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Focusing Attention in Multiple Tasks*

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Abstract

With increasingly complex workplaces, agents face a multitude of different tasks. Standard contract theory predicts similar complex contracts, however, actual contracts are simpler. In order to explain this puzzle I propose a model in which agents' limited attention leads to an instinctive focus on tasks with high outcome variation. This focus of attention leads to a countervailing effect, where despite optimal incentives for a rational agent, the focusing agent chooses the wrong allocation of effort. This provides an explanation of findings in field studies, when the reduction of additional incentives increases productivity. In order to prevent the agent from focusing too much on some tasks over others, the principal needs to assimilate the incentives. Thus even if all outcomes can be measured, the principal will not condition the optimal contract on all available information.

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The modern 'representative firm' is a large, complex organization. Its major functions are performed by different divisions more or less coordinated

Cyert and March, 1963, p.1

One of the most puzzling and troubling failures of incentive models has been their inability to account for the paucity of explicit incentive provisions in actual contracts.

Holmström and Milgrom, 1991, p.34

1 Motivation

In modern economics the typical job description contains a variety of different tasks. Not only the manager has to fulfill multiple tasks but also the project manager and the white collar worker. The work environment becomes increasingly complex with the addition of new tasks. Standard contract theory implies increasingly complex contracts that capture the variety of tasks. In this context the quote by Cyert and March (1963) and Holmström and Milgrom (1991) opens up the questions: With increasing complex organizations, why don't we observe increasingly complex contracts? Why aren't compensation schemes tied to all tasks individually but rather the use of one signal in form of stock market performance or overall performance evaluations?

In their seminal work Holmström and Milgrom (1991) suggest as explanation for the lack of complexity that several tasks are not observable. Those tasks cannot be contracted upon and therefore are ignored by the agent. However, if these tasks are important to the principal and agents are willing to exert effort in all dimensions even if they have no explicit incentives, then it is optimal to set no incentives at all and rather pay a flat wage.

I show that simple incentives are optimal, even if all tasks are verifiable. The reason is agent's limited attention. A complex contract with incentives for multiple tasks will divert the agent's focus to those tasks that have the highest influence on his compensation. This

mechanism combines a model of multiple tasks with context-dependent preferences, where the agents choose their effort in each task. The variation in the different outcomes influences the agent's perception, which in turn leads to higher effort in tasks with higher variation. In order to prevent the agent from focusing too much on some tasks over the others, the principal needs to align the incentives. Thus even if all outcomes can be measured, the principal will not condition the optimal contract on all available information. This violates the informativeness principle. In addition, if the number of tasks increases, then the risk of wrong effort allocation increases. Therefore an incomplete contract that only specifies a fraction of tasks can increase performance. My results give a new perspective on the role of framing of compensation schemes and the agent's perception of contracts.

My first main result shows if a contract is not 'focusing-proof', an otherwise optimal contract will induce an effort allocation contrary to the principal's intentions. This result provides a simple explanation for findings in field experiments (Barankay (2012), Manthei and Sliwka (2013), Englmaier et al. (2016)), how incentives can result in inefficient effort choices. Especially in Englmaier et al. (2016) the focusing effect is very clear, because workers focus on the task with a high prize and high uncertainty.

My second main result derives the optimal contract for focusing agents. As an application of Kőszegi and Szeidl (2013) I can show that in order to avoid the wrong effort allocation, the optimal contract will assimilate incentives. This results in a higher perceived similarity of the different tasks from the agent's perspective.

An incomplete contract that only specifies a fraction of tasks can increase performance. Therefore my results give a new perspective on the role of framing of compensation schemes and the agent's perception of contracts.

The remainder of the paper is organized as follows. Section II reviews the literature in the fields of limited attention, contract design and empirical organizational economics. Section III uses an example of two tasks and two different compensation schemes to motivate the basic insights. Section IV sets up the general framework with a Holmström and Milgrom (1991) model and derives the main results. Section V concludes.

2 Literature

My work contributes to the intersection of organizational economics and behavioral economics. First, with regard to classic contract theory it complements the literature on unintended consequences of incentive contracts. When the objective performance measure is imperfect, an explicit incentive contract can crowd out effort in tasks that are important to the firm but cannot be contracted upon (Holmström and Milgrom (1991) and Baker et al. (1994)). The result is either fraudulent behavior, e.g. the sales agents deceiving their customers to increase sales, or the neglect of important (but unincentivized) tasks, e.g. the teacher who only cares for his students' test scores and neglects their personal development. These unintended consequences are the result of poor contract design that ignores unmeasurable tasks. Better monitoring or fewer incentives are the proposed remedies, depending on the structure of effort costs. Nonetheless, as long as tasks are measurable, the informativeness principle states that all available information should be considered in the incentive contract. My approach complements this strand of literature by changing the question. It is not the task or its observability but rather the agent's reaction to increasing complexity: the agent simplifies his work by focusing on certain tasks.

Second in order to model the agent's reaction to complexity I use recently developed models in behavioral economics. The main idea of these models is that an agent's perception of tasks is influenced by the decision context. These context-dependent preferences provide a simple explanation for a variety of violations of vonNeumann and Morgensterns Independence Axiom. Especially complex decisions are simplified subconsciously, which dimensions it is worth using the agents limited attention on. Focusing is a fast and intuitive assessment of a given situation, which Daniel Kahneman describes as System 1 (Khaneman (2011)). In economics context-dependent preferences capture the simple intuition that, as Tom Cunningham puts it, *'the sensitivity to an attribute depends on the set of quantities that you're considering'*¹. This implies for example that when thinking about a car purchase cars in the decision makers consideration set influence his perception of the different attributes. Economists have

¹<http://tecunningham.github.io/>

started developing models on focusing in economic choice that endogenously derive which dimensions stand out and receive more weight in the agent's perception. Kőszegi and Szeidl (2013) follow the intuition, that the sensitivity increases with the range of observed values in an attribute. Bushong et al. (2015) assume the opposite, with larger differences in attributes agents pay more attention to those dimensions where products' attributes are fairly close to each other. Bordalo et al. (2012) propose a proportional range, where agents evaluate the range in attributes with respect to the average. While Kőszegi and Szeidl (2013) and Bushong et al. (2015) assume a different underlying direction of focusing, their basic mechanism is the same. Therefore I use their approach to study focusing in contracts.² I contribute to this literature through the application to a new field, that hasn't been discussed so far. While the authors already proposed several applications, there has been to the best of my knowledge only one further application by Wisson (2015), who uses focusing agents to study screening in second degree price discrimination.

Third, my application answers to empirical findings from field experiments that raise questions about agent's perception of incentive contracts. Barankay (2012) looks at rank incentives for furniture salespeople in a field experiment. One of his key findings involves increasing the sales performance by dropping the rank feedback. This implies that the ranking system draws the salespeoples' attention to tasks that increase their rank rather than focusing on sales. Manthei and Sliwka (2013) find that at different bank branches the supervisors' use of objective performance measures can have a detrimental effect in small branches. In those branches it leads to a strong focus of agents on those dimensions with high payment variation and a neglect of other tasks. Englmaier et al. (2016) show that in a setting with two measurable tasks, amount and quality of harvested lettuce, agents make mistakes. In a field experiment lettuce harvesters put too much effort in the quality dimension, because it was rewarded by a tournament prize. The variation of outcomes in the tournaments draws agents attention in comparison to the piece rate for quantity. These findings suggest another

²The model by Bordalo et al. (2012) yields similar results through focus on certain states. However the interpretation changes, since the different states matter instead of the payment frames of the contract). In addition the model is not designed for a higher number of states/tasks.

force at work than the observability of outcomes in multiple task models. My approach is able to provide a model that is able to explain the distorted effort decisions as a result of the perceived contracts.

Fourth, there have been experiments on framing effects in contracts. The research has been focusing on penalty contracts, i.e. contracts that use a loss rather than a gain framing in order to provide agents with additional incentives (Hossain and List (2012), deQuidt (2016), Imas et al. (2016)). Although the contracts are equivalent from a classic contracting perspective, the authors find that the loss frame increases the agents' effort, which is in line with behavioral economics. Their research raises the question how the framing of contracts influences the agent's perception and therefore his effort decisions. Outside the field of organizations the empirical evidence on limited attention on decisions has been documented by Chetty et al. (2009) and Finkelstein (2009) in field experiments on non-salient taxes. In both experiments grocery shoppers and drivers are not aware of the taxes they face and don't adjust their behavior accordingly. In a lab experiment Abeler and Jäger (2015) show that in a complex tax system participants adjust too little to new tax rules. They find, that this effects subjects differently on the basis of their ability. While highly able subjects adjust properly to increasing complexity, other subjects disregard the increasing complexity at all. Last, I provide a new angle to the literature on managerial (in)attention and style. The debate on managerial cognition and capabilities has been started in the 1990s in the management literature and focuses on an organizations chances to adapt to changes and pursue new business opportunities (Ocasio (1997), Johnson and Hoopes (2003) and Kaplan (2008)). In economics Dessein et al. (2015) and Dessein and Santos (2016) recently introduced models to explain manager fixed effects, that influence strategic choices in companies. While those models focus on the strategic direction in an uncertain environment, limited attention in form of expertise in certain areas can help the organizations to adapt faster to changes and make better decisions. These models look at the positive aspect of managerial attention, while they abstract from optimal contracts to provide the managers with the correct incentives. My research complements this literature by providing an understanding how the

framing of an incentive contract can direct attention.

3 Example

The main mechanism is captured by an example close to the setup in Englmaier et al. (2016). Suppose a risk neutral principal (she) needs a risk neutral agent (he) to perform two distinct tasks $i \in \{1, 2\}$: quantity ($i = 1$) of production and quality ($i = 2$) of the produced goods. The agent's effort in both tasks determines the principals profit $B(e_1, e_2)$. In order to focus on the effort allocation, I assume $C(e_1, e_2) = 0$, so the agent has to choose one dimension in which he will exert high effort: $\langle e_h, e_l \rangle$ or $\langle e_l, e_h \rangle$, with $e_h > e_l$. The principle sets the reward for quantity as a piece rate $w \cdot e_1$, while for the quality dimension she uses a quality check, that pays a bonus b if the tested products are of high quality and 0 if the product is of low quality. The probability of receiving high quality depends on the effort the agent exerts in the quality dimension, $p(e_2)$. The agent receives an outside option of \bar{U} if he doesn't accept the offered contract. His utility function is additively separable in both dimensions:

$$U(e_1, e_2) = u(e_1) + u(e_2) = e_1 w + p(e_2) b$$

I assume that $B(e_1, e_2)$ is maximized with $\langle e_h, e_l \rangle$ and it is socially optimal to employ the agent, $B(e_1, e_2) \gg \bar{U}$.

Rational Benchmark

The principals maximizes her objective function:

$$\max_{w, b, e_1, e_2} B(e_1, e_2) - w e_1 - p(e_2) b \tag{1}$$

s.t.

$$(PC) \quad w e_1 + p(e_2) b \geq \bar{U} \tag{2}$$

$$(ICC) \quad \max_{e_1, e_2} w e_1^* + p(e_2^*) b \geq w e_1 + p(e_2) b \tag{3}$$

Both (PC) and (ICC) have to bind, otherwise the principle would leave a rent to the agent. Therefore the optimal choices for the piece rate w^* and the bonus b^* are given by:

$$w^* = \bar{U} \frac{p(e_h) - p(e_l)}{p(e_h)e_h - p(e_l)e_l} \quad (4)$$

$$b^* = \bar{U} \frac{e_h - e_l}{p(e_h)e_h - p(e_l)e_l} \quad (5)$$

A focusing agent

If the agent's attention is drawn to the task with the highest variation in pay, the optimal choices for piece rate and bonus payment reverse. For the model I use the definition of focusing in economic choices under uncertainty put forward by Bushong et al. (2015). In each dimension the utility function receives additional weight that captures how much the dimension stands out. The weight is determined by the range of outcomes in this dimension Δ_{e_i} that serves as argument for the weighting function $g(\cdot)$. I use the Kőszegi and Szeidl (2013) definition of a convex weighting function, because its idea of larger differences drawing more attention is in line with the behavior in the field data. The utility function for the focusing thinker is defined as follows:

$$U^{FT}(e_1, e_2) = g(\Delta_{e_1})u(e_1) + g(\Delta_{e_2})u(e_2) = g(\Delta_{e_1})e_1w + g(\Delta_{e_2})p(e_2)b \quad (6)$$

Since task one does not involve any risk, the definition of its range is straight forward:

$$\Delta_{e_1} = \max_{e_1 \in \{e_h, e_l\}} u(e_1) - \min_{e_1 \in \{e_h, e_l\}} u(e_1) \quad (7)$$

Therefore:

$$\Delta_{e_1} = we_h - we_l = w(e_h - e_l) \quad (8)$$

The second task, however, involves the risk of a bad produce being detected and therefore the agent not receiving the bonus b . In order to determine the range under risk Bushong et al. (2015) propose a formulation that considers the expected value E_F as well as the average self-distance S_F for risky prospects, where F denotes the probability distribution:

$$\Delta_{e_2} = \max_{F \in \mathbf{F}} (E_F[u(e_2)] + \frac{1}{2}S_F[u(e_2)]) - \min_{F \in \mathbf{F}} (E_F[u(e_2)] - \frac{1}{2}S_F[u(e_2)]) \quad (9)$$

The average self difference is defined as follows: $S_F[u(e_2)] = \int \int |u(e'_2) - u(e_2)| dF(e'_2)dF(e_2)$.

The intuition for using the average self-distance of a distribution is that in comparison to only using the expected value it also depicts the variation in outcomes in a distribution.

The minimum for the focusing range is always given by e_l :

$$\min_{F \in \mathbf{F}} (E_F[u(e_h)] - \frac{1}{2}S_F[u(e_h)]) > \min_{F \in \mathbf{F}} (E_F[u(e_l)] - \frac{1}{2}S_F[u(e_l)])$$

Since:

$$\underbrace{p(e_h)b}_{E_F[u(e_h)]} - \frac{1}{2} \underbrace{2|b-0|p(e_h)(1-p(e_h))}_{S_F[u(e_h)]} = p(e_h)^2b$$

$$\underbrace{p(e_l)b}_{E_F[u(e_l)]} - \frac{1}{2} \underbrace{2|b-0|p(e_l)(1-p(e_l))}_{S_F[u(e_l)]} = p(e_l)^2b$$

It always holds that,

$$p(e_h)^2b > p(e_l)^2b$$

Therefore low effort generates the smaller minimum range.

The maximum of the focusing range is always given by e_h :

$$\max_{F \in \mathbf{F}} (E_F[u(e_h)] + \frac{1}{2}S_F[u(e_h)]) > \max_{F \in \mathbf{F}} (E_F[u(e_l)] + \frac{1}{2}S_F[u(e_l)])$$

With:

$$\underbrace{p(e_h)b}_{E_F[u(e_h)]} + \frac{1}{2} \underbrace{2|b-0|p(e_h)(1-p(e_h))}_{S_F[u(e_h)]} = p(e_h)b[2-p(e_h)]$$

and

$$\underbrace{p(e_l)b}_{E_F[u(e_l)]} + \frac{1}{2} \underbrace{2|b-0|p(e_l)(1-p(e_l))}_{S_F[u(e_l)]} = p(e_l)b[2-p(e_l)]$$

high effort generates the higher maximum:

$$p(e_h)b[2-p(e_h)] > p(e_l)b[2-p(e_l)]$$

$$2[p(e_h) - p(e_l)] > [p(e_h)^2 - p(e_l)^2]$$

This translates to

$$2 > p(e_h) + p(e_l)$$

which is always true.

Therefore,

$$\Delta_{e_2} = b[2p(e_h) - p(e_h)^2 - p(e_l)^2] \quad (10)$$

The difference in the ranges of both tasks results from the higher variation of the quality task. The frame of the task on its own influences the perception of the tasks. While my example compares a task without risk to a task with risk, even for two risky reward schemes (e.g. tournament and bonus payment or bonus payments in both tasks) the basic intuition remains the same: the agent will focus on the task with the higher variation in outcomes.

Effort Allocation of a Focusing Agent

For a focusing agent the perceived contract changes, therefore I introduce a new participation constraint (PC^p) and a new incentive compatibility constraint (ICC^p), that reflect the agents perception. I first show that the agent's perception leads him to choose the wrong effort allocation. This provides an explanation for the findings in the field. Second, when the principal reacts to the agent's focus and takes the perceived participation and incentive compatibility constraint into account, I show how the optimal compensation scheme changes.

$$(PC^p) \quad g(\Delta_{e_1})we_1 + g(\Delta_{e_2})p(e_2)b \geq \bar{U} \quad (11)$$

$$(ICC^p) \quad \max_{e_1, e_2} g(\Delta_{e_1})we_1^* + g(\Delta_{e_2})p(e_2^*)b \geq g(\Delta_{e_1})we_1 + g(\Delta_{e_2})p(e_2)b \quad (12)$$

First, in order to show that a focusing agent will chose an effort allocation contrary to the principal's plan, I use the compensation schemes b^* and w^* , that were optimal for a rational agent, and show that the (ICC^p) is necessarily violated.

I assume the violation, that the perceived utility for effort allocation $\langle e_l, e_h \rangle$ is higher and rearrange (ICC^p):

$$g(\Delta_{e_2})b^*(p(e_h) - p(e_l)) \geq g(\Delta_{e_1})w^*(e_h - e_l) \quad (13)$$

From equations 4, 5, 8 and 10 we can rewrite 13:

$$g(\bar{U} \frac{(e_h - e_l)(2p(e_h) - p(e_h)^2 - p(e_l)^2)}{p(e_h)e_h - p(e_l)e_l}) \bar{U} \frac{(e_h - e_l)(p(e_h) - p(e_l))}{p(e_h)e_h - p(e_l)e_l} > g(\bar{U} \frac{(e_h - e_l)(p(e_h) - p(e_l))}{p(e_h)e_h - p(e_l)e_l}) \bar{U} \frac{(e_h - e_l)(p(e_h) - p(e_l))}{p(e_h)e_h - p(e_l)e_l} \quad (14)$$

The only difference between LHS and RHS is the range of tasks. Therefore the equation simplifies to

$$(2p(e_h) - p(e_h)^2 - p(e_l)^2) > (p(e_h) - p(e_l))$$

which is true for all increasing $g(\cdot)$ weighting functions.

Rearrangement leads to 15

$$p(e_h) + p(e_l) > p(e_h)^2 + p(e_l)^2 \quad (15)$$

Equation 15 states, that under the optimal compensation scheme for a rational agent, the higher variation in pay for the quality task draws the focusing thinker's attention. Thus, the reward scheme implements the effort allocation $\langle e_l, e_h \rangle$, which opposite to the principals intention. In comparison to the classic contract theory the distortion stems entirely from the agent's biased perception of the reward scheme. This result is captured by proposition 1:

Proposition 1. *If the principal does not regard the effect of the framing of incentive contract on the agent's perception, the optimal contract for a rational thinker induces the opposite effort allocation for a focusing thinker.*

Optimal Contract for Focusing Agents

After having shown, that an incentive contract for a rational agent will result in wrong incentives for a focusing thinker, I now derive the optimal contract for a focusing thinker. The principal has to use the perceived participation (PC^p) and incentive compatibility (ICC^p) constraints.

$$\max_{w,b,e_1,e_2} B(e_1, e_2) - we_1 - p(e_2)b \quad (16)$$

$$(PC^p) \quad g(\Delta_{e_1})we_1 + g(\Delta_{e_2})p(e_2)b \geq \bar{U} \quad (17)$$

$$(ICC^p) \quad \max_{e_1,e_2} g(\Delta_{e_1})we_1^* + g(\Delta_{e_2})p(e_2^*)b \geq g(\Delta_{e_1})we_1 + g(\Delta_{e_2})p(e_2)b \quad (18)$$

I again assume that the principal leaves no rent for the agent, therefore (PC^p) and (ICC^p) have to be binding. For simplification, I assume $g(x) = x$, in order to put as little emphasis on the weighting function as possible. The optimal contract now looks as follows:

$$w^{FT} = (\bar{U} \frac{1}{e_h - e_l} \frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)})^{\frac{1}{2}} \quad (19)$$

$$b^{FT} = \frac{1}{p(e_h) - p(e_l)} (\bar{U} \frac{(e_h - e_l)(p(e_h)e_h - p(e_l)e_l)}{2p(e_h) - p(e_h)^2 - p(e_l)^2})^{\frac{1}{2}} \quad (20)$$

It is not straight forward to compare the new reward scheme (w^{FT}, b^{FT}) to the old (w^*, b^*). The conditions for the new reward scheme being smaller than the old are given by:

Condition 1. $w^* > w^{FT} \Leftrightarrow \bar{U} > \frac{1}{e_h - e_l} [\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)}]^3$

Condition 2. $b^* > b^{FT} \Leftrightarrow \bar{U} > \frac{1}{e_h - e_l} [\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)}]^2 \frac{p(e_h)e_h - p(e_l)e_l}{2p(e_h) - p(e_h)^2 - p(e_l)^2}$

The first condition, $w^* > w^{FT}$, is stronger, i.e. whenever $w^* > w^{FT}$ is fulfilled $b^* > b^{FT}$ is automatically fulfilled as well. Therefore three different cases emerge:

First, when the outside option is high enough, then the new reward scheme is smaller in both tasks, i.e. $w^* > w^{FT}$ and $b^* > b^{FT}$. Since the outside option enters the weighting function, a higher outside option increases the overall perception of compensation and therefore makes it easier to fulfill the participation constraint: $\bar{U} > \frac{1}{e_h - e_l} [\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)}]^3$.

Second, when the outside option is very low, the focusing thinker wouldn't accept the initial proposed contract, since it violates the participation constraint. In order to motivate the agent in the first place, the principal has to offer higher incentives and therefore increases both tasks in the new reward scheme, $w^{FT} > w^*$ and $b^{FT} > b^*$: $\frac{1}{e_h - e_l} [\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)}]^2 \frac{p(e_h)e_h - p(e_l)e_l}{2p(e_h) - p(e_h)^2 - p(e_l)^2} > \bar{U}$.

The third case is the most interesting one, because it foreshadows one important result from the general setup. When the outside option is in an intermediate range, $\frac{1}{e_h - e_l} [\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)}]^3 > \bar{U} > \frac{1}{e_h - e_l} [\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)}]^2 \frac{p(e_h)e_h - p(e_l)e_l}{2p(e_h) - p(e_h)^2 - p(e_l)^2}$, the piece rate has to be increased, while the bonus payment has to be decreased. Therefore from the focusing thinkers perspective the incentives

for both tasks become more similar.

This leads to my second proposition:

Proposition 2. *As long as*

$$\frac{1}{e_h - e_l} \left[\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)} \right]^3 > \bar{U} > \frac{1}{e_h - e_l} \left[\frac{p(e_h)e_h - p(e_l)e_l}{p(e_h) - p(e_l)} \right]^2 \frac{p(e_h)e_h - p(e_l)e_l}{2p(e_h) - p(e_h)^2 - p(e_l)^2}$$

holds, the principal has to assimilate incentives, i.e. increase the piece rate and decrease the bonus, in order to prevent the focusing agent from choosing the opposite effort allocation.

The intuition behind the proposition is that a focusing thinker views both tasks differently, because of their difference in payoffs and involved risk. The higher outcome in the quality task draws his attention to this task, resulting in higher effort in the quality dimension. Since this assessment of the tasks works intuitively, the treatment variation by Englmaier et al. (2016) of pointing out the true payoffs was able to disrupt the assessment of the situation, which led to their effect of higher effort in the piece rate.

4 The Model

The previous results can be translated in a more general framework. Therefore, I use a framework similar to Holmström and Milgrom (1991) and Ederer et al. (2014). A principal hires an agent to perform several different tasks, N . The performance in each task can be measured, x_j with $j \in N$, and is verifiable. The performance depends on the agent's effort in the task, e_j , as well as a random shock, ϵ_j . Neither effort nor the shock can be verified. The performance in each task is therefore given by $x_j = e_j + \epsilon_j$. The realized random shocks have a multivariate normal distribution with mean 0 and variance σ_j . For simplicity I assume that there is no correlation of shocks. This allows for clear results with increasing number of tasks, because only their individual variance matters and not the interaction with other tasks.

For the first two results, I limit the number of tasks to two, i.e. $j \in 1, 2$. In order to obtain interior solutions, I assume the cost function to be convex in both tasks, $c(e_1, e_2) = \frac{1}{2}(e_1^2 + e_2^2)$,

and the benefit function is $B(e_1, e_2) = e_1 + e_2$. I restrict my attention to compensation schedules in which the agent's payment is a linear and separable function of the performance measures: $s(x_1, x_2) = \alpha_1 x_1 + \alpha_2 x_2 + \beta$. The agent is risk averse and has an exponential von Neumann-Morgenstern utility function with coefficient of absolute risk aversion r :

$$u(s(x)) = -e^{-r[\alpha_1 x_1 + \alpha_2 x_2 + \beta - C(e_1, e_2)]}$$

Rational Benchmark

The solution for a rational agent is given by choosing the linear sharing rule that maximizes the certainty equivalent (CE):

$$\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} -\exp(-r[\alpha_1 x_1 + \alpha_2 x_2 + \beta - \frac{1}{2}(e_1^2 + e_2^2)]) \frac{1}{\sqrt{2\pi\sigma_1\sigma_2}} \exp(-\frac{1}{2}[(\frac{x_1 - e_1}{\sigma_1})^2 + (\frac{x_2 - e_2}{\sigma_2})^2]) dx_1 dx_2 = -\exp(-rCE) \quad (21)$$

This results in the equation for the certainty equivalent:

$$CE = \alpha_1 e_1 + \alpha_2 e_2 + \beta - \frac{1}{2}e_1^2 - \frac{1}{2}e_2^2 - \frac{r}{2}\alpha_1\sigma_1^2 - \frac{r}{2}\alpha_2\sigma_2^2 \quad (22)$$

From the resulting first order conditions, I know that $\alpha_i = e_i$ and by setting $CE = 0$, I can derive

$$\beta = -\frac{1}{2}e_1^2 - \frac{1}{2}e_2^2 + \frac{r}{2}\alpha_1\sigma_1^2 + \frac{r}{2}\alpha_2\sigma_2^2$$

The principal is solving her maximization problem: $B(e_1, e_2) - (\alpha_1 e_1 + \alpha_2 e_2 + \beta)$.

$$\max_{e_1, e_2} e_1 + e_2 - e_1^2 - e_2^2 + \frac{1}{2}e_1^2 + \frac{1}{2}e_2^2 - \frac{r}{2}e_1\sigma_1^2 - \frac{r}{2}e_2\sigma_2^2 \quad (23)$$

Therefore the optimal choices for effort and the linear sharing rule are given by:

$$\begin{aligned} \alpha_1^* &= 1 - \frac{r}{2}\sigma_1^2 = e_1^* \\ \alpha_2^* &= 1 - \frac{r}{2}\sigma_2^2 = e_2^* \\ \beta^* &= -1 + r\sigma_1^2 - \frac{3}{2}(\frac{r}{2}\sigma_1^2)^2 + r\sigma_2^2 - \frac{3}{2}(\frac{r}{2}\sigma_2^2)^2 \end{aligned} \quad (24)$$

Effort Allocation of a Focusing Agent

With the rational benchmark I can first analyze how a focusing agent will choose effort under

the optimal incentive scheme for a rational agent. Therefore I introduce a salience distortion to the agent's utility function:

$$u_{fi}(s(x)) = -\exp(-r[g(\Delta_1)s(x_1) + g(\Delta_2)s(x_2) + \beta - C(e_1, e_2)]) \quad (25)$$

The focusing distortion influences the agents perception of the linear sharing rules for each task. This influence is generated through a weighting function, that is increasing in the range of outcomes in each task. I deviate from the authors definition by using the expected value and the variance of a task instead of expected value and average self-distance in order to generate results that are easier to interpret. The basic intuition is, that those tasks with higher payment variation receive more attention and therefore a higher weight. In addition I normalize the variance by the slope α_i for each task, which also simplifies the analysis and is being relaxed in ongoing work.

$$\Delta_i = \frac{1}{\alpha_i} \max_{F \in \mathcal{F}} (E_F[\alpha_i x_i] + \frac{1}{2} Var_F[\alpha_i x_i]) - \frac{1}{\alpha_i} \min_{F \in \mathcal{F}} (E_F[\alpha_i x_i] + \frac{1}{2} Var_F[\alpha_i x_i]) \quad (26)$$

Since the distribution for the error term is always the same, equation 26 simplifies to:

$$\Delta_i = \frac{1}{\alpha_i} Var_F[\alpha_i x_i] = \alpha_i Var_F[\epsilon_i] = \alpha_i \sigma_i^2 \quad (27)$$

I include the focus weights into the agents optimization problem with the optimal linear sharing rule for a rational agent and, again, set the weighting function to be linear, $g(x) = x$. The agent will optimize his certainty equivalent by choosing his effort:

$$\max_{e_1, e_2} g(\Delta_1)\alpha_1^* e_1 + g(\Delta_2)\alpha_2^* e_2 + \beta^* - \frac{1}{2}e_1^2 - \frac{1}{2}e_2^2 - \frac{r}{2}\alpha_1^* \sigma_1^2 - \frac{r}{2}\alpha_2^* \sigma_2^2 \quad (28)$$

The focusing agent's effort choice is given by:

$$\begin{aligned} e_1^{FT} &= (1 - \frac{r}{2}\sigma_1^2)^2 \sigma_1^2 \\ e_2^{FT} &= (1 - \frac{r}{2}\sigma_2^2)^2 \sigma_2^2 \end{aligned} \quad (29)$$

Comparing the optimal effort choices for the rational and the focusing agent, it is clear that $e_i^* > e_i^{FT}$. Taking the partial derivatives of the effort choices with respect to the variance

leads to:

$$\begin{aligned}\frac{\partial e_i^*}{\partial \sigma_i} &< 0 \\ \frac{\partial e_i^{FT}}{\partial \sigma_i} &> 0\end{aligned}\tag{30}$$

The partial derivative for the second equation holds as long as the variance in the task dimension is smaller than $\sigma_i < (\frac{2}{3r})^{\frac{1}{2}}$. Therefore, tasks with higher variance in outcomes attract the agents attention which in turn leads to the effort distortion characterized in Proposition 1, which I can state more formally now:

Proposition 3. *As long as $\sigma_i < (\frac{2}{3r})^{\frac{1}{2}}$ holds,*

$$\frac{\partial e_i^{FT}}{\partial \sigma_i} = 2\sigma_i(1 - \frac{r}{2}\sigma_i^2)[1 - \frac{3r}{2}\sigma_i^2] > 0\tag{31}$$

This implies, if the principal does not regard the effect of the framing of incentive contract on the agent's perception, the optimal contract for a rational thinker induces a focusing thinker to exert higher effort in those dimensions with higher variation.

The proposition shows, that if the contract is not 'focusing-proof' the agent will deviate from the principals intended effort. The contract fails to implement the optimal effort allocation. Comparing this result with the example in section III highlights that the distortion can also be found in structural similar reward schemes. Although the exact framing of a contract might have an additional influence.

Optimal Contract for Focusing Agents

The optimal contract for a focusing thinker can be derived similar to the rational benchmark with the addition of the focus weighting functions to the linear sharing rule.

$$\begin{aligned}\int_{-\infty}^{\infty} \int_{-\infty}^{\infty} & - \exp(-r[g(\Delta_1)\alpha_1x_1 + g(\Delta_2)\alpha_2x_2 + \beta - \frac{1}{2}(e_1^2 + e_2^2)]) \frac{1}{\sqrt{2\pi\sigma_1\sigma_2}} \\ & \exp(-\frac{1}{2}[(\frac{x_1 - e_1}{\sigma_1})^2 + (\frac{x_2 - e_2}{\sigma_2})^2]) dx_1 dx_2 = - \exp(-rCE)\end{aligned}\tag{32}$$

The equation for the agent's certainty equivalent differs from the rational benchmark:

$$CE = \underbrace{e_1\alpha_1^2\sigma_1^2 + e_2\alpha_2^2\sigma_2^2 + \beta}_{\text{linear sharing rule}} - \underbrace{(\frac{1}{2}e_1^2 + \frac{1}{2}e_2^2)}_{\text{effort cost}} - \underbrace{(\frac{1}{2}r\alpha_1^4\sigma_1^6 + \frac{1}{2}r\alpha_2^4\sigma_2^6)}_{\text{risk premium}}\tag{33}$$

The optimal choices for the linear sharing rule are given by:

$$\begin{aligned}\alpha_1^p &= e_1^{\frac{1}{2}}\sigma_1^{-1} \\ \alpha_2^p &= e_2^{\frac{1}{2}}\sigma_2^{-1} \\ \beta^p &= -\frac{1}{2}e_1^2 - \frac{1}{2}e_2^2 + \left(\frac{1}{2}r\alpha_1^4\sigma_1^6 + \frac{1}{2}r\alpha_2^4\sigma_2^6\right)\end{aligned}\tag{34}$$

On this basis I can solve the principals optimization problem:

$$\max_{e_1, e_2} e_1 + e_2 - \alpha_1 e_1 - \alpha_2 e_2 - \beta\tag{35}$$

The first order conditions implicitly define e_i :

$$1 - \frac{1}{2}e_1^{-\frac{1}{2}}\sigma_1^{-1} + e_1 - re_1\sigma_1^2 = 0$$

The implicit function theorem provides the basic insight, that the optimal effort in each task is now decreasing in the variance:

$$\frac{\partial e_i(\sigma_i)}{\partial \sigma} = -\frac{\frac{1}{2}e_i^{-\frac{1}{2}}\sigma_i^{-2} - 2re_i\sigma_i^2}{\frac{1}{4}e_i^{-\frac{3}{2}}\sigma_i^{-1} + 1 - r\sigma - i^2} < 0\tag{36}$$

In order for this to happen, the linear sharing rule has to compensate for the focusing weight. This implies a higher correction factor for dimensions with a higher variation in outcomes. In order to balance the focusing weights, the principal needs to increase the slopes of flatter linear sharing rules, while she decreases the slope of steeper ones. This could be achieved through introducing additional noise terms. In expectations this results in a higher perceived similarity between the different tasks.

5 Conclusion

In complex environments classic economic theory predicts similar complex contracts in order to provide the agent with the right incentives. However, if the agent is not fully capable of processing all information a natural reaction is to reduce the complexity by focusing his

attention. When he focuses on those tasks that have the highest influence on his payoffs the agent ends up allocation his effort among the tasks contrary to the principal's intention.

Through a combination of a model on multiple tasks with a model on focusing in economic choices, I can derive this very basic result. It provides another argument for the existence of incomplete contracts and the observed paucity of incentive schemes. In ongoing work I allow for an increasing number of tasks. The distortion through focusing increases with the tasks therefore it becomes is optimal for the principal rather than using several different measures to resort to one overall measure of productivity or paying a flat wage as long as some tasks decrease the effort costs of other tasks.

My results explain findings of field experiments in organizational economics, where the reduction of incentives increases overall productivity. While I was able to show the distortion for a general multiple task framework, it is an open and interesting question how different contract frames influence the agent's perception and therefore influence his effort choices beyond the financial incentives. The work by Hossain and List (2012), deQuidt (2016) and Imas et al. (2016) is instructive in thinking about the differential effects of contract frames on workers motivation and effort choice.

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