In this equilibrium, workers occasionally exert extra effort following empowerment. Beliefs in this equilibrium satisfy the intuitive criterion.*

Proof. Let $\beta = \frac{(1-\lambda)(v^N(1,1)-v^N(1,0))-k}{\alpha(\underline{\lambda}^P v^E(1,1)+(1-\underline{\lambda}^P)v^E(1,0)-v^E(0,0))}$ be the probability of an observable signal that committed workers use as a prompt for exerting effort after empowerment. Note that this probability lies strictly between zero and one because $\alpha(\underline{\lambda}^P) < \alpha$. Then managers with weak beliefs are indifferent between empowering and not empowering while managers with strong beliefs have a clear preference for empowering. At the same time, the probability with which a manager with weak beliefs empowers can be such that committed workers are indifferent between exerting extra effort and not exerting extra effort after empowerment. Following interference, they do not exert extra effort. □

A.2.2 Well informed manager

Lemma 13. *Suppose initial beliefs are weak($\lambda < \lambda^E$) and the manager is well informed ($\underline{\lambda}^P < \hat{\lambda} < \bar{\lambda}^P$). Then, there is no pooled empowerment in equilibrium.*

Proof. Suppose empowerment by all managers is an equilibrium and $\lambda < \lambda^E$. Then, managers with weak beliefs earn $\underline{\lambda}^P v^N(1,1) + (1-\underline{\lambda}^P)v^N(1,0) + \alpha(\underline{\lambda}^P v^E(0,0) + (1-\underline{\lambda}^P)v^E(0,0))$ while a deviation is more profitable: $\underline{\lambda}^P v^N(1,1) + (1-\underline{\lambda}^P)v^N(1,1) + \alpha(\underline{\lambda}^P v^E(0,0) + (1-\underline{\lambda}^P)v^E(0,0)) - k$. $\square$

Lemma 14. *Suppose $\alpha(\underline{\lambda}^P) < \alpha$, initial beliefs are strong ($\lambda > \lambda^E$), the manager is well informed ($\underline{\lambda}^P < \hat{\lambda} < \bar{\lambda}^P$), and the monotonicity condition is met. Then, pooled empowerment occurs in equilibrium. Beliefs in this equilibrium satisfy the intuitive criterion.*

Proof. In equilibrium, managers earn

$$\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0)).$$

A deviation maximally yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0)) - k$, which is not enough to entice a manager with strong beliefs since $\hat{\lambda} < \overline{\lambda}^P$. Consequently, the intuitive criterion requires that a deviating manager is taken to have weak beliefs and workers respond by exerting no extra effort. Thus the deviation actually yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(0,0) + (1-\lambda^P)v^E(0,0)) - k$, which is not enough as the extra task is sufficiently important: $\alpha(\underline{\lambda}^P) < \alpha$. $\square$

A.2.3 Badly informed manager

Lemma 15. *Suppose $\alpha(\underline{\lambda}^P) < \alpha$, initial beliefs are strong ($\lambda > \lambda^E$) and $\underline{\lambda}^P > \hat{\lambda}$, and the monotonicity condition holds. Then, pooled empowerment occurs in equilibrium. Beliefs in this equilibrium satisfy the intuitive criterion.*

Proof. In equilibrium, managers earn

$$\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0)).$$

A deviation maximally yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0)) - k$, which is not enough to entice the manager with weak beliefs, let alone the managers with strong beliefs because $\underline{\lambda}^P > \hat{\lambda}$ and $\bar{\lambda}^P > \hat{\lambda}$. $\square$

Lemma 16. *Suppose $\alpha(\underline{\lambda}^P) < \alpha$, initial beliefs are strong ($\lambda > \lambda^E$), $\bar{\lambda}^P < \hat{\lambda}$ and the monotonicity condition is met. Then, pooled empowerment occurs in equilibrium. Beliefs in this equilibrium satisfy the intuitive criterion.*

Proof. Suppose such an equilibrium exists and that workers belief that a manager who deviates has weak beliefs. Then, managers earn $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0))$. A deviation maximally yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(1,0) + (1-\lambda^P)v^E(1,0)) - k$, which would be enough to entice both types of managers. So, the belief that managers who deviate have weak beliefs does not fail the intuitive criterion. Given these beliefs, deviation actually yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(0,0) + (1-\lambda^P)v^E(0,0)) - k$, which is neither enough for managers with weak nor with strong beliefs. $\square$

Summarizing the lemmata on empowering, empowering can only arise as an equilibrium if the extra task is sufficiently important $\alpha > \alpha(\underline{\lambda}^P)$ and initial beliefs are strong.

A.3 Pooled Interference in Equilibrium

This section presents several conditions under which pooled interference can arise in equilibrium. Again, we distinguish general results, results for well informed and badly informed managers.

A.3.1 General results

Lemma 17. *Suppose $\alpha < \alpha(\bar{\lambda}^P)$. Then, pooled interference occurs in equilibrium. Beliefs in this equilibrium satisfy the intuitive criterion.*

Proof. The payoff in equilibrium to a manager with strong beliefs is at least

$$\bar{\lambda}^P v^N(1,1) + (1-\bar{\lambda}^P)v^N(1,1) + \alpha(\bar{\lambda}^P v^E(0,0) + (1-\bar{\lambda}^P)v^E(0,0)) - k,$$

while deviation maximally yields $\bar{\lambda}^P v^N(1,1)+(1-\bar{\lambda}^P)v^N(1,0)+\alpha(\bar{\lambda}^P v^E(1,1)+(1-\bar{\lambda}^P)v^E(1,0))$. The latter is smaller because $\alpha < \alpha(\bar{\lambda}^P)$. The manager with weak beliefs has an even lower gain of deviating and will hence also stick with interference. $\square$

Lemma 18. *Suppose $\alpha(\bar{\lambda}^P) < \alpha < \alpha(\underline{\lambda}^P)$, initial beliefs are weak ($\lambda < \lambda^E$), the monotonicity condition holds and beliefs satisfy the intuitive criterion. Then, pooled interference cannot occur in equilibrium.*

Proof. Suppose interference would be an equilibrium. Then, the payoff to managers is $\lambda^P v^N(1,1)+(1-\lambda^P)v^N(1,1)+\alpha(\lambda^P v^E(0,0)+(1-\lambda^P)v^E(0,0))-k$. A deviation maximally yields $\lambda^P v^N(1,1)+(1-\lambda^P)v^N(1,0)+\alpha(\lambda^P v^E(1,1)+(1-\lambda^P)v^E(1,0))$, which is only enough to entice managers with strong beliefs. So, workers will conclude that the deviation comes from an manager with strong beliefs and the payoff of the deviation attains the maximum and is hence profitable. $\square$

A.3.2 Well informed manager

Lemma 19. *Suppose $\alpha(\bar{\lambda}^P) < \alpha$, initial beliefs are strong ($\lambda > \lambda^E$), the manager is well informed ($\underline{\lambda}^P < \hat{\lambda} < \bar{\lambda}^P$), the monotonicity condition holds, and beliefs satisfy the intuitive criterion. Then, pooled interference does not occur in equilibrium.*

Proof. Suppose interference would be an equilibrium. Then, the payoff to managers is $\lambda^P v^N(1,1)+(1-\lambda^P)v^N(1,1)+\alpha(\lambda^P v^E(1,1)+(1-\lambda^P)v^E(1,0))-k$. A deviation maximally yields $\lambda^P v^N(1,1)+(1-\lambda^P)v^N(1,0)+\alpha(\lambda^P v^E(1,1)+(1-\lambda^P)v^E(1,0))$, which is just enough to entice the manager with strong beliefs because $\underline{\lambda}^P < \hat{\lambda} < \bar{\lambda}^P$. The worker concludes that the deviating manager has strong beliefs and exerts extra effort, so that the deviation is profitable. $\square$

Lemma 20. *Suppose $\alpha(\underline{\lambda}^P) < \alpha$, initial beliefs are weak ($\lambda < \lambda^E$), the manager is well informed $\hat{\lambda} < \bar{\lambda}^P$, and the monotonicity condition holds. Then, pooled interference does not occur in equilibrium.*

Proof. Suppose pooled interference is an equilibrium. Then the payoff to managers is $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(0,0) + (1-\lambda^P)v^E(0,0)) - k$. A deviation yields at least $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(0,0) + (1-\lambda^P)v^E(0,0))$, which is profitable to a manager with strong beliefs because $\bar{\lambda}^P > \hat{\lambda}$. □

A.3.3 Badly informed manager

Lemma 21. *Suppose $\alpha(\bar{\lambda}^P) < \alpha$, initial beliefs are strong ($\lambda > \lambda^E$), $\bar{\lambda}^P < \hat{\lambda}$, and the monotonicity condition holds. Then, pooled interference occurs in equilibrium. Beliefs in this equilibrium satisfy the intuitive criterion.*

Proof. In equilibrium, the payoff to managers is $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0)) - k$. A deviation maximally yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0))$, which is not enough to entice even the manager with strong beliefs. □

Lemma 22. *Suppose $\alpha(\bar{\lambda}^P) < \alpha$, initial beliefs are strong ($\lambda > \lambda^E$), $\hat{\lambda} < \underline{\lambda}^P$, costs k are sufficiently small, and the monotonicity condition holds. Then, pooled interference occurs in equilibrium. Beliefs in this equilibrium do not satisfy the intuitive criterion. If beliefs are required to satisfy the intuitive criterion, pooled interference cannot occur in equilibrium.*

Proof. In equilibrium, the payoff to managers is $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0)) - k$. A deviation maximally yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0))$, which is enough to entice the managers with weak or strong beliefs. The worker may conclude that the deviating manager has weak beliefs and not exert extra effort. This belief of the worker does not satisfy the intuitive criterion since managers with strong beliefs too would be enticed by the maximal payoff following deviation. Given this belief, the deviation yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(0,0) + (1-\lambda^P)v^E(0,0))$. This deviation is profitable if and only if $(1-\lambda^P)(v^N(1,1) - v^N(1,0)) + \lambda^P(v^E(1,1) - v^E(1,0)) + (1-\lambda^P)(v^E(1,0) - v^E(0,0)) < k$, which is wrong if k is sufficiently small.

If beliefs are required to fulfill the intuitive criterion, workers' beliefs after seeing empowerment must be at least equal to their initial strong beliefs. Accordingly, they will exert effort. But this means that there is a profitable deviation. □

Lemma 23. *Suppose $\alpha(\underline{\lambda}^P) < \alpha$, initial beliefs are weak ($\lambda < \lambda^E$), $\bar{\lambda}^P \leq \hat{\lambda}$, and the monotonicity condition holds. Then, pooled interference occurs in equilibrium. Beliefs in this equilibrium satisfy the intuitive criterion but the equilibrium is pareto-dominated.*

Proof. In equilibrium, the payoff to managers is $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,1) + \alpha(\lambda^P v^E(0,0) + (1-\lambda^P)v^E(0,0)) - k$. A deviation maximally yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(1,1) + (1-\lambda^P)v^E(1,0))$, which is enough to entice managers with weak and strong beliefs. The worker may not update their beliefs when seeing a deviation. Given these beliefs, the deviation yields $\lambda^P v^N(1,1) + (1-\lambda^P)v^N(1,0) + \alpha(\lambda^P v^E(0,0) + (1-\lambda^P)v^E(0,0))$. The deviation is not even profitable for an manager with strong beliefs since $\bar{\lambda}^P \leq \hat{\lambda}$.

If the extra task is important $\alpha(\underline{\lambda}^P) < \alpha$ and initial beliefs are weak ($\lambda < \lambda^E$), there is also a Perfect Bayesian Nash equilibrium, in which managers with strong beliefs empower and with weak beliefs occasionally empower by Lemma 23. In this equilibrium, the payoff for managers with weak beliefs is the same. Managers with strong beliefs and committed workers are strictly better off because extra effort is exerted occasionally. Uncommitted workers are better off because they can slack on normal effort. The equilibrium described above is hence pareto-dominated. $\square$

B Proof of Proposition 1

Proposition 1 distinguishes four cases: the importance of the extra task can be low ($\alpha < \alpha(0)$) or high ($\alpha > \alpha(0)$) and workers can be strong ($\lambda > \lambda^E$) or weak ($\lambda < \lambda^E$). To prove existence and uniqueness in these cases, we heavily draw on the preceding lemmata. When applying the lemmata, it is important to note that $\bar{\lambda}^P = 1$ so that $\alpha(\bar{\lambda}^P) = \alpha(1) = 0$ by equation (5) and $\bar{\lambda}^P = 1 > \hat{\lambda}$, while $\underline{\lambda}^P = 0 < \hat{\lambda}$. Moreover, the monotonicity condition is always met because of Lemma 2.

B.1 Extra task not important to managers with weak beliefs: $\alpha < \alpha(0)$

By Lemma 9, there is a separating equilibrium where interference signals weak beliefs and by Lemma 7, there is no equilibrium where interference signals optimism. Next, we want to ensure that there are no pooling equilibria. By Lemma 11, a pooling equilibrium where both empower does not exist. It remains to be shown that there is no pooling equilibrium where both interfere. This is where we need to evoke the intuitive criterion. First, consider the case of workers with weak beliefs ($\lambda < \lambda^E$). Then, there is no pooling equilibrium, where both interfere by Lemma 18. In the case of workers with strong beliefs ($\lambda > \lambda^E$) pooled interference can be ruled out by Lemma 19.

B.2 Extra task important to managers with weak beliefs: $\alpha(0) < \alpha$

In this case, it is expedient to distinguish between the sub-cases where workers have weak and strong initial beliefs.

B.2.1 Workers with strong initial beliefs

By Lemma 14, pooled empowerment occurs in equilibrium. By Lemma 7, there is no equilibrium, where interference signals strong beliefs of the manager. By Lemma 10, there is no equilibrium, where interference signals weak beliefs of the manager. It remains to be shown that there is no pooling equilibrium, where all managers interfere; this follows from Lemma 19, where we have to rely on the intuitive criterion again.

B.2.2 Workers with weak initial beliefs

By Lemma 12, there exists an equilibrium, where managers with strong beliefs always empower and managers with weak beliefs only empower occasionally. By Lemma 7, there is no equilibrium, where interference signals strong beliefs of the manager. By Lemma 10, there is no equilibrium, where interference signals weak beliefs of the manager. By Lemma 13 pooled empowerment is no equilibrium and by Lemma 20 pooled interference is not an equilibrium.

C Imperfectly informed manager

When the manager is imperfectly informed, the information may not be useful to the workers. This implies that the monotonicity condition may not be fulfilled.

C.1 When is the manager's information useful?

As guaranteed by Lemma 3, committed workers will exert effort if and only their belief is above λ^E. The manager, who is now imperfectly informed, can only influence the worker's decision if the information matters to the worker. This is the case if and only if $\bar{\lambda}^P > \lambda^E > \underline{\lambda}^P$. By plugging in the respective quantities and solving for λ, we get

$$\frac{1 - p^P(1 - \lambda^E)}{1 - (1 - \lambda^E)(1 - 2p^P)} > \lambda > \frac{(1 - p^P)\lambda^E}{1 + \lambda^E(1 - 2p^P)}.$$

Examining this inequality we can state the following lemma.

Lemma 24. *There is always some initial belief for which the information of the manager matters for the worker. Given this belief the monotonicity condition is met.*

Proof. The denominator of the left-hand-side is smallest if $p^P = 1$ in which case it amounts to λ^E. The numerator becomes largest for $p^P = 0.5$ and the left-hand side is then equal to λ^E and for any real p^P (which has to be the same in the numerator and denominator), it is larger than λ^E. The right-hand side denominator gets largest for $p^P = 0$ and then amounts to λ^E while the numerator is largest for $p^P = 0.5$ and attains one, so the right-hand side is always smaller than λ^E. As the left-hand side is always larger than the right-hand side, there are always values for λ in between for which the worker is curious. □

If the manager is perfectly informed, the monotonicity condition is fulfilled for all initial beliefs. If the manager is almost perfectly informed, the monotonicity condition is fulfilled for all but extreme initial beliefs. If the manager is badly informed, the monotonicity condition is at least fulfilled for some initial belief. So, the more the manager knows (or is believed to know), the more likely is it that her information matters for the worker.

Because the monotonicity condition is met at least for some initial belief, we can again draw on the various lemmata to derive the behavior in equilibrium for this case.

C.2 Proof of Corollary 2

In contrast to Proposition 1, the manager is only almost perfectly informed: p is near but not necessary equal to one. Accordingly, $\bar{\lambda}^P$ is near one and $\underline{\lambda}^P$ near zero. More importantly, $\alpha(\bar{\lambda}^P)$ is no longer zero. This means, we have an additional case to examine. The case $\alpha(\bar{\lambda}^P) < \alpha < \alpha(\underline{\lambda}^P)$ is completely analogue to the case $\alpha < \alpha(0)$ in Proposition 1 because $\bar{\lambda}^P > \hat{\lambda}$ and $\underline{\lambda}^P < \hat{\lambda}$. Similarly, the case $\alpha > \alpha(\underline{\lambda}^P)$ can be proven analogously to the case $\alpha > \alpha(0)$ before.

The only new case that did not exist in Proposition 1 is the case $\alpha < \alpha(\bar{\lambda}^P)$. In this case, there is an equilibrium with pooled interference by Lemma 17. The equilibrium is unique because there is no inverted signaling due to Lemma 7, no normal signaling because of Lemma 8, and no pooled empowerment because of Lemma 14.

C.3 Robustness when the manager is badly informed

If the manager is badly informed, there are a few new sub-cases and there are new equilibrium candidates in known cases.

Two new cases occur if the extra task is very important, $\alpha(\underline{\lambda}^P) < \alpha$, and beliefs are strong. As before when $\alpha(\underline{\lambda}^P) < \alpha$, pooled empowerment is an equilibrium (Lemma 15 and Lemma 16). Another case occurs if the extra task is important, $\alpha(\bar{\lambda}^P) < \alpha$, beliefs are strong, and interference is effective, $\bar{\lambda}^P < \hat{\lambda}$. In this new situation, interference occurs in equilibrium (Lemma 21).

The examined three cases describe the behavior in situations that did not occur before. There are also situations, which we have considered before, and in which new Perfect Bayesian Nash equilibria are possible, now. These equilibria, however, fail either the intuitive criterion (Lemma 22) or are pareto-dominated (Lemma 23). Accordingly, they do not fall into the class of equilibria, which we are considering in this article.

D Contractible output example

For the sake of simplicity, we have assumed that team output is not contractible and that workers cannot credibly communicate to co-workers that they are committed. Also, we have used a reduced form to model the interference of the manager. This section presents a simple example which addresses these three issues and shows that our main results do not conflict with these assumptions.

Suppose that effort costs are $c^N < 1 < 1.5 < c^E < 2$ and assume the following value production functions: $v^N(e) = e_1^N + e_2^N$, $v^E(e) = e_1^E + e_2^E + e_1^E \cdot e_2^E$ such that the overall value of team production is $v = v^N + v^E$. Hence, there are six outcomes of team production $\{0, 1, 2, 3, 4, 5\}$. Reflecting the idea that extra effort cannot be ensured, we assume that a court can easily distinguish whether no ($v = 0$), some ($v = 1$) or a substantial ($v > 1$) team output has been achieved. The finer details with respect to the team output cannot be verfied.

In order to motivate an uncommitted worker, the manager has to pay a bonus. As worker A is always exerting at least normal effort, the bonus has to be paid for substantial effort. If the bonus exceeds one and the committed worker A exerts no extra effort, the uncommitted worker B has an incentive to exert normal effort. If A exerts extra effort, the team output is already substantial, the uncommitted worker B pockets the bonus independent from his behaviour and has hence no reason to exert any effort. It is impossible to entice an uncommitted worker B to exert extra effort: B can obtain the bonus cheaper by exerting normal rather than extra effort.

Observe that an uncommitted worker B, who has not been empowered by the manager, i.e., who has been promised a bonus when substantial output is achieved, has all reason to convince the committed worker A to engage in extra effort. If an uncommitted B manages to convince worker A that he is committed, A may exert extra effort, which allows B to slack.

Summarizing, (partially) contractible team output is not conflicting with our reduced form assumption that only normal effort can be enforced. Moreover, a bonus based on team output provides an explanation why it is difficult for the committed worker B to credibly communicate that he is committed.