



## Research paper

## The role of cognitive frames in combined decisions about risk and effort

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## ABSTRACT

Cognitive framing influences the subjective valuation of monetary payoffs and an individual's willingness to exert effort and take risk. In this paper, we explore how cognitive frames created by incentive design and the outcome's fairness influence decisions on risk and effort. While such decisions are often combined in practice, the theories that study risk-taking and motivation to exert effort remain discrete. We set up a multiperiod,  $2 \times 2$  experiment in which we analyze the effects of a bonus versus a penalty contract and a fair versus an unfair outcome distribution. We use a modified Sternberg task to measure risk-effort decisions. We hypothesize that in the case of conflicting cues from the two frames, the cue that creates a perception of loss dominates the decision. We also hypothesize that over time, prior performance influences current decisions by creating a new cognitive frame. We find that if the pay is unfair, neither a bonus nor a penalty seems to matter. If it is fair, high risk-effort tasks are stimulated more by a penalty than a bonus contract. The effect of prior performance eventually outweighs the effect of both incentive manipulations. Our results help to advance the management accounting literature by integrating separate theories on risk-taking and effort exertion to better understand interactive cognitive frames in comprehensive decision-making.

## 1. Introduction

Notable psychological theories stress that decision-making depends on an individual's cognitive frames or mental representations of the decision problem (Birnberg et al., 2007). The design of incentive systems has an important effect on cognitive frames that influence individuals' perception of fairness, their levels of aspiration, and whether they see outcomes as gains or losses. Two leading psychology theories – organizational justice theory (Adams, 1963, 1966) and prospect/framing theory (Kahneman and Tversky, 1979; Kahneman, 2003) – propose that cognitive frames arise by comparing an outcome to a reference point. In organizational justice theory, the reference point represents a comparison with a relevant other, whereas in prospect theory the reference point is basically the status quo (Kahneman, 2003) and may be invoked by a variety of characteristics of the incentive system. An idea common to both theories is that reference points shape cognitive frames and that a deviation from them causes internal conflicts that individuals try to avoid (Birnberg et al., 2007). In more complex decision situations, individuals face several cognitive frames at the same time, and the question arises on which one plays a central role in decision-making and how they interact.

Although the two theories share a profoundly related concept, it is interesting that they remain discrete: whereas the organizational justice theory applies reference values to decisions about motivation to exert

effort without explicit consideration of the outcome risk, prospect theory uses them to predict risk-taking behavior (pure monetary payoffs in the absence of any effort). Yet, in practice, decisions about risk and effort are often simultaneous: in many settings individuals face an option that requires a lot of effort, which potentially brings a high payoff, but the probability of obtaining that payoff depends on the success in completing the task. The alternative is to choose an easy option that requires little effort and has a high probability of success but results in a low payoff. Examples of these options are choosing between a more difficult or an easier field of study that leads to different future salary levels; between a demanding or a less demanding job with the corresponding pay levels and chances of success; between writing a scientific paper for a high impact journal or a low impact journal with the corresponding effort, probabilities of success, and impact factors; choosing between highly uncertain but high-yielding projects in which a lot of effort and new knowledge has to be invested or certain low-yielding projects that require an average amount of work and acquired knowledge.

The aim of this paper is to use both theories to establish which cognitive frames dominate in simultaneous decisions on risk and effort. The literatures on neuroscience, psychology (Hughes et al., 2015; Salamone et al., 1994; Treadway et al., 2015; Walton et al., 2006; Wardle et al., 2012), and animal behavior (Cocker et al., 2012; Hosking et al., 2014a,b) jointly examine the relation between risk and effort

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(reviewed in Salamone et al., 2012; Miller et al., 2013). This body of work reinforces the conjecture that decisions about risk and effort are related because the neural networks activated in both types of decisions tend to overlap.

We analyze the decisions on effort and risk when two features of the incentive scheme give two distinct cues for the formation of the reference point. The first cue comes from labeling performance pay as a bonus rather than a penalty. The second comes from the fairness or unfairness of the payoff with respect to peers. As the base pay is likely to be perceived as the reference point, labeling performance pay as a bonus creates a perception of a gain, and labeling it as a penalty creates a perception of a loss. Similarly, if peers receive a larger bonus or a smaller penalty for the same effort, then the peers' pay level could become the reference point, and the individual's own bonus could appear as a loss. We explore whether one cue strengthens the effect of the other if they are consistent or whether one cue dominates the other if they are inconsistent.

To understand these questions, we develop a three-period, between-subjects,  $2 \times 2$  (bonus vs. penalty and fair vs. unfair outcome) experiment in which we test the effects of manipulations on joint risk-effort decisions. We use a modified Sternberg task (Sternberg, 1966). The Sternberg task is broadly used in psychology to measure cognitive effort (Burrows and Okada, 1973a,b; D'Esposito et al., 2000; Jansma et al., 2007; Zakrzewska and Brzezicka, 2014). We operationalize the risk component by designing three periods, offering increasing incentives for rising task difficulty and probability of failure. We, thus, operationalize joint risk-effort decisions as choices between a high-yielding task that requires high effort with a higher chance of failure (a difficult task) and a low-yielding task that requires low effort with a lower chance of failure (an easy task). A temporal setting creates a third cognitive frame because a positive or a negative prior outcome affects the current decision differently (Thaler and Johnson, 1990). The experiment is tested on 100 students.

We find that the frequency of high risk-effort decisions is the lowest under a fair bonus contract and higher under either a penalty or unfair contract. In a comprehensive setting where both incentive frames are at work if the pay is unfair, it matters little whether the contract is framed as a bonus or a penalty. If the pay is fair, high risk-effort decisions are stimulated more by a penalty than a bonus contract. A fair penalty contract elicits high risk-effort decisions most frequently. A fair bonus contract seems to represent a comfort zone that invokes risk-effort decisions least frequently. In the second round, we observe that the participants' prior performance becomes relevant; and in the third round, the effect of prior performance completely overrides all others: the incentive frames are no longer important. This effect suggests that the evaluation of the probability that one can successfully complete a task based on prior performance and prior choices becomes more important than the incentive scheme or the outcome's fairness and forms a reference point on its own.

The paper makes several contributions to the literature. The first contribution is the examination of simultaneous risk-effort decisions. Without considering such decisions, it is impossible to fully understand the effectiveness of incentive schemes. Performance is frequently a function of risk and effort, yet to our knowledge there is only one paper that explicitly addresses how managerial accounting practices affect risk and effort decisions (Sprinkle et al., 2008). However, unlike our study in which risk and effort are related, Sprinkle et al. (2008) examine risk-taking independently of the participants' exertion of effort. Most management accounting studies adopt the expectancy theory's assumption about the relationship between risk and effort where the higher the probability that effort will lead to increased performance, the more motivated a person will be to exert effort (Vroom, 1964). In this decision context, an individual may affect the probability of success by exerting more effort (i.e., probability of success is endogenous). On the other hand, we study the decisions in which an individual ex ante chooses a level of a task difficulty that comprises the required effort and

acceptable risk. In our decision context, the estimated probability of success is exogenously chosen. Once a level of task difficulty is chosen, the expectancy theory's assumption applies in that more effort will increase the probability of success.

The paper's second contribution is in analyzing how individuals consider more than one cognitive frame at a time. Our findings indicate that the bonus and penalty schemes invoke cognitive frames in line with prospect theory, which adds to the evidence on how various incentive practices shape cognitive frames. We show that when multiple frames interact they stimulate different behavior to that elicited by a single cognitive frame. Third, by studying decision-making in a multiperiod setting, we show that the effect of incentive schemes fades over time as a new salient piece of information emerges (i.e., prior performance) that helps re-evaluate the probability of an outcome. Fourth, our findings hold practical implications for designing effective incentive schemes. The penalty scheme has been found to fuel high risk-effort decisions. As penalty schemes are gaining popularity via a bonus deferral system containing potential penalties and clawback clauses (Hartmann and Slapničar, 2014; Van der Stede, 2011), our findings indicate that they must be implemented with a clear awareness of their effects. Finally, this paper integrates two influential psychological theories with the management accounting literature and practice.

The remainder of the paper is organized as follows. The theoretical background and hypotheses are presented in Section 2. Section 3 introduces the experimental design and its execution. Section 4 presents the results, while Section 5 concludes with a discussion and the implications and limitations of the study.

## 2. Theoretical background and hypotheses development

The importance of cognitive frames was first described by Kahneman and Tversky (1979). In their paper on prospect theory, they showed that the utility of an outcome depends on whether it is perceived as a gain or a loss, rather than on its absolute value and probability. This perception depends on a reference value against which the outcome can be measured. The wording of a decision problem itself (i.e., framing) may change the perceived outcome's utility and influence risk choices. In general, people are risk-averse in the gain domain and risk-seeking in the loss domain: they opt for a higher but probable loss over a smaller but certain one. Further theoretical development has resulted in the so-called theory of framing (Kahneman, 2003), which postulates that reference points may arise from various comparisons, such as with relevant others and with prior periods. The explanation of framing closely coincides with Thaler's (1999) idea of mental accounting.

Independently of the research on decision-making under risk, the organizational justice literature stresses the importance of reference values for motivation. This literature proposes that people are motivated if they perceive a balance in exchange relationships and evaluate the balance by comparing their effort and outcomes to comparable others' effort-outcome ratios (Adams, 1963). If they perceive injustice, they adjust their effort downwards. Comparison with a relevant other is hence one of the central reference points in organizational justice theory. A large body of evidence demonstrates that a perception of distributive fairness has a major impact on motivation.

While the organizational justice theory acknowledges that cognitive frames affect risk-taking and the willingness to exert effort, the questions of which cognitive frames various management accounting practices elicit and whether they are perceived as fair or unfair are less understood. What is the reference point against which one evaluates gains and losses for risk-taking, and does the same reference point impact decisions about effort? Druckman (2001) and Maule and Villejoubert (2007) find that people consider different reference points. These different points explain why the empirical findings on the effects of framing are contradictory. The management accounting literature has relatively neglected the examination of an incentive scheme's effect

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