Risks, Interrupted: the Effect of an Interruption on Decisions of Risk

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We demonstrate that interruptions increase risk-taking by reducing stimuli’s sensory novelty due to the introduction of a repeat exposure to the decision. We further show how this mechanism is distinct from other disruptors, and we propose a general theory of interruption effects that extends previous literature.

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The Curious Case of Risk and Uncertainty

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Paper #1: Risks, Interrupted: The Effect of an Interruption on Decisions of Risk
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Paper #2: Changing How Probability is Represented Attenuates the Reflection Effect
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Paper #3: Not All Money is Created Equal: Neural Signature of Mental Accounting
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Paper #4: Field Experiments on the Effectiveness of Uncertain Incentives
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SESSION OVERVIEW

Life is rife with risk and uncertainty. No one knows what will happen tomorrow; it could be a peace treaty or a declaration of war, and it may bring sun or rain. Despite decades of decision research exploring how consumers contend with risk and uncertainty (e.g., Loewenstein et al. 2001; Gonzalez and Wu 1999; Gneezy, List, and Wu 2006; Kahneman and Tversky 1979; Thaler and Johnson 1990; Tversky and Kahneman 1992; Weber, Blais, and Betz 2002), some fundamental questions remain open: What are “risk” and “uncertainty” in people’s minds? And, how do people learn to make decisions under risk and uncertainty repeatedly?

Papers in this session seek to shed lights on these core questions. The contribution of this session is threefold: Theoretically, we aim to reveal the unexplored drivers of risk-taking behaviors and enrich the literature on consumer decision making under uncertainty. Methodologically, we employ a combination of experimental design, empirical modeling, and neural examination to forge a more nuanced understanding. Practically, we aim to provide data-driven recommendations and advice for marketers and policymakers to better understand and utilize risk and uncertainty.

How do people “feel” about risk? The first paper, by Kpor, Liu, and Amir, demonstrates that although risk and uncertainty elicit fear, interruptions (e.g., a phone call) during the decision-making process allow for mere exposure processes to temper this apprehension, consequently increasing individuals’ willingness to take risks.

What do people “think” about risk? The second paper, by Duke, Mochon, and Amir, investigates the mental representation of risk and uncertainty. They find that merely introducing probabilities in more conversational, easier-to-visualize formats (e.g., a coin toss) can mitigate both risk aversion in gains and risk seeking in losses.

What does risk look like in the brain? The third paper, by Sheng, Hsu, and Shiv, points out that, in the brain, mental accounting matters for risky choices. They find differential loss aversion with endowed versus earned money, and trace neurocognitive activation that may underlie these differences.

How do people work under uncertain incentives? The last paper, by Shen, Hsee, and Talloen, examines the effectiveness of uncertain incentives in a field experiment, and models repeated decisions under uncertainty across time.

This session presents four high-quality research papers centered around one important topic: risk and uncertainty in consumer behavior. Each asks interesting questions, takes unique approaches, and provides exciting findings. This session should appeal to a wide audience who are interested in judgment and decision making in general, and risk and uncertainty in particular. Data collection in all papers is complete and all participants have agreed to present, should the session be accepted.
were equally likely to take the risk ($\chi^2 = .19, p = .663$), were more likely to take the risk than uninterrupted participants (15.4%; $\chi^2 > 6.11, ps < .013$), and trended toward being more likely to take the risk than participants under load (18.0%) and time pressure (18.3; $\chi^2 > 2.79, ps < .095$).

Study 3 tests whether the current effect is due to elongated decision making. Participants decided how much money to invest in a risk that offered a 10% chance of 20 times the amount invested, and a 90% chance of a loss. Participants were randomly assigned to an uninterrupted, interrupted, or elongated duration condition (i.e., 60 seconds, which was the cumulative duration that interrupted participants in a pre-test devoted to making this decision). Condition significantly impacted average investment amount, $F(2, 597) = 4.86, p = .002$. Interrupted participants ($M = 49.56$) took greater risk than uninterrupted participants ($M = 37.65; p = .005$) as well as participants who thought for an extended duration ($M = 38.95; p = .012$), and participants in these latter two conditions took the same amount of risk ($p = .754$).

In study 4 we test the core proposition of our theory—that the interruption effect is driven by reduced sensory novelty upon resuming the decision. We did so by adding a variant of the original interruption condition where we changed the presentation format of the decision (while keeping the informational content the same) when participants resumed the decision. We predicted that this condition would reduce the subjective feeling of familiarity with the decision after the interruption, thereby eliminating the decision interruption effect. Results confirmed our hypothesis—out of a real $1.50, condition significantly impacted investment amount ($M_{\text{Uncertainty}} = .45; M_{\text{Uncertainty}} = .57; M_{\text{Uncertainty With Format Change}} = .50$), $F(2, 484) = 2.97, p = .05$.

Study 5 demonstrates that reduced apprehension mediates the interruption effect. Participants made a hypothetical choice between a sure $50, or a risky option that had a 10% chance of $1,000 and a 90% chance of a $50 loss. Participants who were interrupted chose the risky option more frequently (50.6%) than participants who were not interrupted (38.6%), $\chi^2 (df = 1, N = 330) = 4.85, p = .028$. Moreover, apprehension mediated the interruption effect.

Previous research (Liu 2008) shows interruptions reduce focus on feasibility attributes (e.g., probability). Study 6 demonstrates that interruptions increase risk-taking even in contexts where all options are equally feasible (i.e., probable). In particular, participants made a choice between two risks: Option A offered a 50% chance of $4 and a 50% chance of $7, and Option B offered a 50% chance of $0 and a 50% chance of $18. Although the outcomes in each option were equally feasible (i.e., probable), a pre-test revealed that the prospect of Option B’s $0 evoked more apprehension than the prospect of accruing an amount smaller than the possible maximum. Consistent with our theorizing, interrupted participants (47.1%) chose Option B more frequently than uninterrupted participants (33.3%), $\chi^2 (df = 1, N = 302) = 5.94, p = .015$. Thus, reduced apprehension increases risk-taking even when a reduced focus on feasibility cannot.

Our research sheds light on a fundamental mechanism by which interruptions affect decisions—repeated exposure and its resulting effect on apprehension. Our findings thus have important implications for understanding the dynamic course of risky decisions.

### Changing How Probability is Represented Attenuates the Reflection Effect

**EXTENDED ABSTRACT**

Consumers constantly engage in decisions involving risk and uncertainty, from choosing investments to trying new products. In general, consumers tend to be risk averse among gains, but risk seeking among losses, a pattern termed the “reflection effect” (Kahneman and Tversky 1979). This asymmetry is typically attributed to diminishing marginal sensitivity—that is, to how individuals process payoffs. In four experiments, we instead focus on how individuals process probabilities, and provide evidence that small changes to how probability is represented can attenuate the reflection effect.

In particular, we contrast probabilities expressed as percentages with those represented by outcomes (e.g., the result of a coin toss) involving processes that can be easily mentally simulated (e.g., the flipping and landing of the coin). Prior research suggests that this mental simulation should make the probabilities feel more concrete and vivid (Taylor and Schneider 1989), and therefore seem more likely (Taylor et al. 1998; Johnson et al. 1993). Further, this change should have a greater influence on the perceived likelihood of low rather than high probabilities, as in our context, the options involving low probabilities also offer more extreme outcomes, which should naturally attract more attention (Bordalo et al. 2012).

Overall, we propose that changing from percentages to easy-to-simulate probability representations should increase the perceived likelihood of risky options. Accordingly, this should increase individuals’ willingness to take risks with potential gains, and decrease their willingness to take risks with potential losses. Experiments 1-2 investigate our basic effect, while experiment 3 provides process evidence supporting our theoretical account. Finally, experiment 4 explores a boundary condition.

In experiment 1, participants in the gain (loss) conditions chose between a 75% chance of winning (losing) $20, and a riskier 17% chance of winning (losing) $85. The probabilities were represented either as percentages or in an easier-to-simulate format (drawing balls from an urn). Percentage condition participants showed the reflection effect: risk aversion in gains (88% chose the safe option) and risk seeking in losses (36% chose the safe option), $\chi^2(1) = 31.67, p < .001$. However, this asymmetry disappeared in the easier-to-simulate conditions (gains = 52% vs. losses = 61%), $\chi^2(1) = 0.71, p = .40$ (interaction between gain/loss domain and probability representation: $\beta = 2.96, Wald z = 4.84, p < .001$).

Experiment 2 replicates this effect with an option offering certainty. Participants in the gain (loss) conditions chose between winning (losing) $20 and a 25% chance of winning (losing) $70. Participants saw these probabilities either as percentages or in an easier-to-simulate format (tossing 2 coins). In the percentage conditions, 90% of gains participants chose the safe option, compared to 21% of losses participants, $\chi^2(1) = 25.04, p < .001$. However, representing probabilities in the easier-to-simulate format again attenuated the reflection effect: gains (72% vs. losses = 62%), $\chi^2(1) = 0.31, p = .58$ (interaction: $\beta = 3.02, Wald z = 3.19, p = .001$).

Experiment 3 tests our proposed process. Participants in the gain (loss) conditions chose between a 70% chance of winning (losing) $8 and a 17% chance of winning (losing) $37. Half of participants saw percentages, and the other half saw the easy-to-simulate probability representation from experiment 1. After choosing, participants reported their perceived likelihood of either the risky or the safe option (scale: 1= Extremely unlikely to 7= Extremely likely). The reflection effect again arose in the percentage conditions (81% chose the safe option in gains vs. 41% in losses), $\chi^2(1) = 99.54, p < .001$, and was again attenuated in the easier-to-simulate conditions (gains = 56% vs. losses = 51%), $\chi^2(1) = 1.14, p = .28$ (interaction: $\beta = 1.63, Wald z = 6.52, p < .001$). Furthermore, gains participants perceived the risky option to be more likely in the easier-to-simulate format ($M = 2.85$) than in the percentage format ($M = 2.31$), $t(284) = 4.12, p < .001$, as did losses participants ($M = 3.30$ vs. 2.90), $t(294) = 2.95, p = .003$.
2.90, \( p = .004 \). These shifts in judged likelihood mediated the effect of probability representation on choice in both gains (effect = .19, \( SE = .09, 95\% CI: [.06 to .41] \)) and losses (effect = -.23, \( SE = .10, 95\% CI: [-.47 to -.07] \)). Probability representation had no effect on the perceived likelihood of the safe outcome in losses, \( n(275) = -.56, p = .58 \), and unexpectedly decreased the perceived likelihood in gains (\( M = 5.25 \text{ vs. } 4.88 \)), \( n(230) = -3.12, p = .002 \), but this did not mediate the effect of probability representation on choice. Thus, experiments 1-3 converge to suggest that easier-to-simulate probability representations make riskier outcomes appear more likely, which promotes risk seeking in gains and risk aversion in losses.

Experiment 4 expands our investigation by identifying a boundary condition. Participants imagined choosing between two health insurance plans, one costing $300 less/more (depending on condition) than the previous plan, and another whose costs would be determined by uncertain treatment needs (an 83.3% chance of paying $0 less/more and a 16.7% chance of paying $1900 less/more). The uncertain probabilities were described either in percentage terms, or based on the outcome of a dice roll. Percentage condition participants were again risk averse in gains (75%) and risk seeking in losses (45%), \( \chi^2(1) = 28.31, p < .001 \), and changing the probability representation again attenuated this difference (interaction: \( \beta = 1.25 \), Wald \( z = 3.62, p < .001 \)). However, in this context, it did so through promoting risk aversion in both gains (74%) and losses (73%), \( \chi^2(1) < .001, p > .99 \). Thus, because baseline risk aversion is high in insurance contexts (e.g., Rabin and Thaler 2001), easier-to-simulate probability representations attenuated the risk-attitude asymmetry by promoting risk aversion in both gains and losses.

In summary, our experiments illustrate how the renowned reflection effect is quite sensitive to a feature that is easy for marketeers to modify: the representation of probability information. Importantly, these results suggest that consumers’ risk preferences shift not only when reframing payoffs (e.g., Kühberger et al. 1999), but also when reframing probabilities.

**Not All Money is Created Equal:**

**Neural Signature of Mental Accounting**

**EXTENDED ABSTRACT**

Mental accounting describes how individuals compartmentalize their financial activities by a set of mental accounts associated with different propensity of investment or expenditure (Thaler, 1985). Critically, mental accounting violates the principle of fungibility of money: despite of identical economic value, money in one mental account is not psychologically equivalent with money in another.

In so-call “income accounting”, substantial evidence exists that decision-makers treat money differently depending on how money was acquired (Thaler, 1999; Levav and McGraw, 2009). For example, O’Curry (1997) found that people were less likely to make frivolous consumption with money earned by overtime work than money received as winnings from a football pool. Similarly, people were more reluctant to purchase a vacation with money earned from work than with money received as a gift (Henderson and Peterson, 1992). More generally, mental accounting has been invoked to explain a variety of behaviors ranging from consumption, to investment, to saving and to borrowing, and has been tested in the context of the laboratory, the household and the market.

Despite this wealth of evidence, a number of fundamental questions remain regarding the nature and even existence of mental accounting. In particular, it remains largely unclear whether mental accounting indeed exists as a set of cognitive processes used by the human mind to record financial transactions, or whether it is a useful metaphor to describe dynamic changes in a decision-maker’s sensitivity to gain and losses in response to past outcomes. Second, in the specific case of income accounting, it is unclear the extent to which how money was acquired affects diminishing sensitivity to gains and losses (risk aversion), or the relative weighting of gains and losses (loss aversion).

To address this question, we used a novel experimental paradigm that comprised of two phases: acquisition phase and investment phase. In the acquisition phase, participants acquired money in two purported accounts, namely, salary account and bonus account, respectively. Specifically, they earned $20 in the salary account by completing an effortful visual search task, and received $20 in the bonus account as an endowment effortlessly. Next, in the investment phase, participants made a series of decisions of whether to accept or reject a gamble enabling 50/50 probability of winning vs. losing with money in the two accounts.

We collected both behavioral and neural data using this paradigm, and asked (i) the extent to which how money was acquired in the acquisition phase affected behavior in the investment stage, and (ii) whether the human brain flexibly encodes and processes gains and losses in the investment stage according to how money was acquired in the acquisition phase, as predicted by mental accounting.

Behaviorally, we adopted a prospect theory approach to examine how risk and loss aversion attitudes varied with earned money and endowed money. Specifically, we found that, relative to the baseline model where risk and loss aversion were unaffected by the two accounts, a two-account model where loss aversion was affected by accounts explained choices significantly better. In contrast, this was not the case with a two-account model where risk attitude was affected by the two accounts. Thus, earned money, relative to endowed money, selectively modulated individuals’ attitude toward losses as opposed to attitude toward risks.

The validity of the behavioral finding was further examined by the analysis of neural data. First, we calculated the utility of each gamble according to each of the three models and obtained three separate utility for each gamble. Next, we subtracted the utility calculated from the one-account model from the utility calculated from the two-account model with account-dependent loss aversion. Finally, and critically, we searched for neural activity tracing the differential utility independent from neural activity tracing the utility calculated from the one-account model. We found that medial prefrontal cortex, a brain region known for its role in value representation, did not only represent the utility of the one-account model, but also represented the differential utility of the two-account model relative to the one-account model. Thus the brain responds in a manner better predicted by the two-account model than the one-account model.

By employing the novel approach of brain imaging, this study shows that mental accounting is not merely a metaphor, but indeed exists as a set of the neural processes in the human brain. Thus, the concept of mental accounting is not only useful, but also valid, biologically.

**Field Experiments on the Effectiveness of Uncertain Incentives**

**EXTENDED ABSTRACT**

Many of the decisions we make are repetition decisions, choosing whether to repeat an activity or not; for example, deciding whether to order another drink at a restaurant after having just finished one, or deciding whether to return to the gym after having worked out yesterday.
Prior behavioral research has identified various determinants of behavioral repetition, such as token size and progress perception. We focus on a factor that has received less attention: incentive uncertainty, that is, whether the financial outcome of an action is certain or uncertain. For example, which pay scheme, a certain per-task pay of $5 or an uncertain per-task pay of either $3 or $5 with equal chances, is more effective at motivating a research assistant to complete a task repeatedly?

We propose that uncertain incentives can lead to more repetitions than certain incentives, even if the uncertain incentive is strictly dominated by the certain incentive, which we refer to as the reinforcing-uncertainty effect. In other words, we predict a positive effect of uncertainty in repetition decisions. We conducted two natural field experiments to test the proposed reinforcing-uncertainty effect.

In one field experiment, we collaborated with a local running club in Hong Kong. Club members participated in a spring running event in which they could earn points by working out on the track. Half of them received 5 points for each lap they completed (certain), and the other half received 3 or 5 points (uncertain). All points they earned could be exchanged for the equivalent amount of Hong Kong dollars into a gift card from a café. At the end of the event, the uncertain incentive scheme made the club members run, on average, about 6.48 extra laps compared to the certain incentive scheme. This experiment shows a positive effect of uncertainty on repetition: People literally ran “the extra mile” (precisely, 1.61 more miles) for uncertainty.

In another field experiment, we replicated the reinforcing-uncertainty effect in repetition decisions with more substantial incentives. The experiment took place on a Hong Kong pay-by-task survey platform (similar to Amazon’s Mechanical Turk) affiliated with a large local public university. In the certain pay condition, for each 10-min survey they were paid HK$40 (US$5.13), whereas in the uncertain pay condition they were paid either HK$20 or HK$40 with equal chances. These incentive magnitudes were on par with about four times the standard wage of a business-school graduate student working as a research assistant in Hong Kong.

We found that: (a) in terms of “entry,” the uncertain pay did not seem attractive; workers were 20% less likely to show up and take any survey if they were promised an uncertain pay; (b) in terms of “repetition,” the uncertain pay excelled at maintaining an active worker pool; among those who showed up, an uncertain-pay worker, on average, completed 5.65 more surveys (out of 42 surveys) than a certain-pay worker. The contrast between entry and repetition indicates that uncertain dynamic incentives are more effective than certain incentives because people learn about the pleasure of uncertainty resolution through, not before, repetitions.

Together, the two field experiments showed a positive effect of uncertainty on repetition and documented the effectiveness of uncertain incentives with real consequences and in serious decision contexts.

REFERENCES


