CROWDING-OUT OF INTRINSIC MOTIVATION – OPENING THE

BLACK BOX

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There has been a controversy about the frequently replicated finding that performance-contingent rewards undermine people's intrinsic motivation. The aim of this study is to examine how performance-contingent rewards affect motivation and behavioural intentions. Based on two studies we suggest that a) performance-contingent pay strengthens extrinsic motivation, i.e., elicits a price effect: respondents' behavioural intentions to perform increase. Simultaneously b) performance contingent pay weakens intrinsic motivation, i.e., provokes a crowding-out effect: respondents' behavioural intentions to perform decrease. The total effect on behavioural intentions is composed of the opposing effects of performance contingent rewards on the unobservable construct motivation.

INTRODUCTION

There has for some time been controversy regarding the effect of performance-contingent rewards on behaviour. Standard economic approaches generally assume that such performance-contingent rewards act as a positive stimulus on performance, i.e., that there is a price or disciplining effect (Holmström & Milgrom, 1991; Lawler, 1971; Prendergast, 1999). However, studies in psychological economics and psychology show that performance-contingent rewards can lead to a reduction in effort, particularly in the case of activities which are originally intrinsically motivated.¹ This effect, introduced to the economic literature by Frey (1997b) as the crowding-out effect and to the field of psychology as the corruption effect (Deci, 1975) or as the hidden costs of rewards (Lepper & Greene, 1978), works in opposition to the price effect.

The design of previous studies on the crowding-out effect is exemplified by a field experiment by Gneezy and Rustichini (2000a). The authors investigate the influence of monetary incentives on the behaviour of school pupils while making a voluntary collection. 180 pupils were divided into three groups. The first group received no reward, while the second group received 1%, and the third group 10%, of the sum collected. The group receiving 1% collected significantly less than that which received nothing more than a 'thank-you'. The third group collected more than the second group, yet still collected less than the first group. The weak monetary incentive of 1% of the sum collected reduced (crowded out) the pupils' intrinsic motivation. However, the strong incentive of 10% of the sum collected produced a larger total sum collected than that of the second group due to the price effect, and so once more concurs with the standard economic model.

¹ An activity is intrinsically motivated when it is done for its own sake, i.e., due to interest in or fun from the activity in question or to an adherence to internalised norms. An activity is extrinsically motivated when it is instrumental in obtaining some result which lies outside the activity itself. The distinction between intrinsic and extrinsic motivation goes back to Atkinson (1964), DeCharms (1968) and Deci (1975).

Gneezy and Rustichini's (2000a) field experiment exhibits the characteristics of the reasoning typical of behavioural or psychological economics. The effect – here the crowding-out effect – is postulated post hoc: if performance-contingent rewards show no positive effect on behaviour, this is explained by a negative effect on motivation. However, such an experimental design can provide no evidence of any change in motivation. This is not measured at all; the experiment merely indicates that performance-contingent rewards have no uniform positive effect on performance. What cannot be shown is why performance-contingent rewards fail in certain situations. The untested effect of a third factor is always feasible as a possible cause for the counterproductive effects of performance-contingent rewards.

We test our propositions with two studies. First, we conduct a meta-analytic review of previous empirical studies on the relationship between tangible rewards and performance. In this meta-analysis we establish the baseline motivation for tasks as a moderator to analyze the types of tasks with which tangible rewards lead to a positive or to a negative net effect on performance. We then conduct an experimental vignette design, which allows us to measure changes in both motivation and in intended behaviour and to explain why performance-contingent rewards sometimes lead to a positive or negative net effect on performance. Through random selection, we alter various characteristics of a working situation in the vignette and then elicit the situation-specific responses of the participants to this working situation in the forms of (1) intended behaviour in this context and (2) the motivation for this. Among other factors, the situation is characterised by either performance-contingent or fixed rewards. To augment external validity, the vignette environment was modelled on a project organisation, which is often found in practice.

Our contribution to the current discussion on the effect of performance-contingent rewards is threefold: (1) In contrast to previous studies, we include measures of motivation, rather than merely inferring a change in motivation indirectly from an observed reduction in effort. Thus we avoid circularity in our experimental design (meeting the critique of Kunz and Pfaff (2002) and of others mentioned in this overview). (2) On the basis of our vignette analysis we show that the effort observed always results from both price and crowding-out effects if there was a pre-existent intrinsic motivation. The standard economic model predicts outcomes correctly whenever the price effect exceeds the crowding-out effect. However, it does not predict correctly when the crowding-out effect is stronger than the price effect. In this way, the influence of a simultaneous price and crowding-out effect in situations similar to commercial reality (Gagne & Deci, 2005; Sliwka, 2003).² Our experimental vignette design, applied to participants from professional backgrounds, and our selection of studies for the meta-analysis deals with this criticism.

INCENTIVES AND EFFORT

The Standard Economics View of Incentives and Effort

Traditional economic theory in general is based on the assumption of extrinsically motivated actors, the so called homo oeconomicus (see Frey, 1999), who react to external incentives in a predictable manner. This is based on stimulus-response theory, which involves only observable factors in a black-box treatment. Changes in behaviour are invariably traced back to changes in

 $^{^2}$ Noteworthy exceptions include Jordan (1986) and Deckop & Cirka (2000), who investigate the crowding effect of variable rewards on intrinsic motivation in a context similar to practice. These studies do not test (1) what effect a decrease in intrinsic motivation has on performance, and (2) how high the price effect of variable rewards is.

restrictions and not to changes in preferences (see Stigler & Becker, 1977). Human behaviour can thus be directed through the selective deployment of rewards or sanctions (Thorndike, 1927). Consequently, a central prediction of standard economics is that individuals will increase their working effort most when the incentive system links rewards as closely as possible to performance (see FIGURE 1) (e.g. Foss, 2003; Lazear, 1999; Prendergast, 1999).

Insert FIGURE 1 about here

However, in recent times significant deficiencies in this approach have also been revealed. This is the starting point of modern psychological economics, which integrates the empirical findings of psychology and seeks to base assumptions about human behaviour on a realistic and empirically established foundation (Barkema, 1995; Fehr & Falk, 2002; Frey & Jegen, 2001; Frey & Oberholzer-Gee, 1997; Gneezy & Rustichini, 2000b; Osterloh & Frey, 2000).

The Psychological Economics View of Incentives and Effort

Two differences between psychological economics and the standard economic model are relevant in relation to our argument. (1) People are not only extrinsically motivated, but also intrinsically, and the two types of motivation do not operate additively. (2) People process external incentives cognitively and react differently depending on the differing forms of these incentives.

Extrinsic and intrinsic motivation. In contrast to the assumption of standard economics, extrinsic and intrinsic motivation are not independent of each other, i.e., the two types of motivation do not operate independently. This is shown by numerous experiments and field studies in psychology (Deci, 1975; Deci, 1971; Deci, Koestner, & Ryan, 1999a; Lepper, Greene, & Nisbett, 1973) and psychological economics (Frey et al., 1997). This effect is referred to as the "hidden costs of reward" (Lepper et al., 1978) or as the "crowding-out-effect" (Frey, 1997b).

This effect explains why monetary rewards – as in Gneezy and Rustichini's experiment (2000a) – initially reduce effort substantially. They shift the effort curve from S to S' and so raise the the price of the same performance from R to R' (see *Figure 2*). This is true for "enjoyment-based intrinsic motivation" such as playing or reading an exciting novel (Deci, 1985). However, it is also true for "obligation-based intrinsic motivation" (Frey, 1997a; Frey, Eichenberger, & Oberholzer-Gee, 1996), which is caused by feelings of duty or internalised norms (see Lindenberg, 2001). Intrinsically motivated behavior is central in working situations and are referred to in the literature by, amongst others, the term "Organizational Citizenship Behavior" (Katz & Kahn, 1978; Organ, 1988).

Incentive, cognition und motivation. Several theories have been advanced to explain the crowding-out effect. In psychological economics, for example, the economic approach to the looking-glass self (Benabou & Tirole, 2003) and Lindenberg's (2001) framing theory have gained considerable attraction. In attribution theory self-perception-processes have been brought forward to explain a lasting negative influence of some forms of rewards on intrinsic motivation (Bem, 1972; Ferrin & Dirks, 2003). In further discussion we will draw on a psychological theory: self-determination theory (Deci, 1985; Deci, Connell, & Ryan, 1989). This approach is, of all the explanations, the most comprehensive and is, in addition, broadly empirically supported (for an overview Deci et al. (1999a).³ (1) Based on the concept of the "locus of causality" (De Charms, 1968), it systematically explains the transition from intrinsic to extrinsic

³ The crowding-out effect is empirically well established: Deci and his research group (Deci et al., 1999a) have demonstrated in numerous laboratory experiments that monetary rewards for intrinsically motivated activities have the consequence of reducing future intrinsic motivation: c.f. in this respect Rummel & Feinberg (1988), Wiersma (1992), Tang & Hall (1995). All these meta-analyses indicate that external interventions with a controlling character crowd out intrinsic motivation. In addition, field experiments confirm the crowding-out effect (Frey et al., 2001). See also the critical discourse between Deci and co-authors (1999b) and Eisenberger and coauthors (1999).

motivation and (2) it accounts for why and under which conditions external incentives lead to a shift in motivation.

Insert FIGURE 2 about here

(1) *The locus of causality*: Activities may be undertaken due to an inner incentive (internal locus of causality), i.e., the activity requires no external pressure and is intrinsically motivated. Or they may be the result of external incentives (external locus of causality), i.e., the activity requires external pressure and is extrinsically motivated. In most cases, both motivations play a role simultaneously. Most activities result from both interest in the activity and as a consequence of external incentives. The magnitude by which the internal or external locus of causality preponderates varies. In general, we assume that monotonous simple tasks may be ascribed an external locus of causality, i.e., are extrinsically motivated. And indeed the findings demonstrate evidence for the price effect in the case of such simple tasks (cf. Lazear, 1999). However, it in no way excludes the possibility of undemanding tasks being done for pleasure or from a sense of duty. In contrast, complex, knowledge-intensive activities in teams always require a high proportion of internal locus of causality, and therefore a high intrinsic motivation, because their results cannot be observed and attributed (Osterloh et al., 2000).

(2) *Cause and direction of motivation shift:* the self-determination theory analyses why and in which direction the locus of causality, and with it motivation, is changed (Deci & Ryan, 2000; Gagne et al., 2005). It works from the assumption that individuals have a need for selfdetermination (Deci, 1980). The satisfaction of this need therefore requires that they take responsibility for their activities (Deci, 1985; Deci & Flaste, 1995). The more completely external incentives satisfy the need for self-determination, the more strongly an internal locus of causality develops, i.e., the activity is carried out largely as a result of intrinsic motivation. Incentives which strengthen internal motivation are, for instance, the possibility to participate in decision-making in the workplace, joint setting of objectives, or constructive feedback (Deci et al., 1995; Deci et al., 2000). At the same time such incentives reduce perceived external control. The external locus of causality, and thus extrinsic motivation, decreases. On the other hand incentives that reduce self-determination reduce the internal locus of causality. Performance-contingent rewards are mostly perceived as reducing self-determination (Deci et al., 1999a). As a result contingently rewarded activities are interpreted as being externally caused. This weakens the internal, and simultaneously increases the external, locus of causality.

Stimulus, cognition, motivation and behaviour. Incentives are interpreted by people and can shift the locus of causality. This shift influences intrinsic and extrinsic motivation in opposing ways. Every external incentive which reduces the self-determination of the actor simultaneously creates an unobservable price effect, strengthening the influence of extrinsic motivation on behaviour, and simultaneously creates an unobservable crowding-out, reducing the influence of intrinsic motivation on behaviour. The converse is true for measures which strengthen self-determination. This increases the effect of intrinsic motivation and reduces that of extrinsic motivation. The relative strengths of these two contrary effects produces the observable total effect on behaviour.

Insert FIGURE 3 about here

Drawing on FIGURE 3 we are able to explain under which conditions performancecontingent rewards lead to a positive net effect on performance. Performance-contingent rewards increase efforts when a) the original extrinsic motivation is high, and when b) the incentive shifts the locus of causality far in the direction of external motivation. Under these conditions the standard economic model will tend to predict behaviour correctly (see the right-hand, upward curve in *Figure 3*). However, should intrinsic motivation originally predominate and the desired price effect is, due to the size of the incentive, slight, then the performance-contingent reward will reduce the working effort , and the standard economic model will predict behaviour falsely (see the left-hand, downward curve in FIGURE 3).

These considerations lead to the following conclusions. (1) Every external incentive which undermines self-determination simultaneously creates a price effect and a crowding-out effect. (2) The standard economic model tends to predict behaviour correctly when the price effect more than compensates for the crowding-out effect. (3) The standard economic model does not explain the total effect of external incentives on behaviour, but only traces increases in performance to the price effect. The costs of performance-contingent rewards – as a result of these hidden costs – are therefore always higher than assumed by standard economics.

Hypotheses

In the following we formulate these insights as hypotheses about the incentive effect of performance-contingent rewards. To do this, we begin with the standard economic model and extend this subsequently to motivation shifts.

Performance-Contingent Rewards and Behaviour

In the classic economic view, extrinsic incentives are the more effective the more clearly an immediate relationship between the desired result and the activity of the individual is made. The nature of the incentive given is tied to clearly measurable assessments and reward mechanisms

(Prendergast, 1999). From the stimulus-response assumption of the classic economic view, it follows that:

Hypothesis 1. Performance-contingent rewards increase the efforts of employees.

Intrinsic Motivation und Behaviour

Numerous experiments show that intrinsic motivation strengthens efforts. This relationship holds true for, for instance, charitable giving, charity work, and volunteering (Frey et al., 1996; Frey & Götte, 1999) or for complex creative tasks and Organizational Citizenship Behaviour (Organ, 1988; Organ, 1990). Intrinsic motivation is related to high satisfaction with work, leads to higher cognitive effort, a more effective processing of information, increased creativity and sustained identification with the firm (Amabile, 1997; Bargh & Schul, 1980; Gottfried, 1990; Kogut & Zander, 1996; Pintrich & Degroot, 1990). In addition, intrinsic motivation improves the execution of simple tasks when these tasks require sustained effort and discipline (Koestner & Losier, 2002). Intrinsic motivation costs little apart from appropriate organisational measures, but occurs as a by-product of the activity in hand. The following hypothesis arises from these findings:

Hypothesis 2. Intrinsic motivation increases the efforts of employees.

Interaction of Performance-Contingent Rewards and Motivation: Price Effect and

Crowding-Out Effect

As a consequence of the non-additive relationship between extrinsic and intrinsic motivation, performance-contingent rewards always bring about a shift in these two types of motivation. Meta-studies have confirmed the crowding–out effect of performance-contingent rewards on enjoyment-based intrinsic motivation (Deci et al., 1999a; Deci et al., 1999b). Frey

und Jegen (2001) reach the conclusion that performance-contingent rewards also have a negative influence on obligation-based intrinsic motivation such as adherence to social norms. Based on these theoretical considerations, we infer that performance-contingent rewards have both a price effect and a crowding-out effect on motivation, and consequently on effort:

Hypothesis 3. Performance-contingent rewards affect the relation between intrinsic motivation and effort negatively: high performance-contingent rewards reduce the effect of intrinsic motivation on effort.

Hypothesis 4. Performance-contingent rewards affect the relation between extrinsic motivation and effort positively: high performance-contingent rewards increase the effect of extrinsic motivation on effort.

The relative strength of both effects governs the observable total effect of performancecontingent rewards on effort. We test these hypotheses with a two-study design. On the basis of study 1, the meta-analysis, we show that tangible rewards affect performance differently, depending on the type of tasks performed. In accordance with standard economic theory, tangible rewards strengthen performance in the case of predominantly extrinsically motivated tasks. However, in the case of predominantly intrinsically motivated tasks the price effect of tangible rewards is overwhelmed by the crowding effect of the rewards, and thus net performance declines. In study 2 we shed light on the underlying motivational processes to explain the effect demonstrated by the meta-analysis. Through our experimental vignette design within a work context, we are able to open the black box and test why tangible performancecontingent rewards sometimes lead to a positive or negative net effect on performance. Furthermore we show that the total effect on performance is a composition of the price and crowding effects and that therefore (tangible) performance-contingent rewards tend to be more costly than traditionally assumed, since they produce hidden costs.

STUDY 1: META-ANALYSIS

Methods

Rationale for a new meta-analysis. With few exceptions previous meta-analytic studies (see for an overview Cameron, Banko, & Pierce, 2001; Deci et al., 1999a) focus directly on the effect of tangible rewards on intrinsic motivation⁴. These meta-analytic studies sparked a reward controversy which is still not completely resolved, although there is some agreement that tangible rewards undermine intrinsic motivation under certain conditions. Because of the ambiguity surrounding these results, management science is rather hesitant to embrace these findings. Additionally this hesitance is fed by the fact that in a firm context the "bottom line" of an intervention is what matters; the net effect of tangible rewards on performance in different conditions is of focal interest rather than the effect of rewards on motivation per se. To date there has only been one meta-analysis, conducted by Jenkins, Mitra, Gupta and Shaw (1998), which analyzes how tangible rewards affect performance and which substantiates whether this effect is moderated by differently motivated task types. We suggest that this meta-analysis needs to be complemented for the management perspective, since it a) focuses exclusively on results found in psychology and OB journals, that is, results reported in economic journals are not taken into account and b) has a cut-off point of 1996, so the meta-analysis stops at a time when studies of motivation in behavioural economics were just starting to gain momentum (see Frey, 1997b).

⁴ Intrinsic motivation is measured as subjective self-interest or as the free-time spent on a task after the intervention.

Sample. We take the current criticism of management science on the existing meta-studies into account by applying the following rules of inclusion: we focus on experimental studies which a) address the effect of incentives on task performance and not on some other dependent variable such as intrinsic motivation, b) report "hard" performance measures (quantity and/or quality measures), c) manipulate tangible incentives on an individual level, d) have a control group, e) provide enough information to allow us to determine the effects of incentives on the performance measure used for rewarding subjects, and f) use adult populations. We identified these studies through four search avenues. Firstly, we conducted computerised database searches from 1971⁵ to 2006 using the key words "pay for performance", "tangible rewards", "monetary rewards", "performance-contingent rewards", "performance" and "intrinsic motivation". Secondly, we conducted manual searches of those journals which featured prominently in our database search - namely of Academy of Management Journal, American Journal of Psychology, Journal of Accounting Research, Journal of Applied Psychology, Journal of Management Accounting Research, Journal of Personality and Social Psychology, Quarterly Journal of Economics, Organizational Behavior and Human Performance, and Organizational Behavior and Human Decision Processes. Thirdly, we examined the reference lists in several metaanalyses⁶. Finally, we made a query for unpublished working papers in the field of behavioural or psychological economics. We conducted this query because in this field the search for studies is particularly difficult as economists often do not report simple correlation coefficients or F-Values needed for computation in meta-analysis. The four search avenues and the five inclusion

⁵ We took 1971 as the starting point because in this year the first study on the undermining effect of tangible rewards was published (Deci, 1971).

⁶ (Bonner, Hastie, Sprinkle, & Young, 2000; Cameron & Pierce, 1994; Deci et al., 1999a; Eisenberger & Cameron, 1996; Jenkins et al., 1998; Rummel et al., 1988; Wiersma, 1992).

rules yielded 46 empirical studies (n= 27.524) with 155 usable subgroup-samples (n= 46.363). Descriptive information of these studies is contained in TABLE 1.

TABLE 1 about here

Procedures. Our meta-analysis was conducted using the approach of Hunter and Schmidt (2004). Meta-analysis allows the aggregation of results across separate studies and thus provides an estimate of the true relationship between two variables in a population. The zero-order correlations between the variables of interest are weighted by the sample size of the study in order to calculate the mean weighted correlation across all of the studies in the analysis. The standard deviation of the observed correlations is then calculated to estimate their true variability. Computations for the meta-analysis were performed by using the Comprehensive Meta Analysis (Borenstein, 2000). This software package allows one to control for three artefacts – sampling error, measurement error, and range restriction - which mask true variability by employing Hunter and Schmidt's (2004) artefact distribution formulas.

Nonindependence and Outliers. As noted, many of the 46 studies report more than one mean difference between the rewarded group and the control group. We used the following criteria to ensure an acceptable level of independence among those studies with multiple subgroups. For studies with multiple independent samples, statistics from each sample were included. If a sample reported more than one statistic for a single relationship (for instance, because it involved multiple operationalisations of the same construct), we combined these statistics. Further, we plotted a study's effect size against its standard error to detect outliers. The studies were distributed symmetrically about the combined effect size and point out the absence of publication bias.

Moderator. Since we aim to analyse the overall relationship of tangible rewards and performance, as well as the relationship between these variables in originally predominantly intrinsically motivated tasks vs. predominantly extrinsically motivated tasks, a moderator analysis was conducted. We coded the articles in terms of one potential moderator: task type. Two independent coders did a content analysis of each article searching for key words such as extrinsic/intrinsic, boring/interesting, simple/difficult tasks. The coders agreed on each other's coding. Subsequently the total sample was divided into two groups according to task type. For each group a separate net effect and a critical ratio can be calculated.

Results and Discussion

TABLE 2 illustrates the results of our meta-analysis: overall we find a significant and positive net effect of tangible rewards on performance (0.23^{**}) . Task type consistently moderated the tangible rewards-performance relationship. Tangible rewards increase performance in the case of extrinsically motivated tasks (0.41^{***}) , whereas in the case of predominantly intrinsically motivated tasks tangible rewards actually reduce performance (-0.13^{***}). Thus, the findings of the meta-analysis substantiate our assumption that tangible rewards increase efforts, i.e. have a positive net effect on performance, when the original intrinsic motivation is low. Tangible rewards decrease efforts, i.e. have a negative net effect on performance, when the original intrinsic motivation is high.

TABLE 2 about here	

To control the validity of our findings we additionally tested whether the type of publication outlet moderated the findings. We found no moderator effect of the publication outlet, that is, studies published both in economic and in psychological journals show a positive and commensurate net effect of tangible rewards on performance $(0.26^{***}, 0.22^{***})$.

STUDY 2: VIGNETTE STUDY

Experimental Design

We now turn to the question why performance-contingent rewards sometimes lead to a positive or negative net effect on performance and how this total effect comes about. In order to open the black box we conducted a vignette study, also called a factorial survey (Rossi & Anderson, 1982). Vignette studies are suited to the analysis of the conditions of social contexts, for instance the scope of norms (Beck & Opp, 2001; Buskens, 1999; Jasso & Opp, 1997; Rooks, Raub, Selten, & Tazelaar, 2000). The vignette design resembles the method used in marketing termed conjoint design, which examines a bundle of product benefits, in several significant respects (Teichert, 2001). Vignettes provide "... short descriptions of a person or a social situation which contain precise references to what are thought to be (...) important factors in decision-making or judgment-making processes of the respondents..." (Alexander & Becker, 1978: 94). Within the description, the independent variables are systematically varied by the experimenter. Then the targeted variable, for instance behavioural intentions, is asked about.

Participants are led to weigh the significance of single characteristics to arrive at an overall preference for one alternative. As in reality, the participants are involved in a trade-off. In short, vignette analyses, like the conjoint method, are based on the following three concepts (Teichert, 2001): (1) Every situation consists of a bundle of characteristics. (2) Every participant makes an individual evaluation of the benefits of various combinations of characteristics. (3) The

combination of the benefits of various characteristics provides the relative overall benefit to an individual.

Vignette studies, like all experimental methods, possess the advantage of the isolated alteration of a few factors under controlled conditions (Starmer, 1999). The controlled environment provides the preconditions for a precise analysis. One significant disadvantage in comparison to field studies is the artificial isolation of independent factors: real connections are often not uncovered or are wrongly estimated. In contrast to other experimental methods in organisational research, vignette designs exhibit the following advantages and disadvantages:

- *In contrast to laboratory experiments* vignette designs possess the following advantages: laboratory experiments usually only isolate one or a few test factors, and thus tend to overvalue the causal relationship between test and effect factor. In contrast to this, vignette designs isolate numerous test factors. They are characterised, as are actual social situations, by multidimensionality. The operationalisation of hypotheses is embedded in the organisational environment (Picot, 1975). Thus vignette designs, in contrast to many laboratory experiments, allow for real-life role interpretations (Hughes, 1998). Furthermore, because the experimenter is not present at the vignette experiment there will be no effects of expectation.
- In contrast to field experiments, vignette experiments as with laboratory experiments exhibit particular drawbacks. The advantage of field experiments is that they are conducted under natural conditions. The external validity of the findings is improved because the level of abstraction for the participants is slight and real behaviour is observed (Harrison & List, 2004). However, the complexity of the natural situation in field experiments complicates the control of error terms. In addition, the findings of a field experiment are not free from effects

of expectation. In contrast, the advantage of vignette experiments is that the conditions of the situations can be systematically varied.

- *In contrast to the observation method*, which is often used in laboratory and field experiments, factorial surveys have the disadvantage that the data may not reflect the actual behaviour of the participant. Intentions and behaviour sometimes do not correspond to each other (Bagozzi & Yi, 1991; Bertrand & Mullainathan, 2001). Furthermore, the findings of vignette experiments – as in survey methods – may be impaired by the reporting of socially desirable behaviour. In exchange, survey methods have the advantage that they provide a view into the black box, and do not merely ascribe observed behaviour *post hoc* to underlying motivations.⁷

Experimental Procedure

Our vignette is composed of 10 independent factor variables; each factor represents a different characteristic of the organizational context. Each of these test factors can be given a positive value (e.g., "you can largely organise your own working day"), or a negative (e.g., "the organisation of your working day is prescribed for you"). The test variable "performance-contingent pay" is an exception in that we present three potential forms for this. The vignette covers three dimensions of a working context: Job design, work climate and external incentives.

The design we used was not a reduced design, in contrast to most conjoint method experiments. We asked the entire combination of vignettes across several participants. This procedure possesses the advantage that an analysis of the moderation effects between test factors

⁷ Another method of looking into the black box would be the (rather more laborious) "thinking aloud procedure" (see Hurrle & Kieser, 2005).

and effect factors is later possible. The consideration of the moderating influences of contextual factors is widespread in the social sciences and should also be observed in experimental designs.

These different vignettes were allocated randomly to respondents in a specific order. We first generated "extreme" vignettes which were either very positive or very negative, that is, we selected all possible vignettes with more than 7 variables with a high (positive) value (respectively with more than 7 variable with a low value). In a second step four vignettes were allocated randomly to each respondent in the following order: one extremely positive vignette, one in-between, one extremely negative vignette and another one in-between vignette

In order to achieve a high external validity and to avoid cognitive overload we conducted a pretest with executive MBA students (100 questionnaires i.e. 400 vignettes, response rate 25%). As a result the vignettes were shortened (one variable was dropped) and the wording was adapted. Our main study was conducted in 2006 with 186 part-time executive MBA students on site, who each filled out 4 vignettes (149 questionnaires i.e. 596 vignettes, response rate 80%). A typical respondent had been working for nine years and had completed a college of professional studies. 67% had managing functions.

Operationalisation

Performance-contingent pay. Three different values could be given for the test factor "performance-contingent pay":

- "Your pay does not vary. You receive a fixed salary."
- "Your pay varies only slightly. It consists of 95% fixed salary and up to 5% performancecontingent bonus."
- "Your pay varies widely. It consists of 50% fixed salary and up to 50% performancecontingent bonus."

The values for fixed salary and fixed salary with 5% bonus showed no significant differences in the answers and were subsequently consolidated.⁸

Additional performance. The vignettes present hypothetical project situations for which we then asked intended behaviour. We measure the effect factor "above-average effort" with the item: "To complete these tasks, I will within my working hours invest additional time in meetings which, while voluntary, are significant for the project. *Estimate how many hours of your working week you would give.*" (Scale: >5 h; \leq 3-4 h; \leq 2 h; \leq 1 h; no hours). Intended behaviour may be overstated due to a social desirability bias. This problem can be reduced with the help of the random design used; the analysis of findings measures the differences in the answering behaviour of a person. The person-specific constant effect of social desirability is thus subsequently isolable. However, we do not measure behaviour itself which has to be taken into account when interpreting the results. It must be arrived at by the interpretation of results.

Motivation. Motivation was measured with a version of the self-regulation questionnaire that assesses the degree to which an individual's motivation for a particular behaviour tends to be relatively autonomous or relatively controlled (Ryan & Connell, 1989).⁹ The instrument has been validated in various fields of motivation research (e.g. Biddle, Soos, & Chatzisarantis, 1999; Grolnick, Ryan, & Deci, 1991). The participants have to indicate on a 1-5 scale why they have

⁸ Performance-contingent rewards can only have an effect when they are seen by participants as "salient" (Deci et al., 1999a). The value for 5% bonus is not sufficiently distinguishable from the no-bonus option in the context of this study.

⁹ In psychology intrinsic motivation (which corresponds to an internal locus of causality) is often measured using an instrument which goes back to Lawler & Hall (1970). It differs in two respects from the scale used here. Firstly, motivation is surveyed for the whole workplace. In contrast, we survey motivation for specific behaviours. Secondly, Lawler & Hall (1970) understand "intrinsic" to mean any activity which is undertaken without external pressure. This contradicts the definition of the self-determination theory. There are actions which are indeed undertaken without external pressure but which are nonetheless still externally caused. For instance, an employee voluntarily works overtime, either to make a good impression on his superior and so increase his long-term chances of promotion, or to push the project forward. In the first case, she or he works overtime so as to reach other objectives, thus we can say that the behaviour is induced externally. In the second case, she or he works overtime because the project itself takes centre stage: this behaviour is internally induced. It is only in the second case that we talk about intrinsic motivation.

chosen a particular behaviour ("*Referring to your previous answer about the use of additional time in meetings:* please describe why you give this much additional time). Intrinsic motivation corresponds to an internal locus of causality and was measured with the items (1) "I behave so because I like doing this", and (2) "I behave so because I think it is the right thing to do. It reflects my personal work ethics". Item (1) reflects enjoyment-based intinsic motivation and item (2) obligation-based intrinsic motivation. Extrinsic motivation corresponds to an external attribution and is measured with the item: "I behave so because another behaviour would involve many disadvantages for me".

Price effect of performance-contingent rewards. We measure the price effect of performance-contingent rewards, that is, the strengthening of extrinsic motivation for work effort through performance-contingent rewards as the interaction of performance-contingent pay (1= yes, 0= no) and the degree of extrinsic motivation. A positive, significant coefficient for additional performance corresponds to hypothesis H4.

Crowding-out effect of performance-contingent rewards. We measure the crowding-out effect of performance-contingent rewards, that is, the weakening of intrinsic motivation for work effort through performance-contingent rewards as the interaction of performance-contingent pay (1 = yes, 0 = no) and the degree of intrinsic motivation. A negative, significant coefficient for additional performance corresponds to hypothesis H3.

Control variables. We controlled the realistic quality of the individual vignettes (scale: 1= very unrealistic, 5= very realistic). For the individual participants we controlled for gender, year of birth, length of employment (in years), and the complexity of knowledge in their current work (scale: 1= not knowledge-intensive, 5= very knowledge-intensive).

TABLE 3 about here

Analytical Method

We excluded all the extremely negative vignettes (=149 vignettes), i.e., situations in which the participants had little or no motivation (amotivation), from this analysis. We chose this course of action because circumstances of amotivation are of little interest from an economic point of view, and, in addition, hinder the transferability of the results due to the unrealistic nature of such circumstances. The data base was therefore reduced to 447 vignettes from 149 people (= 3 vignettes per person).

The analysis proceeds via a multilevel mixed-effects linear regression . This method takes account of the hierarchic design of the data and the related divisions of variance: every person answers three vignettes. A participant is always presented with several vignettes to generate changes in behaviour at the level of the individual. The multilevel mixed-effects linear regression allows the estimation of a fixed-effects model allowing for random effects. The random effect indicates that the differences determined between the participants are a result of their (unobservable) personal differences and has no causal relationship with the different situations in the vignettes. The fixed effect indicates that the differences determined are a result of the different characteristics of the situations in the vignette, because a significant majority of the people – independent of their personal qualities – react to a change in the situation in the same way. On this basis the multilevel mixed-effects linear regression firstly specifies a random effect on the level of the individual before the fixed effect of the independent variables is calculated as a regression coefficient.

Results and Discussion

TABLE 4 demonstrates the differences in content between the models 1-4. TABLE 5 shows the results of the regression.

Insert TABLE 4 about here

Insert TABLE 5 about here

Model 2 shows that performance-contingent rewards raise the intention of our participants to make additional commitments to work (β =0.24***). This positive total effect corresponds to the predictions of economic models and provides tentative confirmation of hypothesis H1. In Model 3 we introduce motivation as a further parameter for work effort. Intrinsic motivation, unsurprisingly, shows a strong positive correlation with additional work efforts and provides tentative confirmation of hypothesis H2. (β =0.60***). In addition, Model 3 shows that extrinsic motivation also raises performance slightly (β =0.11*).

Model 4 takes account of the interaction between motivation and performance-contingent pay. It tests whether performance-contingent rewards within the fictional vignettes have an effect on motivation and the behaviour of our participants. In agreement with hypotheses H3 und H4, the findings show that performance-contingent rewards have a strong negative effect on intrinsic motivation, and thus reduce the intention to deliver additional effort at work (β =-0.25** = hidden crowding-out effect). So the introduction of performance-contingent pay reduces the intrinsically motivated component of additional effort by 0.25. At the same time the performance-contingent rewards exert a positive effect on the extrinsic motivation of the participants and so raises the intention to make additional efforts at work (β =0,14* = hidden price effect). The introduction of

performance-contingent pay increases the extrinsically motivated component of additional effort by 0.14.

What is remarkable in model 4 is that the observable total effect of performance-contingent rewards on additional work effort is no longer significant. This observation corroborates the criticism made of the standard economic model. The findings suggest that performancecontingent rewards do not influence (intended) behaviour in a direct stimulus-response chain, but only indirectly through motivation in a stimulus-motivation-response chain.

Our analysis shows that performance-contingent rewards can lead to a shift in the type of motivation for an activity. As the right side of Figure 4 shows, the standard economic model tends to predict behaviour correctly, provided that the external incentive produces a high price effect in comparison to the crowding-out effect. There, where little of the performance is determined by intrinsic motivation, not much can be crowded out. This is particularly true for individuals whose activities were predominantly extrinsically motivated before the announcement of performance-contingent pay, for instance production-line work. In contrast to the previous black-box approach, however, we can show that the direction, but not the magnitude, of the price effect can be correctly predicted. The announcement of performancecontingent rewards always lead to a crowding out of intrinsic motivation. This crowding-out effect is more than compensated for by the relatively high price effect, so that a positive total effect of performance-contingent rewards on the intended performance results.

Insert FIGURE 4 about here

As the left side of FIGURE 4 shows, the standard economic model tends to predict behaviour incorrectly when the external incentive produces a low price effect in comparison to the crowding-out effect. Here, where a great deal of intrinsic motivation is decisive for performance,

a great deal can also be destroyed. This is particularly true for individuals whose activities were predominantly determined by intrinsic motivation before the announcement of the performancecontingent pay. The intrinsic motivation for the execution of these activities is crowded out faster than extrinsic motivation can be built up.

As FIGURE 4 shows, performance-contingent rewards are thus not principally negative. Given an activity predominantly executed due to extrinsic motivation, performance-contingent rewards will have a positive total effect on effort. However, overall performance-contingent rewards *always cost more* than they appear to at first sight. The hidden costs of reward must be added to the financial costs of performance-contingent rewards.

IMPLICATIONS

The core of our findings is that the neglect of intrinsic motivation in the standard economic frame of reference masks central motivational processes, as does the psychological economics model, which deals only with observable behaviour. However, these motivational processes are of decisive importance for the success or failure of external incentives. Financial rewards can simultaneously affect extrinsic motivation positively, through the price effect, and intrinsic motivation negatively, through the "hidden costs of reward" or the crowding-out effect. Therefore, the black box must be opened and the cognitive processes must be included within the theoretical model. Behaviour is usually both intrinsically and extrinsically motivated: it is the combined effect of both which produces the total effect.

One important practical consequence is with regard to the optimal combination of various incentive systems. External incentives simultaneously produce two effects: a price effect and a crowding-out effect. In the literature incentive combinations are often discussed which, through coordinated bundles of incentives, are intended to lead to higher performance. Instances include

"high performance" human resource practices which combine workplace participation with performance-contingent rewards (e.g. Huselid, 1995; Ichniowski, Shaw, & Prennushi, 1997). These practices do not take account of the opposing effects of external incentives we have observed, which can actually even cancel each other out (Edwards & Wright, 2001). The strengthening of intrinsic motivation through participation is undermined by performancecontingent rewards.

Several important theoretical consequences arise. Optimal incentive combinations can only be determined by inclusion of the stimulus-motivation-response chain. Our contribution therefore provides empirically supported starting points for further research. Firstly, future studies could examine the possible distribution of price effect and crowding-out effect in relation to the arrangement of variable performance incentives and that of fixed salaries. For instance, it is feasible that performance-contingent pay in combination with a relatively high and fair fixed salary could have a far less crowding-out effect than when the performance-contingent pay is combined with a low fixed salary. Secondly, one object of future research could be the testing of the stimulus-motivation-response chain with further external incentives. For instance, some studies show that awards and prizes may not crowd out intrinsic motivation but may even strengthen it (Frey & Neckermann, 2006). Thirdly, further interactions between external incentives and intrinsic motivation could be investigated. Often employees initially take on activities only hesitantly and as a result of external pressure. However, the practice of these activities can in fact awaken intrinsic motivation and interest in the task, for instance because it is seen as highly challenging (Frey & Osterloh, 2002). In this case, the external incentive sets off an internalisation process; in the long term, extrinsic motivation is crowded out and intrinsic motivation strengthened.

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The stimulus-response relation in the standard economic model



Note: The relation between external incentives and working effort is illustrated in the graph. Within the standard economic model, the absence of an external incentive produces slight effort (E). An incentive of I will stir the individual to perform E', that is, to raise the effort the distance EE'. This additional deployment of effort, brought about by external intervention, is extrinsically motivated.

FIGURE 2

Crowding-out effect with a negative net effect



Note: The figure indicates how the preferences of an individual are altered by an external incentive. Satisfaction at work and the resultant exertion of effort is represented by the distance OA. This declines in *Fig.* 2 to O. The supply curve S shifts to S'. In consequence the price difference I I' must be paid to achieve a comparable exertion of effort E'



Stimulus response relationship as an explanation of the crowding-out effect



FIGURE 4

Scope of the standard economic model for predicting behaviour



TABLE	1
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Study 1: Statistic for each study of the meta-analysis

ID	Study name	Number of Subgroups within study	Control sample size (mean)	Bonus sample size (mean)	Std diff in means (performance bonus group – performance control group) ^A	Standard error	Z- Value	Journal (1=econ., 2=psych.)	Task (1=simple and/or boring, 2=difficult and/or interesting)	Outcome measurement (1=quality, 2=quantity)
1	Ashton 1990	2	23	25.5	0.22	0.20	1.10	1	1	2
2	Bailey, Brown, & Cocco 1998	2	24	24	0.81 ***	0.21	3.80	1	1	2
3	Baumeister 1984	2	9	9	-1.07 ***	0.36	-2.99	2	1	2
4	Brockner & Vasta 1981	1	26	26	-0.49 *	0.28	-1.73	2	2	2
5	Campbell 1984	16	14	14	-0.63 ****	0.10	-6.50	2	2	1
6	Chow 1983	10	10.4	10.4	0.66	0.14	4.62	1	1	2
7	Daniel & Esser 1980	1	32	32	1.51	0.28	5.34	2	2	2
8	Fabes, Moran, & McCullers 1981	23	19	22.3	-0.29 ****	0.07	-4.39	2	1 & 2	1 & 2
9	Farh, Griffeth, & Balkin 1991	1	14	8	1.58	0.50	3.14	2	1	2
10	Farr 1976	1	45	45	2.56	0.28	8.99	2	1	2
11	Fatseas & Hirst 1992	8	15	15	0.37 ***	0.13	2.86	1	1	2
12	Fehr & Götte 2005	2	22	20	-0.02	0.22	-0.10	1	1	2
13	Fossum 1979	3	20	20	1.39 ****	0.20	6.84	2	1	2
14	Frey & Goette 1999	2	306	63.5	0.11	0.12	0.96	1	2	2
15	Gneezy & Rustichini 2000	5	48	48	-0.17 *	0.09	-1.86	1	2	2
16	Hamner & Foster 1975	8	16	16	0.11	0.13	.90	2	1 & 2	1 & 2
17	Harackiewicz, Manderlink, & Sansone, 1984	1	15	15	0.87 **	0.38	2.29	2	2	2
18	Henry & Strickland 1994	1	68	69	0.99 ***	0.18	5.49	2	1	2
19	Hogarth et al. 1991	2	20	20	0.36	0.23	1.59	2	2	2
20	Lazear 2000	1	1377	1377	0.36 ***	0.04	9.33	1	1	2
21	Lee, Locke & Phan 1997	12	11.7	11.5	-0.33 ***	0.12	-2.72	1	2	2
22	Libby & Lipe 1992	2	40	38	0.33 **	0.16	2.04	1	1	2
23	Lienhard 2006	1	112	112	0.43 ***	0.14	3.16	2	1	2
24	Lopez 1981	1	93	93	1.18 ***	0.16	7.42	2	1	1

ID	Study name	Number Subgroups within study	Control sample size (mean)	Bonus sample size (mean)	Std diff in means p- (performance bonus Value group – performance control group) ^A	Standard error	Z- Value	Journal (1=econ., 2=psych.)	Task (1=simple and/or boring, 2=difficult and/or interesting)	Outcome measurement (1=quality, 2=quantity)
25	Mowen, Middlemist, & Luther 1981	1	62	62	-0.46 ***	0.18	-2.53	2	2	2
26	Paarsch & Shearer 2000	1	17	17	1.08 ***	0.37	2.93		1	2
27	Phillips & Freedman 1988	4	17	17	0.70 ***	0.18	3.97	2	1 & 2	2
28	Pinder 1976	2	20	20	0.75 ***	0.33	2.30	2	1	2
29	Pokorny 2004	8	17	17	-0.03	0.12	-0.22		1 & 2	2
30	Pritchard et al. 1977	1	14	14	0.18	0.38	0.48	2	2	2
31	Remus, O'Connor, & Griggs 1998	2	17	17	0.01	0.24	0.05	2	1	1
32	Saari & Latham 1982	3	12	12	2.43 ****	0.31	7.82	2	1	2
33	Scott, Farh, & Podsakoff 1988	1	48	48	2.69 ****	0.28	9.56	2	2	2
34	Shearer 2004	1	9	9	0.85 *	0.49	1.73	1	1	2
35	Stajkovic & Luthans 2001	2	23.5	23	0.50 ***	0.21	2.39	2	1	1 & 2
36	Stone & Ziebart 1995	1	42	42	1.05 ****	0.23	4.50	2	1	1
37	Terborg & Miller 1978	2	30	30	0.08	0.18	0.45	2	2	1 & 2
38	Turnage & Muchinsky 1976	1	20	20	-1.49 ****	0.36	-4.16	2	1	2
39	Turnage & Muchinsky 1977	1	20	20	1.19 ****	0.34	3.47	2	2	2
40	Vecchio 1982	2	43	0	-0.26	0.16	-1.56	2	2	1 & 2
41	Wageman & Baker 1997	2	36	38	0.84 ****	0.17	4.90	2	1	2
42	Wimperis & Farr 1979	1	16	16	-1.51 ****	0.40	-3.76	2	2	2
43	Wright 1990	3	55	55	0.46 ****	0.11	4.10	2	1	2
44	Yukl & Latham 1975	2	13	12.5	-0.69 **	0.29	-2.39	2	1	2
45	Yukl, Latham, & Pursell 1976	3	15	15	-0.29	0.22	-1.30	2	1	2
46	Yuk, Wexley ,& Seymore 1972	3	5	5	1.80 ****	0.43	4.16	2	1	2

p < 0.01, p < 0.05, p < 0.1. Note: A In this column, positive values indicates that monetary rewards raise the work performance and negative values indicate that monetary rewards decrease the work performance.

Number Studies (Number sub-	Est. ^A	Std. Err.	Z- value	Hetero- geneity (Q-value)
groups)				
46 (155)	0.23 **	* 0.02	11.03	700.56 ***
31 (82)	0.42 **	* 0.03	16.24	338.88 ***
20 (73)	-0.13 **	* 0.04	-3.46	235.17 ***
11 (47)	0.26 **	* 0.03	8.87	72.36 ***
34 (99)	0.21 **	* 0.03	6.75	616.09 ***
	Number Studies (Number sub- groups) 46 (155) 31 (82) 20 (73) 11 (47) 34 (99)	Number Est. ^A Studies (Number sub- groups) 46 (155) 0.23 31 (82) 0.42 20 (73) -0.13 11 (47) 0.26 34 (99) 0.21	Number Studies Est. ^A Err. Std. Err. (Number sub- groups) 6 (155) 0.23 **** 0.02 31 (82) 0.42 **** 0.03 0.04 11 (47) 0.26 **** 0.03 34 (99) 0.21 **** 0.03	Number Studies Est. ^A Std. Z- Err. Vumber sub- groups) Err. value 46 (155) 0.23 *** 0.02 11.03 31 (82) 0.42 *** 0.03 16.24 20 (73) -0.13 *** 0.04 -3.46 11 (47) 0.26 *** 0.03 8.87 34 (99) 0.21 *** 0.03 6.75

TABLE 2

Study 1: Results of the Meta-Analysis

*p <0.01, ***p <0.05, *p <0.1.

Note: ^A In this column, positive values indicates that monetary rewards raise the work performance and negative values indicate that monetary rewards decrease the work performance.

	Study 2: Means, Standard Deviation	s, and (Corre	lation	Matrix	x (447 ⁻	vignet	tes fro	om 14	9 peop	le)
	Measures	Mean	S.D.	1	2	3	4	5	6 '	7	8
1	Additional performance:	3,52	,96								
2	Performance-contingent pay	,42	,49	,09**							
3	Intrinsic motivation:	3,76	,77	,53***	,03						
	Enjoyment-based	3,45	1,03								
	Obligation-based	4,06	,75								
4	Extrinsic motivation:	3,30	1,03	,18***	,15***	,28 ^{***}					
5	Realistic vignettes	2,64	,83	-,25***	,05	-,17***	·-,11**	•			
6	Gender	,58	,49	-,11**	,01	-,19***	-,07	,14**	¢		
7	Year of birth	1977	4,98	-,04	,07	-,18***	,01	,08*	,06		
8	Length of employment	9,48	5,75	,01	-,05	,16***	-,05	-,11**	* -,03 ·	-,53***	
9	Complexity of knowledge in current work	3,89	,94	,10	,06	,03	,05	-,01	,03	,01	,10**

TABLE 3

*p <0.01, ***p <0.05, *p <0.1.

Measurements and Scales: (1) Additional performance: To complete these tasks, I will within my working hours invest additional time in meetings which, while voluntary, are significant for the project (1 = no hours, 5 = >5 h). (2) Performance-contingent pay: 0 = pay is fixed, or, performance-contingent pay is only slight (5% bonus), 1 = pay is performance-contingent (50% bonus). (3) *Enjoyment-based* intrinsic motivation: Additional time in meetings because I want to (1 = strongly disagree, 5 = strongly agree). *Obligation-based* intrinsic motivation: Additional time in meetings because I think it is the right thing to do. It reflects my personal work ethics (1 = strongly disagree, 5 = strongly agree). (4) Extrinsic motivation: Additional time in meetings because another behaviour would involve many disadvantages for me (1 = strongly disagree, 5 = strongly agree). (5) Realistic vignettes: 1 = very unrealistic, 5 = very realistic. (6) Gender: 0 = female, 1 = male. (8) Length of employment: in years. (9) Complexity of knowledge in current work: 1 = not knowledge-intensive, 5 = very knowledge-intensive.

Determinants of additional performance	Model 1	Model 2	Model 3	Model 4
Do the characteristics of the person and the	Х	Х	Х	Х
situation influence the person's reaction?				
Do the existing performance-contingent rewards		Х	Х	Х
influence performance?				
Does the extent of intrinsic and extrinsic			Х	Х
motivation influence performance?				
Do the existing performance-contingent rewards				Х
influence the effect of intrinsic and extrinsic				
motivation on performance?				

Study 2: Differences in content between the models calculated in the regression

TABLE	5
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Dependent variable: Additional performance Model 1 Model 4 Model 2 Model 3 **Independent variables:** Est. Sig. Т Est. Sig Т Est. Sig Est. Sig Т Т **External incentive::** 2 Performance-contingent pay .24 *** (2,56).23 *** (2,75) ,68 (1, 36)Motivation: 3 Intrinsic motivation .60 *** (10,12) ,71 *** (9,08)(1,88) -,03 Extrinsic motivation .11 * 4 (-,53)**External incentive * motivation:** Performance-contingent pay * intrinsic motivation -,25 ** (-2, 19)Performance-contingent pay * intrinsic motivation ,14 * (1,66)**Control variables:** 5 Realistic vignettes (-5,35) ,34 *** (5, 48),26 *** (4,99),22 (3,96),33 *** *** (-1,31) -,17 (-1,36) ,02 (.13) .02 6 Gender -,16 (.14)7 Year of birth -,03 (-1,50) -,03 (-1,56) ,00 (,22) -,01 (-,57)8 Length of employment -.04 * (-1,88) -.04 * (-1,83) -,01 (-,37) -,03 (-1.58)(2,44) ,15 ** 9 Complexity of knowledge in current work .16 ** (2,35) ,03 (,57) ,12 * (1, 87)**Random-Effects:** Std. Err. Est. Est. Std. Err. Est. Std. Err. Est. Std. Err. sd(R.idl) ,48 .07 ,50 ,07 ,47 .06 ,51 ,06 sd(Residual) ,77 ,04 ,75 ,04 ,65 ,03 ,63 ,03 Model fit: Log-restricted likelihood -382 -420 -418 -379 159 Wald chi2(DF) 40 47 186 Prob > chi2,00 ,00, ,00, ,00,

Study 2: Empirical results of the multilevel mixed-effects linear regression (447 vignettes from 149 people)

**** p <0.01, ** p <0.05, * p <0.1.