

**ABSTRACTS**



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# Plenary Sessions

## Plenary 1

**Keynote Speaker** sponsored by CAGE



**"Agreeing to Disagree in Large Worlds"**

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## Plenary 2

**Keynote Speaker** sponsored by Behavioural GRP



**"Preference: Primitive or Constructed Value?"**

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## Plenary 3

**Keynote Speaker** sponsored by CAGE



**"Biological Foundations of Choice Theory"**

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## **Round Table Sessions**





# **NIBS Round Table**

## **Ambiguity and Learning**

# Information and Decisions: Description and Experience Come Together in Individual and Social Interactions

*Cleotilde Gonzalez*

## Abstract

A theoretical distinction has emerged in the past decade regarding how decisions are made from description (explicit definition of risks, outcomes, probabilities) or experience (implicit collection of past outcomes and probabilities). Explanations of choice under descriptive information often rely on Prospect Theory, while experiential choice has been plagued by highly task-specific models that often predict choice in particular tasks but fail to explain behavior even in closely related tasks. Furthermore, in social interactions the information about others (preferences, beliefs, degree of interdependence) may also influence interactions and choice, but narrow self-interest and complete information is a common assumption in empirical game theory paradigms, limiting our understanding of the types of uncertainty that people face in real-world social interactions. In this talk I will discuss recent research that crosses the borders of traditional descriptive or experiential approaches that attempt to address decision making in situations where many levels of information may be available.



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## Incomplete Information Games with Ambiguity Averse Players

*Sujoy Mukerji and Peter Klibanoff*

## Abstract

We study incomplete information games of perfect recall involving players who perceive ambiguity about the types of others and may be ambiguity averse as modeled through smooth ambiguity preferences (Klibanoff, Marinacci and Mukerji, 2005). Our focus is on equilibrium concepts satisfying sequential optimality - each player's strategy must be optimal at each stage given the strategies of the other players and the player's conditional beliefs. We show that for the purpose of identifying strategy profiles that are part of a sequential optimum, it is without loss of generality to restrict attention to beliefs generated using a particular generalization of Bayesian updating. We also propose and analyze strengthenings of sequential optimality. Examples illustrate new strategic behavior that can arise under ambiguity aversion. Our concepts and framework are also suitable for examining the strategic use of ambiguity.



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# The Effect of Learning on Ambiguity Attitudes

*Aurélien Baillon*

## Abstract

Learning information can affect people's beliefs but also their attitudes towards ambiguity. We propose a method to separate ambiguity attitudes from subjective probabilities and to decompose ambiguity attitudes into two components. Under models like prospect theory that represent ambiguity through non-additive decision weights these components reflect pessimism and likelihood insensitivity. Under multiple priors models, they reflect ambiguity aversion and perceived ambiguity. We apply our method in an experiment varying the level of information subjects had access to. Ambiguity perception and likelihood insensitivity diminished with more information. Ambiguity aversion and pessimism were largely unaffected by new information. Subjects' behaviour moved towards expected utility with more information, but substantial deviations remained even in the maximum information condition.



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**CAGE Round Table**  
**Behavioural Game Theory**

# Two Ways of Reasoning about Coordination Problems

*Robert Sugden*

## Abstract

I review evidence from experiments on coordination games. (I define a coordination game as a simultaneous-move game with two or more Nash equilibria, in which for each player, any differences between payoffs between equilibria are small relative to differences between any equilibrium payoff and any non-equilibrium payoff; strategies may or may not have payoff irrelevant labels). I distinguish between bounded best response reasoning (as in level-k and cognitive hierarchy theory) and collective optimality reasoning (as in the payoff dominance criterion and team reasoning theory). I argue that, in order to explain the evidence as a whole, we need to assume that a typical player is capable of using both modes of reasoning, and that which mode he or she uses depends on properties of the game being played.



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# The Interplay of Economic Modelling, Experimental and Behavioral Economics, Neuro Economics, and Humanities through Beauty Contest Games

*Rosemarie Nagel*

## Abstract

In this round table discussion we show how recently experimental economics has become a bridge for interdisciplinary collaborations across economics, biology, neuro science, psychology, and other disciplines of the social and natural sciences, and hopefully also in the near future with a link to the humanities. The point of departure is economic modelling through game theory. These abstract situations are then transformed into feasible experiments in which humans act according to a given set of rules in the lab or in the field. The resulting behavior is compared with the rational solutions. In case of divergence between theory and behavior new descriptive bounded rational models are derived. At the same time of playing the games the actors are linked with all possible apparatus, like eye trackers, fMRI, skin conductance etc. to obtain biological data during the decision process. The new data is useful to understand procedural or emotional factors (not) visible in decision making. We will use the Beauty contest game to exemplify these modern developments, some of which have been discussed long time ago in the humanities, like in short stories or philosophy. We conclude with a poem, "The Rational Man as a Tuning Fork".



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# Protocol Analysis Reveals Promiscuous Reasoning in Common Interest Games

*Andrew M. Colman; Briony D. Pulford and Diana G. Pinto*

## Abstract

Research on how players coordinate in common interest games has generally tested specific theories, such as Level-k or cognitive hierarchy theory, team reasoning, and strong Stackelberg reasoning, all of which predict it. We used protocol analysis, which seeks to determine from the bottom up how players reason and has the potential to discover approaches never imagined by researchers. Our 16 players managed to coordinate 84% of the time in nine dyadic common interest games. Frequently used reasons for strategy choice were maximax and vicarious maximax (assuming the co-player will use maximax, these two often being used together), followed by team reasoning and avoid-the-worst. To a much lesser extent there were instances of Level-1 and Level-2 reasoning, equality-seeking, vicarious avoid-the-worst and relative payoff maximization. The biggest surprise was that many players used multiple reasoning processes, even within the same game.



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# Virtual Bargaining as a Theory of Social Interaction

*Nick Chater*

## Abstract

One starting point for a theory of social interaction is that participants ask: "what would we agree?" and behave accordingly. Explicit communication will be necessary only to the extent that agreement cannot reliably be established. But with no external enforcement, and where people cannot necessarily trust the good will of others, what kinds of agreement can be made? I outline a theory, virtual bargaining (developed with Tigran Melkonyan, Jennifer Misyak & Hossam Zeitoun), which allows a broader set of 'equilibria' than Nash and selects between them via a simulated bargaining process. This viewpoint can be viewed a variant of team reasoning, where the team's preferences are generated by the preferences of its members through the mechanism of bargaining.



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# **The Leverhulme Trust Round Table**

## **Imprecision and Noise**

# Stochastic Specifications for Imprecise and Noisy Preferences

*John Hey*

## Abstract

It seems that many experimenters, when analysing experimental data relevant to decision theory, pay more attention to the preference functional than to the stochastic specification. The default specification is usually a normal distribution. However, as Nat Wilcox has argued in “Stochastic Models for Binary Discrete Choice Under Risk: A Critical Primer and Econometric Comparison” *Research in Experimental Economics*, 2008, “choices of stochastic models may be far more consequential than choices of structures such as expected utility or rank-dependent utility.” His context there was pairwise choice experiments. Other contexts are being increasingly used by experimenters. For example, many experimenters are using allocation data – it being potentially more informative. I take that context and show that his strictures are also relevant there.



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## Bayesian Comparison of Quantum versus Standard Decision Accounts of the Disjunction Effect

*Jerome R. Busemeyer*

## Abstract

One of the most puzzling findings observed in behavioral decision making is the “disjunction effect” originally reported by Shafir and Tversky (1992). Using a series of one shot prisoner’s dilemma games, they found that many individuals chose to defect when they knew the opponent defected, and these individuals chose to defect when they knew that the opponent cooperated, but these same individuals reversed and chose to cooperate when the opponent’s action was unknown. They interpreted this as a violation of Savage’s “sure thing” principle. Recently, Pothos and Busemeyer (2009) proposed a quantum probability model to account for this finding. Quantum models of decision making apply the mathematical principles of quantum theory to model human judgment and decision making behavior. We report the results of our own replication of the original Shafir and Tversky (1992) results. Furthermore, we provide a quantitative comparison of the quantum model with more traditional probabilistic models of strategic choice. The models are compared using Bayesian model comparison methods that evaluate how robustly each model accurately predicts the data over the plausible range of parameter values.



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# Sources of Variability in Choice Tasks and Criteria for Evaluation of Models

*Michael H. Birnbaum*

## Abstract

When the same person is asked to respond to the same choice problem on two occasions, that person does not always make the same response. Models have been proposed to account for this variability, often for the purpose of analyzing whether or not choice behavior conforms to-or systematically violates-some theoretically important testable behavioral property such as transitivity or independence of a common consequence. My discussion at the round table will focus on (1) potential sources of variability or error in choice tasks; (2) criteria for theories or models of variability; and (3) discussion of a key property, response independence, that distinguishes certain models of response variation. The true and error model will be used to discuss these properties, and common consequence independence -or paradox (Allais)-cited as an example of a behavioral property to be tested against a model of error.



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# The Geometry of Probabilistic Choice Induced by Heterogeneous Preferences and/or Error-prone Responses

*Michel Regenwetter*

## Abstract

Heterogeneity of decision behavior has many potential sources: Different people may have difference preferences, a given individual may fluctuate in her preferences or be uncertain about them. Even for a given, fixed, latent preference, overt behavior may vary due to probabilistic errors in responses. It is plausible that much behavior inside and outside the lab combines all of these sources of heterogeneity. This talk reviews a general geometric framework through which the parameter spaces induced by different types and sources of heterogeneity can be compared. This framework makes it possible to diagnose whether heterogeneity in observed behavior is due to heterogeneity in hypothetical constructs or in overt response processes.



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# Noisy Parameters in Risky Choice: A Cautionary Note

*Graham Loomes and Sudeep Bhatia*

## Abstract

The parameters that characterise an individual's intrinsically variable preferences can interact with zero-mean and symmetrically distributed extraneous noise to distort systematically the resulting observed patterns of choice, leading to false conclusions. For example, intrinsic preferences modelled as a random preference form of expected utility theory can manifest as patterns that appear consistent with cumulative prospect theory. Likewise, differences in choice proportions across different categories of decision makers might be due to differences in the amounts of noise rather than to differences in underlying parameter values. Caution is needed when trying to infer the underlying preferences of decision makers, and further thought needs to be given to how we model the various sources of noise and their interactions.



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**CAGE Young Talent Round Table**  
**Biological and Neuro Foundations of Utility and  
Risk**

# Gaze Data Reveal Distinct Choice Processes Underlying Model-Based and Model-Free Reinforcement Learning

*Ian Krajbich*

## Abstract

Organisms appear to learn and make decisions using different strategies known as model-free and model-based learning, where the former is mere reinforcement of previously rewarded actions and the latter is a forward-looking strategy that involves evaluation of action-state transition probabilities. Prior work has used neural data to argue that both model-based and model-free learners implement a value comparison process at trial onset, but model-based learners assign more weight to forward-looking computations. Using eye-tracking, we find evidence for a different interpretation of prior results: model-based subjects make their choices prior to trial onset. In contrast, model-free subjects tend to ignore model-based aspects of the task and instead seem to treat the decision problem as a simple comparison process between two differentially valued items, consistent with previous work on sequential-sampling models of decision making. These findings illustrate a problem with assuming that experimental subjects make their decisions at the same prescribed time.



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# Neurocomputational Insights into Values, Morals, and Self-control

*Cendri Hutcherson*

## Abstract

Selfish, unethical, and short-sighted decision-making lies at the heart of some of society's most pressing problems, but it is unclear why people so often struggle to make virtuous choices. Here, I show how a simple neurally-informed computational model of choice can account for a wide range of complex social decisions. The model makes novel predictions, borne out by behavioral and neural data, about when and why some choices are more difficult than others. It suggests new methods for estimating value in the absence of choice variability and reveals novel insights into when and why people may resist or succumb to temptations. Finally, it suggests a need to refine popular competitive dual-system models of choice in light of computational model predictions, and points to new ways to help people make better choices for themselves and others.



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# Dynamically Re-Evaluating Future Prospects

Joseph McGuire

## Abstract

Even when future rewards are relatively certain, the associated costs can be hard to predict. A decision maker might be sure of obtaining a particular reward—the bus will eventually come, the checkout line will eventually move, the paper will eventually be written—but nevertheless face substantial uncertainty as to how much time or effort it will take. In this kind of situation it makes sense to reassess anticipated costs continuously over time while pursuing the reward, not just at the moment of the initial choice. Consider, for example, the case of a reward with an uncertain delay. If the delay has gone on longer than expected, this might, depending on the context, be grounds either for an optimistic or pessimistic assessment of how long a delay still remains. I will discuss behavioral evidence that decision makers reappraise future prospects in a dynamic and context-sensitive manner and use this ongoing reappraisal as a basis for deciding whether to sustain or curtail persistence. This form of ongoing reappraisal can account for patterns of choice that superficially resemble dynamic inconsistency or delay-of-gratification failure. I will also discuss how human neuroimaging methods can advance our understanding of valuation processes. A substantial existing literature has made progress in characterizing and reading out neural valuation signals during discrete economic choices. Our current work seeks to extend these findings to dynamic, temporally extended forms of valuation.



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## People and Pigeons Gamble Alike

*Elliot Ludvig; Marcia Spetch, Chris Madan, and Jeff Pisklak*

## Abstract

People often display different patterns of risk preference when making decisions based on explicit descriptions as opposed to when learning from experience. These decisions from experience resemble the decisions made by other animals, who can only rely on their own experience. Here, in a series of experiments, we show that both people and pigeons exhibit a similar bias toward overweighting the extreme outcomes (biggest win and biggest loss) in an experience-based risky choice task. As a result, and contrary to the described case, both species are more risk seeking for relative gains than losses. Pigeons are, however, more sensitive to the total absence of reward (zero outcomes) than people. The emergence of a common mechanism for this risky choice across disparate phyla either indicates similar evolutionary pressures or stems from a shared ancestry.



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## **Parallel Sessions**

## Cost-Benefit Analysis in Reasoning

*Larbi Alaoui; Antonio Penta*

### Abstract

When an individual thinks about a problem, his decision to reason further may involve a tradeoff between cognitive costs and a notion of value. But it is not obvious that this is always the case, and the value function is not well-defined. This paper analyzes the primitive properties of the reasoning process that must hold for the decision to stop thinking to be represented by a cost-benefit analysis. We find that the properties that characterize the cost-benefit representation are weak and intuitive, suggesting that such a representation is justified for a large class of problems. We then provide additional properties that give more structure to the value of reasoning function, including "value of information" and "maximum gain" representations. We also apply our model to sequential heuristics in choice, particularly the well-known rational shortlist method (Manzini and Mariotti (2007)), and discuss how our model can be used from a positive and normative perspective. Lastly, to analyze the limits of the cost-benefit approach, we consider psychological phenomena which cannot be cast in this domain. We show that different psychological mechanisms for these phenomena map to distinct violations of properties of the reasoning process.



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# Bayesian Updating: Evidence from the Field

*Constantinos Antoniou; Christos P. Mavis*

## Abstract

To apply Bayes Rule when forming expectations agents must correctly assess the inherent "process variance" of each relevant cue, and place a larger weight on those cues with a smaller process variance. We test this notion by analysing subjective probabilities inferred from odds on the outcomes of tennis matches, exploiting natural variation in process variance related to the format with which tennis matches are played. Specifically, men's tennis matches are played in either a best-out-of-three set format (Master-series matches) or a best-out-of-five set format (Grand-Slams). In the longer Grand-Slam matches the more skilful player is more likely to win, therefore, an indicator of skill (like the players official ranking) is a signal with relatively lower process variance for those matches. Our tests examine whether bookmakers sufficiently adjust their subjective probabilities for the high-skill player in Grand-Slam matches to reflect this reduction in process variance. Our results are consistent with "process variance neglect", i.e., bookmakers are not adjusting their subjective probabilities for the high-skill player sufficiently, which results in a higher probability bias for the best-out-of-five matches. Although we mainly use bookmaker (fixed) odds to infer subjective probabilities, our results continue to hold when we infer probabilities from odds achieved on a person-to-person betting exchange. Because the bias in Grand-Slams implies that bookmakers are offering overly attractive odds for the high-skill player, the bias is costly and bookmakers are on average earning significantly less in best-out-of-five matches. To control for other factors that vary between Master and Grand-Slam matches, other than match length, we conduct a placebo test using data for women matches, where both Master and Grand-Slam matches are played in a best-out-of-three match format. In these tests we find insignificant differences in probability biases and insignificant differences in profits between Master and Grand-Slam matches.



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## Can Context Explain Violations of Procedural Invariance in Health State Valuation?

*Danae Arroyos-Calvera; Rebecca McDonald; Graham Loomes; Andrea Isoni; Judith Covey; Jose Luis Pinto-Prades; Mike Jones-Lee*

### Abstract

Some governmental bodies (such as the UK's Department of Transport) use people's stated preferences about their willingness to trade off their wealth for physical risk reduction to inform policies that have an impact upon society's investment in safety. Several methods are used to elicit people's values. According to standard economic theory, these values should be invariant to the method used to infer them. However, substantial failures of procedural invariance have been observed. Jones-Lee et al (1995), for example, obtained values for preventing injuries through willingness to pay questions (WTP) that were 3 to 10 times higher than those elicited through standard gambles (SG). One possibility is that such disparities arise because health states, as described in typical valuation studies, are unfamiliar and difficult to imagine, they may be highly dreaded, and are not an item people have experience in trading off for money. Such factors may be contributing to respondents' failure to respond consistently. In addition, WTP and SG health valuation studies cannot be incentivized and typically confront participants with very small probabilities, which may be difficult for them to handle. Another possibility is that WTP and SG questions each prompt rather different mental processes and are liable to produce disparities irrespective of the items to which they are applied. To investigate this possibility, we apply WTP and SG methods to consumer goods (e.g. toasters) which, by contrast with health states, do not produce strong emotional responses, people are familiar with their characteristics and often own these items or have used, bought or sold them. Also, we use larger probabilities (the lowest is 5/100 in our study vs 1/1,000 in physical risk studies), and fully incentivize responses. In our study, participants see 10 objects. First, they rank them in order of preference, then value them by providing money equivalents. Finally, they undertake a series of standard gambles in which half of the gambles involve only the objects and the other half substitute in their money equivalents. If we find that disparities between WTP and SG persist, we hope to be able to identify the circumstances in which they are stronger or weaker, in order to better understand the nature of the procedural effects involved. If such disparities are largely eliminated when familiar goods and larger probabilities are used, this may suggest that anomalies in health and safety studies are primarily due to the use of unfamiliar outcomes and/or small probabilities. The experiments are now underway. By the time of the conference, we will have run the study and have an initial analysis of the data.



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# Are Sellers Biased? A Meta-Analysis of Buyers and Sellers' Pricing of Risky Prospects

Nathaniel Ashby

## Abstract

The disparity existing between buyers and sellers valuations where buyers valuations are lower than sellers "commonly referred to as the endowment effect" has been frequently investigated. A plethora of theories have resulted from these investigations, with many positing that the effect is driven by sellers, who for whatever reason (e.g., affective attachment and loss aversion), show upward biases in their valuations. Our investigations highlight four additional asymmetries existing between the valuations provided by buyers and sellers for risky prospects (lotteries) "asymmetries which suggest that sellers rather than buyers show valuations more in line with normative bench marks (expected values). We employed a meta-analytical approach looking at 28 studies, reported in 18 papers, totaling 3,295 experimental participants "nine of which we were able to obtain raw data for. In our first analysis we found that the classic endowment effect was robust, though we also find evidence that lack of monetary incentivization likely leads to larger estimates of the difference between buyers and sellers valuations: Indicating that incentivization is important if one wishes to obtain unbiased estimates. In our second analysis we find that compared to buyers, sellers provide valuations that are closer to normative values (i.e., show less of a difference between their valuation and the expected value of the risky prospect). However, as in our analyses of the common endowment effect, we find that incentivization decreases the size of this effect, further highlighting the importance of proper incentivization. In our third analyses we find that sellers rank ordering of prices are closer to the true rank ordering of normative prices than buyers. In our final analyses we find that while the variance in sellers valuations is higher than that of buyers, the variance per unit - also known as the precision score or coefficient of variance "is lower for sellers suggesting greater precision in sellers valuations than buyers. Together, these findings challenge common explanations for buyer-seller differences suggesting that disparities between the valuations provided by buyers and sellers are driven by sellers' showing upwards biases in their valuations. Instead, these findings indicate that sellers show greater accuracy in their valuations than do buyers, and suggest that current theories of why the endowment effect occurs likely require some revision.



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## Social Influence in Gain, Loss and Mixed Domain

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### Abstract

The impact of social influence on decision making under risk has only been recently explored in economics (Rohde and Rohde, 2011; Linde and Sonnemans, 2012; Schmidt et al., 2015). From prospect theory we know that people evaluate their payoffs relative to a reference point. Translating this to a social context, we expect payoffs of others to serve as a reference point for individual choice. Much of the existing empirical evidence on risk attitudes is concentrated on gains. This paper aims to fill some of this gap in empirical information. I conducted an experiment based on Linde and Sonnemans (2011) to observe choices under risk in three types of prospects: gain, loss, and mixed prospects (outcomes can be gains or losses) in an individual and social context. Each participant made 21 choices between two urns each containing 3 balls. In gain (loss) prospects, all balls in the urn have a positive (negative) value. In mixed prospects, balls in the urn can have a positive or negative value. In the individual treatment, subjects faced a private lottery. In social treatment, subjects were matched with two others who chose the same urn in a randomly selected choice situation. The urn represented a within group distribution of earnings. Each subject participated in both treatments. The results show that risk attitudes vary across treatments and domains. There is a significant difference in attitudes towards risk between individual and social treatments in the gain and mixed prospects. In gain domain, subjects are more risk averse in social treatment. However, in mixed prospects, subjects are more risk averse in individual treatment. In loss domain, no significant difference arises in attitudes towards risk. I also investigate how the skewness of the payoff distribution in an urn influences choices. The difference of skewness between the safe and the risky urn affects negatively the probability of choosing a safe lottery in gain and loss domain.



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# Lottery- and Survey-Based Risk Attitudes Linked Through a Multichoice Elicitation Task

*Giuseppe Attanasi; Nikolaos Georgantzis; Valentina Rotondi; Daria Vigani*

## Abstract

In this paper we compare two mutually uncorrelated risk-attitude elicitation tasks. In particular, we test for correlation of the elicited degrees of monetary risk aversion at a within-subject level.

We show that sufficiently similar incentivized mechanisms elicit correlated decisions in terms of monetary risk aversion only if other risk-related attitudes are accounted for.

Furthermore, we ask subjects to self-report their general willingness to take risks. We find evidence of some external validity of the two tasks as predictors of self-reported risk attitudes in general human domains.



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## Cases in Memory, Decisions from Experience, and Black Swans

*Ilke Aydogan; Yu Gao*

### Abstract

This paper investigates the putative underweighting of rare and extreme events - so called "black swans"- to understand the gap between decisions from experience (DFE) and decisions from description (DFD). We first resolve the problem of lack of control over experienced probabilities by adjusting the sampling paradigm of Hertwig et al. (2004). Accordingly, our subjects were required to draw complete samples without replacement from finite outcome distributions. By doing so, they acquired complete knowledge of probabilities and outcomes. Our experimental design also controlled for utility, which enabled us to observe the true weightings of probabilities. Although our results confirmed the well-known gap, they did not provide evidence for underweighting of small probabilities. Overall, our findings suggested a clear de-biasing effect of sampling experience: while it attenuates "rather than reverses" cognitive deviations from Expected Utility (reduced likelihood insensitivity), it has no impact on motivational deviations (persistent pessimism).



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# Do Customers Return Excessive Change in a Restaurant? A field Experiment on Dishonesty

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## Abstract

We conducted a field experiment on dishonesty in a restaurant. Customers who paid with cash received excessive change, and we examined whether customers behaved honestly and returned the excessive change to the waiter, and how this depended on various factors. In total, we collected data from 192 tables. The excessive change was either 10 or 40 extra Shekels (about 2 or 8 Euros). The two levels of excessive change allow us to test whether higher stakes (in a zero-sum game) increase dishonesty. To examine gender differences in our experiment, we documented the customers' gender and limited our sample to tables with one or two diners. We hypothesized that female tables will return the excessive change more often than male tables. Assuming that honesty is a valuable trait, we hypothesized that people would have more incentive to behave honestly and return the extra change given to them when they dine with someone else compared to the case that they dine alone. To examine the issue of closeness, we recorded for every customer whether he is a repeated customer or not, and whether he holds a membership card of the restaurant. A repeated customer gets to know the waiters and therefore is closer to them, and is also likely to return in the future to the restaurant compared to one-time customers. Therefore, we hypothesized that repeated customers and restaurant members will return the excessive change more often than others. The dependent variable we are interested in is whether the customer returned the extra change that he received. Only 64 customers out of 192 (33%) returned the excessive change. We found, in line with our hypothesis, that repeated customers return the extra change much more often than one-time customers and that diners who have the restaurant club membership return much more often than non-members. The hypothesis that two diners will return the change more often than one diner is not supported. Female tables returned the extra change much more often than male tables. Interestingly, the behavior of mixed tables (a man and a woman) is much closer to male tables than to female tables. Only 15.6% of the people who got 10 extra Shekels returned it, whereas 51% of those who received 40 extra Shekels returned it, in opposite direction to our hypothesis. This seems to suggest that the psychological disutility from behaving dishonestly increases when the amount involved increases, and can even increase more than linearly. That is, the disutility from keeping 40 Shekels that should not be yours is so much higher than the disutility of keeping 10 Shekels (and in particular more than four times higher), that despite the economic gain increasing by a factor of four, many people behave dishonestly in the 10-Shekels case but honestly in the 40-Shekels case (in the experiment the comparison is between subjects).



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# Reference Point Adaptation in Stock Price Evaluation: Further Experimental Evidence

*Ana Balatel; Michele Bernasconi*

## Abstract

In this paper we study the process of reference point adaptation in stock price evaluation. In a series of two survey-based experiments we recruit American/European participants through Amazon Mechanical Turk platform and collect responses through Qualtrics survey software. We obtain a total of 1148 distinct observations from the participants who successfully passed our manipulation checks and finished the survey. The main survey questions (two per treatment) are built by varying the basic question structure adapted from Arkes et al. (2008 and 2010, for reference points) and Baucells et al. (2011, for values of reference points) in terms of our specific research interests, such as the valence (positive, negative, zero) within the textual frame (gain, loss, neutral), time frame (week, month, year) and counterfactual emotion involved (namely, regret and relief manipulations). In the first experiment we have 12 such questions paired for a total of 18 treatments. We also introduce the BIG 5 score measure (Costa and McCrae 1992, Goldberg 1993, Russell and Karol 1994) in-between the two main survey questions, expecting the participants with extreme scores for some of the traits (Extraversion, Agreeableness, Conscientiousness, Neuroticism and Openness) to adjust the reference point differently from the participants with average scores. In the second experiment we employ a totally neutral textual frame to study reference point adjustment in a "clean" state "we have 9 neutrally-framed questions paired for a total of 9 treatments. We investigate how the controlled variation of the timeframe (namely, 1 week, 1 month, 6 months, 1 year and 2 years) affects the response patterns and whether the existing temporal discounting models are able to predict accurately the reference point adjustment. We intend to propose an improved model of temporal reference point adjustment based on experimental outcomes which result from using objective, absolutely neutral, bias-free textual frames. To understand better the experimental results and look into the connection between the personal characteristics and background of the participants and their response patterns, we inquired into the participants' level of economic knowledge and understanding of economics, their sources of financial information and advice, familiarity with the concepts of framing and reference points, and also tested the participants on a risk aversion scale. Additionally, we asked whether they had an active trading account online and whether they owned stocks. The preliminary results confirm that the magnitude of reference point adaptation is significantly greater following a gain than following a same size loss. We find little effect of time, some effect of counterfactual emotions manipulation, and evidence of influence by personality traits, as the BIG 5 scores affect the stock price evaluation (asymmetrically after gains and losses). A full account of the evidence to follow at FUR.



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## Focal Foods in Schools: Identifying Pluralistic Ignorance with Behavioural Games

Nicholas Bardsley; Nicholas Bardsley; Rachel McCloy; Simone Pfuderer; Aljaz Ule

### Abstract

The quality of schoolchildren's food intake is a matter of concern even in affluent societies. Evidence suggests that children misperceive the dietary choices of their peers, believing that their intake of healthy foods is lower than it really is (Lally et al. 2011). But it is less clear what role social norms play in guiding their perceptions or choices. We sample 54 children aged 14-15 at a comprehensive secondary school in the North of England, using behavioural games to identify norms. We compare norms to individual preferences, elicited using a questionnaire, and beliefs about others' preferences, elicited using a guessing game. A stated preference survey using Likert scales was administered under three conditions. In the "coordinate" condition, pupils have to state what the most common response will be in circumstances that all other pupils are attempting to identify the most common response. This constitutes a coordination game and has been used by researchers in numerous contexts to identify social norms. In the "answer" condition, pupils simply state their own preferences for various food items using rating scales. In the "guess" condition pupils have to guess what the most common response was in the "answer" condition. Two protocols were used. In the first (N=30) pupils responded under "answer" followed by "guess" conditions. The second (N=24) used "coordinate" followed by "answer". Responses in the guess and coordinate conditions were incentivised using £10 music store vouchers for questionnaires with the most correct responses. We find strong evidence of misperceptions of preferences, with children systematically under-rating attractiveness to others of healthy items and over-rating that of unhealthy items ( $p < .01$ ; signed rank tests). The bias is generally consistent with a perceived influence of social norms: norms are against healthier items and in favour of less healthy items, often contrasting with modal preferences ( $p < .05$ ; signed rank tests). Norms coincide with beliefs about others' preferences in direction (positive versus negative attitudes) but not intensity ( $p < .05$ ; rank sum tests). A tendency to overestimate the extent to which others have internalised a norm would explain our results but also implies 'pluralistic ignorance', whereby individuals privately reject a norm but believe that others mostly accept it. Consistently with this interpretation, very few pupils admit to 'fitting in' when choosing food, but nearly 50% predict fitting in responses by others. The overall pattern of results suggests potential for shifting pupils' norms towards healthier options, by making public the distributions of their stated preferences.



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## What Determines Contributions to a Real-Life Public Good?

Ronen Bar-El

### Abstract

We examine the determinants of contributions to a real-life public good. We conduct five rounds of contribution experiments for the procurement of sustainable supplies to two colleges' synagogues, a religious college and a secular college. The choice of the campus synagogue as the real-life public good has two advantages. First, it is located within the campus and may be voluntarily used by the students. Second, like many religious institutions around the world, synagogues raise funds from their users (unlike other types of public goods, such as roads and schools). Thus, it is likely that the participants of the experiment had a prior position as to what extent they should contribute (or not) to synagogues. Nevertheless, it is important to note that there is no religious obligation to donate to synagogues. In addition, being part of the campus, the campus synagogues are financed by the academic institution, so the students had not contributed to their campus synagogue prior to the experiment. The results show that the intensity of use at the campus synagogue (measured by the reported number of monthly visits at the campus synagogue) affects the total contributions as well as their path. Accordingly, we find that the contribution path of the religious subjects (who make frequent use of their campus synagogue) is upward sloping, while that of the non-religious subjects (who rarely use their campus synagogue) is lower and decreases toward the end of the experiment. The upward slope of the religious' contribution path holds also under terms of lack of information about the others' contributions, although it is lower than the path under terms of information about the accumulated sum of contributions after each round. The non-religious group of subjects consisted of individuals who rarely use their campus synagogue and individuals who reported that they do not use their campus synagogue. The latter's contribution cannot be considered a contribution to a public good. We separately analyzed the contributions of the group of non-religious subjects who reported zero visits at their campus synagogue. The results show that the latter group's average total contribution and the contribution path are lower than those of former. We examined whether the religious population is more inclined to cooperate and to contribute compared with the non-religious population, by conducting a standard linear public good experiment among religious students. The results of the experiment show that the average contributions decline over rounds, that is, free-riding increases over rounds, and the end-game effect is present. We also found that the contribution level in the standard VCM is not related to the number of visits at the campus synagogue. In addition, we find in all the experiments that religious females consistently contribute more than religious males. Overall, our findings may indicate that contributions are motivated by contextualization, by the effect of asking and by peer effect. Finally, we derive practical implications from our findings.



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# Anchors or Targets? An Examination of Credit Card Statements

*Daniel M. Bartels; Abigail B. Sussman*

## Abstract

Anchors and reference points differ in important ways. Notably, reference points serve as targets, with motivational properties, whereas anchors act as neutral starting points for subsequent judgments. One area where these differences may be particularly critical is in the domain of personal finance and specifically, choices of credit card payment amounts in response to values appearing on credit card statements. Research designs are often unable to disambiguate whether these minimums are anchors or reference points, and researchers have been agnostic regarding this distinction. Instead, this literature often refers to minimum values as anchors despite the fact that they appear to have many properties of reference points (e.g., Stewart, 2009). However, this distinction may be important for understanding which values can effectively be used to increase chosen payments. From a practical perspective, we investigate how information provided on credit card statements influences subsequent payments. Importantly, we aim more generally to better understand how people rely on cues in their environments. We put forth methods for distinguishing anchors from references points and highlight the importance of this distinction. Additionally, we examine how people use external cues as goals to motivate themselves. We begin by examining how participants select payments as a function of suggested values proposed to them on credit card statements (Study 1). In Studies 2 and 3, we investigate whether suggested values take on properties consistent with reference points, namely loss aversion and diminishing sensitivity. We test for loss aversion by examining whether people feel different amounts of satisfaction if an identical payment is above or below the suggested amount. We also examine whether people have higher motivation to pay when they are close to (vs. far away from) their goal. Study 4 tests whether disappointment tracks the same patterns as motivation does. To test for the ecological validity of these findings, we turn to a large data-set of Chase cardholder payments. We examine distributions of payments around values that have been explicitly selected by cardholders as goals, and examine how inclusion of these values alters payments (Study 5). After our detailed look at values on credit card statements, we broaden our findings by revisiting existing datasets on anchors and reference points across domains (Study 6). We conclude with a discussion of how distributions of anchors and reference points vary and describe how our more nuanced understanding of values on credit card statements can be used to encourage debt reduction.



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## About Delay Aversion: the Topological Approach

Lorenzo Bastianello

### Abstract

One of the standard assumptions made in most economic models is that agents have preferences for advancing the time of future satisfaction. The classical way of describing impatient preferences is to use a discounted sum of utilities. The willingness of the Decision Maker (DM) to anticipate future consumption is expressed through a discount function. Instead of working utility (and discount) functions, this paper takes as a starting point a behavioral definition that represent the notion of "delay aversion". Suppose that a DM is to choose between two extra amounts of income, the smaller one paid at an earlier period. Then she is delay averse if she chooses the smaller and earlier extra amount whenever the bigger one is delivered sufficiently far in the future. It turns out that the discounted sum of utilities entails very strong notions of preferences for advancing the time of future satisfaction. If a DM behaves as if she is discounting utilities, then she is, for instance, myopic (see Brown and Lewis (1981)). As a consequence, such a model does not allow to distinguish among different nuances of impatience. In order to study delay averse preferences, a more general framework is needed: this paper uses a topological approach. New topologies over the space of bounded sequences are presented. These topologies "discount" the future consistently with the notion of delay aversion. More formally, I defined a new topology,  $T_{\{DA\}}$ , over the space of streams of income. The key idea is simple. A suitable topology should make a cash flow which pays one unit of income in the  $n$ -th period very close to the cash flow paying zero at all periods, provided that  $n$  is big enough. Such a property could be rephrased as 'the far future is negligible'. There are two main mathematical results. First, the delay averse topology,  $T_{\{DA\}}$ , is weaker than the sup-norm topology, and stronger than the Mackey topology. Second, the dual of  $T_{\{DA\}}$  is the set of bounded charges,  $ba$  (following the standard mathematical notation). These results have, in turns, interesting economic implications. - Delay aversion is a weak notion of preferences for advancing the time of future satisfaction. A delay averse DM is "in between" a myopic agent (see Brown and Lewis (1981)) and a patient one. - If agents do not discount the future strongly enough (namely as a myopic DM), a market equilibrium may fail to exist. This refines a famous result in general equilibrium proven in Araujo (1985). - Usually it is thought that price-bubbles cannot occurs when agents are impatient (see Gilles and LeRoy (1992)). We show that if the DM are delay averse, then this is no longer true. - I show that delay aversion is the correct notion derived from the paper of Benoît and Ok (2007), where the authors studied the concept of more delay aversion but not delay aversion itself.



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## Where Does Satiation Come From?

*Manel Baucells; Daniel Smith*

### Abstract

In the mid 1800's psychologists Weber and Fechner pioneered the quantitative study of the human response to a physical stimulus, and postulated a law of diminishing marginal returns. This translated into the notion of a concave utility function, central to economics. What exactly governs the attenuation and recovery of marginal returns? We address these questions by introducing a simple -yet novel- model of the neurobiological mechanism of chemical signaling. The model is a system composed of particle inputs, receptors, and response outputs. The system is a natural extension of the occupancy problem in probability theory. It provides a justification -at the neurobiological level- for the notion of diminishing marginal returns, in the precise sense formulated by the satiation utility function. By maximizing the satiation utility function we uncover some key properties of neurobiological signal transmission. Our central results shows that the optimal temporal distribution of inputs follows a high-low-high pattern.



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# The Relationship between Measures of Preferences in Public Good Games

*Benjamin Beranek; Robin Cubitt; Simon Gaechter*

## Abstract

Theory predicts under provision of public goods as the benefits of these goods are non-rivalrous and non-excludable while the individual contributions to their provision are costly. In spite of this theoretical prediction we do still observe greater contributions than expected in both real-world situations as well as in laboratory experiments. It further appears that contribution behavior follows distinct patterns such as conditional cooperation in which people match contributions they believe others will contribute and free riding in which people never contribute to the public good (Fischbacher, Gächter, & Fehr, 2001) [FGF]. Many possible behavioral motivations have been offered to explain these patterns of behavior. In this study our primary aim is to see if inequality aversion can explain these FGF patterns of conditional cooperation. Further, our research design allows us to examine (a) the association between FGF types and direct response public good game contributions (providing a robustness check to the results of Fischbacher, Gächter, & Quercia, 2012) as well as (b) the association between inequality aversion parameters, beliefs, and direct response public good game contributions (replicating the results of Blanco, Engelmann, & Normann, 2011 with greater specificity). Using a within subject design, we employ the Blanco, Engelmann, & Normann, 2011 method to parametrize inequality aversion using the modified dictator game and the FGF public good game with contribution table to observe contribution behavior patterns. We compare these measures one to another to answer our primary research question of whether inequality aversion can explain the FGF patterns of conditional cooperation. We further use the results of these games to make inequality aversion predictions and FGF predictions for a separate direct response public good game. We observe that distributions of  $\beta$  values (the parameter of advantageous inequality aversion) vary by FGF type with conditional cooperators having higher  $\beta$  values than free riders. We also observe that most people tend to contribute the amount predicted by theory or deviate by contributing even more, rather than less, than the amount expected. These results show that, while it can account for some public goods provision, inequality aversion is likely to be just one of many behavioral motivations at play in the public goods contribution decision making process. In a final exercise to evaluate these two behavioral motivations one against another, we conduct a horse race between these two competing explanations of public good game contributions: parameter based inequality aversion predictions and the strategy based FGF predictions.



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# Measuring the Utility for Money in a Riskless Context: Evidence on Separable Representations

*Michele Bernasconi; Christine Choirat; Raffaello Seri*

## Abstract

The utility of money, which assign measures of subjective value to physical amounts of money, is a fundamental concept in decision theories. Most of the modern empirical literature (experimental and from the fields) focus on preferences over money gambles, eliciting jointly the utility for money and the decision rules used to combine probabilities of money-utilities. Very few recent experiments have investigated the possibility to measure the utility of money directly. In this paper we investigate the possibility to measure the utility of money in a riskless context. We conduct an experiment in which participants are asked to suppose to receive a monetary gift  $d_1$  and are asked to indicate a monetary response  $d_2$  which they would want in order to feel in some proportion  $p$  as happy as the amount  $d_1$  would make them to feel. The experimental framework is similar to one used in a classical investigation by Galanter (1962), based on what in psychophysics Stevens (1946, 1951, 1975) called ratio magnitude production. It is well known in behavioral sciences that Stevens' approach can be criticized because of lack of mathematical and psychological foundations justifying the proposition that, when assessing a ratio judgment, a "subject is, in a scientific sense, 'computing ratios' " (Narens, 1996, p. 109). However, in recent years, an important stream of research has clarified the conditions and given the precise set of axioms that can justify ratio estimations and ratio productions (Luce 2002, 2004, 2008, Narens 1996, 2002, 2006). In particular, it has been shown that two axioms are essential to obtain meaningful representation measure from subjects' ratio scaling: multiplicatively and commutativity. Several experiments conducted in recent years have tested the two axioms in various contexts (Ellermeier and Faulhammer, 2000; Zimmer, 2005; Steingrimsson and Luce, 2005b,a, 2006, 2007; Augustin and Maier, 2008; Bernasconi, Choirat, Seri, 2008, 2010; Steingrimsson and Luce, Narens 2012). The evidence in the various domain is in general in favor of commutativity, but against multiplicativity. This is consistent with models of so called separable representations. Separable representation incorporate the notion that various and independent distortions may occur both in the assessment of subjective intensities and in the determination of subjective ratios. In the context of binary monetary gambles, when one of the outcome is zero, an example of a model separable representations is offered by Prospect Theory. Both axioms of multiplicativity and commutativity are tested in our experiments. We find substantial evidence in favour of commutativity, but against multiplicativity. We provide estimate of the psychophysical functions of interest, including the utility function for money.



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# Expectations and Emotions: A Field Study with Big Data

*Sudeep Bhatia; Barbara Mellers*

## Abstract

Decision affect theory (Mellers et al., 1997) proposes that expectations influence emotional reactions in the presence of uncertainty, with surprising outcomes generating the strongest affective responses (see also Bell, 1985; Loomes & Sugden, 1986). Expectations have also been hypothesized to play a role in determining reference points in economic decisions, in influencing the strength of conditioning in reinforcement learning tasks, and in guiding dopamine-based learning in the brain (Kőszegi & Rabin, 2006; Schultz et al., 1997; Sutton & Barto, 1998). In all of these domains, decision makers' beliefs about the occurrence of uncertain events affects the ways in which outcomes are processed. Most existing work documenting the above relationship has used laboratory experiments. In this paper, we tested this relationship in the field, with the microblogging platform Twitter.com. Study 1 examined tweets made about National Football League (NFL) teams in the 2014/2015 NFL season. We downloaded all tweets referencing individual teams made within a 24 hour window of games played during this season. We also obtained expectations for these games using point spreads offered by popular betting websites. Our final dataset consisted of 7,515,023 tweets, which we coded for affect using standard sentiment analysis techniques. Our goal was to examine how the affective content of the tweets for a team after each game was influenced by the expected scores (as specified by the point spread) and the final scores. Overall, we found that tweets for teams that strongly beat their expectations greatly increased in affect after the game, and tweets for teams that strongly fell short of their expectations greatly decreased in affect after the game, consistent with decision affect theory. There was little change in tweet affect when teams performed as expected. A formal analysis controlling for the various game outcomes (i.e., winning or losing), as well as other relevant variables, showed a strong effect of expectations on tweet affect. Study 2 tested for the robustness of these results. It obtained 372,981 tweets referencing individual candidates in the 2014 US Senate elections. We examined changes in tweet affect after the election as a function of expectations for the candidates winning or losing. Expectations were formalized using the predictions of political forecasters. As in Study 1, there was a significant effect of expectations, with unexpected winners and losers being associated with the largest changes in tweet affect. Again, this is consistent with decision affect theory. Overall, our results show that expectations strongly influence reward processing in sports games and elections, and demonstrate that existing expectation-based theories of emotion make successful predictions in large-scale real-world settings. In doing so, they show how naturally occurring online data can be used to test psychological decision theories in the field.



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## Ambiguity in Games?

*Ken Binmore*

### Abstract

Various modifications of rational choice theory have sought to accommodate reported deviations from Bayesian decision theory in experiments on the Ellsberg paradox. The new theories usually postulate some ambiguity in the probabilities assigned to uncertain events. How well do such theories work when applied in game theory? This question is explored from the viewpoint of Leonard Savage, who argued that his newly created theory of subjective expected utility is only realistically applicable in what he called a small world. The world of classical game theory is small almost by definition, but we endorse the view that the classical notion of a mixed strategy needs to be expanded to allow for devices from the theory of algorithmic randomization that permit pure strategies to be muddled together in a manner that defies a Bayesian description. However, we depart from the developing orthodoxy on game theory in the presence of Knightian uncertainty in also denying that a description in terms of multiple priors is adequate. In particular, we offer an argument against the common use of the maximin criterion in evaluating the payoffs that result when the players use Knightian strategies modeled in terms of multiple priors. The paper continues by offering an argument that favors replacing the standard additive Hurwicz criterion by a multiplicative Hurwicz alternative. An example demonstrates that such a replacement sometimes generates muddled Nash equilibria that are Pareto-improvements on standard mixed Nash equilibria.



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# True and Error Models of Response Variation

Michael H. Birnbaum

## Abstract

True and Error Model of Response Variability Theories of decision-making are based on axioms or imply theorems that can be tested empirically. For example, expected utility (EU) theory assumes transitive preferences; if A is preferred to B and B is preferred to C, then A should be preferred to C. However, human behavior shows variability; the same person may make different choice responses when presented the same choice problem. A person may choose A over B on one trial, and B over A on another trial. How do we decide whether a given rate of violation exceeds what would be expected by the inherent variability of response? A standard approach has been to test stochastic properties such as weak stochastic transitivity or the triangle inequality on the binary choice proportions. It will be shown that this method can lead to systematically wrong conclusions regarding transitivity when the data contain random error. Similarly, EU theory also implies independence properties whose violations are known as Allais paradoxes. For example, EU implies  $R = (\$98, .1; \$2, .9)$  is preferred to  $S = (\$47, .2; \$2, .8)$  if and only if  $R' = (\$98, .9; \$2, .1)$  is preferred to  $S' = (\$98, .8; \$48, .2)$ . But some people switch. Are these reversals due to variability of responses or are they “real”? A standard approach has been to compare the number of cases that switch from R to S' to the number who switch in the opposite direction using the test of correlated proportions. It will be shown that this statistical test is not diagnostic and easily leads to wrong conclusions. This talk will present a family of true and error (TE) models that can be applied to individual or group data. The TE models require the experimenter to present the same choice problems at least twice to each person in each session. Variability of responses by the same person to the same choice problem in the same session is used to estimate the error variability. The TE models are testable models, and provide special cases representing the properties to be tested. This means that there are at least two statistical tests in any given application: First, one tests the TE model; second, one tests the special case (assuming the formal property such as transitivity or branch independence). TE models are more general than the “tremble” model. They also include the transitive, Thurstone and Luce models as well as certain random preference models as special cases. They are generic, like the Analysis of Variance. Whereas in ANOVA, there is a breakdown of total variance into components representing main effects, interactions, and errors, in TE, response variability is decomposed into probabilities of true response patterns and error rates. This talk will present both hypothetical and real data to illustrate how TE analysis works and to illustrate how it can lead to different theoretical conclusions from commonly applied methods that make unnecessary assumptions.



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## Searching for the Reference Point

*Han Bleichrodt; Aurélien Baillon; Vitalie Spinu*

### Abstract

This paper presents evidence on the formation of reference points. In a high-stakes experiment with payoffs up to a weekly salary, we found that most subjects used the status quo or a security-level (the maximum of the minimal outcomes of the prospects under consideration) as their reference point. Between ten and twenty percent of the subjects used expectations-based reference point as in the model of Köszegi and Rabin (2006, 2007).



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## But Where do the Probabilities Come From? Part 2.

*Fergus Bolger*

### Abstract

At FUR 2014 I argued that, in order to develop expert knowledge elicitation procedures that ensure the highest quality estimates of uncertain quantities for risk and decision analysis, it is necessary to analyze how judgments might be made across a range of tasks with varying features. My 2014 analysis was purely conceptual, but in this paper I compare the output of simulations based on three different models of probability judgment with data obtained from novice and expert judges performing some common probabilistic judgment tasks ('expert' taken to mean that the judges had some experience of the task, either prior to performing it, during it, or both). As a starting point I assume that judges are naïve social scientists who are attempting to gain support for their hypotheses using one of three common strategies: classical Neyman-Pearson hypothesis testing (as exemplified by t-test and ANOVA); Brunswikian cue-based linear modelling (as exemplified by Multiple Regression); and Bayesian updating. Each of these strategies produces a probability of a hypothesis being true as an output that can then be compared to subjective probabilities provided by real judges performing a given task. To enable this comparison I apply the three judgment strategies to tasks commonly studied by decision scientists such as drawing balls from urns, answering two-alternative forced-choice questions (and providing confidence correct), and forecasting uncertain quantities. Similarities and differences, and pros and cons of the three different models are discussed in the light of the results of the comparisons between simulated and real judgment data.



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# Pareto Optima and Competitive Equilibria in Markets with Expected and Dual Utility

*Tim Boonen*

## Abstract

This paper analyzes optimal risk sharing between agents that are endowed with either expected utility preferences or with dual utility preferences. We find that Pareto optimal risk redistributions and the competitive equilibria are obtained via bargaining with an hypothetical representative agent of expected utility maximizers and an hypothetical representative agent of dual utility maximizers. The representative agent of expected utility maximizers resembles an average risk-averse agent, whereas representative agent of dual utility maximizers resembles an agent that has lowest aversion to mean-preserving spreads. This leads to an allocation of the aggregate risk to both groups of agents. The optimal contract for the expected utility maximizers is proportional to their allocation, and the optimal contract for the dual utility maximizing agents is given by ‘tranching’ of their allocation. We show a method to derive the equilibrium prices. We identify a condition under which prices are locally independent of the expected utility functions, and given in closed form. Moreover, we characterize uniqueness of the competitive equilibrium.



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## Cognitive Bubbles

*Ciril Bosch Rosa*

### Abstract

Smith et al. (1988) reported large bubbles and crashes in experimental asset markets, a result that has been replicated many times. Here we test whether the occurrence of bubbles depends on the experimental subjects' cognitive sophistication. In a two-part experiment, we first run a battery of tests to assess the subjects' cognitive sophistication and classify them into low or high levels of cognitive sophistication. We then invite them separately to two asset market experiments populated only by subjects with either low or high cognitive sophistication. We observe classic bubble-crash patterns in the sessions populated by subjects with low levels of cognitive sophistication. Yet, no bubbles or crashes are observed with our sophisticated subjects. This result lends strong support to the view that the usual bubbles and crashes in experimental asset markets are caused by subjects' confusion and, therefore, raises some doubts about the relevance of this type of experiments.



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# Risk and Information Aversions' Influences on Screening Decision

*Lea Bousquet; Goldzahl; Guillon*

## Abstract

Risk aversion predicts engagement in primary preventive care. Risk aversion is negatively associated with smoking, overweight, heavy drinking, seat belt non-use or poor diet (Jusot and Khlal (2013) and Anderson and Mellor (2008)). Empirical predictions of the effect of risk aversion on secondary preventive care remain ambiguous (Picone, Sloan and Taylor Jr (2004), Goldzahl (2015)). Secondary preventive care, such as cancer screening, aims at detecting and treating a disease as soon as possible. The rationale for these mixed results is the difference between primary and secondary preventive cares. The latter implies the acquisition of available but potentially harmful information. This paper aims at understanding the effect of risk aversion on cancer screening decision. The screening decision for cancer depends on how much the individuals value the information. We consider that the value of information provided by the test has two components: the instrumental value which allows individuals to improve her future health status and the emotional one provoked by the information itself. Thus two risks intervene in the decision-making process. The first one applies to the future health states: screening diminishes the risk of the worse health state occurrence. The second risk applies to the emotion-provoking component of information. The negative value and the disutility directly derived from getting this information may induce screening avoidance. By considering into one model these two aspects, we investigate how and when information and risk aversion influence the screening decision. The patient will undertake screening if the value of information is positive. First, we analyze separately the effects of risk aversion on instrumental value of information, and information aversion on emotional value of information. Information aversion decreases the emotional value of information until a point where the value of information is negative and the patient does not screen. Only considering the instrumental value of information shows that higher risk aversion always increases the likelihood to get tested. However, we find that risk aversion increases the value of instrumental information under a threshold probability to have the disease. Above this threshold, although the instrumental value of information remains positive, risk aversion decreases it. Second, we study the interaction between risk aversion and information aversion on the total value of information, i.e., the sum of the instrumental and the emotional values of information. While information aversion always decreases the total value of information and so the likelihood to screen, the effect of risk aversion on the total value of information depends on the level of information aversion. For high level of information aversion, increasing risk aversion decreases the total value of information. Consequently, given a high information aversion, a more risk averse individual is less likely to screen.



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# Measuring Time Preferences and Anticipation: A Lab Experiment

Lea Bousquet

## Abstract

Several biases related to time preferences, in particular present and future biases, have important consequences on economic decisions. Present bias concerns individuals' self-control problem. Future bias can be defined as the anticipatory emotions individuals feel in the period preceding the consequences of their decision. Individual's acumen for anticipating also has economics consequences. The individual aware of his bias seeks to constrain his action to overcome the consequences of his bias. Whereas a naive individual does not anticipate his bias and might choose the wrong commitment or the wrong action plan. This paper proposes a methodology for eliciting anticipation of time preferences using a lab experiment. Though extensive literature exists on the measurement of time preferences and related biases, scant attention has been given to the elicitation of the anticipation of these biases. This paper reports on a lab experiment in two rounds with the same subjects. On the one hand, the second round elicits their time preferences regarding the temporal allocation of monetary rewards between two dates (CTB method of Andreoni and Sprenger (2012)). The comparison between allocation decisions for which the sooner allocation date is « Today » — the immediate present is involved — with the allocation decisions for which the two allocation dates are in the future allows me to elicit if they are present-biased, future-biased or if they exhibit no bias. On the other hand, the first round elicits their anticipation of their allocation choices. During this round, two weeks before the second round, the participants were asked to anticipate what they think their allocation decisions will be. By comparing their anticipated allocations at the first round and the ones chosen at the second round, I am able to determine whether participants are naive, i.e., if they underestimate their bias. It is assumed that participants have  $(\beta, \delta)$  preferences (Laibson (1997)). Whereas  $\delta$  represents the traditional long-term discount rate,  $\beta$  represents the short-term discount rate used only between the immediate present and the future. This latter parameter captures the relative weight participants attribute to immediate utility compared to future utility. Given, the estimated value of this parameter, it is possible to determine whether the participant is present-biased, future-biased or exhibits no bias. Moreover, I assume that the anticipation accuracy of their allocation decisions depends on their belief on their bias, i.e., their belief on their short-term discount rate. Estimating this belief and comparing it with the estimated value of  $\beta$  indicates whether biased participants are also naive. I find that even though a majority of the participants can not be considered as biased and accurately anticipate their time preferences, when they are biased, both present- or future-biased participants tend to be naive about their bias, i.e., they underestimate their bias.



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## What is Risk Aversion?

*Richard Bradley; H. Orri Stefansson*

### Abstract

Risk aversion is behaviourally characterised by an inclination to choose any action over one with the same expected benefit but with greater variance in its consequences 'a mean-preserving spread' of the action). In the orthodox treatment of risk, an agent's degree of risk aversion is associated with the curvature of the von Neumann and Morgenstern (vNM) utility function representing her preferences over the goods serving as outcomes of lotteries. A common criticism is that this treatment collapses two distinct attitudes: to marginal increases in the quantity of the good in question and to the variance in the outcomes of the lotteries. To which it can be retorted that the criticism is simply senseless unless utility can be cardinalised independently of the rationality conditions on risk preferences built into the vNM framework. A number of recent theories (e.g. Cumulative Prospect, Rank Dependent Utility and Risk-Weighted Utility theory) take up this challenge by deriving a risk function on probabilities and a separate utility function on outcomes from preferences satisfying weaker conditions than the vNM ones. In this paper we explore a different (and more conservative) way of doing so: using Bayesian decision theory to provide the required cardinalisation of utility. Our crucial postulate is that chances (objective probabilities) of outcomes, being objective features of the world, can figure as possible consequences of actions. The application of Savage's theory to preferences over acts with consequences that include both 'ordinary' outcomes and chances of such outcomes then yields a cardinalisation of the utilities of both without imposing any constraints on how the utilities of chances are related to the utilities of the outcomes of which they are chances of. Within such a framework it is possible to separate attitudes to marginal increases in quantities of a good from attitudes to marginal differences in the chances of a (fixed quantity of) a good. Agent's preferences over lotteries will then reflect both factors. For instance, risk neutrality, qua indifference between an act and mean-preserving spreads of it, can result from concave utilities for both the good and for chances of the good, or from convex utilities for both, as well as, of course, linear utilities for both. We show that the typical patterns of preferences observed in both the Allais and Ellsberg paradoxes can be explained within such a broadly Bayesian framework, in terms of the dependence of the utility of marginal differences in chances of goods on the chances of other outcomes. We conclude by comparing this approach to modelling risk attitudes with that of Cumulative Prospect theory and related approaches.



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# Precise Versus Imprecise Datasets: Revisiting Ambiguity Attitudes in the Ellsberg Paradox

Roxane Bricet

## Abstract

The famous Ellsberg paradox (1961) was a first experimental attempt to illustrate the failure of the expected utility hypothesis to predict individual behavior in an uncertain environment. Consider two urns: one urn is filled with 50 red and 50 black balls while the other urn is filled with 100 balls in an unknown composition of black and red balls. Whether the bet is on black or on red, most people prefer betting on the known urn. This behavior provides evidence of ambiguity aversion. While the classic Ellsberg experiment has been replicated several times (Camerer and Weber, 1992), this research deals with the question of decision making in ambiguous situations when the information is provided in the form of datasets. Indeed, decision makers usually observe data generated by the process at hand and have to make a decision based on more or less precise data sets (Gilboa and Schmeidler, 2001). Therefore, we draw on the Ellsberg experiment with two urns and two colors of balls and we describe both urns by sets of data. We investigate the Ellsberg paradox in this context of "partial ambiguity". For our purpose, we design a short experiment of simple binary questions on preferences over pairs of bags containing 200 balls (blue and red - in unknown proportions). Each bag is described by a dataset which can be either relatively precise (100 draws) or relatively imprecise (10 draws). The participant is asked to choose his preferred bag to bet on blue and to bet on red, when the datasets exhibit different but very similar frequencies. A frequentist (or a Bayesian with a prior  $1/2, 1/2$ ) would choose the bag with the highest frequency of desirable outcomes for the respective bet. In contrast, a pessimist (i.e. an ambiguity-averse subject) might prefer to bet on the bag with more draws regardless of the color of the ball, suggesting that the difference in frequencies does not compensate for the precision of the datasets. Similarly, subjects who choose the less precise bag for both bets exhibit an optimistic (i.e. ambiguity-loving) attitude. Such preferences are axiomatized in Eichberger and Guerdjikova, 2013. The slight difference between the frequencies of the two bags serves as a robustness test for these preferences. We ran 6 experimental sessions in the LEEP (Laboratoire d'Economie Experimentale de Paris). We recruited 91 participants and the average payment was above 13 euros for a 30 minutes experiment. Among answers satisfying monotonicity (87%), 2/3 of choices are ambiguity-neutral (frequentists and bayesians). The remaining 1/3 of answers contradict the expected utility hypothesis and can be interpreted as an expression of non-neutral ambiguity attitude. Among them, 2/3 displays ambiguity-aversion. We also calculate an individual score of pessimism. Although our results suggest a significant bias towards ambiguity-aversion, it is weaker than in the relevant experimental literature (Arad, Gayer, 2009 ; Baillon et al., 2013 ; Chew et al., 2013).



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# Prospect Theory in Dynamic Games: Theory and Evidence from Online Pay-Per-Bid Auctions

*Tobias Bruenner; Jochen Reiner; Martin Natter; Bernd Skiera*

## Abstract

Abundant evidence exists that expected utility theory does not adequately describe decision making under risk. Despite the popularity of the leading alternative, prospect theory, few applications of it have surfaced in strategic situations in which risk arises through individual interaction. This study incorporates prospect theory preferences into a dynamic game-theoretical model of pay-per-bid auctions, a variant of the war of attrition. Because a subgame-perfect Nash equilibrium does not exist, we use backward induction as solution concept. We explicitly address dynamic inconsistency by considering various ways bidders address this inconsistency in our analysis. Using field data covering 53,647 online auctions, we show that prospect theory provides a unified explanation for two anomalies in bidder behavior: average auctioneer revenues well above the current retail price and the sunk cost fallacy. Furthermore, our parameter estimates indicate that bidders are loss averse and overweight small probabilities so that expected revenues of a representative auction exceed the current retail price by 56.57 percent. Our results show that prospect theory is a good descriptive theory for bidders' behavior and, which is a unique contribution of our study, that it also adequately describes bidders' beliefs about other bidders' behavior.



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# Communication Situations with Partially Verifiable Information: An Experimental Approach

*Valeria Burdea; Maria Montero; Martin Sefton*

## Abstract

We study communication situations with partially verifiable information. Our motivating example is an employer who wishes to hire a worker if her performance in two previous jobs is satisfactory on average. There are two possible scenarios for how the decision making process might take place. In both cases, the worker describes her performance in the two previous jobs. In one case, the worker provides two references and the employer, due to various constraints, chooses only one to follow up. In the other case, the worker decides which one of her references to provide for the employer to follow up. Given these situations, is the employer better off deciding which verifiable message to validate, or rather allowing the worker to decide? In other words, we want to investigate the relationship between having control over the verification action and the ensuing strategic behaviour. We address this enquiry by using an experiment with a setting similar to the sender-receiver persuasion game described by Glazer & Rubinstein (2004). In this game, the sender is randomly dealt two cards. The values on the cards are initially unknown to the receiver. Each card can take a value between 1 and 9. The sender has a good hand if the sum of the two cards is at least 9, and a bad hand otherwise. The receiver would like to accept good hands and reject bad ones. The sender's goal is to induce the receiver to always accept. In order to do so, the sender reports (possibly untruthfully) the values of the cards by sending a message to the receiver. The difference between our treatments lies in what follows after the message stage. In one treatment ('receiver-verifies'), the receiver selects which card to verify, while in the other ('sender-reveals'), the sender is the one that makes the decision regarding which card the receiver can observe. Afterwards, in both treatments the receiver chooses whether to accept or reject. From a theoretical point of view, the second scenario should lead to better payoffs for both players. Our experimental results show that the opposite is the case. The reason is that receivers are too skeptical when senders make the decision regarding which card to reveal. Conversely, receivers are too lenient when they are the ones that have the verification control. Despite this, senders' messages are more informative in the latter case. This leads to both parties gaining when the verification action is delegated to the receiver. To explore deeper the strategic behaviour in this game, we implement a second version of the treatment in which the sender has verification control. In this third treatment, the sender no longer has the option to send a message. This setting appears to minimize the issue of high skepticism observed in the 'sender-reveals' treatment where messages were allowed. As a result, the theoretical equilibrium has higher predictive power in treatment number three.



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## Isolating Distributional Social Preferences in 2x2 Games

*David Butler; Pavlo Blavatskyy*

### Abstract

We design a novel experiment to isolate the existence of distributional social preferences. Using four sets of popular 2x2 games (asymmetric matching pennies, battle of the sexes, prisoner's dilemma and chicken) we elicit choices both when payoffs to the other party are hidden and when they are revealed. This design contrasts a player's attitude to risk over the underlying lotteries paying out to self with preferences over the same outcomes coupled with consequences to the other. In this design the 'recipient' is a passive player, permitting a tightly controlled investigation of Fehr & Schmidt's inequality-aversion parameters as only attitudes to the impact of these factors can account for any differences between treatments. No other source of intentions-based social preferences, such as reciprocity or team-reasoning, are possible in this design, removing common confounds in earlier tests of their model. Our experiment employs a Holt & Laury-type method for eliciting risk preferences over the underlying lotteries then a related 'generalised strategy method' to do the same when the full game is revealed to subjects. We run a simulation of a random preference formulation of the Fehr & Schmidt model with risk-aversion for each of our games to see the likely parameter magnitude and distribution that can match our experimental findings. We find evidence of pro-social concerns in the prisoner's dilemma and stag hunt games. Importantly, we also find evidence that those showing such concerns in one game also exhibit them in others. Previous tests of Fehr-Schmidt have found some support for the model in aggregate but not at the individual level. However, we find only mild evidence of pro- or anti-social preferences in the asymmetric matching pennies and battle of the sexes' games, suggesting distributional concerns are context dependent. At most a half of our participants showed evidence of any pro- or anti-social preferences across the set of these games. The other half of the subjects is best modelled as having inequality-aversion parameters equal to zero. While offering support to the existence of Fehr-Schmidt preferences in some games by some people, the magnitude of the effects in general is not large. This suggests distributional preferences of the kind proposed by Fehr & Schmidt may be milder and less general than previously assumed. But it also shows there is an independent effect of inequality aversion for some even after controlling for intentions-based forms of social preference.



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## When Are Severe Outcomes More Probable? – Role of Base Rate

*Eglé Butt; Miroslav Sirotab; Marie Juanchichb; Gaëlle Vallée-Tourangeaua*

### Abstract

Communicating risk of uncertain outcomes (e.g., court sentence) often involves probabilities. People prefer to receive probabilistic information numerically (e.g., there is 70% chance that your case will not end in your favour), but they prefer to express it verbally (e.g., it is likely that your case will not end in your favour) (Erev & Cohen, 1990). Consequential decisions (e.g., should I take the plea bargain?) thus require an adequate interpretation of verbal probabilities. Some research suggests that severe outcomes trigger higher probability estimates (Harris & Corner, 2011) whereas other line of research suggests that higher base rates inflate probability (Fisher & Jungermann, 1996). A critical challenge in risk perception research is that severity and base rate are natural confounds. To draw any robust conclusions about the severity bias we need to test the effect of outcome severity while also controlling for its base rate.

In three experiments we tested how severity and base rate of a court sentence may influence the perceived probability of suspect's conviction. In a 2(base rate: low vs. high)  $\times$  2(severity: low vs. high) between-subjects design, we manipulated base rate by describing the sentencing in similar cases as low or high and severity by describing the corresponding sentences as mild or severe. Participants then provided a numerical estimate for the lawyer's statement: "it is possible that you will be convicted".

The effect of severity on probability was not moderated by base rate in Experiment 1 ( $\beta_3 = -.53$ ,  $p = .94$ , 95% CI [-13.62, 12.57]) nor in Experiment 2 ( $\beta_3 = -5.85$ ,  $p = .25$ , 95% CI [-15.94, 4.24]), but it was moderated by base rate in Experiment 3 ( $\beta_3 = -13.03$ ,  $p = .03$ , 95% CI [-24.83, -1.24]). Conditional effects confirmed that the severity effect occurred at low levels of base rate ( $\beta = 10.66$ ,  $p = .01$ , 95% CI [2.13, 19.19]). When meta-analysed, we found a significant severity effect in a low base rate condition ( $g = 0.29$ ,  $p = .03$ , 95% CI [.04, .53]) and non-significant severity effect in a high base rate condition ( $g = -.03$ ,  $p = .77$ , 95% CI [-.26, .19]). Moderated meta-analysis of the three experiments showed that the overall moderation effect of base rate was not significant (QM (df = 1) = 3.75,  $p = .05$ ).

In three experiments we showed that participants were not susceptible to the severity bias when estimating risk of uncertain events. Instead they used base rate as a primary tool for their judgment. Experiments 1 and 2 showed that the severity effect on probability perception was independent of base rate, whereas Experiment 3 showed that the severity effect occurred at low levels of base rate. Moderated meta-analysis model of the three experiments reached marginal significance, suggesting that the severity bias may emerge at low levels of base rate. These findings lend support to the asymmetric loss function account (Weber, 1994), but offer to re-examine the assumption that the severity bias occurs independent of its base rate.



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# Harmonic Probability Weighting Functions And Core Expected Utility Theory Plus Stochastic Error

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## Abstract

We introduce a harmonic probability weighting function (HPWF) that decomposes the class of generalized expected utility theory (EUT) models, e.g., regret theory, rank dependent utility, Chew-MacCrimmon weighted utility, prospect reference theory, Gul's disappointment aversion, and Koszegi-Rabin hybrid reference dependent preference model, into core EUT plus stochastic error. The upshot of the HPWF is that it comprises a linear anchor probability that supports EUT, and a harmonic addend that is functionally equivalent to a probabilistic version of binary switching functions like the Loomes-Sugden rejoice-regret function or the gain-loss utility function in Koszegi-Rabin hybrid reference dependent preferences model. Our HPWF analysis proves that those functions mimic stochastic error in a core EUT plus noise decomposition. This allows the HPWF to bring several seemingly different generalized EUT models under one probabilistic umbrella, and it provides theoretical support for Hey-Orme seminal experiments which found no statistical difference between core EUT and generalized EUT models.



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# Voluntary Cooperation in Local Public Goods Provision An Experimental Study

*Daniela Di Cagno; Daniela Grieco*

## Abstract

In a circular neighborhood with each member having a left and a right neighbor individuals choose two contribution levels, one each for the public good shared with the left, respectively right, neighbor. This allows for general free riders, who do not contribute at all and general cooperators, who contribute to both local public goods, as well as for those who contribute in a discriminatory way. Although all local two-person games are structurally independent, we mainly aim to confirm intra- as well as interpersonal spillover effects. Additionally we try to answer questions like: Will one differentiate between one's two direct neighbors when they differ, e.g. in game parameters or past behavior? Will there be clusters of similarly behaving types? Will one observe initial cooperation up to end game effects? We hope to infer more clearly motives for voluntary cooperation like direct and indirect reciprocity concerns via analyzing individual adaptations in playing two structurally independent games. Treatments differ in cooperation incentives and structural (a)symmetry of local public goods.



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## Testing Biseparable Preferences

*Veronica Roberta Cappelli; Fabio Maccheroni; Giorgia Romagnoli*

### Abstract

A large body of empirical evidence shows violations of expected utility. In response, decision theory and behavioral economics have provided a large variety of non-expected utility theories. However, the existing evidence does not clearly discriminate among such theories. On the gains domain, many of the most well-known non-expected utility models belong to the class of biseparable preferences (Ghirardato and Marinacci, 2001), which includes Rank Dependent Utility models (Choquet Expected Utility, Prospect Theory and Choice-Acclimating Personal Equilibria), models of Disappointment Aversion, Maxmin Expected Utility and its Alpha-maxmin extension. Biseparable preferences satisfy the minimal behavioral restrictions that allow to separate tastes (as captured by a utility function on outcomes) and beliefs (as captured by the willingness to bet on events, often a distorted probability). In this paper we derive a non-parametric procedure for testing the biseparability of preferences hypothesis and we apply it to the results of a preliminary lab experiment. In the data we find little support for the separation of utility and beliefs as characterized by biseparable preferences. On the other hand, the observed behavior can be accommodated by alternative models, such as Smooth Ambiguity and Source Dependent Expected Utility.



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## Individual and Group Behaviour in a Life-cycle Experiment under Ambiguity

*Enrica Carbone; Konstantinos Georgalos; Gerardo Infante*

### Abstract

Experiments on saving behaviour reveal both the substantial heterogeneity of behaviour and performance and the difficulties that subjects face in optimally solving similar problems. Previous studies have focused on contexts in which the future income stochastic process was characterised by an objective probability distribution (risk). We present the results of an intertemporal consumption/saving laboratory experiment in the presence of ambiguity (lack of objective probabilities) regarding the future income level. We study the effects of ambiguity to the consumption/savings decisions. Behaviour at an individual choice level treatment is compared to a group treatment where pairs are asked to solve the same decision task. In addition, the experimental design provides the participants the opportunity to obtain partial information and update their beliefs regarding the stochastic income process. The latter allows us to study the effects of learning to the optimal choice. Our results contribute to the understanding of the under-saving and over-consumption patterns that are being generally observed as well as to the understanding of the difference between individual and group preferences when solving a stochastic intertemporal problem. Our results show that groups deviate less compared to individuals from the optimal theoretical predictions. We also find extended evidence of dynamically inconsistent behaviour (myopic planning horizons). The latter allows us to assess the effects of these inconsistencies to the well-being of the individuals and the groups and to explore whether policy intervention is justified.



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# Distribution-Free Fechnerian Binary Choice

*Daniel Cavagnaro; Michel Regenwetter*

## Abstract

Fechnerian binary choice is a probabilistic modeling framework based on the simple idea that the more strongly a person prefers one option to another, the more likely they are to choose it (Luce and Suppes, 1965). Fechnerian models, including the classic Logit and Probit models, transform strengths of preference into binary choice probabilities, enabling statistical testing of algebraic decision theories, such as Cumulative Prospect Theory in risky choice, or Hyperbolic Discounting in intertemporal choice. At their full level of generality, Fechnerian models permit any strictly monotonic transformation, with the constraint that the preferred option in any pair has a choice probability exceeding one half. However, the most heavily used Fechnerian models assume specific families of cumulative distribution functions (CDFs) to map strengths of preference into choice probabilities (e.g., a standard normal CDF for the Probit model, or an extreme value CDF for the logit model) (Wilcox, 2008). Although seemingly innocuous, these distributional assumptions have important consequences for parameter estimation and model selection (Hey, 1995; Stott, 2006; Blavatskyy and Pogrebna, 2010). Therefore, in this talk, we aim to abstract away from distributional assumptions about response mechanisms in common Fechnerian models, so as to understand how uniquely the core theory and parameter estimates are identifiable without the added structure imposed by distributional assumptions. We do this by formalizing a distribution-free Fechnerian model family, which makes minimal assumptions about how binary choice probabilities are derived from strengths of preference. The results expand a broad class of classical econometric specifications to a general geometric representation of choice probabilities, characterized by linear equality and inequality constraints. We show that these model families are mathematically simple and can be tested statistically using modern and fast order-constrained frequentist and Bayesian inference methods (e.g., QTEST, Regenwetter et al. 2014).



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## Experiments on Aggregate Informational Cascades

*Elisa Cavatorta; Antonio Guarino; Steffen Huck*

### Abstract

A feature in many everyday-life decisions is that decision makers can gather aggregate information about the decisions of other people, but rarely observe all the individual decisions. E.g., a customer deciding whether to dine in a restaurant has some private information on the restaurant's quality and is able to look inside and see how many people are already dining. He can only speculate about how many people passed by and decided not to enter. The work by Guarino et al. (GEB,2011) studies the properties of social learning in these situations. They show that, in equilibrium, an "aggregate informational cascade" arises only on the observable action – e.g., if a restaurant goes sees many people in a restaurant, he joins the crowd disregarding his own signal. A cascade on the unobservable action never arises – e.g., an empty restaurant with good reviews will not remain empty forever. In related work, Herrera&Hörner (GEB,2013) characterise the process of social learning when agents can only observe one of two types of actions and can observe time passing. Motivated by these theories, we studied how subjects learn from the actions of others in the lab. In a first set of treatments, based on Guarino et al.'s model, subjects make a binary decision in a random sequence and are not aware of their own position. When deciding, subjects are only informed about the total number of people who chose the observable action before them. We put Guarino et al.'s model to test in a small group treatment of size 3, whereby incentives to follow the equilibrium outcome are strong, and a large group treatment of size 10, whereby incentives to follow the equilibrium outcome are weaker - hence a stronger test of the theory. Our results show that on average subject decisions are close to Guarino et al.'s equilibrium predictions. In the small group, theory suggests that an informational cascade occurs when 2 agents are observed choosing the (observable) action. In the lab, 86% of subjects follow the others despite their private bad signal in line with theory. In the large group, theory predicts that the cascade forms after 4 agents are observed choosing the observable action. In the lab, 70% of subjects follow the predecessors' decision (disregarding their own signal) after observing 5 predecessors making that action, as if they are in a cascade. Informational cascades on the unobservable actions rarely occur. Albeit not every subject behave according to the theoretical predictions, the theory explains the data rather well. In recent treatments, we allow subjects to observe predecessors who made the observable actions with some randomness, and never predecessors who made the unobservable action. Subjects know their order (which plays a role similar to the passing of time in Herrera&Hörner). In this case, we should observe cascades on both actions. We also examine the heterogeneity of behaviour in the various treatments in terms of cognitive skills and personality traits.



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## A Note on Comparative Ambiguity Aversion and Justifiability

*Simone Cerreia-Vioglio; Pierpaolo Battigalli; Fabio Maccheroni; Massimo Marinacci*

### Abstract

In this paper we consider a decision maker (DM) who ranks alternatives under uncertainty. The DM holds subjective beliefs over a set of probabilistic models  $\Sigma \subseteq \Delta(S)$ , where  $S$  is a set of states of nature, or actions of an opponent in a game. We assume that the DM ranks choices according to the smooth ambiguity criterion of Klibanoff et al. (2005). With this, we show that higher ambiguity aversion expands the set of actions that are best replies to at least one belief; for brevity, we call such actions "justifiable." Empirically, they are the actions that an outside observer can infer as possible from the knowledge of the DM attitudes toward uncertainty. Our result shows that such inference becomes rougher as ambiguity aversion increases. In turn, this implies that higher ambiguity aversion expands the set of rationalizable actions of a game, where the rationalizability concept is modified to take into account ambiguity attitudes. We derive our result from a generalization of the duality lemma of Wald (1949) and Pearce (1984) that should be of independent interest. Another consequence of the same duality lemma is that, under ambiguity neutrality, higher risk aversion expands the set of justifiable actions, and hence the set of rationalizable actions in a game. This risk version of our result was independently obtained by Weinstein (2013) for subjective expected utility maximizers in finite games. For expository purposes and to exploit economies of scope, we present the results about comparative risk aversion and comparative ambiguity aversion jointly. The result is not intuitively obvious. Indeed, if the DM deems possible very different probabilistic models, then higher ambiguity aversion increases the attractiveness of "safe" actions whose objective expected utility is somewhat low for each model, but does not change much with the model. Given the same belief over probabilistic models, actions that give high expected utility for some models and low expected utility for other models become instead less attractive. Yet, an increase in ambiguity aversion cannot make such actions unjustifiable, because ---regardless of ambiguity attitudes--- they can always be justified by extreme beliefs assigning high probability to models under which they yield high objective expected utility. This comparative statics result is analogous to another result of ours, which also relies on the smooth ambiguity criterion: higher ambiguity aversion expands the set of self-confirming equilibria (Battigalli et al., 2015). However, the similarity between these results is only superficial, because they rely on different assumptions about the decision or game problem and have very different explanations.



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# Does TV Consumption Affect Health and Well-being? Evidence from a Natural Experiment

*Adrian Chadi; Manuel Hoffmann*

## Abstract

Standard utility theory fails in the attempt to explain why people voluntarily decide to spend a large amount of time doing something that from multiple perspectives seems to be bad for them: watching television. The explanation given in previous economic discussions is that this is a case of irrational behavior and that people have self-control problems. However, a critical review of the literature reveals that even the most seminal studies on individual well-being do not establish causal evidence. Researchers typically observe all kinds of problems in the lives of those who spent much time on watching TV, but the direction of causality is unclear. The problem here is that it is extremely difficult to manipulate some people's television consumption in significant ways to measure potential implications in comparison to a random group of unaffected individuals. To establish causality based on quasi-experimental evidence, we argue that regional heterogeneity in the provision of media during their implementation period can trigger differences in TV consumption that are free of selectivity issues. The happenstance that we exploit took place in the mid-1980s when Germany lifted a ban on private television. While TV consumption had already reached high levels in other countries, the average German still watched less than two hours of television per day. In the sequel, the legalization of private television brought up new channels that increased consumption significantly. However, citizens in many areas of the country did not watch any of these new programs due to reception problems, as the responsible public institution failed to establish satellite or cable TV in a timely manner. Hence, the officials of the emerging TV channels looked for other ways to reach the German households, and they found a way that establishes our natural experiment: terrestrial frequencies that by chance were still open. All across Germany, there are dozens of transmitter stations that were built in the 1960s and up to this day provide the country with free terrestrial TV signals. We exploit original data from the official records for all of Germany's TV transmitters in the late 1980s. We merge our technical calculations on the reach of each station's signal with data from the German Socio-Economic Panel (SOEP) study, which includes exact hours for someone's time use on a typical day regarding a broad set of categories (job, housework, television, etc.). Most importantly, the data gives us the great opportunity to analyze the causal effects of watching TV for various standard outcomes in the fields of health and happiness. Our empirical evidence stands in contrast to the common belief and previous studies without (quasi-)experimental evidence. First, we find a significantly positive effect of television consumption on people's well-being. Second, increased television consumption does not impair people's health, at least not in the short-run.



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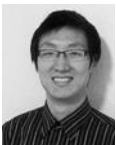


# An Experiment on Reference Points and Expectations

*Song Changcheng*

## Abstract

This paper uses several controlled laboratory experiments to accomplish three objectives. First, I test to what extent lagged expectations and the status quo determine the reference point based on different theoretical implications. I explicitly manipulated expectations by exogenously varying the fluctuations of lagged beliefs and tested whether expectations affect risk attitudes. For the control group, I send an email that said they would receive a fixed payment for the experiment (\$10). For the treatment groups, the email said that they would receive payment through a lottery (1/3 chance to receive \$10, 1/3 chance to receive \$15, and 1/3 chance to receive \$20). When the subjects were in the lab, the lottery resolved and then those in the treatment groups ascertain whether they would receive \$10, \$15, or \$20. Then both groups would answer risk-attitude questions to elicit their risk attitudes. I find that those who are treated to expect higher payoff are significantly less risk averse. These results suggest that both lagged expectations and the status quo influence the reference point significantly. Second, I exogenously varied the time of receiving new information and tested whether individuals assimilated new information into their reference points, and if so, at what rate. I randomly split the overall treatment group into two groups: the 'no-waiting' treatment group and the 'waiting' treatment group. I elicit the risk attitude of the 'no-waiting' group immediately after they discovered the realization of the lottery. The 'waiting' group filled out a survey about their social economic background after they knew the realization of the lottery, and then - after a few minutes - answered the risk attitude questions. I find that those in the waiting group are more risk averse than no-waiting group. These results suggest that while reference points are sticky to lagged expectations, subjects adjust their reference points quickly after receiving new information, which further confirms the role of expectation as the reference point. Finally, I derive new theoretical predictions from the model with fixed reference points and that with stochastic reference points. The model with fixed reference points predicts that increase in expectation of higher payoff in a certain range does not change the risk attitudes. In contrast, the model with stochastic reference points predicts that the increase in the same range will make individuals less risk averse. I then manipulate the expectation within the range that distinguishes these two expectations-based reference-dependent models. I find that increase the expectation of higher payoff make individuals less risk averse, supporting the stochastic reference point model. Moreover, structural estimation also support the model of the stochastic reference point reflecting full distribution of expected outcomes rather than that with a fixed reference point.



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## Alteration of Political Belief by Non-Invasive Brain Stimulation

Caroline Chawke; C. Chawke; R. Kanai

### Abstract

People generally have imperfect introspective access to the mechanisms underlying their political beliefs, yet can confidently communicate the reasoning that goes into their decision making process. An innate desire for certainty and security in ones beliefs may play an important and somewhat automatic role in motivating the maintenance or rejection of partisan support. The aim of the current study was to clarify the role of the DLPFC in the alteration of political beliefs. Recent neuroimaging studies have focused on the association between the DLPFC (a region involved in the regulation of cognitive conflict and error feedback processing) and reduced affiliation with opposing political candidates. As such, this study used a method of non-invasive brain stimulation (tRNS) to enhance activity of the bilateral DLPFC during the incorporation of political campaign information. These findings indicate a crucial role for this region in political belief formation. However, enhanced activation of DLPFC does not necessarily result in the specific rejection of political beliefs. In contrast to the hypothesis the results appear to indicate a significant increase in conservative values regardless of participant's initial political orientation and the political campaign advertisement they were exposed to



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# Pooled Data Do Not Tell Much about Individuals - An Illustration with Intertemporal Choice Paradigm

*Muye Chen; Michel Regenwetter*

## Abstract

Pooled data are frequently and widely used to infer properties of individuals. Combining individuals' opinions and preferences, however, can be misleading. Pooled data usually are not representative enough for a population because they do not capture all information regarding preferences and opinions conveyed by individuals. Additionally, aggregating data can engender conclusions that contradict the behavior of a population. These issues have been manifested by many paradoxes in social choice theory. Yet, problems of pooled data are still oftentimes overlooked today. Using intertemporal choice paradigms, we show that pooled data do not tell much about individuals due to well-known voting paradoxes. Decisions involving trade-offs among benefits and costs at different time points are referred to as intertemporal choices (Frederick, Loewenstein, and O'Donoghue, 2002). To illustrate issues with pooled data, we consider five intertemporal choice paradigms: the exponential discounting (ED) model (Samuelson, 1937), the hyperbolic discounting (HD) model (Ainslie, 1975), the quasi-hyperbolic discounting (QHD) model (Laibson, 1997), the DRIFT model (Read, Frederick, and Scholten, 2013), and the intertemporal choice heuristics (ITCH) model (Ericson et al., 2015). Using simulation-based examples, we show that pooled data can induce the Condorcet paradox and the paradox of multiple elections within intertemporal choice paradigms. According to the Condorcet paradox (Condorcet, 1785), individual transitive preferences predicted by ITCH can collectively satisfy the logistic specification of an intransitive preference predicted by DRIFT. Furthermore, individual transitive preferences violating all models can collectively satisfy the logistic specification of an intransitive preference predicted by ITCH. Even if data are fit perfectly and repeatedly by a logistic specification of a theory, every individual might violate that theory. Additionally, according to the paradox of multiple elections (Brams et al., 1998), individuals satisfying QHD can collectively satisfy a mismatching QHD preference pattern, and also an HD only preference pattern. We tested aforementioned intertemporal choice models with individual and pooled data collected from laboratory experiments. Using state-of-the-art Bayesian methods (Regenwetter et al. 2014) and assuming each decision maker had fixed preference with choice variability caused by response errors, we disclosed that combining individuals' decisions can be misleading. The analysis results suggest that HD can best describe and predict individuals' behavior. Treating all individuals as a whole, however, led to either mismatching HD predictions or chaos that no model can explain. Scholars should take care in inferring properties of individuals from pooled data, and rely more on individual data when they are accessible.



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## Decision-Making under the Gambler's Fallacy: Evidence from Asylum Judges, Loan Officers, and Baseba

*Daniel L. Chen; Martin Schonger*

### Abstract

We find consistent evidence of negative autocorrelation in decision-making that is unrelated to the merits of the cases considered in three separate high-stakes field settings: refugee asylum court decisions, loan application reviews, and major league baseball umpire pitch calls. The evidence is most consistent with the law of small numbers and the gambler's fallacy "people underestimating the likelihood of sequential streaks occurring by chance "leading to negatively autocorrelated decisions that result in errors. The negative autocorrelation is stronger among more moderate and less experienced decision-makers, following longer streaks of decisions in one direction, when the current and previous cases share similar characteristics or occur close in time, and when decision-makers face weaker incentives for accuracy. Other explanations for negatively autocorrelated decisions such as quotas, learning, or preferences to treat all parties fairly, are less consistent with the evidence, though we cannot completely rule out sequential contrast effects as an alternative explanation.



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# Canonical Riskless Choice Over Bundles: Aint No Reflection Effects Here

Hui-Kuan Chung; Paul Glimcher; Agnieszka Tymula

## Abstract

Since Kahneman and Tversky proposed prospect theory, numerous studies have found that the evaluation of changes in wealth by individuals is best modeled (in a positive sense) as gains and losses with respect to a reference point rather than as being computed over total wealth. Prospect Theory presumes that people have diminishing sensitivity from the reference point and this feature of the utility function is consistent with the commonly discussed reflection effect: a switch from risk aversion in gains to risk seeking in losses. Paradoxically, although it is widely assumed that such gain-loss asymmetry also describes riskless choices, diminishing sensitivity (with most reasonable parameterizations) would suggest normally convex indifference curves over gains, but concave indifference curves over losses. This predicts that people prefer mixed bundles in the gain domain, but retaining all of one type of good to any mixed bundles in the loss domain. There is little empirical evidence supporting the existence of asymmetries in indifference curves around the reference point for choices made under conditions of certainty. We, therefore, used two incentive-compatible (randomly interleaved) riskless and risky choice tasks conducted with the same consumer goods and the same experimental participants in the gain and loss domains. Our novel design allows us to estimate utility curvature for gains and for losses in risky choices and indifference curves for gains and losses in riskless choice with minimal assumptions. More parametrically, we formalize the relationship between the curvature of the utility function and indifference curves under three currently dominant theories of choice: expected utility, prospect theory, and Koszegi-Rabin reference point. For each theory, we derive our predictions assuming that the same utility function describes choice in risky and riskless conditions as in these theories. Surprisingly, while we find reflection effects in risky choice as expected "we see no evidence of such a phenomena in randomly interleaved, nearly identical, riskless choices. These findings are not consistent with any of the three standard models "expected utility, prospect theory, and Koszegi-Rabin preferences. In the domain of losses, in riskless choice over bundles, our participants have a consistently concave utility function, rather than convex ones, as Thaler and others have interpreted prospect theory to predict. This happens even though the same participants in the same experimental session show the convex utility in losses in a risky choice task. These results imply that one of the key tenants of reference-dependent theories, diminishing sensitivity relative to a reference point, might not be present under some conditions of riskless choice. Parametrically, we do not find any relationship between parameterized utility functions elicited in risky and riskless conditions, even when we restrict ourselves to gain or loss domain only.



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## Strength of Preferences in Repeated Prospects: Some Experimental Evidence

*Alessandra Cillo; Enrico De Giorgi*

### Abstract

Experimental studies have found that people reject a single lottery but accept a repeated play, the "n independent draws of a lottery" (Redelmeier and Tversky 1992). Other studies have also found higher acceptance rates for a sequence of lotteries if the overall distribution is displayed (aggregated mode) instead of the "n independent draws of a lottery". Langer and Weber (2001) suggest the higher acceptance rate for the aggregated mode is not a general phenomenon but it does depend on the risk profile. These results have critical managerial relevance: they suggest how a portfolio of risky assets should be presented, since the attractiveness of financial products depends on the way people process the single components. All these results are based on acceptance rates, being silent on the strength of preferences. Moreover, it is not clear what is the editing rule that people use when facing "n independent draws of a prospect". The paper provides a theoretical framework, which allows quantifying the strength of preferences in repeated prospects. We provide an experiment to test possible editing processes in "n independent draws of a lottery", and to test if subjects' risk attitudes and lotteries' risk profiles matter in such context.



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# Heterogeneity in Risk Attitudes across Domains: A Bivariate Random Preference Approach

*Anna Conte; Werner Guth; Paul Pezanis-Christou*

## Abstract

In a series of field experiments, we elicit risk preferences for financial, life-duration, and environmental domains using sequential multiple price-list auctions. We intentionally oversample subjects who frequently engage in activities that increase their mortality risk. Under the assumption that subjects are Rank Dependent Utility maximizers, we estimate the joint distribution of the CRRA and probability weighting coefficients. The model we propose to estimate the data is the Bivariate Random Preference (BRP) model. This is a new estimation approach that enables us to incorporate all available information derived from subjects' switch points in the lists. We find that the experienced risk takers are less likely than the student control group to overweight small probability, extreme events in their decision making. This is true in all three domains. We find that the tendency of women to be more risk averse in the financial domain than men arises from probability weighting rather than differences in the utility function. Finally, we show that a significant minority of subjects deviate from the type of s-inverse probability weighting typically observed in experiments.



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# Are Intertemporal Preferences Transitive? A Bayesian Analysis of Repeated Choices

*Junyi Dai*

## Abstract

Transitivity of preferences is a central axiom of rational decision making. Previous research on intertemporal choice has suggested that intertemporal preferences might be intransitive, for which nonadditivity in delay discounting is one of the reasons. Most studies in this line of research have either analyzed aggregate data or ignored the probabilistic nature of intertemporal choice when addressing individual data. In this article, I present a refined experiment for studying transitivity of intertemporal preferences with repeatedly presented choice questions tailored to each individual participant. A state-of-the-art Bayesian model comparison was applied to the individual choice data to test four stochastic models of transitivity"weak, moderate, and strong stochastic transitivity, as well as a mixture model of transitive preference"against the most general model allowing for all types of preference orders, and intermediate models accommodating nonadditivity in delay discounting. The results showed that individual data from a majority of participants were consistent with a transitive view of intertemporal preferences. In addition, nonadditivity in delay discounting "defined as special cases of violating weak, moderate, or strong stochastic transitivity" rarely occurred at an individual level. On the other hand, the individual data of a small portion of participants provided strong evidence for intransitive intertemporal preferences, suggesting either subadditivity or superadditivity in delay discounting. The heterogeneous individual responses bring about a theoretical issue, that is, whether different participants adopt distinct decision strategies for intertemporal choice, and thus are best described by distinct choice models. The relevant findings also provide critical information for developing and testing competing cognitive models of intertemporal choice. One critical question to answer in this endeavor is whether models consistent with both transitive and intransitive preferences, such as the tradeoff model, should be preferred to models that provide better description of individual data from a majority of participants with transitive intertemporal preferences but perform poorly for intransitive participants.



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## Regret Theory and Risk Attitudes

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### Abstract

Regret theory (Loomes and Sugden 1982, Bell 1982) is one of the most popular descriptive theories for decision-making under uncertainty. It is an intuitive theory that captures the psychological content of anticipated regret (or rejoice) associated with decisions and naturally accommodates several violations of expected utility. Regret theory's intuitive content and explanatory power make it suitable for real world applications (Barberis and Huang 2006, Muermann et al. 2006, Perakis and Roels 2008, Filiz-Ozbay and Ozbay 2007). Although regret theory is widely applied, the risk attitudes under that theory are not well understood. To understand risk attitudes under regret theory, the risk premium under regret should be analyzed. Bell (1983) formalized the risk premium under regret theory and showed that it consists of two distinct components: a resolution premium and a regret premium. However, Bell (1982, 1983) did not suggest an empirical method suitable for measuring these two components of the risk premium (Anand 1985). In this paper, we provide an analytical expression for both the resolution premium and the regret premium. These expressions enable "for the first time" a precise characterization of risk attitudes under regret theory and thus rigorous predictions about the risk attitudes of a regret-averse decision maker. We predict that regret-averse DMs will be risk seeking for low probabilities of gains and risk averse for high probabilities; we also postulate that risk attitudes are reinforced by feedback. We introduce a method, based on Bleichrodt et al. (2010), to measure the risk premium under regret theory empirically. This method allows to compute both the resolution and regret premiums and thereby to understand the effect of feedback on regret attitudes. Finally, we design an experiment to estimate empirically the risk premium's components and to test our predictions about risk attitudes. The experiment serves also as a descriptive test of regret theory. The data support regret aversion as a robust empirical phenomenon. By measuring risk premium components empirically, we confirm that immediate feedback increases the regret aversion of regret-averse subjects but discover that it actually reduces regret aversion within the entire subject pool. However, we find no statistically significant support for the risk attitude predictions of regret theory. By modeling the risk attitudes and measuring resolution and regret premium empirically, we show that regret theory is a simple yet powerful framework to describe the pervasive emotion of regret and the risk attitudes associated. However the experimental results suggest that regret theory provides a partial account of risk attitudes as it captures the regret-rejoice trade-offs on the outcome scale only. Decision theorists should target their efforts in developing new models (like PRAM) to capture the regret-rejoice trade-offs also on the probability scale.



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## Group-Shift and the Consensus Effect

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### Abstract

Group decision-making is ubiquitous in social, economic and political life. It is well-known that individuals tend to make different choices depending on whether the outcome of interest is a result of their choice alone or also depends on the choices of others in a group. These "choice shifts" in groups have been demonstrated in a variety of contexts across fields. The available evidence supports the idea that choice shifts in groups are largely predicted by the preference of the majority of individuals. Group decisions reflect two underlying processes: aggregating information known by the members of the group and aggregating preferences of the members of the group. A robust literature has been exploring how private information is aggregated within groups. In contrast, we focus on the latter process. In doing so, we assume that there is no private information, thus simplifying the role of the group decision to that of aggregating preferences. If individuals are expected utility maximizers, their behavior in group situations should be identical to their behavior in isolation (where their decision is the only one that matters). In contrast, we show that individuals have preferences that are strictly quasi-convex in probabilities if and only if they exhibit a "consensus effect" a decision-maker who is indifferent between two options when choosing as an individual will, in a group context, instead actually strictly prefer the option that is sufficiently likely to be chosen by the group. More precise results are obtained with respect to several well-known models of non-expected utility which can satisfy quasi-convexity, including rank-dependent utility, quadratic utility, and Koszegi and Rabin's (2007) model of reference-dependence. We extend our analysis to a full equilibrium setting, showing that with quasi-convex preferences we can accommodate observed phenomena such as group polarization, the bandwagon effect, and preference reversals. For example, we demonstrate that, in contrast to the results under expected utility, when individuals exhibit the consensus effect, in equilibrium, group decisions can fail to aggregate preferences properly and in fact strictly Pareto-dominated equilibria may result.



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# Perfect Bayesian Equilibrium - A Robustness Test against Ambiguity

Adam Dominiak

## Abstract

In this paper, I conduct a "robustness test" for the canonical solution concept for signaling games, the Perfect Bayesian Equilibrium (PBE), against the ambiguity perception of the uniformed player (the Receiver). Ambiguity is accommodated into signaling games via the dynamic extension of the CEU preferences axiomatized by Gilboa and Schmeidler (1993). The parametric approach to games suggested by Marinacci (2000) is adapted. That is, the equilibrium behavior is characterized for an exogenously given degree of ambiguity. I propose an extended version of the PBE notion, called the "alpha"-PBE, where "alpha" corresponds to a vector of parameters measuring the Receiver's ambiguity perception. The existence of an "alpha"-PBE is proven for any level of ambiguity perception. A given PBE is said to be robust against ambiguity if and only if, for any level of ambiguity perception, the "alpha-PBE" which is obtained as an "alpha-distortion" of the equilibrium beliefs in the fixed PBE remains behaviorally equivalent to the PBE. It is then shown that any separating PBE is robust whatever the level of ambiguity perception is (i.e., different messages might be perceived with different measures of ambiguity). Yet, pooling PBE is in general not robust. There is an "alpha-PBE" corresponding to a given PBE which supports equilibrium behavior that is neither compatible with the fixed PBE nor with any other PBE. However, any pooling PBE is (weakly) robust against ambiguity if and only if the level of the Receiver's ambiguity perception is constant (i.e., all messages are perceived with the same degree of ambiguity).



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## The Endowment Effect in Games

*Michalis Drouvelis; Joep Sonnemans*

### Abstract

We study experimentally whether the endowment effect survives in a social and strategic context. Participants are asked for their Willingness-to-Accept (WTA) or Willingness-to-Pay (WTP) to play a series of 2x2 games. In the second part of the experiment, we study the endowment effect in lotteries with the same payoffs as the games in the first part. Our findings provide robust evidence for the endowment effect both in games and in lotteries, with the size of the effect actually being larger in games than in lotteries. We also find that the endowment effect can partly be attributed to optimism.



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## Prudent Discounting for Risky Times

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### Abstract

How should we discount outcomes that occur at random ('risky') times? Through a symmetry in the discounted expected utility (DEU) model's treatment between such time risks and outcome risks, well-known results for utility functions carry over to discount functions. I start this research agenda by defining the concepts of prudent and temperate discounting in analogy to the influential behavioral traits of prudent and temperate utility. I characterize time risk preferences, i.e. preferences towards delay risk, through preferences over simple and intuitive time risk apportionment lotteries, through behavior in optimal stopping problems (e.g., prudent optimal stopping), a precautionary patience motive, and by signing the discount function's derivatives of all orders. Finally, noting that the derivatives of commonly used discount and utility functions are consistently opposite in sign, it follows that the standard parametrizations of the DEU model imply an anti-symmetric behavior towards outcome and time risk if and only if outcomes are desirable.



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## Zooming in on Ambiguity Attitude: Rare Events Matter

*Aysil Emirmahmutoglu; Aurelien Baillon*

### Abstract

Kahneman & Tversky (1979) pointed out that rare events are either completely neglected or overweighted. For decision making under risk, the common view in the literature is that small probability events are overweighted (e.g., Tversky & Kahneman, 1992; Gonzalez & Wu, 1999). However, the picture is not that clear when we consider decision making under uncertainty. Recent research in psychology has shown that if unlikely events are not described but experienced by agents, they tend to be partly neglected or underweighted (e.g., Barron & Erev, 2003; Hertwig et al, 2004; Hertwig & Erev, 2009). On the other hand, there is also evidence that rare events are overweighted, but less so under experience-based decisions than description-based when the events concern gains, and they are overweighted similarly in both decisions when they concern losses (Abdellaoui et al., 2011). Understanding the attitude towards rare events helps to explain certain economic activities. For example, policies to prevent or cope with environmental catastrophes concern such events with losses. When rare events relate to gains, overweighting can explain betting behavior while underweighting might hinder entrepreneurship. In this paper we measure ambiguity attitude for very unlikely events in an Ellsberg-like experiment. Despite the fact that decision making for ambiguous rare events is crucial, there are no other studies that empirically examine ambiguity attitude with events as unlikely as ours. This paper is the first study of ambiguity attitude for very unlikely events, more than 100 times smaller than in typical ambiguity studies. Additionally, the literature on ambiguity focuses mostly on gains, while there is little known about losses (Trautmann & van de Kuilen, 2014). We measure ambiguity attitude both for gains and losses, and therefore contribute to the existing literature by being one of the few studies that uncover the loss domain, providing opportunities for direct comparison with gains. We deal with two main challenges of measuring ambiguity attitude. The first one relates to identifying ambiguity attitude generated on top of risk attitude when we move from decision making under risk to decision making under uncertainty. We use the solution proposed by Dimmock et al. (2015), namely matching probabilities, to deal with this issue. The second challenge relates to controlling for beliefs, for which we compare matching probabilities with themselves and study their internal consistency, as Baillon et al. (2015) suggested. We do this by the use of additivity measures. We find that very unlikely events are overweighted and loom larger in isolation, more under ambiguity than under risk. This corresponds to ambiguity seeking for unlikely gains and ambiguity aversion for unlikely losses. Additionally, we observe more overweighting of unlikely losses than unlikely gains. Therefore, ambiguity aversion for catastrophes is stronger than ambiguity seeking for betting behavior.



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# Quasi-homotheticity Preferences over Lotteries

Thomas Epper

## Abstract

We introduce a general characterization of Allais paradoxes. Our characterization motivates a generalized homotheticity condition which precludes particular Allais paradoxes while permitting others. Preferences over lotteries are quasi-homothetic (qHT(L)) if a scaling of two lotteries relative to a homothetic center does not revert preferences. The class of preferences obeying the qHT(L) axiom entails existing proposals to weaken independence as special cases. For example, if the homothetic center is a lottery inferior to the two lotteries under comparison, it precludes the classic common ratio effect. Similarly, if the homothetic center lies at infinity, it precludes the classic common consequence effect. A homothetic center being equal of the original two lotteries leads to the betweenness axiom. If the homothetic set consists of all lotteries in the  $n$ -simplex, we obtain mixture independence. If qHT(L) holds for comonotonic sets, it is equivalent to comonotonic independence. qHT(L) also yields to a number of interesting and novel results. First, if preference are homothetic with respect to two distinct homothetic centers not lying on the same indifference curve, they obey mixture independence. Second, a preference relation on a specific subdomain of the  $n$ -simplex can never imply both common ration and common consequence violations. Third, we propose a class of quasi-homothetic non-expected utility theories. Adopting an extended version of Bergson's theorem, i.e. additive separability together with qHT(L) and the standard axioms, is equivalent to probability distorted non-expected utility model with a particular weighting function. Quadratic preferences (i.e. preferences obeying the mixture symmetry axiom) are a subclass of this representation. Restricting preferences to comonotonic sets of lotteries, further constrains this class of preferences to rank-dependent utility representations. Fourth, there is a direct link between violations of qHT(L) and dynamic inconsistency. Fifth, qHT(L) preferences can be recovered from choices using triangulation. We derive some direct tests of qHT and the large domain of theories it encompasses. qHT(L) helps to understand the drivers of various behavioral patterns documented in the literature. For example, we find that preferences for late resolution of uncertainty and preferences for one-shot resolution of uncertainty are driven by certain violations of qHT(L), and do not depend on other characteristics of the representation. Also, qHT(L) is crucial for the aggregation of preferences. Representative agent results are systematically biased as compared to population means when the qHT(L) axiom fails.



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## Why Accommodate Decision-Making Heuristics in Discrete Choice Experiments?

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### Abstract

The discrete choice experiment (DCE) is a technique for eliciting individuals' preferences. Notwithstanding the appeal of DCEs, there are some issues raised in the literature that might be important. For example, in DCE studies, the typical assumption that individuals consider and trade-off between all attributes within the choice sets is often questioned. Indeed, a number of studies show that many respondents exhibit signs of adopting a range of simplifying mental processing rules, which are referred to as decision-making heuristics. Making decisions based on certain criteria, such as the cost thresholds, is one of such heuristics. 'Elimination-by-aspects' (EBA) and 'selection-by-aspects' (SBA) like behaviours are examples of such cases where respondents make choices by eliminating or selecting some alternatives based on some decision criteria. Despite the increased attention on decision-making heuristics within the stated preference literature, EBA and SBA behaviour have largely been overlooked. This paper furthers this line of enquiry and explores EBA and SBA behaviour in the context of public preferences for health service innovations. To do this we use empirical data obtained from a DCE survey administered in the UK exploring public preferences relating to health service innovation investment decisions. The modelling approach we use is flexible and capable of addressing EBA and SBA choice behaviour, whilst addressing preference heterogeneity. We use the approach to investigate the extent to which respondents eliminated alternatives based on who the health service innovations were aimed at or limited their choice to those alternatives that targeted a certain population. The empirical application of our modelling approach shows that it has important implications for model fit and welfare analysis. Our findings reveal that accommodating EBA and SBA concurrently proved to give a richer insight into respondents' behaviour and suggested that as few as 40 percent of respondents did not present these heuristics. In line with previous studies, we found that assuming homogeneous preferences in respondents was inappropriate. Going beyond this, we also show that each segment of respondents differed not just in their preferences, but also in the decision-making heuristics they adopted. To conclude, failing to account for EBA-like and/or SBA-like choice behaviours was not optimal and has implications for welfare analysis. Where our models accounted for such behaviours they outperformed those based solely on the no-heuristics assumption. Although there are a large number of other decision-making heuristics and processing strategies that can also be considered and there is the potential to uncover additional random taste variation, the models illustrated here provide additional insight into the manner in which respondents arrive at their final decision. This represents an exciting research challenge.



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## From Anomalies to Forecasts

*Ido Erev; Eyal Ert; Ori Plonsky; Doron Cohen; Oded Cohen*

### Abstract

Experimental studies of choice behavior document distinct, and sometimes contradicting, deviations from maximization in different settings and experimental paradigms. Specifically, different behavioral phenomena emerge in decisions under risk and decisions under ambiguity, in decisions from description and decisions from experience, and in choice between binary gambles and choice between multi-outcome gambles. Most previous efforts to develop descriptive models of choice behavior address the distinct results by assuming different processes and proposing different models (or parameters) capturing the different choice anomalies. Implicit in these efforts is the assumption that the task of developing descriptive models is similar to the task of solving a puzzle: It is wise to start with a focus on the easy and interesting problems (areas); and the progress (added parts) will eventually clarify the more difficult areas, and the relationship between the different areas. The current paper evaluates an alternative approach: We consider the possibility that the development of descriptive models is more similar to the game "Scratch and Guess." The optimal strategy in this game is to distribute the data collection efforts over a wide space to facilitate evaluation of the big picture. That is, we try to develop a general model capturing the coexistence and relative importance of the contradicting tendencies shown to emerge in different settings. Three steps are taken to reduce the risk of overfitting the data. First, we replicate 14 classical anomalies in one experimental paradigm. Next, we studied 60 problems randomly selected from a space that includes all problems examined in the replication study. Finally, to reduce the danger of an arbitrary selection of feasible models, an open choice prediction competition was organized. The organizers (first three co-authors) presented their favorite model and challenged other researchers to develop better models. Models were evaluated based on their predictions of 60 new problems. The results suggest that the classical "pre-feedback" phenomena are replicable, but that feedback eliminates most and instigates choice of the prospect minimizing probability of regret. The models that best capture the results assume: (a) high sensitivity to the best estimates of the expected values, (b) the use of several feedback-dependent heuristics, and (c) reliance on small samples.



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## Decisions with Compound Lotteries

Yuyu Fan; David V. Budescu; Enrico Diecidue

### Abstract

The Reducibility of Compound Lottery axiom (ROCL) states that a multi-stage compound lottery can be reduced to its equivalent simple form. Violations of ROCL were documented, but they are not fully understood, and only few descriptive models of DMs' decisions in such cases, were offered. To study systematically the factors that lead to violations of ROCL and evaluate their importance and prevalence, we created two types of lotteries, simple one-stage binary lotteries (16 in total) with various winning probabilities and payoffs, and compound lotteries (32 in total) obtained by manipulating (1)the number of stages (2, 3), (2)the global winning probability (.09, .18) paired with the payoff (\$20, \$10), (3)the resolution mechanism (simultaneous, sequential), (4)equality, or inequality, of the probabilities of the various stages, (5)the descending/ascending order of the stage probabilities in sequential lotteries, (6)the magnitude of the differences between the probabilities of adjacent stages. Six groups of DMs (125 students, 39% females, mean age = 22) evaluated different partially overlapping subsets of these lotteries by providing Certainty Equivalents (CEs) via a two-stage choice procedure. All participants evaluated the single stage lotteries and some 2-stage and 3-stage lotteries in various orders. We confirmed the existence of the systematic violations of ROCL and tested the effect of each factor. Half of the DMs preferred the compound lotteries, and only one-fifth preferred the equivalent one-stage lotteries. The effect of each factor was examined via multi-level modeling. We found that the number of stages and the global probability were the major drivers of the CEs. We also inferred pair-wise choices from the CEs and used them to fit the Bradley-Terry (BT) model. For the most part, the scale values from the BT model were consistent with the multi-level models. Prospect Theory (PT) is mute with respect to compound lotteries and does not explain how their probabilities are aggregated. To model the DMs' CEs of compound lotteries, we developed three classes of models (16 in total) based on PT: (1)DMs aggregate stage probabilities first, and then generate a decision weight; (2)DMs weight stage probabilities first, and then aggregate them; (3)DMs anchor on one of the stage probabilities and then apply the weighting. Model fits were compared in terms of RMSE and pair-wise tournaments. Overall, the best fitting model was the one that assumes that DMs anchor on the minimal stage probability and then apply the weighting function. We assume that even DMs with minimal knowledge of probability theory recognize that the global winning probability cannot exceed any of the stage probabilities, so they use the minimal stage probability as an anchor. Results also showed that, in general, the "aggregate first and weigh second" outperformed the "weight first and aggregate second" models, presumably because it is cognitively easier and more natural.



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## The Magnitude Paradox

*Helga Fehr-Duda; Thomas Epper*

### Abstract

It is a common observation that risk aversion increases with stake size, implying that the elasticity of the utility function is decreasing. In the domain of time discounting, however, we often find patience increasing with stake size, which implies the opposite characteristic of the utility function. These contradictory findings have been interpreted as evidence of two different utility functions governing behavior in the domains of risk and time. We show that the magnitude effects in risk taking and time discounting can be reconciled if decision makers perceive the future as inherently uncertain and are prone to Allais-type common-ratio violations. In our model, decreasing elasticity of the utility function over risky outcomes predicts patience increasing with stake size. Therefore, the unity of utility can be preserved, which is desirable when dealing with prospects that are both risky and delayed.



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## Who knows it is a game? On strategic awareness and cognitive ability

*Dietmar Fehr; Staffen Huck*

### Abstract

We examine strategic awareness in experimental games, that is, the question of whether subjects realize they are playing a game and thus have to form beliefs about others' actions. We conduct a beauty contest game and elicit measures of cognitive ability and beliefs about others' cognitive ability. We show that the effect of cognitive ability is highly non-linear. Subjects below a certain threshold choose numbers in the whole interval and their behavior does not correlate with beliefs about others' ability. In contrast, subjects who exceed the threshold avoid choices above 50 and react very sensitively to beliefs about the cognitive ability of others.



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## Bringing new medicines to market sooner? Bayes decision theoretic modelling of a sequential trials

*Martin Forster; Stephen Chick; Paolo Pertile*

### Abstract

Increasing pressure on health care budgets has led to extensive innovation in clinical trial design and health technology assessment: adaptive designs seek to alter the balance of allocation of patients to treatments as trial evidence accumulates, sequential designs permit early stopping when evidence becomes sufficiently persuasive. Despite such progress, much work either follows the frequentist tradition, defining stopping rules via error spending functions, or implements Bayesian policies based on posterior probabilities of selecting the best alternative. We present a Bayesian decision-theoretic model [1-3] of a sequential clinical trial which fully accounts for the costs of carrying out research, benefits accruing to patients, the cost of switching technologies and the size of the population to benefit. The model yields an optimal stopping policy based on the solution of a free boundary problem in which the investigator learns about comparative cost-effectiveness as trial evidence accumulates. It provides a unified policy defining optimal 'do not experiment'/'fixed sample size experiment'/'sequential experiment' decisions as a function of prior information. The important matter of delay in the arrival of primary endpoints is dealt with using predictive distributions for the posterior reward once observations on the trial's 'pipeline' patients have arrived. We use a published trial investigating the clinical- and cost-effectiveness of drug-eluting stents versus bare metal stents to illustrate the potential gains from the approach, in terms of the maximisation of net benefits of the trial and adoption decision. Of particular interest is that the model does not seek to minimise expected sample size, a traditional statistical objective; rather it commits additional patients (in expectation) when the benefit of learning by sampling is highest. Hence the design does not always imply earlier stopping, in expectation. We illustrate how longer delays in observing the primary endpoint reduce the benefits of learning over time, and how smaller populations imply earlier stopping, so that adoption decisions will be made earlier for rare diseases.



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# Characterising Risk Preferences Under Prospect Theory: A Study of Ghanaian Farmers

*Iain Fraser*

## Abstract

An unpredictable climate and the increasing likelihood of extreme weather events in Ghana means that farmers are subject to significant issues associated with risk and uncertainty. To understand how this environment influences farmers' preferences, our study examines risk preferences using (Cumulative) Prospect Theory (PT) so that we can examine how respondents compare prospects in the gain domain as opposed to those in the loss domain. An feature of this study is that we explicitly assess if the restrictions on the power parameters for value functions used by Tversky and Kahneman (1992) are supported by our data. That is, the concavity and convexity of the value functions are exactly reversed in the loss and gain domains. We allow for heterogeneity amongst respondents in the way in which we econometrically model our data following Balcombe and Fraser (2015). Specifically, we model heterogeneity by employing a Hierarchical Bayesian (HB) approach that has only been employed in a limited number of studies within the risk literature to date (e.g., Nilsson, Rieskamp and Waenmakers 2011). This research adds to the literature on risk preferences by authors such as Tanaka et al (2010), Liu (2013), Liu and Huang (2013), de Brauw and Eozenou (2014), Liebenheim and Waibel (2014). In general we find broadly support for "Weak" PT over Expected Utility (EU), and a model allowing farmer heterogeneity is supported relative to a representative agent model. As PT suggests, an "Inverse S" probability weighting is supported with respect to the "largest gain" within a prospect, but farmers' seem almost globally optimistic concerning the "largest loss". Farmers in our analysis show little tendency towards weighting losses more heavily than gains, within the range of the prospects considered. Our results indicate that models that allow for individual parameter heterogeneity are warranted. Also PT models cannot be usefully restricted to EU models and, the restrictions frequently employed in the literature on the power parameters for value functions, is not universally supported. This is an important result as it has implications for parameter interpretation. Specifically, as we discuss, this means that different parameter values interact and require careful interpretation. We pay particular attention to whether, 'loss aversion' or 'loss seeking' behaviour can be identified. Thus, in contrast with what appears to be the majority finding in the literature, we find mixed evidence with regard to loss aversion, with many individuals being largely 'loss neutral' within a relevant payoff range. However, we do not make this conclusion simply with regard to the "loss aversion" parameter, as it has been labelled in the literature. Finally, we ask whether the estimates of individuals PT parameters can be used to explain a hypothetical decision to adopt a drought resistant technology. We find that the PT has some capacity to do so, but not in the way that we expected.



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## Characterization of Privacy Loss

*Gail Gilboa Freedman; Rann Smorodinsky; Kobbi Nissim*

### Abstract

How much privacy is lost by a mechanism? This question is not a new question. However, an un-equivocal answer is still missing in the literature. Our research aims to formalize the conceptual notion of privacy. We suggest a new measure for privacy-loss and rigorously justify this measure. The applicability of our research is for having a standard methodology of prioritizing mechanisms by their level of privacy-loss. We model any privacy-jeopardizing-mechanism abstractedly, as a signaling-matrix. The set of rows represents a set of types (secrets). The set of columns represents a set of signals. In each row there is a distribution, representing the association between the corresponding type and the signals. Publication of such matrices jeopardizes privacy to some level. Consider any two signaling matrices, it is natural to ask: which mechanism is preferable in the context of keeping the type secret? We follow a Decision-Theory-flavored approach and capture the natural properties for such decisions by a list of ordinal axioms. These axioms imply a (subjective) preference relation model. We identify that  $f$ -divergence represents this preference relation model, and therefore can serve as a natural measure of privacy-loss.  $f$ -divergence is familiar in the realm of information-theory for quantifying the distance between a pair of probability distributions. We also follow a reverse direction of the axiomatization approach in order to characterize differential privacy, which is a standard privacy-loss measure in the computer- science literature. We give a rigorous construction for this measure and examine if it stems from natural behavioral axioms or not.



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## Revealing Sophistication and Naivete from Procrastination

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### Abstract

Consider a person with time inconsistent preferences who must complete a task, and is given a set of options for completing the task at different times. The person cannot commit her future behaviour except by completing the task. This paper shows that comparing a person's completion time across different sets of completion opportunities can reveal her sophistication or naivete about her dynamic inconsistency. I show that adding an extra opportunity to complete the task can lead a naïve (but not a sophisticated) person to complete it even later, and can lead a sophisticated (but not a naïve) person to complete the task even earlier, even if the extra opportunity is not used. This result can be obtained with or without parametric assumptions about utility. In the quasi-hyperbolic discounting model with partial naïveté, such "doing-it-earlier" reversals are shown to exist for any partially sophisticated individual, while "doing-it-later" reversals always exist for any partially naïve individual. Additional results completely characterize models of naïve and sophisticated individuals in this environment. These results provide the framework for revealing the preference and sophistication types studied in O'Donoghue and Rabin (1999) from behaviour in a generalization of their environment.



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## A Revealed Preference Test of Quasi-Linear Preferences

*Mikhail Freer; Marco Castillo*

### Abstract

Quasi-linearity is an essential assumption underlying important results in different areas of economics (e.g. the revenue equivalence theorem, implementation in dominant strategies and the rotten kid theorem). Brown and Calsamiglia (2007) propose a test of the joint hypothesis of quasi-linear and concave preferences with linear budget sets. We develop a test of quasi-linearity of preferences that relaxes both assumptions: concavity of the utility function and linearity of budgets. That is, 1) observed demand can be generated by maximization of utility function that represents quasi-linear preferences if and only if revealed preference relation passes the test and 2) the test imposes minimal requirements on budget sets, hence it can be used to test quasi-linearity of preferences in strategic environments like auctions. The test we propose has combinatorial nature and can be executed in polynomial time. The paper presents several applications of the test. In the context of Arrow-Debreu securities as in Choi et al (2007) and Choi et al (2014), the condition provides a test of subjective expected utility with risk neutral preferences and constant probabilities. We also test for quasi-linearity of preferences in context of consumption goods. For this purpose we use experimental data from Mattei (2000) to compare the predictive success (Beatty and Crawford, 2011) of the assumption of quasi-linearity in (at least) one good versus the generalized axiom of revealed preference.



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## Revealed Different

*Mikhail Freer; Marco Castillo*

### Abstract

How heterogeneous are individual preferences? Are men's preferences more heterogeneous than women's? Do preferences become less diverse with age? We use revealed preference analysis to answer these questions. In particular, we investigate the nature of the revealed different relation: two people are revealed different if their individual decisions considered jointly are less rational than their individual decisions considered separately. We show that the revealed different relation is useful not only in characterizing the heterogeneity of preferences non-parametrically, but also in evaluating the potential biases generated by imposing additional assumptions on preferences. Using data from a random sample of Dutch population we find that: 1) heterogeneity is a persistent feature of the data, 2) men have more diverse preferences than women and younger people while different from older people are not more diverse, 3) Stricter assumptions on preferences lead to an underestimation of the heterogeneity of preferences. The revealed different relation as defined above is complete and symmetric and it is well defined whether preferences are consistent with rationality or not. This definition is most appealing when the measure of distance to rationality is monotonic on the number of individual decisions (as in Afriat's critical cost efficiency index). Since the revealed different relation is a summary statistics that does not require making parametric assumption about preferences, the relation can be used to directly test if observe heterogeneity in preferences is due to observed demographic differences. We find little evidence that heterogeneity in preferences is due to observed individual characteristics. Finally, we find that the revealed different approach is most informative when multiple decisions per individual are available. When only cross-sectional data is available (i.e. each individual trivially satisfies rationality) lack of differences between individuals might be due to lack of power to detect deviations from rational behavior.



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## The challenges to measuring risk attitudes: Talk may be cheap, but consistent.

*Renato Frey; Andreas Pedroni; Rui Mata; Jörg Rieskamp; Ralph Hertwig*

### Abstract

Two different traditions of measuring people's risk attitudes have emerged over the last decades: On the one hand, self-report measures have capitalized on people's introspective abilities and were widely used in practice and research. On the other hand, the revealed-preference approach stipulates that only incentivized behavior elicited by means of behavioral measures is indicative of a person's true risk attitudes. To what extent do these two traditions share their conception of the construct "risk attitudes" that they claim to measure? Moreover, numerous measures have been developed within each of these two traditions, but the typical assessment of a person's risk attitudes merely involves a single measure. Does this imply that all of these measures capture the identical underlying construct, within but also across the two traditions? We tackled these questions by collecting a battery of risk-attitude measures (self-reports and behavioral measures) from each of 1,000 participants. The evidence suggests a clear gap between self-report and behavioral measures: The former correlated more strongly between each other as compared to the latter, and correlations between measures across traditions were weak. A general "risk factor" only emerged across self-report measures. Moreover, self-reports proved to be relatively stable across time as they may allow people to integrate across similar past experiences when they provide their ratings. In contrast, behavioral measures had lower test-retest reliability, as they may be more susceptible to the influence of situational factors. This interpretation is in line with the view that risk attitudes are constructed preferences that fluctuate across time.



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## Gender Differences in Ambiguity Aversion

*Andreas Friedl; Patrick Ring; Ulrich Schmidt*

### Abstract

The literature seems to agree that women are more ambiguity averse than men. We use two different treatments where participants either face correlated or uncorrelated risks within their reference group to test if the correlation structure of the risks have an influence on ambiguity aversion. Similar to the literature we don't find ambiguity aversion in the loss domain. The results for the gain domain indicate that women are more ambiguity averse when risks are uncorrelated and that men are more ambiguity averse when risks are correlated. This result indicates that the notion that women are more ambiguity averse than men might be only true for specific (uncorrelated) risks.

There exist already studies which investigate whether social comparison or social interaction within a group have an impact on ambiguity aversion. Already since Fox and Tversky (1995) and Heath and Tversky (1991) found the competence hypothesis it is well known that the source of ambiguity can influence the degree of ambiguity aversion. Further Curley et al. (1986) found that people fear a negative evaluation by others. This was supported by Mutukrishnan et al. (2009) and Trautmann et al. (2011). Other studies involving the social interaction within groups have been done as well (Keller et al., 2009; 2011; Charness et al., 2013), but none of them takes into account that the correlation of risks might have an impact on ambiguity aversion. For the risk domain Schmidt et al. (2015) and Friedl et al. (2014) run similar experiments and find a higher treatment effect for men. They observed that men are more sensitive to a change from correlated to uncorrelated risks in both domains. That's why they find that men take more risks when risks are correlated.

In order to distinguish between the loss domain and the gain domain two different experiments have been run. Both experiments were put in a contextual frame. The one for the loss domain is framed as an insurance decision and the one in the gain domain is framed as an investment decision. Both experiments were paper based classroom experiments. They lasted around 15 to 20 minutes and used a between-subject design.

There is evidence for ambiguity aversion in the gain domain. Besides the results for women in the correlated and for men in the uncorrelated treatment, all results are significant. All in all the significant findings underline general ambiguity aversion in the social context, which has also been found by Curley et al. (1986) and Trautmann et al. (2011).

In brief, as expected there is no ambiguity aversion in the loss domain, while general ambiguity aversion can be found in the gain domain. Gender differences can be observed for all features of the experiment. Besides men are ambiguity averse when risks are correlated and women are ambiguity averse when risks are uncorrelated.



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# Regret Sensitive Treatment Decisions

*Yoichiro Fujii; Hideki Iwaki; Yusuke Osaki*

## Abstract

This paper describes a framework that incorporates the concept of regret into the classical medical decision problem. We show conditions for the regret-rejoicing function under which the threshold probability changes monotonically. The threshold probability decreases under conditions that can explain the observed choices. This means that people who are more regret sensitive are more likely to opt for medical treatment. We also discuss some of the implications of our analysis.



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# Linking Experimental and Survey Data for a UK Representative Sample: Risk and Time Preferences

*Matteo M Galizzi; Glenn W Harrison; Raffaele Miniaci*

## Abstract

We report evidence from the first "artefactual field experiment" that directly incorporates experimental measures for risk and time preferences for a representative sample of respondents within the Innovation Panel (IP) of the UK Household Longitudinal Survey (UKHLS, also known as Understanding Society), the world-largest multi-scope panel survey. In wave IP6 we randomly allocated a representative subsample of 708 IP respondents to an experimental module where discounting rates and a-temporal risk preferences were elicited using incentive-compatible methods. Households were independently randomly allocated to either a face-to-face or a web interview mode. Individual respondents had the opportunity to self-select into their preferred interview mode, and to opt out of the experimental risk and time preferences questions. Time preferences were measured with 72 questions asking to choose between a Smaller-Sooner or a Larger-Later monetary reward. Risk preferences were measured with 18 binary-lotteries questions with low and high monetary stakes, and an extra question using a multiple-lotteries task. One question was randomly selected and subjects paid real money at the due date based on their preferred choice in that question. Respondents also answered survey questions on risk and time attitudes. We structurally jointly estimate risk preferences under Expected Utility Theory and Rank Dependent Utility, and time preferences considering a broad class of discounting models such as exponential, hyperbolic, quasi-hyperbolic, and Weibull discounting. The models, and their finite mixtures, are estimated using Maximum Likelihood calculating individual-specific levels of daily 'background consumption' from linked household income data. The structural estimations model the self-selection into the interview mode and into the experimental module, and use sampling weights to adjust for differential attrition and non-response. We have three findings. First, there is high heterogeneity in the responses from our UK representative sample. Overall responses seemingly support risk aversion and non-constant discounting. The finite mixtures models suggest that about half the responses are in line with an implicit exponential discount rate of around 17 percent a year, while the remaining responses could be explained by non-constant, in particular Weibull, discounting. Second, because of the self-selection into the interview mode, web respondents are younger, more educated, and less likely to report poor health. Despite self-selection, there is no significant difference between the web and the face-to-face responses and the structurally estimated parameters of risk aversion and time discounting. Third, the different risk and time preferences measures are systematically cross-validated with a comprehensive range of linked survey, administrative, and biomarkers data in the UKHLS, providing mixed evidence on their external validity.



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# The Misery of Spending Down the Nest Egg

Yu Gao; George Loewenstein; Peter Wakker; Xianghong Wang

## Abstract

Empirical research (Panis, 2004) on happiness and retirement found that retirees with higher annuitization level were more satisfied with their lives, and maintained their satisfaction throughout retirement; retirees without annuities became less satisfied over the years. However, even after controlling for income, wealth, health, gender, marital status, age, etc., it is still possible that people with and without annuities belong to completely different groups. Do people behave differently, and feel differently when spending down from flow vs. lump-sum? To identify the effect of flow payment, we conducted a field experiment where we assigns subjects randomly into these two payment schemes. The main experiment was conducted at Renmin University in Beijing, China in April, 2015. The experiment consists of two stages. The first stage was a pre-survey to recruit subjects and obtain relevant information. In the pre-survey, we measured respondents' "spendthrift-tightwad (ST-TW)" scale which is a measure of individual differences in the pain of paying (Rick, Cryder, Lowenstein, 2008), and asked about their consumption behaviors (frequency of eating at campus, monthly allowance, funding resource and frequency, financial satisfaction). The second stage was the main part, which involves two different payment schemes and daily surveys that last for 10 days. In the Flow treatment, subjects received CNY20 ( $\approx$ USD3.09) in their campus card each day for 10 days consecutively (in total CNY200), whereas in the Lump-sum treatment, subjects received CNY200 ( $\approx$ USD30.9) in their campus card at the first day of the experiment. Spending behavior is recorded by students' campus card spending history provided by the campus card management center. Feeling is measured by self-reported happiness and money anxiety in the daily survey. We obtained spending records for 30 consecutive days: 10 days before the experiment (from 28th March to 6th April), 10 days during the experiment (from 7th April to 16th April), and 10 days after the experiment (from 17th April to 26th April). The spending records consist of location, time (precision up to a second) and amount for each transaction. Coincide with our conjecture, we found that flow treatment makes people spend more, and feel less anxious about money. The treatment effect is interacted by people's ST-TW scale: the treatment effect decreases if the person has a higher ST-TW score (a person with higher ST-TW score means that it is difficult for her to control spending).



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# The Role of Procrastination in Default Opt-Out

*Yu Gao; Giovanna D'adda; Ning Liu; Massimo Tavoni*

## Abstract

The use of defaults as a policy lever has become increasingly common, due to its powerful influence without restricting choices. Defaults are socially desirable when a large majority of agents have a shared optimum. However, even a well-chosen default may be undesirable if agents' optimal choices are highly heterogeneous. For instance, young people, single parents and older employees building their retirement nest egg would need different saving rates for their 401(k) plans. The paternalistic libertarian view favors defaults because people are always free to opt out and actively choose their personal optimal saving rates if the defaults are sub-optimal. In our study, we test whether present bias could hinder such freedom. We claim that the length of the opting out period could influence the decision to opt out. In particular, it might be better to set a shorter response period rather than a longer one, in order to avoid the consequence of procrastination. Intuitively, when the response duration is extended, people should opt out more often. However, Carroll, Choi, Laibson, Madrian and Metrick (2009) pointed out that agents with present-biased preferences may procrastinate in opting out of the default, but this supposition has so far not been tested experimentally. We design a two-stage online experiment. Subjects earn their salaries in a 20-minute real-effort task in the first stage. The salaries were paid as installments that lasted for 5 days. In each day, a proportion of the salary was "invested" by the experimenter as default. The proportion to be invested and the return of the investment differ in conditions. The second stage is the opting-out stage where subjects could opt-out the default investment level and actively choose their optimal investment level. We use a between-subject design consisting of two treatments. In the first treatment subjects have 1 day to opt out. If they fail to change the default investment level, then the future income in the experiment will be invested as in the default. In the second treatment subjects have 5 days to respond online. However, they can only change the default investment level for the future income, but not the past income. It means the earlier they opt-out, they less they suffer. Our prediction is that because some people are unaware of their present-bias (naively inconsistent), they tend to postpone the opt-out in the second treatment, ending up with never opting out during the extensive period. At the aggregate level, with appropriate parameterization (investment level and return), we test whether people in the first treatment (1 day response duration) opt out more than those in the second treatment (5 days response duration). We conclude that sometimes, an extended response duration leads to worse outcomes.



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# Dynamic Collective Choice under Ambiguity: an Experimental Investigation

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## Abstract

Recently, inspired by the advances in the theory of decision making under ambiguity<sup>1</sup>, there have been several empirical studies aiming to test either for the ambiguity attitudes of the subjects or to fit different non-Expected Utility models to identify which theory best describes the data (see among others Halevy (2007), Ahn et al. (2014), Hey and Pace (2014) and Stahl (2014)). Most of these studies have shown extensive heterogeneity in behaviour and attitudes towards ambiguity, and violations of the Expected Utility axioms. Furthermore, this framework has been recently extended so as to capture the effects of group choice to ambiguity attitudes (Charness et al. (2013), Keck et al. (2014)). These studies compare decisions of individuals and groups and aim to understand whether social interactions lead to more ambiguity neutral decisions or not. All the aforementioned studies focus on decision making in an atemporal environment. Nevertheless, a crucial question in the theory of decision making under ambiguity how beliefs are updated upon the arrival of new information. In the standard economic theory, when a decision maker has to cope with a dynamic problem where the various probabilities of the possible states of the world are not given, it is assumed that prior beliefs are updated in a Bayesian way and decisions are made by maximising Expected Utility preferences (Savage (1954)). This requires that the agents' preferences satisfy both the axioms of Dynamic Consistency and Consequentialism. When the agents have not ambiguity neutral attitudes (violate EU), one of the two rationality axioms is not satisfied leading to potential inconsistencies in choices. We extend the collective choice framework to its dynamic dimension where we compare individual and group choice in a dynamic decision problem under ambiguity. We use a transparent and non-manipulable device (a Bingo blower) to represent ambiguity in the lab and we ask the subjects a set of allocation questions in a sequential choice task. Based on the information that is provided by the Bingo blower the participants are able to form priors regarding the probability distribution of the future states of the world. Based on these priors, the subjects are asked to make an initial choice. In the next period, partial information is revealed which provides the decision makers the opportunity to update their prior beliefs and adapt, if necessary, their initial decision. Our data from this experimental design allows the fitting of preference functionals for both individuals and groups. Based on this analysis we are able to investigate the following questions: (1) which axioms do individuals and groups violate, (2) what are the effects of group decision making to the risk and ambiguity attitudes of the subjects, (3) how does decision making in groups influences the updating process and (4) when individuals are dynamically inconsistent, does group decision making help to eliminate these inconsistencies?



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# Cognitive Ability, Character Skills, and Learning to Play Equilibrium: A Level-K Analysis

David Gill

## Abstract

In this paper we investigate how cognitive ability and character skills influence behavior, success and the evolution of play towards Nash equilibrium in repeated strategic interactions. We study behavior in a p-beauty contest experiment and find striking differences according to cognitive ability: more cognitively able subjects choose numbers closer to equilibrium, converge more frequently to equilibrium play and earn more even as behavior approaches the equilibrium prediction. To understand better how subjects with different cognitive abilities learn differently, we estimate a structural model of learning based on level-k reasoning. We find a systematic positive relationship between cognitive ability and levels; furthermore, the average level of more cognitively able subjects responds positively to the cognitive ability of their opponents, while the average level of less cognitively able subjects does not respond. Finally, we compare the influence of cognitive ability to that of character skills, and find that both cognition and personality affect behavior and learning. More agreeable and emotionally stable subjects perform better and learn faster, although the effect of cognitive ability on behavior is stronger than that of character skills.



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## Information Gaps for Risk and Ambiguity

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### Abstract

We apply a model of preferences for information to the domain of decision making under risk and ambiguity. An uncertain prospect exposes an individual to an information gap. Gambling makes the missing information more important, attracting more attention to the information gap. To the extent that the uncertainty (or other circumstances) makes the information gap unpleasant to think about, an individual tends to be averse to risk and ambiguity. Yet in circumstances in which thinking about an information gap is pleasant, an individual may exhibit risk- and ambiguity-seeking. The model provides explanations for source preference regarding uncertainty, the comparative ignorance effect under conditions of ambiguity, aversion to compound risk, and a variety of other phenomena. We present an empirical test of one of the model's novel predictions. Imagine a choice between a gamble and a sure thing. Deciding to play the gamble naturally focuses attention on the question: what will be the outcome of the gamble? Of course, deciding to not play the gamble does not stop an individual from paying some attention to the question but playing the gamble makes the question more important, and that brings about an increase in attention to the question. Whether this encourages risk taking or risk aversion will depend on whether thinking about the information gap is pleasurable or aversive. When thinking about the missing information is pleasurable, then the individual will be motivated to increase attention on the question, which entails betting on it. Conversely, when thinking about the missing information is aversive, the individual will prefer to not bet on it. This may help to explain why, for example, people generally prefer to bet on their home teams than on other teams, especially in comparison to a team their home team is playing against. A preference for betting on uncertainties that one likes thinking about shares much overlap with, but is distinguishable from, a preference for betting on uncertainties that one has expertise about (Heath and Tversky, 1991). Decision making involving uncertainties that are ambiguous is similar to the case with known risks, but with an additional wrinkle: with ambiguity, there are additional information gaps. In a choice between a sure thing and an ambiguous gamble, for example, a second relevant question is: what is the probability of winning with the ambiguous gamble? Again, betting on the ambiguous gamble makes this question more important and thus increases attention to it. So, desire to play the gamble will be increasing with the degree to which thinking about the gamble is pleasurable. To the extent that abstract uncertainties are not pleasurable to think about, this model provides a novel account of ambiguity aversion in Ellsberg choices.



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## Goal Setting in the Principal-Agent Model: Weak Incentives for Strong Performance

*Joaquín Gómez-Miñambres; Brice Corgnet; Roberto Hernán-Gonzalez*

### Abstract

We study a principal-agent framework in which principals can assign wage-irrelevant goals to agents. We find evidence that, when given the possibility to set wage-irrelevant goals, principals select incentive contracts for which pay is less responsive to agents' performance. We show that average performance of agents is higher with goal setting than in its absence despite weaker incentives. We develop a principal-agent model with reference-dependent utility that illustrates how labor contracts combining weak monetary incentives and wage-irrelevant goals can be optimal. It follows that recognizing the pervasive use of non-monetary incentives in the workplace may help account for previous empirical findings suggesting that firms rely on unexpectedly weak monetary incentives.



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## When it Pays to Be Nice in the Prisoner's Dilemma

*Cleotilde Gonzalez*

### Abstract

The Prisoner's Dilemma is a classic conundrum representing many decision problems between two players: they decide whether to cooperate with each other or to act in their own interest. Past research indicates that individual incentives influence cooperation especially in repeated interactions. However, these studies typically underplay the influence of intrinsic social preferences from each member of the pair. To what extent do genuinely nice people cooperate? To what extent do nice people get exploited? And to what extent do nice people get compensated for their behavior? In an experiment using a collection of prisoner's dilemma games and a measure of social preferences as an individual difference, we find evidence for three distinct phenomena emerging from explicit incentive structures. We identify incentive structures in which: (1) cooperation is insensitive to social preferences; (2) where nice people can be exploited; and (3) where being nice is consistently rewarding. We discuss the theoretical and practical implications of these findings.



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## Costly Self-Control and Limited Willpower

*Simon Grant*

### Abstract

We present a representation theorem for individual choice among sets (that is, "menus") of lotteries, from which the individual will later choose a single lottery. Our axioms, building on those in Gul and Pesendorfer (2001), allow for a preference for commitment and self-control subject to sufficient willpower. Four of the five axioms of our characterization are as in Theorem 3 of Gul and Pesendorfer except that the independence axiom is restricted to singleton menus and those two-element menus in which any failure of self-control in the second period arises from the individual being unwilling to incur the cost of exercising such self-control rather than from being unable to exert self-control because of limited willpower. We add one new axiom to regulate willpower as a limited cognitive resource in which the available "stock" of willpower does not vary across menus. In our characterization, agents with insufficient willpower to resist temptations are bound to choose an option with lower "compromise utility" while the behaviors of agents who are able to resist temptations remain unchanged.



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## Discounting Future Gains and Losses of Time

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### Abstract

In many decisions, saving or losing time, now or in the future, is as relevant as saving or losing money now or in the future. Benefits of projects such as automation solutions for high-speed production lines or enlarging expressways are economically justified by the value of time saved. It is however usual to assess the economic value of such saved/lost time by discounting the corresponding monetary values over time rather than discounting the very values of time over time. While intertemporal choice of money has been studied extensively, very few studies have analyzed the way people discount time, despite the fact that it is a scarce and valuable resource. We investigate this issue in a laboratory experiment where consequences are measured in units of time and real incentives are implemented in gains and losses. We created a concrete scenario in order to facilitate subjects' understanding of the concepts of gains and losses of time, and to give them a common reference point from which gains and losses of time were defined. We used this scenario for the implementation of real incentives. We also measured intertemporal decisions with monetary consequences, as a benchmark. We estimated all the components of the discounted utility model using maximum likelihood. We took a descriptive perspective and allowed for discount rates to vary over time. We also measured utility of time and money in order to disentangle attitudes towards delays from attitudes towards outcomes. Finally, we used mixed modeling in order to take into account heterogeneity in intertemporal preferences. We find that subjects discount more gains of time than gains of money. This difference between time and money is reversed for losses: people discount less losses of time than losses of money. Moreover, we observe that subjects are more likely to exhibit non-constant discount rates for time than for money in both gain and loss domains. Analyses also show that there is a significant correlation between impatience towards money and impatience towards time: subjects who are impatient for money also tend to be impatient for time. Finally, mixed modeling analyses show that there is more heterogeneity in discounting behavior for time consequences than for monetary consequences. As a conclusion, we find that people do not discount time as they discount money. The paper also reveals the complexity and diversity of intertemporal preferences.



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## Does Overconfidence Affect Ambiguity Attitudes?

*Cedric Gutierrez; Mohammed Abdellaoui; Thomas Astebro*

### Abstract

Excessive investment and excessive risk taking have often been linked to overconfidence of individuals in their skills and/or knowledge. For instance, pathological gamblers have been found to be more overconfident than the general population, and as a consequence to accept less favorable bets. Similarly, there is evidence that overconfident investors trade too much even when trading is not profitable. Studies in transportation research have also found that most drivers think that they are less likely to be involved in an accident than is the average driver, and that drivers' overconfidence in their skills can cause biased risk-assessment and road crashes. The proposed mechanism to explain these findings is that overconfident individuals overestimate the likelihood of success of a positive event. In other words, they put higher subjective probabilities on ambiguous events for which the outcome depends on their skills. However, a decision to gamble does not depend only on one's perception of the probability of success of the gamble, but also on ambiguity attitude. We propose to disentangle beliefs and ambiguity attitude, and to test whether overconfidence in one's skills affects one's attitude toward ambiguity, when the source of ambiguity depends on skills. To do so, we ran an incentivized experiment in which we elicited certainty equivalents of risky and ambiguous lotteries. We used two uncertain variables: the subjects' absolute performance (score) or relative performance (rank) on a test. We analyze the relationship between overconfidence and ambiguity attitude by manipulating the level of confidence of the subjects in their own skills. We focus on two types of overconfidence: overestimation of one's absolute performance and overplacement of one's performance relative to those of others. We find that overconfidence has an impact on attitude toward ambiguity. First, overconfidence increases the level of optimism toward ambiguous sources. Second, it increases the sensitivity to intermediate changes in likelihood. Finally, we find that the effect of overconfidence is different for the two sources of ambiguity. The strongest effect is observed when the subjects bet on their own score, and therefore when ambiguity is fully endogenous.



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# Ambiguous Description and Limited Experience

*David Hagmann; Jason L. Harman; Cleotilde Gonzalez*

## Abstract

Experiments traditionally provide participants either with a full description of probabilities and payoffs (decisions under risk) or no information about the probabilities (decisions under ambiguity). In many real world settings, however, decision makers have access to description that inadequately describes the true state of the world. The decision to stay at a particular hotel, for example, may be heavily influenced by the first few people to review the hotel, even though their experience may not be representative of the hotel's quality. While an overly positive initial evaluation may quickly be corrected once disappointed guests leave their reviews, initial negative evaluations may deter others from staying there and thus prevent ratings from reverting to the mean. In this experiment, we study ambiguous descriptions of probabilities. We provide participants with descriptive information about probabilities, but base these descriptions on small samples (and disclose that we do so). Participants choose between the same two lotteries (also known to them) after limited sampling and after observing ambiguous descriptions based on the same number of independent draws. We vary whether they first see the ambiguous description or whether they first experience the lotteries. We benchmark their decisions against participants who received descriptive information based on large samples, as in traditional decision under risk. Moreover, we explore the effect of observing ambiguous description after having had experience with the lotteries, or experiencing the lotteries after having seen the description.



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# Wait, Wait... Don't Tell Me: Repeated Choices With Clustered Feedback

David Hagmann; Cleotilde Gonzalez

## Abstract

When decision makers repeatedly choose between safe risky assets, their decision can depend on how frequently they receive feedback [1]. Someone who invests in stocks, for example, can expect to see a larger gain after a year than someone who invests in bonds. However, on any given day, she is more likely to experience a loss, as stock returns exhibit greater volatility. A loss-averse decision maker may prefer the safer asset if she receives feedback every day, but the risky asset if she receives feedback annually. Decision makers choose differently when they have to learn about outcomes by receiving feedback from experience than when outcomes and probabilities are given explicitly [2]. Feedback is instrumentally valuable and learning about a good option early on allows a decision maker to exploit the option, rather than continue exploring an inferior alternative. However, experiencing an unfavorable outcome early on may lead her to give up too quickly and miss options that are more rewarding. The present study explores whether giving participants less frequent feedback can improve ex post outcomes and whether this can close the decision-experience gap. Participants ( $n=1,200$ ) in a  $2 \times 2 \times 3$  design make 110 static, binary decisions and earn the sum of all realized outcomes. On the first dimension, we vary whether decision makers receive ex ante a description of the two options. On the second dimension, we vary how frequently participants receive feedback about the realization of the selected option: either immediately after each choice or in blocks after every 10 choices. Immediate feedback has been the standard form of feedback in decisions from experience paradigms [3]. In the novel clustered feedback condition, participants make 10 decisions without seeing any outcomes, then observe the individual realizations of the past 10 trials at once. We vary on the third dimension the structure of the lottery-pairs, each consisting of a safe and a risky option. The safe option in all lotteries provides a guaranteed payoff of 4. The risky option has a fixed expected value of 5 and includes two outcomes: a low payoff of 0 and a high payoff that is different in every lottery-pair. The high payoff is either 6.25 with 80% probability (low-variance condition), 10 with 50% probability (medium-variance), or 25 with 20% probability (high-variance). In decisions from experience, the proportion of risky choices is substantially higher with clustered feedback compared to immediate feedback in the medium and high variance lotteries (both  $p < 0.001$ ), but not in the low-variance lottery. The effect size is substantial, shifting decisions by about 20 percentage points toward the risky option. However, we find no significant difference across the feedback conditions with description. The net effect is that clustering feedback closes the description-experience gap and improves ex post outcomes.



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## Action-Dependent Beliefs: Could Game Theory Be Bad for You?

*Peter J. Hammond*

### Abstract

Several past experiments have sought to elicit participants' beliefs about other players' strategic behaviour, and then to test the best response hypothesis that players maximize their expected payoffs given these beliefs. To date, these beliefs were restricted to be independent of a player's own action, in which case no dominated strategy is ever a best response. To accommodate observed choices of dominated strategies, this paper discusses an alternative experiment allowing participants to state beliefs that are action-dependent " i.e., they may depend on the player's own action. We allow beliefs to be action-dependent. Such beliefs made their first significant appearance in Newcomb's Problem, named after the physicist William Newcomb who originally devised it as a thought experiment. The problem was analyzed in depth by the philosopher Robert Nozick (1969), and discussed a few years later in *Scientific American* (e.g., Gardner 1974). The hypothesis to be investigated here is whether similar action-dependent beliefs could help to explain observed behaviour in experimental games better than is possible with the more restrictive action-independent beliefs that feature in earlier work. To test this hypothesis, we have conducted an incentivized laboratory experiment in three stages. Throughout participants were faced with a variety of strategic games that had previously been used to elicit players' beliefs and to test the best response hypothesis. The key difference in our experiment was that participants were explicitly allowed to report both action-dependent and action-independent beliefs, along with their decisions in these strategic games. We compared participants' actual decisions with: (i) Nash equilibrium predictions; (ii) their best-responses given their own stated action-independent beliefs (henceforth, AIB); as well as (iii) their best responses given their own stated action-dependent beliefs (henceforth, ADB). Our major finding is that allowing action-dependence explains the data better than other prominent alternatives. Our results (1) suggest that action-dependent beliefs could play an important role in explaining observed behavior, as well as beliefs, in strategic games; and (2) call for further research about the comparative descriptive and predictive power of both types of beliefs.



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## Diversity in Cognitive Ability Enlarges Mispricing

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### Abstract

How does known diversity in cognitive ability among market participants influence market outcomes? We investigated this question by first measuring subjects' cognitive ability and categorizing them as 'H' type for those above median ability and 'L' type for those below median ability. We then constructed three kinds of markets with six traders each: 6H, 6L, and 3H3L. Subjects were informed of their own cognitive type and that of the others in their market. We found heterogeneous markets (3H3L) generated significantly larger mispricing than homogeneous markets (6H or 6L). Thus, known diversity in cognitive ability among market participants impacts mispricing.



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## Measuring Uncertainty Preferences for Health

*Olivier L'Haridon; Arthur Attema; Han Bleichrodt*

### Abstract

It is well-known that expected utility has empirical deficiencies. Prospect theory has developed as an alternative with more descriptive validity. This study elicits utility of life duration in a framework that is robust to violations of expected utility. In addition, our method allows for a parameter-free measurement of loss aversion and probability weighting for both gains and losses. Finally, we are the first measure utility of life duration in the case of uncertainty. We conducted individual experiments where respondents had to make choices using health outcomes, which included a treatment with known probabilities and treatment with unknown probabilities. First, when comparing these treatments, we found evidence for uncertainty aversion. Despite this, the two treatments showed the same general pattern: concave utility for gains, convex utility for losses, and steeper utility for losses than for gains. Hence, our findings confirm the S-shaped utility that has often been observed for monetary outcomes. The amount of loss aversion was not significantly different between the treatments, with median loss aversion coefficients varying between 1.3 and 1.8 (depending on the specific definition used). The probability weighting functions showed the usual inverse S- shape, indicating overweighting of small probabilities and underweighting of large probabilities, both for gains and for losses. In particular, our results suggest duality of the probability weighting functions. In conclusion, our data are supportive of prospect theory and source dependence in the health domain. However, our finding of convex utility for lost life years contradicts results of previous studies that used a different elicitation method, and suggests this behaviour may be method-specific. More research is needed to settle this issue.



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# Can Imprecision Determine a Decision? Can Prelec's Function be Discontinuous at $p = 1$ ?

Alexander Harin

## Abstract

The dispersion is a common measure of imprecision and noise. An existence theorem has been proven for non-zero “forbidden zones” (bounds) for the expectation of a discrete random variable that takes on a finite set of possible values in a finite interval. The non-zero “forbidden zones” have been proven to exist at the borders of the interval under the condition of the non-zero dispersion. A new formula has been obtained for the dependence of the width of the “forbidden zones” on any dispersion value (see, e.g., Harin, 2015). Due to the theorem, under the condition of the non-zero imprecision and/or noise, the probability weighting (Prelec's) function  $W(p)$  can be discontinuous at the borders of the probability scale, in particular at the probability  $p = 1$ . A discontinuity is a topological feature of a function. Therefore, it can determine properties of the function in its vicinity. Prelec's function is a basic one in the field of utility and can determine subjects' decisions. Therefore, its discontinuity at the probability  $p = 1$  can determine subjects' decisions at  $p \sim 1$ . Note, this discontinuity can be hidden by a “certain-uncertain” inconsistency between certain outcomes and uncertain incentives of the usual experimental procedures in the field of utility (see, e.g., Harin, 2014). The well-known experiment of Starmer and Sugden (1991) confirms the possibility of existence of these discontinuity and “certain-uncertain” inconsistency. So, the non-zero imprecision and/or noise can lead to the non-zero “forbidden zone” for the data expectation near  $p = 1$  and to the discontinuity of Prelec's function at  $p = 1$ . So, the imprecision and/or noise can determine a decision at the probabilities  $p \sim 1$ .



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# Attention Shapes Valuation in Intertemporal Choice: A Test of Procedure Invariance

*Lisheng He; Kenneth Lim; Marc Scholten; Adam Sanborn; Daniel Read*

## Abstract

Background Violations to procedure invariance provide an avenue to understanding the cognitive processes underpinning choice and behavior. One approach to the relationship between cognitive processes and procedure variance is through the role of attention. Empirical studies taking this approach usually link visual attention to choices in a correlational fashion or manipulate attention by forcing options' exposure time respectively. In this paper we propose (and test) a new method: Using the variation in an option's context to manipulate the direction of attention. Methods We conducted two experiments to test how attention shapes intertemporal choice and thus induces violations to procedure invariance. In addition, we assessed whether the effects of attention are moderated by cognitive style, as measured by the Cognitive Reflection Test. Both experiments involved between-subject designs. In Experiment 1, participants made 81 intertemporal choices. In all items, the smaller-sooner (SS) option was held constant [\$110 in 2 months], but the larger-later (LL) option varied in both the outcome [which could take nine values ranging from \$120 to \$200] and delay [ranging from 4 to 20 months]. The 81 choices were divided into nine blocks, either LL-outcome-varying (LOV) blocks or LL-delay-varying (LDV) blocks contingent on the experimental condition. In each LOV block only one value of LL delays appeared within the block, but all nine outcomes appeared. In each LDV block, the situation was reversed with the outcomes constant and the LL delays varying. In Experiment 2, the method was very similar except that the LL option was held constant, and there were nine values for the SS outcome and the SS delay respectively. In each SS-outcome-varying (SOV) block only one value of SS delays appeared within the block and, in each SS-delay-varying (SDV) block, only one value of SS outcomes appeared. Results Results from both experiments exhibited attention's bidirectional effects. First, respondents in the LOV condition were more likely to choose the larger-later option than those in the LDV condition (Experiment 1); By contrast, those in the SOV condition were more likely to choose the smaller-sooner option than those in the LDV condition (Experiment 2). Second, whichever the varying attribute is, respondents were more sensitive to a change to this attribute than when it is kept constant in a block (both experiments). Cognitive reflection moderated attention's effects too. Experiment 1 showed that high-reflection respondents were less susceptible to the attention framing than low-reflection respondents, while Experiment 2 showed a less significant moderation effect, however, in an opposite direction. It is also implied that preference is always uncertain and the preference uncertainty may differ across people with different cognitive styles, highlighting the importance of the measurement of preference uncertainty.



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# A Comprehensive Comparison of Intertemporal Choice Models

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## Abstract

**Backgrounds** There are three types of static intertemporal choice models. Delay discounting models assume that options are evaluated independently by assigning a value to their outcomes, discounting those values as a function of the delays to the outcomes, and choosing the option with the highest discounted value overall (alternative-based choice). Tradeoff models, instead, assume that options are directly compared along the time and outcome attributes, and the option favored by these comparisons is chosen (attribute-based choice). Interval discounting models adopt hybrid evaluation rules. They differ from delay discounting models by assuming direct comparisons along the time attribute, so that the discount functions for options are interdependent, but that the evaluation is otherwise alternative-based. Problems with the few existing studies that compared different types of intertemporal choice models include: (1) Always missing some prominent models, (2) rarely comparing different forms of tradeoff models, (3) model misrepresentations, (4) sometimes unjustifiably pooling data with heterogeneity and (5) neglect of model selection's sensitivity to the structure of stimuli. These problems not only challenge the reliability and the validity of existing studies, but also render between-study comparisons practically impossible, and thus leave each study as a discrete piece of evidence. **Methods** The present study made a comprehensive comparison among the three types of intertemporal choice models. To address the issues above, we collected or formulated a list of seven delay discounting models, two interval discounting models and four tradeoff models and collected 260 intertemporal preference datasets from 99 studies, most of which were not originally designed for model selection. First, we presented a qualitative analysis of each model's explanatory or predictive power across different empirical phenomena. Second, we used Bayesian model selection to quantitatively compare models across datasets, calculating pairwise Bayes factors for every pair of models separately for every given dataset. We further aggregated evidence from different datasets in a no-pooling manner. **Results** Results consistently suggest that attribute-based tradeoff models fit data better than other models. First, according to [overall] pairwise Bayes factors, every tradeoff model outperforms any of the delay or interval discounting models. Especially, the power tradeoff model, with a power utility function for outcomes and a power weight function for delays, is the best among all. Second, based on our qualitative analysis, a difference between a tradeoff model and a discounting model is that the tradeoff model can always accommodate the magnitude effect while the discounting model cannot. Thus we further compared models based on the subset of the datasets whose structure cannot elicit the magnitude effect. Results show that any of the tradeoff models still outperform all discounting mo



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# An Additive Model of Decision Making under Uncertainty

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## Abstract

In this paper, we model ambiguity as the anticipated receipt of different objective lotteries obtained in different states. Using Savage's acts that map the set of states to the set of simple objective probability measures as the ambiguous lotteries faced by the decision maker, we develop preference conditions to separate "ambiguity" from "risk" to obtain an additive model of decision making under uncertainty consisting of two parts, i.e., the risk part and ambiguity part. This model explicitly captures the tradeoff between the magnitude of risk and the magnitude of ambiguity when making choice over ambiguous lotteries. The risk of an ambiguous lottery is evaluated by von Neumann and Morgenstern's expected utility model; the ambiguity is evaluated by a nested utility model similar to the smooth ambiguity model developed by Klibanoff, Marinacci, and Mukerji (2005). A measure that ranks lotteries in terms of the magnitude of ambiguity can also be obtained using this separation. Using Taylor expansion, we show that this ambiguity measure is the variance of the compound lottery based on the second order subjective probability over possible objective lotteries. By applying our model to asset pricing under uncertainty, we show that the equity premium can be decomposed into two parts: the risk premium and the ambiguity premium, where the risk premium takes the standard form in the literature and the ambiguity premium is proportional to the ambiguity measure. Further, combining this model with the standard risk-value model developed by Jia and Dyer (1996), we obtain a risk-ambiguity-value preference model. This model is consistent with the mean-variance-ambiguity approximation of the smooth ambiguity model (Maccheroni, Marinacci, and Ruffino. 2013), but we do not need to rely on an approximation argument to obtain the additive form.



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# On the Development of Risk Aversion and Prudence: An Experimental Study With Chinese Children and Adolescents

*Timo Heinrich; Jason Shachat*

## Abstract

This study tests risk preferences of children and adolescents in a Field experiment in China. We employ a simple binary choice task that measures not only risk aversion but also prudence. We observe that the share of risk-averse and prudent choices increases from grade 3 through grade 11. This effect is driven by changes in behavior that appear mainly between grades 3 and 5 for boys and between grades 5 and 7 for girls. The correlation between the participants' financially incentivized choices and their parents' hypothetical choices in the same tasks is consistent with the transmission of preferences.



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## Randomized Strategies and Prospect Theory in a Dynamic Context

*Vicky Henderson*

### Abstract

Applying prospect theory (PT) in a dynamic context brings new challenges. We study PT agents facing optimal timing decisions and consider the impact of allowing them to follow randomized strategies. In the discrete model of casino gambling of Barberis (2012) we show that allowing randomization leads to gains in PT value. In the continuous analog (Ebert and Strack (2015)) we show that allowing randomization can significantly alter the predictions of the model. Ebert and Strack show that a naive investor never stops. We show that allowing naive PT agents to use randomized strategies leads to predictions which are closer to reality and include voluntary cessation of gambling.



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## That's Just - Not Fair: Gender Differences in Notions of Justice

*Jan Heufer; Nicole Becker; Kirsten Haeger*

### Abstract

There are at least two possible reasons for why people demand redistribution: immediate self-interest, and concerns for distributional justice. A voter with a high income should oppose more redistribution from high to low income individuals, while a voter with low income should support it. Pure concern for distributional justice however does not depend on self-interest. While many voters may favor more equal distributions per se, some might worry that it leads to deadweight loss, reducing overall wealth. They might prefer a higher level of wealth even if it comes at the cost of inequality. This preference for efficiency over equality is an example of a notion of justice. Interestingly, women tend to be more in favor of redistribution than men (Edlund and Pande 2002). Is this based on self-interest, or do they have different ideas about distributional justice? In Becker et al. (2013a,b), we proposed a theory to explain giving behaviour in dictator games by a combination of self-interest and preferences over just distributions. We used a dictator game with varying transfer rates as in Andreoni and Vesterlund (2001) and Andreoni and Miller (2002) to measure self-interest, and a social planner (Dickinson and Tiefenthaler 2002) and a veil of ignorance game (Rawls 1971, Schildberg-Hörisch 2010) to learn about individual notions of justice. In this paper, we analyze the results of this experiment with a specific focus on gender differences. In our dictator game, we replicate the result of Andreoni and Vesterlund (2001): we find that men react more strongly to changes in the transfer rates. However, while Andreoni and Vesterlund (2001) find that men are somewhat more selfish as they give less on average, we find that men give more on average, although the difference is insignificant. We find that gender differences in the social planner and veil of ignorance games are even stronger than in the dictator game; in particular, women are far more concerned with equality than men. While this result may not be surprising per se, the combination of the two experiments allows us to test if differences in giving behavior in the dictator game are due to differences in self-interest between men and women. We find strong evidence that this is not the case: Differences in the dictator game can be explained by differences in the notion of justice. In situations where women give more money than men, this is not because men are more selfish, but because men feel that the situation does not warrant passing a great amount as it would be inefficient to do so. In situations where men give more money than women, this is not because women are more selfish, but because women feel that passing a great amount would not be just as they prefer more equal outcomes. We employ both parametric (CES estimates) and novel non-parametric techniques developed in Becker et al. (2013a) and partially inspired by Karni and Safra (2002b), both of which confirm the results.



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# Ambiguity Aversion under Maximum Likelihood Updating

*Daniel Heyen; Timo Goeschl; Boris Wiesenfarth*

## Abstract

Maximum likelihood updating (MLU) is a well-known approach for extending static ambiguity sensitive preferences to dynamic set-ups. This paper develops an example in which MLU induces an ambiguity averse maxmin expected utility (MEU) decision-maker to (i) prefer a bet on an ambiguous over a risky urn and (ii) be more willing to bet on the ambiguous urn compared to an (ambiguity neutral) subjective expected utility (SEU) decision-maker. These preferences are challenging for two reasons. The first reason is that prior to observing any draws from the urns, the MEU decision-maker - in line with the usual notion of ambiguity aversion - actually preferred the risky over the ambiguous bet and was less willing to bet on the ambiguous urn than the SEU decision-maker. The second reason is that the information that caused this switch in betting preferences was symmetric across urns and agents: both decision-makers observed from both urns a draw of the same color. Relating this finding to other well-known results in the context of dynamic extensions of ambiguity averse preferences, the paper clarifies that the identified switch in betting preferences is not due to a violation of dynamic consistency or consequentialism. Rather, the deeper reason lies in MLU's selection of extreme priors, causing a violation of the stability of set-inclusion over the course of the updating process.



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## The Misery of Knowing: When Information Is Aversive

*Emily Ho; David Hagmann; George Loewenstein*

### Abstract

The Information Aversion Scale is a unified treatment of two primary dimensions: that of domain specificity and of psychological causal mechanism. We hypothesize that individuals are more inclined to avoid information with negative valence and that this inclination is moderated by domain-specific self-serving bias. For example, a smoker will tend to avoid information about cancer screenings but not necessarily avoid looking at credit card statements. Avoiding information serves to maintain subjective social reality (Bless, Fiedler, & Strack, 2004), whereby an individual's perception of reality helps guide cognition and reaffirm sense of self. We develop a scale that profiles people based on their propensity to avoid information in health, finance, and intra-personal domains. Information within these fields is germane to everyday decisions and, if avoided, also can be extremely costly at both the individual and institutional (e.g., insurance companies that incur sustained costs for preventable illnesses) levels. For example, we ask participants whether they would open immediately a medical bill that they suspect will be small, but worry might be large. There may be many causes for avoiding information. For example, people may be regret averse and would rather not find out how well a mutual fund they did not invest in is performing. By avoiding this information, they deprive themselves of the opportunity to change their investment allocations in favor of a potentially better fund. To develop our scale, we make use of a large dataset provided by a survey company in which millions of people answer randomly selected questions during their regular browsing activity. In addition to previously provided responses, they answer either part or the full scale, allowing us to impute missing data. This allows us to examine correlations with a diverse set of other scales and miscellaneous questions, establishing convergent and divergent validity of the theoretical information avoidance construct. For example, we may expect a positive relationship between a tendency to avoid information and pessimism, but a negative relationship between avoiding information and curiosity. We may also expect, for an unhealthy individual, a positive relationship with health-specific information aversion but no relationship with finance-specific information aversion. The Information Aversion Scale furthers the understanding of the valuation of information under risk, with broad implications for welfare-enhancing behaviors such as interventions to lower credit card debt or increasing likelihood of obtaining test results. We anticipate that the scale can also help shape policy design.



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# Improving the Communication of Uncertainty in Climate Science and Intelligence Analysis

*Emily Ho; David Budescu; Mandeep Dhami; David Mandel*

## Abstract

Public policymakers routinely receive and communicate information characterized by uncertainty. Decisions based on such information can have important consequences, so it is imperative that uncertainties are communicated effectively. Many organizations have developed dictionaries or lexicons to express uncertainty that contain specific language (e.g., very likely). But these lexicons vary greatly and few of them have been empirically tested. We have developed evidence-based methods to standardize the language of uncertainty so that it has clear meaning shared by all parties in a given communication. We tested these methods in two policy-relevant domains: climate science and intelligence analysis. We show that in both domains evidence-based uncertainty lexicons are better understood than those currently advocated by organizations such as the Inter-Governmental Panel on Climate Change (IPCC), the US National Intelligence Council (NIC), or the UK Defence Intelligence (DI). A method based on the terms' membership functions that represents their full meaning, was especially effective for deriving such lexicons.



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## The Probability Discounting Model: A Primer For Economists

*Andre Hofmeyr*

### Abstract

The probability discounting model is a popular framework for investigating people's instantaneous or atemporal attitudes toward risk in experimental settings. It is particularly common in studies of addiction where delay discounting data is also often obtained. The model was developed in a series of three papers, which have been cited collectively over 1000 times, by Rachlin, Logue, Gibbon and Frankel (1986), Rachlin, Castrogiovanni and Cross (1987), and Rachlin, Raineri and Cross (1991). As its name suggests, the probability discounting model draws its inspiration from models of temporal or delay discounting, where the delay to a reward is replaced with the odds against receiving a reward. This paper explains the model in language familiar to decision theorists, statisticians and economists, and it shows how the model relates to standard theories of choice under risk like expected utility theory, prospect theory, rank-dependent utility theory, and rank-dependent expected value theory. It highlights the way in which researchers typically collect probability discounting data and how they analyse it statistically. The paper then uses data from a well-cited study to show that more flexible specifications of a probability weighting function outperform the probability discounting model's implicit probability weighting function. It concludes by arguing that researchers who are interested in investigating choice under risk should adopt theoretical, methodological and statistical tools appropriate to the task, and should therefore abandon the probability discounting model.



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# Effort and Accuracy in Social Preferences

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## Abstract

Social preferences, i.e. that people take the effect of their choices on others into account, are often observed in lab experiments. E.g., in dictator games participants tend to voluntarily share a large part of an endowment with a passive co-participant. However, this behavior may not always correctly reflect real-world preferences. If the causes for such inconsistency are identified, these can be used to improve both the validity of further experiments and the efficacy of real-world applications [6]. In this experiment, I investigate a new potential source of inconsistency: the larger complexity of real-world settings, e.g. [4], by which it may not be obvious what the effect of individuals' choices is on themselves and on others. This may lead to a tradeoff between accuracy in making the right choices and saving effort in finding out the exact choice effect by using simpler choice rules [5]. My hypothesis is that the willingness to sacrifice accuracy in order to save effort is significantly larger when it concerns others' payoff than when it concerns own payoff. Thus, in more complex situations, people tend to focus on the effect of their choices on themselves. The experiment explicitly controls for the extent that shifts in social preferences are explained by strategic ignorance [2] and real effort choice [1]. It involves eight adapted dictator games with varied tradeoffs between own and other's payoff (of which a random game is paid-out) and uses a payoff table [3] to manipulate complexity between subjects: 0. payoff information in a covered decision matrix is revealed by a single click to reflect the transparency of a typical lab setting (baseline treatment) 1. payoff information in the covered boxes of a decision matrix is revealed by separate clicks (strategic ignorance treatment) 2. payoff information in the covered boxes of a decision matrix is revealed by performing separate counting tasks sufficiently well (real effort complexity treatment) 3. payoff information in the boxes of a decision matrix is presented by means of a simple function of the outcomes of separate counting tasks to reflect real-world opacity of choice effects (intuition-proof complexity treatment) The presentation contains the results of the experiment and an extensive debriefing as executed in the local infrastructure [7] in November 2015 with 204 subjects, and discusses implications for future experiments as well as real-life applications. Acknowledgement This project is supported by research assistance of Jana Baur and Jannik Wendorff and funded by the Excellence Initiative of the German federal and state governments. Help from Zachary Grossman as well as lab management and seminar participants at the School of Business and Economics of RWTH Aachen University is appreciated.



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## Belief Updating under Ambiguity

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### Abstract

Belief updating is at the heart of decision theory and statistical theory, and has been applied to economic theory and artificial intelligence. This paper examines belief updating under ambiguity from three approaches. One is the traditional Bayesian updating, where only ambiguity neutral behavior is accommodated. The other two approaches are non-Bayesian, introduced by Gilboa and Schmeidler (1993) (GS) as well as Dempster (1967) and Shafer (1976) (DS) respectively, where both ambiguity averse and ambiguity seeking behavior are accommodated. Under the framework of decision theory, this paper compares Bayesian and non-Bayesian updating in its model specification and numerical implications. Ambiguity attitudes affect not only static decisions, but also the way in which new information is incorporated. For an ambiguity averse (seeking) decision maker, GS updating leads to more pessimistic (optimistic) behavior than DS updating, and favorable or unfavorable information has bigger (smaller) impact on GS updating than on DS updating.



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## Reciprocity Towards Groups and Individuals: A Comparison

*David Hugh-Jones; Roi Zultan*

### Abstract

Conflicts are frequently driven by cycles of intergroup revenge, in which innocent bystanders are targeted in revenge for the supposed actions of others in the group. We test for the existence of reciprocity towards groups, using an incentivized trust game followed by a sequence of money allocations. We compare the effect of a subject's partner's behaviour in the trust game on his or her allocations to three kinds of people: (a) the partner themselves; (b) other people in the partner's group; and (c) members of a neutral group. Trustors who were betrayed in the trust game display group reciprocity, by allocating less money towards members of the partner's group. Trustees do not display group reciprocity.



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# Willingness to Pay for Public Environmental Goods under Uncertainty

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## Abstract

We develop a microeconomic approach for valuing benefits from a public environmental good under uncertainty with heterogeneous consumption. Most environmental goods (and ecosystem services) are non-market-traded, and benefits from such goods are typically enjoyed under uncertainty. Uncertainty can arise from the environmental side (e.g. ecosystem or climate), or from the economic side (e.g. income). In this paper, we consider (binary) uncertainty in the provision of an environmental good. In addition, we assume income could be uncertain, but with a possibility of insurance. A stylized model of insurance is used. Demand for insurance depends on the real cost of insurance which depends on the (existence and) degree of perfection of an insurance market "the greater the perfection of the insurance market, the lower the real costs of insurance. Then, the consumer's income (after insurance) is already known when solving the choice problem. We use a constant-elasticity-of-substitution (CES) utility function, where utility depends on a market-traded consumption good and an environmental good which is provided in a fixed quantity. The CES function is nested in a constant relative-risk-aversion form. Under certainty, Ebert (2003) provides the conceptual foundation for valuation with fixed supply of non-market goods. We present an alternative framework for such valuation under uncertainty which follows from work done in Freeman (1989, 2003). As a benefit measure, under environmental uncertainty, we derive the marginal willingness to pay (MWTP) for change in (i) probability of loss, (ii) size of loss, and (iii) current level of the environmental good. We also explore relevant comparative static effects, especially, those of elasticity of substitution and risk aversion. Under certainty, we recover the well-known result that MWTP is increasing (decreasing) in income (level of environmental good). The rate of change of MWTP with respect to change in income depends on the elasticity of substitution between the market-traded consumption good and the environmental good. MWTP is also increasing (decreasing) in elasticity of substitution if and only if income (per unit of market good) is larger (smaller) than the current level of environmental good. In terms of the income distribution parameters, marginal effects are also intuitively reasonable "MWTP is increasing (decreasing) in mean (variance of) income. Importantly, the degree of credit market perfection increases available income and, hence, MWTP. Under uncertainty, we assume some standard parameter values to numerically explore comparative static effects. The positive (negative) effect of income (quantity of environmental good) on MWTP for environmental quantity also persists under uncertainty. In addition, an increase (decrease) in probability and size of loss increases (decreases) the likelihood and severity of environmental loss and, therefore, the consumer's MWTP for environmental quantity increases



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# The Impact of the Self-Employment Experience on Entrepreneurs' Attitudes towards Risk

Walter Hyll; Matthias Brachert; Abdolkarim Sadrieh

## Abstract

Entrepreneurship is considered to be an engine for labour market stabilization, for structural change, and for economic growth (Audretsch & Fritsch 1994). Entrepreneurship is also crucial in providing the competitive market entry forces that prevent excess profits, supporting efficient market outcomes (Audretsch, Keilbach & Lehmann 2006). Therefore, it is crucial to understand the determinants of entrepreneurs' decisions to enter self-employment in the first place. One factor that has been widely discussed as a crucial determinant of the self-employment decision is the individual's attitude towards risk (Kihlstrom and Laffont 1979; Bellante and Link 1981; Barsky et al. 1997; Cramer et al. 2002; Fairlie 2002; Lazear 2005; Caliendo, Fossen & Kritikos 2014; Skriabikova et al. 2014). Since studies comparing the risk attitudes reported by entrepreneurs to those reported by other individuals generally report higher values for the entrepreneurs, the usual conjecture is that a positive attitude towards risk is a prerequisite for self-employment. The empirical evidence that we provide in this study, however, suggests that the usual unidirectional conjecture is not rich enough to describe observed data.

Our analysis provides evidence for a bidirectional causality where, on the one hand, individuals' attitudes towards risk affect their self-employment decisions and, on the other hand, experiencing self-employment affects the individuals' risk attitudes. Using a large general population panel, we show that individuals with higher reported risk attitudes are more likely to enter self-employment. Additionally, we find that these individuals' reported risks attitudes are even higher after experiencing self-employment. Hence, we can document a substantial positive effect of self-employment on the willingness to take risks that goes significantly beyond the self-selection bias of the risk-seekers into self-employment. We confirm the robustness of our results with various model specifications and show that all our central findings hold throughout.

Our study adds to the mounting evidence that attitudes towards risk may be affected by environmental factors or individual experiences (Bowles 1998; Heaton & Lucas 2000; Guiso & Paiella 2008; Malmendier & Nagel 2011, Loewenstein, Weber, & Hsee 2001). The central contribution of our study is to show that the self-employment experience is amongst those environmental factors that have a sizeable and positive impact on the development of individuals' risk-taking attitudes



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# Testable Implications of Models of Intertemporal Choice

*Taisuke Imai; Roman Weber; Debajyoti Ray; Daniel Golovin; Andreas Krause; Colin Camerer*

## Abstract

We present revealed-preference characterizations of the most common models of intertemporal choice: the model of exponentially discounted concave utility (EDU), quasi-hyperbolic discounted utility (QHD), and time-separable utility (TSU). Ours is the first axiomatization of these models taking consumption data as primitives. The first and most important question addressed in our paper is: What is the version of GARP that allows us to decide whether data are consistent with EDU? Our main result is that a certain revealed preference axiom, termed the Strong Axiom of Revealed Exponentially Discounted Utility (SAR-EDU), describes the choice data that are consistent with EDU preferences. SAR-EDU is a weak imposition on the data, in the sense that it constrains prices and quantities in those situations in which unobservables do not matter. The constraint on prices and quantities is simply that they be inversely related, or that “demand slopes down.” Essentially, SAR-EDU requires one to consider situations in which unobservables “cancel out,” and to check that prices and quantities are inversely related. This inverse relation is a basic implication of concave utility (that is, of the consumption smoothing motive). We obtain similar characterizations for QHD and TSU. Our characterizations provide non-parametric revealed-preference tests. We apply our tests to data from recent experiments by Andreoni and Sprenger (2012; AS) and Carvalho, Meier, and Wang (forthcoming; CMW). Although the natures of the datasets are different, we obtain similar results. First, the numbers of EDU rational agents are rather small. Second, there is very little added scope for QHD. In the case of the AS experiment, all subjects rationalized as QHD are also rationalized as EDU. There are a few subjects in the CMW data that are QHD, but not EDU, rational. Finally, the fraction of TSU rational subjects is about half; the rest of the subjects are not rationalized by even TSU model. We then study the violations of EDU, QHD, and TSU using the theoretical results derived from axiomatic characterizations. The most important finding is that almost all non-EDU rational subjects display a particular kind of violation of EDU. First, their choices imply that they are not strictly impatient. Second, their choices fail to satisfy the downward sloping demand property. The conjunction of both patterns gives rise to a violation of EDU. We find that there is also a simple pattern behind the violations of TSU. Our methods rest on nonparametric revealed preference tests. As such, the tests are independent of functional form assumptions. One innovation of our paper is to propose a statistical approach to measuring deviations from EDU, QHD, and TSU. It is always difficult to interpret a revealed preference test because it is either passed or not. By introducing a noise to the model, we find a natural statistical test that allows us to calculate p-values associated with each rejected model.



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# Bayesian Rapid Optimal Adaptive Design: Method and Applications

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## Abstract

Questions used in experiments and surveys in social science are typically developed by intuitive hunches and cumulative search for informative questions that can best separate competing theories. The conventional experimental designs that have emerged are therefore typically a fixed set of test questions. We propose an approach, termed Bayesian Rapid Optimal Adaptive Design (BROAD), in which the sequence of questions is customized for each subject rather than fixed. The subjects themselves tell us, through their answers, the “best” (i.e., most informative) question to ask them next. BROAD method has several advantages. First, the posterior distributions of all theories and parameter values are quickly recomputed for each subject after each trial since it is a necessary step in finding the optimal next question. As a result, when the experiment is over, much of the data analysis is already done. Second, since BROAD method economizes on information gained per minute, they are especially useful for subjects who have scarce time or become bored or habituated quickly. In theory, subjects might prefer to strategically manipulate their early responses in order to get “better” (more economically valuable) future test questions. We pay special attention to the problem of manipulation, and discuss tests to detect it and methods to minimize it. In the first application, we tried to separate six theories of decision making under risk: expected value, expected utility with constant relative risk aversion, prospect theory, cumulative prospect theory, mean-variance-skewness, and normalized mean-variance-skewness. We found that most subjects, after making 30 choices, could be reliably classified as choosing according to expected value maximization or two variants of prospect theory. In the second application, we tried to separate four theories of time preferences: exponential discounting, hyperbolic discounting, quasi-hyperbolic discounting, and generalized hyperbolic discounting. We found that the posterior distributions of the generalized hyperbolic discounting and exponential discounting were significantly higher than the other models. Somewhat surprisingly, the evidence for quasi-hyperbolic discounting is not strong. Finally, we discuss applications of the method to Convex Budget design for risk and uncertainty (Ahn et al., 2014; Choi et al, 2007) or time (Andreoni and Sprenger, 2012).



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## A Validation Test for Measures of Preference Imprecision

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### Abstract

Experimental research shows that the preferences that people express in surveys and experiments are often characterised by a considerable degree of noise or imprecision. While preferences are treated as primitive in economics, imprecision is often ignored or simply modelled as an ad hoc white noise term that is appended to otherwise standard preferences. For preference imprecision to be recognised as a meaningful concept in economics, its credentials must be established by (a) being able to reliably measure it, and (b) showing that it is systematically related to choice behaviour.

Our paper addresses these issues in the context of decision-making under risk, a setting in which preference imprecision has often been observed as a tendency for many participants to reverse their preferences over pairs of lotteries when presented with them two or more times during the course of the same experiment. We seek to elicit straightforward measures of preference imprecision that can be easily linked to choice behaviour, regarded by many as the gold standard in preference elicitation.

We conduct an experiment in which we allow participants to express imprecision in their preferences by reporting that, while they prefer one lottery over another, they are not sure about their preference. In the first part of our experiment, we present participants with tables containing series of paired options in which one is kept constant and the other is made progressively better (by varying either a money amount or a probability), in order to identify a range of imprecision, that is, a range of money amounts or probabilities over which they are less than sure about whether they prefer the lottery that is kept constant. In the second part of our experiment, we build a comprehensive picture of each participant's revealed (but potentially probabilistic) preferences over a circumscribed space of lotteries by asking them to make a large number of repeated choices between pairs of lotteries, presented in a random sequence determined independently for each participant.

By their nature, our measures of self-reported imprecision (Mol) cannot be made incentive-compatible, but rely on participants' desire to provide informative responses. Our validation strategy consists in exploring the extent to which our Mol map into the participants' choice behaviour. For each participant, we are able to identify the relationship between the ranges he/she reports in the first part of the experiment and the choices that she makes in the second. While the exact mapping between choice probabilities and the reported imprecision ranges may vary between participants, if they are sufficiently able to introspect about the noisiness of their preferences, we expect to find that wider ranges of imprecision correspond to cases in which choices are less predictable – i.e. choice probabilities are less extreme. Our preliminary results show that participants are prone to report that they are not sure about their preferences, but their ranges of imprecision do not correlate closely with the noise revealed by their choice probabilities.



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# A Dynamic Analysis of the House Money Effect

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## Abstract

We report results of an experimental approach to disentangle and investigate the influence of two widely known mechanisms on risk taking behavior in a two-stage dynamic setting involving real monetary gains and losses, namely the effect of windfalls gains (Arkens et al., 1994) and the house money effect (Thaler and Johnson, 1990). We define a windfall gain as a riskless and unanticipated gain with the effect's intensity being associated with the history of the individuals' endowment in the experiment, whereas house money is considered the difference between the current stake and the initial stake which has been acquired by taking risk.

We ran a two-stage lottery game which is a modified version of Gneezy and Potters' (1997), to elicit individuals' risk attitude and risk attitude changes after winning or losing in the first stage.

Employing four treatments, we aimed at effectively varying the extent to which participants regard their initial endowment as part of their own assets rather than a windfall gain. In the Standard Treatment, individuals were just endowed with 8€ (same amount in all treatments) at the beginning of the sessions. In both of two Time Treatments, we temporally separated the payment of the endowment from the actual gambling task by one week. The difference between Time 1 and Time 2 was that participants made an additional decision about their behavior in the first round in Time 2 at the time the endowment was paid, but could revise that decision one week later at no (monetary) cost. The fourth treatment involved participants completing questionnaires and being compensated with 8€ for their effort (Work treatment), the lotteries were played subsequently.

We observe an unambiguous and significant ranking of risk aversion between treatments by comparing first round decisions, with its degree being highest in the Work treatment, intermediate in the Time 1 treatment and lowest in the Standard treatment.

In contrast, we do not observe any clear effect of first round outcomes on risk attitude in the second round. The only significant change in risk aversion occurs in Time 2 for both, first-round winners and losers, but cannot reasonably be associated with an influence of the prior outcome and is best explained by the strong anchor of the first decision.

On the one hand our results reveal a strong effect of the endowment's history on risk attitude, corroborating the existence of a windfall gain effect, but on the other hand do not exhibit any indication that winning or losing in the first round alters individual risk attitude in a predictable way, challenging the existence of a house money effect as defined in this context.

To the best of our knowledge, this approach is the first to vary the endowment's history in a multi-stage gambling task in such a way. Our results suggest to carefully differentiate between a windfall gain effect and the house money effect. They should also intensify the awareness that paying experimental endowments as windfall money may decrease observable risk aversion significantly.



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## Emotion-Based Health Beliefs and Behaviors

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### Abstract

There are in health beliefs and in health behaviors a certain number of well-known anomalies. (1) Subjective perceived health risk differs from objective health risk. There are systematic biases in the estimation of one's health risk that vary among individuals and among illnesses. (2) There is also heterogeneity in the type of bias. Some individuals underestimate their health risk, but some others overestimate their risk. In the extreme, some individuals are even hypochondriac/ostriches. (3) Testing rates are too low even when there is no cost of testing and when the medical benefits are known and obvious. (4) Testing and preventive health care behavior do not necessarily increase with objective risk. Those who are rationally the most in need of medical services are not those who use them the most. (5) Subjective risk increases with objective risk, testing increases with subjective risk but testing does not necessarily increase with objective risk. (6) Some people overuse health services while others underuse health services ('doctors avoiders'). (7) There are divergent anxiety responses to information: information reduces the anxiety of some individuals (the 'want to knowers') but raises the anxiety of others (the 'avoiders'). (8) Confirmatory testing: some individuals who are certain to be ill test in order to prove what they already know. These health behaviors seem irrational at the individual level, but they also have severe consequences for the public health system: patients who should seek medical care stay inactive while the system is utilized heavily by those who are not in need of medical care. We propose a model in which health risk, or more precisely the risk of bad news (illness), generates emotions *ex-ante*, in the form of anxiety or worry but also *ex-post* in the form of possible disappointment. We consider these emotions in addition to the standard health consumption utility. Health beliefs and behaviors result from the optimal management of these emotions, i.e. realize the best trade-off between anxiety and anticipated disappointment. The perceived risk level can be seen as the choice of the optimal self-insurance level against emotional risk: it represents how much the individual is willing to sacrifice in terms of peace of mind at date 0 to reduce his future vulnerability to disappointment of bad news. Optimists choose less anxiety but more vulnerability to future bad news, whereas pessimists choose more anxiety but more psychological preparedness to the future bad news. Concerning preventive health behavior, the same trade-off is involved. Testing permits to avoid future bad news and associated disappointment but living with the bad news can be costly in terms of anxiety; not testing permits to keep one's illusions but exposes more to future bad news. We show that our assumptions (1) are all supported by considerable evidence and (2) permit to explain all the mentioned anomalies.



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# Strategic Ambiguity in Two-Player Extensive-Form Games with Perfect Information

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## Abstract

This paper proposes a solution concept for finite games of complete and perfect information with ambiguity. We model ambiguity with neo-additive preferences. As the game proceeds players gain new information and update their preferences. This updating is modelled by the Generalised Bayesian Updating rule (GBU), Eichberger Grant and Kelsey-(2007). Individuals who deviate from expected utility theory will not necessarily be dynamically consistent. In an extensive-form game this implies that the equivalence of a strategy in the normal form of the game with a sequence of subgame-perfect optimal actions in the extensive form game no longer holds. Just as a player may no longer want to follow the moves of her ex-ante planned strategy relative to her opponents' behaviour, she may not be able to commit to her own planned actions because her updated beliefs are not additively separable. Following Strotz (1955), Bose-Renou (2014) and Siniscalchi (-(2011), we give up commitment to a strategy in a sequential decision problem in favour of consistent planning. This implies that at each node where the player has to move, a "sophisticated" player will only consider strategies which remain optimal given her updated future beliefs. Consistent planning means that a player takes into account preference changes due to updating at future nodes. Consistent planning is a sequential decision rule leading to a backward-induction consistent sequence of moves, but not necessarily to an ex-ante optimal strategy with commitment. With consistent planning, however, dynamic consistency is no longer an issue. This may be explained intuitively that players anticipate the new knowledge which they may obtain at future decision nodes and any change in ambiguity this may cause. They then choose the current course of action which maximises anticipated future utility. Alternatively this may be described as players acting strategically against their future selves in an agent-normal form of the game. We illustrate the solution concept by applying it to the centipede game. We find that with ambiguity-aversion the only equilibrium involves playing stop at every node. This is similar to the Nash equilibrium. In contrast with ambiguity-loving it is possible to get an equilibrium in which cooperation continues until nearly the final node. For other parameter values it is possible that cooperation will start but will break down at a random point during the game. This is consistent with the experimental evidence on the centipede game.



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# Ambiguity Attitudes towards Imprecise Probabilities

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## Abstract

Although the standard model of rational choice under ambiguity, i.e. subjective expected utility, suggested using subjective probabilities to measure uncertainty, it is nowadays common knowledge that this claim is contradicted by Ellsberg's paradoxes and subsequent experiments. In his two-color paradox, Ellsberg argued that most decision makers prefer a risky option giving a prize with probability  $p=0.5$  to an ambiguous option giving the same prize with  $p$  in  $[0, 1]$ , i.e. the winning probability is somewhere between 0 and 1. Many subsequent Ellsberg-like experiments refined the initial two-color example by focusing on the general case where the winning probability  $p$  belongs to subintervals  $[p^-; p^+]$ . The present paper reports the results of an experimental investigation that aims at understanding how decision makers evaluate probability-interval-based ambiguous bets within an Ellsberg-like setup. Ambiguous bets are not explicitly interpreted in terms of second-order risk as in many multiple-prior-based models of ambiguity. Instead, we primarily consider objects of choice  $(x, [p^-, p^+]y)$  where the decision maker knows that he will get  $x$  with a winning probability lying somewhere between  $p^-$  and  $p^+$ , and  $y$  otherwise, (i.e., the probability of receiving  $y$  is not within that interval). Additionally, we postulate that decision makers evaluate ambiguous bets  $(x, [p^-, p^+]y)$  by subjectively combining the values of envelope (extreme) lotteries  $L^+ = (x, p^+; y)$  and  $L^- = (x, p^-; y)$ . The weight assigned to the upper (lower) envelope depends on the decision makers optimism/pessimism. Specifically, we assume that (i) the decision maker evaluates individual lotteries using rank-dependent utility (RDU); and that (ii) the value of an ambiguous bet  $(x, [p^-, p^+]y)$  is given by the convex combination of RDU values of the envelope lotteries, i.e.,  $\alpha RDU^+(L^+) + (1 - \alpha) RDU^-(L^-)$  where notation  $RDU^+$  and  $RDU^-$  means appealing to a weighting function for upper bound probabilities and a possibly different weighting function for lower bound probabilities respectively. Ambiguity attitude is captured by the coefficient  $\alpha$ . It reflects decision makers optimism/ pessimism. We elicited this model in a laboratory experiment involving 62 subjects. All components of the models are estimated at the individual level using econometric modelling. Our results are consistent with previous research on ambiguity attitudes: subjects exhibit ambiguity aversion in the standard Ellsberg case, and their ambiguity attitudes vary with the size and location of the interval of probabilities. In terms of our model, we observe that probability weighting of the upper bound is radically different from probability weighting of the lower bound: the former is concave whereas the latter is convex. These patterns receive the following psychological interpretation. Attitudes towards the upper bound carry the certainty effect, while attitudes towards the lower bound carry the possibility effect.



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# A Study on Planning and Personality in Operations Management

Alexander Kharlamov; Janet Godsell

## Abstract

Planning in operations management (OM) is balancing supply and demand under uncertainty. Its failure results in inventory costs or lost sales. Manager's behaviour contributes to the challenge due to over-reactions, mistrust, second-guessing and unnecessary interventions. In practice, this translates into overstocking, change of plans and dismissing statistical forecasting. Such behaviour can be partly attributed to myopic loss aversion (MLA) and individual personality traits. We propose to test the hypothesis that behavioural biases and personality traits affect planning decision-making by conducting laboratory and field experiments. Three treatments are tested and results analysed using econometric methodology. The experiment is based on a planning task (modified newsvendor problem) followed by questionnaires with personality inventories and psychometric scales. Both OM students and OM professionals are targeted. From the treatment on the commitment period, supporting the MLA hypothesis, follows that less frequent interventions lead to better planning performance. Considering personality inventories, less extroversion and greater agreeableness both correlate to better planning. Considering Barratt's Impulsiveness Scale, subjects with higher Motor Impulsiveness Perseverance perform better as expected. Similarly, better performance is also observed for lower focus on negative outcomes based on Elaboration of Potential Outcomes scale. Finally, measures for Global Decision Making Style shows better planning performance for subjects exhibiting lower rationality, greater intuition and less dependence; results supported by previous studies. Considering the expected utility theory, results once more suggests that decision-makers fail to maximise their expected utility, exhibiting demand chasing and anchoring effects. The main limitation of this study is the sample size for both students and even more for professionals. Further research should increase the sample size and add priming on planning policy. The findings provide grounds for discussion in practice about planning policies and evidence to suggest that less frequent interventions can lead to better planning performance. The major social implication is that people might not be naturally suited for task relying heavily on mental accounting under conditions of uncertainty and high volumes of data. Exploring planning in the context of OM alongside personality inventories and constructs together with scales for decision approach and style is novel. This is also one of the first efforts to relate a common OM planning issue with MLA.



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# Estimating Indifference Curves Inside the Marschak-Machina Triangle using Certainty Equivalents

Krzysztof Kontek

## Abstract

This paper presents results of a study which shed new light on the shape of indifference curves in the Marschak-Machina triangle. The most important observation concerns (possibly discontinuous) jumps in indifference curves at the triangle legs towards the triangle origin. Such jumps, however, do not appear at the triangle hypotenuse. This points out to discontinuity in the lottery valuation when the range of the lottery outcomes changes. This observation is confirmed by fitting six decision-making models: Expected Utility Theory, Prospective Reference Theory, Cumulative Prospect Theory, the TAX model, Salience Theory, and Decision Utility Theory. Those models, which correctly predict jumps at the triangle legs (CPT is not among them), offer the best fit of the data collected. Focusing attention to the range of lottery outcomes appears thus one of the most important psychological factors driving decisions under risk. Interestingly, the shape of the indifference curves and the model ranking changes when lotteries close to the triangle boundaries are excluded from considerations: the pattern reminds then the "fanning-out" hypothesis and CPT is the winner. The study has been made using a novel non-parametric method of estimating indifference curves, which is based on linear interpolation of certainty equivalent values between adjacent points representing the lotteries under consideration. This allows to plot indifference curves, certainty equivalent 3D surfaces and to estimate slopes of indifference curves in the triangle sub-areas. Moreover, the indifference curves estimated non-parametrically can be graphically compared with those predicted by the models. This helps to understand why some models perform better or worse depending on the set of lotteries.



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## (F)Lexicographic Shortlist Method

*Christopher Kops*

### Abstract

We propose a new model of boundedly rational choice, the flexicographic shortlist method (FSM), that introduces menu-dependence into the idea of lexicographic preferences. The standard lexicographic choice procedure assumes a fixed sequence in which several decision criteria are applied to gradually narrow down the set of available alternatives. We depart from that by refraining from stipulating the order in which two fixed criteria are applied. Rather the consistency that our model retains lies in the fact that it is the same set of criteria that are applied to each choice problem. Our model generalizes the idea of lexicographic semiorders by Tversky (1969) and the rational shortlist method by Manzini and Mariotti (2007), because the FSM essentially provides a non-probabilistic account of the prominent elimination by aspects procedure by Tversky (1972). To arrive at her choice, a decision maker following the FSM narrows down the set of available alternatives by sequentially applying two asymmetric binary relations (rationales) and by dropping those alternatives that are inferior with respect to the current rationale in the sequence. Our procedure can explain a wide range of experimental findings that report choice anomalies in the form of choice cycles (May 1954) or context-dependent choice like the attraction effect (Huber, Payne, and Puto 1982) or the compromise effect (Simonson 1989). Most notably, the structure of the FSM is very close to the psychological interpretation of how these phenomena emerge. We study several properties of our choice procedure and provide a full behavioral characterization that further develops the idea of confirmed revealed preference in Manzini and Mariotti (2007).



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# Information Communication and Quality of Risky Decisions: Reinterpreting the 'D-E gap'

*Orestis Kopsacheilis; Robin Cubitt; Chris Starmer*

## Abstract

'A person in need of serious surgery must consent to undergo general anaesthesia. Prior to the planned operation the scared patient searches on-line for the associated risks and discovers that the number of deaths as a result of general anaesthesia has reached the stunning figure of 5.4 deceased per 100,000 patients. Panicking, the patient calls the doctor who points out that 0.0054% is an extremely small chance and that she would no doubt take it if she was in need of such an intervention. Nevertheless, the patient seriously considers foregoing the operation altogether.' Why is the opinion of the doctor at odds with that of the patient? A predominant stipulation as to why this conflict arises is that people's risky decisions depend on whether they are made based on described outcomes and probabilities (patient) or whether they learn about them through experience (doctor). In particular, when people make decisions from description, they tend to overweight rare events. This is in accord with Prospect Theory's inverse S-shaped probability weighting function. Conversely, when making decisions from experience people act as if they underweight rare events. This disparity is referred to as the 'Description-Experience gap'. This study extends the set of questions by addressing the following: Which type of decision is more beneficial to the patient's well-being? We conduct between-subjects laboratory experiments and elicit - at the individual level - Prospect Theory's components in two contexts: Decisions from Description and Decisions from Experience. In 'Description' subjects learn about the properties of lotteries via objectively defined numerical representations. In 'Experience' subjects infer those properties by pressing on unlabelled buttons and observing their associated outcomes. In Study 1, deviating from the standard sampling paradigm, we include a history table that records sampled outcomes. We use Expected Utility as a benchmark for the quality of decisions and employ two measures to characterize them. First, we use an index measuring the rate of violations of the Independence Axiom. Second, we use certainty equivalents to elicit individual weighting functions and examine their proximity to linearity across the two contexts. Firstly, we find that by including a history table in 'Experience', subjects' memory constraints are alleviated, which leads to an unprecedented increase of the sampling amount. Secondly, we observe only partial support for the underweighting hypothesis. Thirdly and perhaps more intriguingly, we find evidence supporting the claim that subjects in 'Experience' behave more like Expected Utility maximisers than those in 'Description'. In Study 2, we disseminate between the most prominent culprits of the 'Description-Experience gap' (sampling bias, ambiguity aversion, memory constraints and presentation format) by examining their partial contribution to the shape of individuals' weighting functions.



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## Individual Willingness to Compete and Big Five Personality Traits

*Anna Kostanovskaya*

### Abstract

Economic studies, linking individual's decisions in situations of economic competition and personality characteristics in general, are recent. In the study I for the first time link individual willingness to compete measured as entry decisions in a market entry game (Rapoport, 1995, Sundali et al., 1995) and personality characteristics in the Big Five personality model (Costa and McCrae, 1992). Market entry game is conducted with the explicit randomization of entry decisions (as in Schade et al., 2010), which allows analyzing interaction effects between personality characteristics and decisions at different market capacities. I additionally for the first time show that individuals with different values of a personality characteristic may behave differently at low market capacity (mirroring oligopoly situation) and high market capacity (mirroring perfect competition situation). Other studies to link individual competitiveness and personality characteristics are the study of Niederle and Vesterlund (2007), who measure competitiveness differently from the current study and do not work with the Big Five personality model, and Bartling et al. (2009) who as well have a different way of measuring individual competitiveness. Random Effects panel data models are estimated to relate the willingness to compete and the Big Five personality traits. The analysis indicates that individual decisions are related to the personality characteristics of Extraversion, Openness to Experience, and Agreeableness. The relationship between individual willingness to compete and gender is additionally studied at different market capacities. The study facilitates understanding of the basic economic characteristic "an individual willingness to compete - under different economic conditions joining the two perspectives of experimental economics and psychology. The study contributes by measuring the individual willingness to compete over a range of market structures and relating the measure to personality characteristics.



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## Information Acquisition in Entrepreneurial Decision Making

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### Abstract

Empirical research on entrepreneurship has identified two types of strategies to reduce uncertainty, namely, prediction- and control-based strategies (Sarasvathy, 2001). Prediction-based strategies focus on estimating unknowns via sampling methods and control-based strategies focus on shaping unknowns via pro-active behavior. Both prediction- and control-based approaches aim to reduce uncertainty by providing information to refine prior beliefs. Yet they presuppose different cognitive models of the situation at hand and different degrees of involvement by the decision maker. With regard to cognition, predictive strategies may be interpreted as producing reliable information about current market trends, whereas control-based strategies may be seen as first hand evidence of the chances of transforming customers' preferences. As far as involvement is concerned, predictive strategies are passive in nature and their outcomes are relatively independent of the behavior of the entrepreneur. Control-based strategies in contrast, presuppose an active involvement of the entrepreneur and yield results that heavily depend on her efforts. By eliciting distinctive feelings of confidence, the information provided by these strategies may affect the willingness to engage in entrepreneurial action. Experimental evidence on betting behavior provides support for this hypothesis. Based on Ellsberg's urn as a model of uncertainty, Kuechle et al. (forthcoming) model prediction as random sampling from the urn and control as inserting marbles of an exogenously given color. Using a between subjects design that randomly assigns individuals to the treatments, they find that control-based methods to reduce uncertainty lead to a higher proportion of betting behavior after a favorable outcome compared to predictive methods, results that revert in the presence of unfavorable outcomes. This experiment does not measure any preference for the method to acquire information. It is possible that the results are based on decisions of individuals who intrinsically like and dislike the method they were assigned to. If that is the case, these results would underestimate the difference between prediction- and control-based strategies. The goal of our research is to extend this experiment by allowing subjects to decide how much of their endowment they are willing to invest to acquire information before considering whether to bet. Although subjects will be randomly assigned to the two treatments, their willingness to pay will provide a measure of their intrinsic preferences for the procedures to reduce uncertainty. If such preferences exist, namely if the amount that the subjects are willing to pay on average in each treatment is significantly different, we should expect stronger differences in betting behavior between the prediction and the control treatments after receiving information.



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# Measuring Multivariate Risk Preferences

*Gijs van de Kuilen; S. Ebert*

## Abstract

It has long been recognized that risk attitudes play a crucial role in economic behavior. While Pratt (1964) has demonstrated the ubiquitous importance of risk aversion, Leland (1968) and Kimball (1990) showed that the higher-order risk attitudes prudence and temperance complement risk aversion in important ways. For example, in the realm of saving behavior, risk aversion drives a preference to smooth consumption over time ("consumption smoothing"), prudence governs how saving behavior changes as future income becomes riskier ("precautionary saving"), and temperance determines how saving behavior is affected by changes in macroeconomic risks such as interest rate risk or unemployment risk. The existing literature on higher-order risk attitudes has only considered risk preferences for a single, monetary, attribute so far. In many important settings, decision makers face risky alternatives with multiple, potentially non-monetary, attributes (Keeney and Raiffa 1993). According to theory, the cross-risk attitudes correlation aversion, cross-prudence and cross-temperance determine how risk preferences over multiple attributes co-vary and interact. This paper reports the results of an experiment designed to measure multivariate risk preferences for different attributes, not only for the second order (risk aversion), but also for higher orders (prudence and temperance), in three important domains (social preferences, time preferences, and preferences for leisure time). This first systematic empirical exploration of multivariate risk preferences provides evidence for assumptions made in economic models on inequality, labor, time preferences, saving, and insurance. We observe correlation seeking and cross-intemperance in a condition involving social preferences, which is in line with models predicting inequality aversion. Results from a condition involving time preferences cast doubt on the separability of utility across time, an assumption often invoked by models of intertemporal decision making.



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# Present Bias and Everyday Self-control Failures: A Day Reconstruction Study

Leonhard Lades; Liam Delaney

## Abstract

Present bias is the economist's favourite explanation for self-control problems (O'Donoghue and Rabin, 2015). Various studies elicit present bias in monetary delay discounting tasks and show that experimentally elicited present bias (weakly) predicts various behaviours related to self-control (Sprenger, 2015). However, recently monetary delay discounting tasks have come under attack (e.g. Augenblick et al, 2015). Importantly for this paper, also the empirical link between present bias and self-control problems as they occur in everyday life has not yet been established. We directly test whether individual differences in present bias are linked to individual differences in self-control in everyday life. We elicit present bias in a double multiple price list as it is typical procedure using money, avoiding confounds recently highlighted in the literature (Andreoni and Sprenger, 2012). We measure everyday temptations, self-control attempts, and self-control failures using a day reconstruction methodology (DRM) as introduced by Kahneman et al. (2004). The DRM is well-known from happiness research, but this is the first paper that uses the DRM in order to measure everyday decision-making and in particular everyday self-control using the questions suggested by Hofmann et al. (2012). In a sample of 142 participants we find that experimentally elicited present bias is not associated with self-control problems in everyday life. Present bias is also not associated with psychological trait measures of temptation and self-control. These psychological trait measures, however, do predict everyday self-control problems, indicating that the DRM provides valid information about temptations and self-control as they occur in everyday life. The results are in line with a clear distinction between time discounting and visceral influences as determinants of decision making. Present bias as typically measured in delay discounting tasks might be a specific type of dynamic inconsistency resulting purely from the passage of time. Self-control failures in everyday life are more likely to be the result of visceral states (Loewenstein, 1996) that increase the motivational power of short-term desires and are not necessarily correlated with the passage of time. Accordingly, the results can explain why recent studies find only weak empirical associations between present bias elicited in monetary delay discounting tasks and life outcomes related to self-control.



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# Competitive Equilibrium in Generalized Games: A New Interpretation

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## Abstract

The purpose of this paper is to provide an alternative version of a generalized game, slightly different from the one provided in the seminal paper of Arrow and Debreu (1954). In this revised framework, we introduce the concept of a competitive equilibrium and show how it can be applied to the traditional model of general equilibrium theory. A significant result that we obtain is that a strategy profile is a competitive equilibrium if and only if it is a second period maximizer of every Bergson-Samuelson social welfare function. For potential games, existence problems can be simplified. We introduce abstract economies and show that for such economies which are also potential games whose constraint correspondences all agree on the diagonal of the set of strategy profiles, existence of symmetric competitive equilibria reduces to the search for optimal solutions of dynamic choice problems. We prove existence results for the case where all the strategy sets are subsets of Euclidean spaces and for the case where all the strategy sets are non-empty and finite. The Arrow-Debreu economy is introduced in our setting as an illustration of a finite abstract economy where the preferences of the agents are independent of the strategy profile chosen in the initial period. Finally, we suggest a refinement of competitive equilibrium called an optimal competitive equilibrium and study its relationship with competitive equilibrium through some examples.



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## Risk Attitudes, Sample Selection and Attrition in a Longitudinal Field Experiment

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### Abstract

Longitudinal experiments allow one to compare inferences about behavior over time for the same individuals, and evaluate the temporal stability of latent preferences. But longitudinal experiments entail the possibility of sample selection and sample attrition over time, confounding inferences about temporal stability. We evaluate the hypothesis that risk preferences are stable over time using a remarkable data set combining administrative information from the Danish registry with longitudinal experimental data we designed to allow better identification of joint selection and attrition effects with respect to risk attitudes. Our design builds in explicit randomization on the incentives for participation. We show that there are significant sample selection effects on inferences about the extent of risk aversion, but that the effects of subsequent sample attrition are minimal. Ignoring sample selection leads to inferences that subjects in the population are more risk averse than they actually are. Correcting for sample selection and attrition affects utility curvature, but does not affect inferences about probability weighting. Properly accounting for sample selection and attrition effects leads to findings of temporal stability in overall risk aversion. However, that stability is around different levels of risk aversion than one might naively infer without the controls for sample selection and attrition we are able to implement. This evidence of “randomization bias” from sample selection is important given the popularity of field experiments that rely on randomization, and the effects that risk attitudes have for economic behavior in general.



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# The Rationale of Team Reasoning

*Guilhem Lecouteux*

## Abstract

Team reasoning theory (Sugden 1993, Bacharach 2006) has been developed to overcome the predictive failures of standard game theory in cooperation and coordination games: the core argument of this theory is that solving coordination games requires introducing a notion of collective intentionality, and that collective intentions may also offer a satisfactory explanation of cooperative behaviours. Unlike social preferences approaches in which we alter individual preferences, team reasoning implies a transfer of agency from the individual to the collective level, without requiring a modification of individual preferences. In this paper, I develop a game theoretical framework based on Bacharach's (1999) notion of 'unreliable team interaction' to model collective intentions. I argue that collective intentions can be represented as the satisfaction of collective preferences that the team reasoners have strategically chosen. I determine the collective preferences that team reasoners should choose, and show that collective intentionality may lead to aggressive behaviours toward the players outside the team in submodular games. I can then show that, in a very large class of games, team reasoning is the only procedure of choice that rational individuals can adopt: individually rational players, actuated by the intention of maximising their individual payoff, are in general better off by becoming team reasoners and being actuated by the collective intention of maximising the payoff of all the members of their team, since the choice of collective preferences gives them an opportunity to make a strategic commitment.



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## Confidence Biases and Learning Among Intuitive Bayesians

*Louis Levy-Garboua; Muniza Askari; Marco Gazel*

### Abstract

In many circumstances, people appear to be “overconfident” in their own abilities. We are concerned with how people overestimate, or sometimes underestimate, their own ability to perform a task in isolation. We reconcile the cognitive bias interpretation of overestimation with recent literature on learning to be over (under)-confident. To this end, we design an incentivized real-effort experiment which is an experimental analog to the popular “double-or-quits” game. 410 subjects perform a task that becomes increasingly difficult –i.e. risky– over time. “Doublers” could substantially increase their gains if successful but they would lose part of their earnings and step out of the game if they failed. By comparing, for three levels of difficulty, the subjective probability of success with the objective frequency at three moments before and during the task, we examine the speed of learning one’s ability for this task and the persistence of overconfidence with experience. We conjecture that subjects will be first underconfident when the task is easy and become overconfident when the task is getting difficult, which is the hard-easy effect. However, a task that a low-ability individual finds difficult may look easy to a high-ability person. Thus, we should observe that overconfidence declines with ability, which is the Dunning-Kruger effect. The gradient of task difficulty was manipulated after completion of level 1, defining two different tracks with the same requirement to reach the highest level. A third treatment was also considered in which subjects could choose their preferred track. We find that people on average learn to be overconfident faster than they learn their true ability. We present a new “intuitive-Bayesian” model of confidence which, while resting solely on a Bayesian representation of the cognitive process, describes the behavior of subjects who are myopic, poorly discriminate, and thus make measurement errors. Above all, a persistent doubt about their true ability is responsible for their perception of (available) contrarian illusory signals that make them believe, either in their failure if they should succeed or in their success if they should fail. We show that limited discrimination of objective differences and myopia can be responsible for large prediction errors which learning should reduce. However, the fundamental uncertainty about one’s true ability causes systematic and robust confidence biases, namely the hard-easy effect, the Dunning-Kruger effect, conservative learning from experience and the overprecision phenomenon if subjects act as Bayesian learners. Moreover, these biases are likely to persist since the Bayesian aggregation of past information consolidates the accumulation of errors, and the perception of illusory signals generates conservatism and under-reaction to events. Taken together, these two features may explain why intuitive Bayesians make systematically wrong predictions of their own performance.



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## Range-dependent Utility Model with Constant Risk Aversion

*Michał Lewandowski; Krzysztof Kontek*

### Abstract

The range-dependent utility model for choice under risk is a modification of expected utility theory in which utility function depends on the lottery range, i.e. the interval between the lowest and the highest outcome in the lottery support. It differs from a number of approaches assuming context dependence, in which context is usually provided by a set of comparable lotteries and not a single lottery. We present four axioms of a range-dependent preference relation to obtain axiomatic representation of the range-dependent utility model. For operational purposes as well as for prediction, a special case of the model is proposed, which is called the decision utility model. By imposing an additional axiom of shift and scale invariance, great multiplicity of range-dependent utility functions (different functions for different ranges) is reduced to a single decision utility function from which every range-dependent utility function is induced. Due to this axiom, the decision utility model belongs to the class of Constant Risk Aversion of Safra, Segal (1998). After providing axiomatic representation for the decision utility model, we analyze two crucial properties of the model: continuity and monotonicity wrt FOSD. We say that the model satisfies continuity if for every sequence of random variables converging in distribution to a given random variable, the Certainty Equivalent values of this sequence converges to the Certainty Equivalent of this random variable. We demonstrate that the model is in general discontinuous, i.e. there are jumps of indifference lines at those edges of the probability simplex which correspond to the change of lottery range (probability zero either for the highest or for the lowest lottery prize). We provide necessary and sufficient conditions for monotonicity. Intuitively, the conditions require that the marginal utility should be sufficiently small close to the lower and upper bound of the decision utility function domain and higher towards the middle of the domain. As a consequence, it is "easiest" to satisfy monotonicity if the decision utility function is S-shaped and it is "hardest" to satisfy monotonicity if it is inverse-S-shaped. Finally, we test the decision utility model by confronting it with the data. It is verified that the model accommodates a number of well known EU paradoxes, without recourse to probability weighting. The model is then fitted to experimental data. For binary lotteries the model is observationally equivalent to Yaari dual theory and it fits the Tversky, Kahnemann (1992) data well. For the case of three and more outcome-lotteries analyzed experimentally by Kontek (2015), the model fits the data better than any known model of choice under risk, including CPT. Interestingly, it is the S-shape of the decision utility function which a) best fits experimental data, b) is necessary to accommodate the EU paradoxes and c) satisfies monotonicity conditions.



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## Trust and Ambiguity

*Chen Li*

### Abstract

The decision to trust others is of an ambiguous nature: it is difficult to assess the chance that one's trust will be reciprocated. Therefore, people's decision to trust is not only driven by their beliefs about others' trustworthiness, but also by their preferences for this source of social ambiguity. In this study, we used an experimental design that allowed for separate investigation of how these two factors may drive people's decision to trust. In our experiment, subjects first made a trustor decision in a trust game with their randomly assigned partner. We then elicited their ambiguity attitude using the method introduced by Baillon et al. (2015), which allowed for a separation between the additive part of people's subjective beliefs and the non-additive part due to distortions by their ambiguity attitudes. Finally subjects made a trustee decision in the same trust game with the same partner. We found that, people who decided to trust believed that their trust were more likely to be reciprocated by their partners than those who did not. Moreover, people who trusted were also less ambiguity averse. Sapienza et al. (2013), argued that trust has two components: a belief-based one and a preference-based one. Our findings provided direct supporting evidence to this argument. Also, people who decided to trust were those who were more trustworthy themselves when making the trustee decision; and more trustworthy people believed that their partners were more likely to be trustworthy than those who were less trustworthy. This finding is consistent with the finding on "false consensus" (Ross et al. 1977), which implies that people tend to overestimate the proportion of others who would think (behave) like them.



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# Imprecise Beliefs and Belief Updating Under Ambiguity

Zhihua Li; Andrea Isoni; Graham Loomes

## Abstract

Beliefs about probabilities of uncertain events are central to decision making under ambiguity. Different methods have been proposed to better and more accurately elicit beliefs in an incentive compatible way. However, elicited beliefs have often been found to be unreliable predictors of choice behaviour. This paper addresses this issue by studying whether people have stable/precise beliefs to be elicited at the first place. If beliefs are very noisy or unstable, incentive compatible methods based on the assumption that beliefs are precisely-defined and stable will not work as intended. We also investigate whether imprecise/unstable beliefs can be improved by experience or additional information. Our experiment implements ambiguity using devices similar to two-colour Ellsberg urns. Participants make decisions not just about ambiguous bets based on the colour of a randomly drawn ball (eliciting their matching probabilities), but also about ambiguous bets on the composition of the urn (eliciting their priors about the composition of the ambiguous urns). These data have the potential to shed light on various theoretical models of decision making under ambiguity (maxmin model,  $\bar{\pi}$ -maxmin model, variational model, prospect theory and smooth model). Our experimental design also allows us to test probability sophistication, elicit ambiguity attitudes, and derive imprecise intervals for subjective beliefs about uncertain events. We then examine the interaction effect of prior knowledge and new additional information on belief updating, with different prior knowledge of uncertain events given to decision makers in different experimental treatments, to compare how beliefs are updated under conditions of full ambiguity versus partial ambiguity.



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## Uncertainty Communication and Beliefs of COP21 Negotiators

*Ning Liu; Valentina Bosetti; Elke Weber; Loic Berger; David Busescu; Massimo Tavoni*

### Abstract

Complicated estimation about highly uncertain events in the future, such as the estimation about 2100 temperature increase, could only be done through models projections. The uncertainty in estimates comes from states of nature and different models used for estimation. Model uncertainty and state uncertainty are usually confused in information communication, and this project investigates how emphasizing model uncertainty affect the update of beliefs of receivers. At the latest round of climate negotiations, COP21, held in Paris in the December of 2015, we have interviewed more than two hundreds negotiators in order to collect their beliefs concerning a key outcome of the negotiations process, the distribution of 2100 temperature that would result from the Intended Nationally Determined Contributions (INDCs) that countries have committed to. In addition, we have provided negotiators with probabilistic information coming from multiple climate models on the same object, namely 2100 temperature, given a specific global emission pathway that is in line with INDCs and we have collected information on their posterior. The information is given in one of the three formats of presentation of the information. Format 1 represents the mean and 90% confidence interval, as in the IPCC report. This format does not emphasis on the fact that different models give various estimates. Format 2 and 3 convey the same distribution of model estimates but give more information about the level of model uncertainty in different multitudes. We found climate negotiators do not treat the information we provide as posteriors but as information and update their priors accordingly. The data allows us to speak to the issue of effectiveness of alternative modes of uncertainty communication.



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## Rebalancing the Scale of Fairness: Dictator Game with Workloads

Ning Liu; Valentina Bosetti

### Abstract

Fairness presents commonly in daily arguments but often absent in neo-classic economic theories that assumes full selfishness. Experiments on dictator games generally find dictators sharing non-zero proportions of gains with the receivers (Engel, 2011). Such results challenge the descriptive validity of the selfishness assumptions. This challenge would be less relevant for behaviors in the field if people treat experimental gains differently from their own money. One common drawback in dictator game experiments is that the money to allocate is often endowed, and therefore it's worth suspicion if subjects feel entitled to such money. Started by Konow (2000) and Cherry, Frykblom, and Shogren (2002), studies have investigated the effects of earned money in dictator games. In these studies, the allocation phase is preceded by an earning phase in which the subjects earn the money to allocate in the next phase. Under such settings, i.e., when the dictator earns the money, the allocation to the receivers often plummets to almost zero. These results are usually interpreted as evidence of low concerns for fairness with earned money. However, this interpretation is only about the fairness concern in the dimension of money. Another perspective of looking at the results is that subjects are rebalancing the scale of fairness by allocating zero money to the receiver, an allocation merely matching the allocating of effort between the two. In the current paper, we propose an experiment in which the dictators allocate effort (money) given an exogenous allocation of money (effort). By varying the given allocation, we can test if the effort (money) allocation of the dictator matches the given money (effort) allocation in a symmetric manner in cases where the exogenous allocation of effort (money) favors the dictator or the receiver. In our setting, a symmetric manner would indicate a concern for fairness in allocation, and this indication is not biased by the predetermined allocation in one dimension, as in dictator games with earned money. In addition, our design also allows us to explore how the initial allocation of effort/money interact with the sense of fairness of the dictator.



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# Liability Judgment under Uncertainty and Minimization of Social Losses

*Xiaoou Liu*

## Abstract

The updating of information is an important step in many decisions involving uncertainty and is non-trivial for understanding behavior in dynamic contexts such as entrepreneurial activities or the politics of the precautionary principle. It is sometimes not obvious or even debatable that there is information update involved, and intuitions would diverge. However, except for the discovery of base-rate neglect in the 80s, not much recent attention seems to have been given to either description or application of alternative models of behavior in the updating process. This paper presents a curious result of information update process in liability judgements and hopes to inspire more discussions of this interesting aspect of decision-making. We think of liability as a perceived cause, such as an individual act, of an undesirable event, such as a social loss. It is intuitive to expect the working of a liability attribution system, formal or informal, to enhance minimization of social losses that are subject to externality. Under certainty, liability attributions enable social losses to be directly translated to individual losses, and remove any negative externalities in an individual's decision process. Even when there is uncertainty with respect to the perceived cause of a social loss, one would still expect liability attributions to work at least in the direction of reducing externality in social losses. Shavell (1983) for example compared two liability systems and concluded that one is more effective than the other in incentivizing socially optimal behavior. In comparison to having no liability system though, both systems would clearly trump in reducing social loss. This paper contends that this is not necessarily the case. Under uncertainty, the judgement of liability can be considered as judgement of posterior probabilities of a potential causing event conditional on the occurrence of a social loss. According to Bayes' rule, this posterior probability would depend on both the base-rate of the potential causing event and the conditional propensity that this causing event would generate a social loss. An individual trying to minimize liability would then try to reduce both the base-rate and the conditional propensity. However, when there is complementarity (e.g. constant sum) between the loss-generation processes, minimization of total probability of a social loss would mandate opposing directions of movement of the base-rates and the conditional propensities. That is, when base-rate of one particular causing event is lower than the base-rate of the other causing events, it would be optimal for the one causing event to take over more conditional propensities from the other causing events in the loss-generation processes, rather than the other way around. Furthermore, with the presence of base-rate neglect, this dilemma would be resolved and individual would be trapped in keeping lowest conditional propensities and highest base-rates.



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## Intrinsic and Extraneous Noise in Risky Choice Experiments

*Graham Loomes and Lukasz Walasek*

### Abstract

Participants' responses in decision experiments are 'noisy': when presented with exactly the same choice at different moments within the same experiment, many people are liable to answer differently from one moment to another. Some of this may be due to intrinsic variability in the way people generate their decisions; but the experimental environment may also have an impact - e.g. the complexity of the task, the workload, the (lack of) incentives. Moreover, in principle, extraneous and intrinsic factors may interact, and may operate to different degrees for different individuals, making it harder to identify core preferences. Can we identify/separate/measure such effects? We present some results which may shed light on these issues.



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## WTA-WTP Gap: Testing for Loss Aversion

*Hela Maafi; Emmanuel Kemel*

### Abstract

Since the publication of the seminal paper of Kahneman and Tversky (1979), loss aversion has become one of the most important concepts in behavioral economics. Loss aversion refers to the tendency for individuals to strongly prefer avoiding losses than acquiring gains. Put differently, individuals seem to interpret outcomes as gains and losses relative to a reference point and to weight losses substantially more than objectively equal gains. Loss aversion has been widely documented. Many pieces of work have presented empirical evidence for loss aversion (Kahneman et al., 1990, and Tversky and Kahneman, 1991). Loss aversion has the strong feature of explaining many anomalies of choice under risk. Particularly, loss aversion is widely accepted as the cause (or the explanation) of the willingness to accept-willingness to pay gap (WTA-WTP gap). The WTA-WTP gap is the tendency to price substantially more an object as a seller than as a buyer. The WTA-WTP gap was a central topic in the last forty years and was extensively examined and replicated (Horowitz and McConnell, 2002). Recently, a debate confronting Plott and Zeiler, PZ, (Plott and Zeiler, 2005, and Plott and Zeiler, 2011) and Isoni, Loomes, and Sugden, ILS, (Isoni et al., 2011) stresses whether WTA-WTP gap is exclusively due to misconception. While PZ argue that the gap vanishes when misconception is removed, concluding that loss aversion has nothing to do with the observed gap, ISL demonstrate that the gap survive to control of misconception, without favoring any explanation of the gap. This study examines the part of loss aversion in explaining the observed gap between WTA and WTP after controlling for misconception. The approach of this study is as follows; if the WTA-WTP gap results from endowment effect, than loss-averse subjects will exhibit such gap while non-loss averse subject will not. The key point is thus to classify subjects according to their loss aversion. For each subject, (1) we replicate PZ procedure to measure WTA-WTP gap and control for misconception and (2) we elicit loss aversion parameter. Under the hypothesis that WTA-WTP gap is not only due to misconception, we should observe a positive correlation between WTA-WTP measure and loss aversion measure.



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## Multiple Sources of Uncertainty and Varying Risk Confidence

*Fabio Maccheroni; Veronica Cappelli; Simone Cerreia-Vioglio; Massimo Marinacci*

### Abstract

There is by now solid empirical evidence on the dependence of risk attitudes of decision makers on the risk source they are facing (Heath and Tversky, 1991, Fox and Tversky, 1995, Slovic, 1999). For example, human casualties generated by different catastrophic events (such as earthquakes, epidemics, terror attacks, nuclear accidents) may be evaluated in very different ways by policy makers taking prevention measures. Analogously, consumption at future dates is obviously discounted in different ways, but an investor may also take into account the fact that in different future dates he will be more or less affected by outcomes' variability (older people are more vulnerable to consumption shocks than younger ones). In this paper, we provide a framework to describe source dependent prospects and we obtain a general axiomatic foundation for the representation of preferences between these prospects. Specifically, prospects depending on different sources are represented by vectors of source dependent random variables, and we characterize the evaluation of prospects by means of a two stage process: in the first stage, decision makers compute the certainty equivalents of the different components of the vector using source-specific utility functions, probability measures, and probability distortion functions; in the second stage, they take a suitably weighted mean of these certainty equivalents. In particular, when prospects are portfolios of bets on two different urns, like in the classic example of Ellsberg (1961), we are able to characterize evaluation by means of the sum of urn-dependent certainty equivalents, thus immediately rationalizing the eponymous paradox in the spirit of Smith (1969). Analogously, when prospects are consumption streams and sources correspond to dates, we are able to pin down the behavioural assumptions underlying evaluation by means of the sum of discounted date-dependent certainty equivalents. The features of the axiomatic foundation we provide guarantee testability of the model, the possibility of estimating its components, and the sensibility of performing comparative statics exercises.



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## Is an Uncertain Loss Always Better than a Sure Loss?

*Serge Mace*

### Abstract

Consider an individual who has just suffered from a major financial setback or from a serious health loss like a handicap or the beginning of a long-term disease. In a normal context, he should give value to any small positive probability  $p$  of getting its money back or of healing. However, various psychological studies suggest that when the individual is uncertain about the durability of the loss, it can also impede successful psychological adaptation to the loss. Is it then possible that, in some cases, an individual prefers the certainty of a health or wealth loss, to which she can adapt, rather than a small positive probability  $p$  of getting it back? We examined this question theoretically through a modified version of the Koszegi and Rabin's (2006) model. The result depends firstly on how uncertainty affects the weights that the individual ascribes to the two possible outcomes, temporary or permanent loss, used as reference points. In the simplest case in which these weights correspond to the probabilities of these two outcomes, we show that the possibility that the loss is only temporary can reduce the expected utility of the individual i) if loss aversion is strong enough (because the individual anticipates that he will be more disappointed if her loss becomes permanent than he will be satisfied if it disappears) and ii) if is low enough and below a probability threshold that depends on the number of future periods (Intuitively, nobody will refuse a significant probability to return to her initial level of health or wealth, in particular when she can benefit from it over many future periods). The model finds some empirical support in observations showing that the beneficial effects, in terms of adaptation, of the certainty of the loss are often explicitly incorporated in the cost-benefit calculus made by people who decide to stop their efforts to regain past health, wealth, wage or fame. By isolating the necessary conditions under which an individual may turn down a small positive probability of returning to her initial better situation, it also helps explain why this paradox is limited in practice to some specific circumstances.



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## The Calculus of Attitudes toward Ambiguity

*Mark Machina*

### Abstract

This paper adapts and combines aspects of the Schmeidler (1989) objective-mixture and the Epstein (1999) probabilistically- sophisticated-partition definitions of ambiguity aversion, along with the Machina (2004) notion of almost-objective events and the Machina (1992,2005)/Epstein (1999) notions of event-differentiability, to develop a general analytical 'calculus' of attitudes toward ambiguity, including characterizations of ambiguity aversion and comparative ambiguity aversion, over a purely subjective Euclidean state space. The approach can be termed a general 'calculus' of attitudes toward ambiguity in that it involves no functional form restrictions, no objective uncertainty or objective mixtures, and no requirement of probabilistic sophistication over any subset of events.



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# Is Risk-taking Propensity a Reliable Personality Trait? Evidence from Large-scale, Longitudinal Study

Rui Mata; Anika Josef; David Richter; Gregory Samanez-Larkin; Gert Wagner; Ralph Hertwig

## Abstract

Can risk-taking propensity be thought of as a trait that captures individual differences across domains, measures, and time? Studying stability in risk-taking propensities across the lifespan can help to answer such questions by uncovering parallel, or divergent, trajectories across domains and measures. We make a unique and seminal contribution to this effort by examining longitudinal changes in general and domain-specific risk taking. Specifically, we use data from respondents aged 18 to 85 in the German Socio-Economic Panel Study (SOEP) and by examining (1) differential (rank-order) stability, (2) mean-level differences, and (3) individual-level changes in self-reported general ( $N = 44,076$ ) and domain-specific ( $N = 11,903$ ) risk-taking propensities across adulthood. In addition, we investigate (4) the correspondence between cross-sectional trajectories of self-report and behavioral measures of social (trust game;  $N = 646$ ) and nonsocial (monetary gamble;  $N = 433$ ) risk taking. The results suggest that risk-taking propensity can be understood as a trait with moderate rank-order stability. Nevertheless, results show reliable mean-level differences across the lifespan, with risk-taking propensities typically decreasing with age, although significant variation emerges across domains and individuals. For example, while risk taking seems to decrease across the life span in recreational and financial domains, it remains relative constant in the social domain. Interestingly, the mean-level trajectory for behavioral measures of social and nonsocial risk taking was similar to those obtained from self-reported risk, despite small correlations between task behavior and self-reports. Individual-level analyses suggest a link between changes in risk-taking propensities both across domains and in relation to changes in some of the Big Five personality traits, albeit no significant relation to other variables, such as income. Overall, these results raise important questions concerning the role of common processes or events that shape the lifespan development of risk-taking across domains as well as other major personality facets, while questioning the importance of other factors in determining individual and age differences in risk taking that are typically emphasised by economists, such as wealth.



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## Choice Lists: Between Isolation and Integration

Guy Mayraz; Yoram Halevy

### Abstract

Choice lists using the random incentive scheme (RIS) have become a workhorse method for measuring risk preferences. However, several recent studies show differences between choices in a list and in the corresponding single choice setting. We test two alternative explanations for this difference. To study whether the random incentive scheme is behind it, we conduct a treatment in which we present subjects with a choice list in which they know in advance which choice is to be paid. We compare this to treatments in which (i) subjects make only a single choice, and (ii) subjects face a RIS list; also, (iii) we vary the presentation of all lists. We find a large and statistically significant difference between choices in the list and choices in a single choice condition (all comparisons are between subjects). Subjects who make only a single choice display a much stronger certainty effect. However, choices in the conditions in which subjects know in advance which choice is paid are statistically indistinguishable from those in which they do not. Thus, the difference between the RIS list and the single choice condition cannot be explained by incentives. Our results drive a wedge between isolation and integration. Consistent with the examples in Prospect Theory, our subjects do not treat in the set of choices as a single integrated lottery. However, presenting a set of choice problems to a subject induces them to behave differently than if presented with a single binary choice. Our findings suggest the need to go beyond an exclusive focus on incentives, and consider how subjects approach a set of choices, and how it affects their preferences rather than simply reveals them.



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# The Impact of Depression and Anxiety on Choice under Uncertainty

Guy Mayraz; Xue-Ying Cheng

## Abstract

We give subjects a range of risk and ambiguity questions, and test them for the presence of anxiety and/or depression using the Kessler-10 questionnaire. We find no difference in basic risk and ambiguity questions over lotteries. However, we do find a substantial difference in loss aversion, and in real life risk taking questions.



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## Exploring the Consistency of Higher-order Risk Preferences

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### Abstract

Over the course of the last decades it turned out that risk preferences are only captured partially by the concept of risk aversion. Higher-order risk preferences like prudence (Kimball, 1990) and temperance (Kimball, 1992) also impact decisions made by individuals when facing uncertainty. Higher-order risk preferences have been studied in a small number of experiments so far (for an overview see Noussair et al., 2014). These studies reveal that a majority of people is not only risk-averse, but also prudent and temperate. In a recent laboratory experiment, Deck and Schlesinger (2014) "hereafter D&S" test the hypothesis that risky choices can be explained either by a lottery preference for combining "good" with "bad" or for combining "good" with "good" (see Crainich et al., 2013). The former implies mixed risk-averse behavior, the latter mixed risk-loving behavior. Both types differ in their preferences for lotteries of even orders but coincide for odd orders. In line with their hypothesis, D&S in fact observe a consistent pattern of behavior with US-American subjects: Risk averters tend to be temperate (order 4) and risk-apportionate of order 6 while risk lovers tend to choose in the opposite way. Furthermore, both types exhibit prudent (order 3) and edgy (order 5) behavior. We build on the analysis by D&S and explore the consistency of higher-order risk preferences with regards to (A) cross-country differences, (B) differences in stake size, and (C) differences through displaying reduced rather than compound lotteries. We use the elicitation method introduced by D&S and conducted a series of economic laboratory experiments in China, Germany, and the US with a total of 605 subjects. In short, subjects faced a total of 38 tasks in randomized order one of which was randomly selected for payment. In each task subjects had to choose between two lotteries which revealed their risk preference up to the 6th order. In order to investigate the effects of the stake size, we increased the payoff by a factor of ten for some of the Chinese subjects. In order to investigate the effect of reducing compound lotteries on choices, we ran additional sessions in Germany where the participants faced order 1 and order 2 lotteries in original (compound) form plus two additional orders in compound as well as in reduced form. We replicate the finding of mixed risk-averse and mixed risk-loving behavior by D&S in the US and identify a similar pattern in Germany and in China. Moreover, we observe an increase in risk aversion when stakes are increased tenfold. We also observe the pattern of mixed risk-averse and mixed risk-loving behavior with high stakes. Finally, we observe that subjects choose the prudent and temperate options less often when they are displayed in a reduced rather than compound form. In the reduced lotteries there is weak evidence that subjects behave generally prudent and no evidence that they are generally temperate.



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# On the Accuracy of Floods Cumulative Risk Perceptions: Evidence from Judgement and Choice

*Cristobal De La Maza; Ines Azevedo; Alex Davis; Cleotilde Gonzalez*

## Abstract

Previous studies have shown, people have difficulty understanding how risks accumulate over time. We assess how people perceive cumulative risks in the context of flooding events. For example, suppose that there is a 1% chance of flooding in a specific location each year. When asked to assess the probability of at least one flood occurring in thirty years, people use variants of two heuristics for computing the cumulative risk deviating from the normative response (26%): 1) They take the average probability (1%), or 2) They sum the probabilities for all periods (30%) (Doyle 1997, Juslin et al. 2015). Previous studies have asked participants to provide direct assessments of the cumulative risk, measuring risk from their judgments. In this work, we compare two frameworks: a judgment task, similar to what has been used in previous risk perception studies, where participants are asked to provide a direct assessment of cumulative risk, and a choice task, where we use the stated choices from alternatives of insurance coverage to understand the effect of cumulative perceived risks in subjects risky choices, allowing us to compare the perceived risk across two elicitation modes, each with their own heuristics and biases. The survey was implemented using Amazon in M-Turk. We used a randomized controlled trial where MTurk participants were assigned to either a judgment or choice condition. Also we analyzed the effect of providing additional cumulative probability information. We found that subjects judgments can be represented by a bimodal distribution, with a group that severely underestimate the risk and a group that moderately overestimate the risk. Regarding choice preferences, we observe that judgments have an influence in choices. If individuals underestimate the risk they are less inclined to pay for insurance. On the contrary, if individuals overestimate the risk they recognize the insurance coverage option as more favorable. We must highlight that the predicted behavior is not as dramatic as we predicted based on expected and non-expected utility formulation. Further, we propose a model to account for subjective judgments when modeling choices.



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## The EQ-5D in Health Judgements and Choices

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### Abstract

The Quality Adjusted Life Year (QALY) is used in health economics and policy to enable comparisons between different health states. It has two components: duration and quality of life. To estimate the latter, the EuroQol EQ-5D descriptive system presents health states as a combination of scores along 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. Each dimension is assigned a score from 1 (no problems) to 5 (extreme problems). These can be converted into a single, overall quality weight using subjective judgements elicited through experiments and surveys. If preferences for different health states are inadequately captured in this way, then policy decisions made on their basis are likely to be suboptimal. The EQ-5D dimensions are heavily weighted towards physical as opposed to mental health as (with a ratio of 4:1). If survey respondents perceive the 4:1 split as a signal about the appropriate weight to be placed on physical and psychological health, this might influence their survey responses. This is a particular concern where there are doubts surrounding the stability of underlying preferences for health states, and hence for the consistency of health judgments elicited in different ways, or on the basis of different formats of information presentation. We present a series of three experiments that test the extent to which the EQ-5D presentation influences the decisions of healthy individuals making choices or judgments about fifty health states. In our first experiment, we demonstrate that naming the diseases significantly alters their judged severity, an effect explained by how much the health state is feared, or "dreaded". This suggests the EQ-5D does not capture all health state aspects that concern individuals. Our second experiment elicits choices, instead of judgments. Again, we find a significant effect of the label. However, we find remarkable consistency between choice and valuation. Our first two experiments are supplemented by Eye Tracking technology to provide process-level data on attention to different information. In our third experiment we directly address the ratio of mental and physical health dimensions by altering the dimensions of the EQ-5D. We split the mental health dimension into two and combine mobility and usual-activities into one. This significantly alters the relationship between the dimensions and the judged health state severities and indicates that information presentation influences survey responses. Our research has implications for the robustness of EQ-5D-derived quality of life scores, raising questions for practitioners and academics about what factors should be allowed to influence the prioritisation of different health states in policy decisions.



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# I Want to Know it Now: Measuring Preferences Over the Temporal Resolution of Consumption Uncertainty

*Thomas Meissner*

## Abstract

We design an experiment to elicit preferences over the temporal resolution of consumption uncertainty as axiomatized in Kreps and Porteus (1978) and Epstein and Zin (1989). Subjects consume in the lab by surfing YouTube which is contrasted by a real effort task. Lotteries over consumption at different points in time introduce actual consumption uncertainty - as opposed to income uncertainty. Assessing a series of choices, we find that on average, subjects are willing to forgo about 4% of their total consumption in order to expedite the resolution of consumption uncertainty. A structural estimation suggests that subjects on average indeed prefer an early resolution consumption uncertainty. This, however, is mainly driven by a minority of subjects with a strong preference for early resolution.



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## Communicating with an ambiguity averse receiver

*Tigran Melkonyan and Surajeet Chakravarty*

### Abstract

Cheap talk plays a key role in most market and non-market interactions. Professional advice, announcements by government agencies, marketing campaigns, bargaining, and delegation of decision rights and communication in organizations are just few examples of situations with asymmetric information and possibility of sending costless messages. We analyze games where a sender costlessly communicates with a receiver who takes an action on behalf of the sender. The receiver is not only unaware of the type of the sender and is also ignorant about the distribution of the type the sender may be. There has been considerable amount of work on strategic communication recently (Sobel, 2011) most of which has mainly used the Crawford and Sobel (1982) as a model of communication. We develop our analysis in the same spirit of Crawford and Sobel (1982) (CS from now on). In CS the sender communicates a one-dimensional signal to the receiver and the sender has a uniform bias where the sender's preferred action is always to the right of the receiver. In comparison to CS we consider the case when the receiver has ambiguity-averse preferences. The sender therefore knows this and will try and send a message to the receiver in order to convince him to take an action according to his own preferences. We characterize the equilibria of such a game. We show that communication can be informative, and can also be influential. While there is no fully separating equilibrium, we characterize the partial separating equilibria and the pooling equilibrium. And we find like CS, there is an equilibrium where for any message the receiver takes the same action. Finally, we show that as ambiguity increases, the equilibria, which are affected, are the ones where the sender chooses to partially mix and the receiver responds by also partially mixing. But as ambiguity increases the message of the sender becomes more precise. The second contribution we intend to make is in the analysis of authority within organizations. Dessein (2002) uses a CS setup to demonstrate that delegation of decision rights to the agent is preferred to the communication mechanism if the principal's and agent's preferences do not differ too much relative to principal's uncertainty. Our results shed light on how this trade-off between the two authority structures is affected by ambiguity. We show that communication may become more informative as ambiguity increases. The intuition behind this seemingly counterintuitive finding is that the agent will communicate a more informative signal since he will anticipate that increased ambiguity will cause the principal to select an action, which will be further away from his preferred action. To counter this he will send a more informative signal.



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# Preference Incompleteness and the Gains from Trade

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## Abstract

Behavioral inertia is familiar in everyday experience, in economic laboratory experiments, in economic field experiments, and in market settings. Even children understand the proverb: "When in doubt, do nothing!". A variety of explanations have been advanced for such behavior. A prominent economic explanation is incompleteness of preference structures, especially in the presence of ambiguity (Aumann, 1962; Bewley, 2002). This paper shows that whether incomplete preferences rationalize behavioral inertia depends crucially upon the choice set supporting the initial status quo. We illustrate in trade theoretic terms. If preferences are complete, two countries with the same tastes, technologies, and resource endowments would not be expected to trade. This reflects a lack of mutually beneficial opportunities to trade. But our analysis shows that when preferences are incomplete and the technology is suitably convex, two countries with the same tastes, technologies, and resource endowments face potential gains from intercountry trade for generic status quo allocations. Therefore, trade can be expected to emerge. Although other studies have analyzed trade with non-expected utility preferences and production technologies (for example, Bewley 2002; Mandler 2013, Chambers 2014), to our knowledge none have characterized this particular trade-creating effect. The intuitive argument is that for any potential status-quo allocation, the kinkiness of the decisionmaker's indifference contour ensures that a continuum of marginal rates of substitution is consistent with equilibrium for that allocation. That continuum of marginal rates of substitution is consistent with equilibrium for a matching continuum of marginal rates of transformation. If the choice set supporting the status-quo is strictly convex, each marginal rate of transformation maps into an unique efficient point implying that a continuum of status-quo equilibria potentially exists. Even though these potential equilibria may be highly disparate, none is strictly preferred to the others. Hence, starting from any one of these equilibria, if the decisionmaker were to rely on autarkic adjustment alone, inertia would result. Now suppose that the decisionmaker is allowed not only to move between efficient points but also to trade with another identical individual whose status-quo allocation is one of these alternative efficient points. The differences in the underlying marginal rates of transformation ensure that potential benefits exist from agreeing to trade. Preference incompleteness, as compared with preference completeness, creates the heterogeneity necessary in autarkic allocations to ensure the potential to gain from trade. Thus, the possibility of substitution in production coupled with incompleteness of preferences can result in more trade and not less.



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# Predicting the Unpredictable: a Theory of Learning under Unawareness

*Idione Meneghel; Rabee Tourky*

## Abstract

We provide a model of statistical inference in a setting where unawareness matters. In this setting, a decision maker forms an assessment regarding some alternatives available, but before making this assessment he can collect information about the environment. More specifically, we assume that the decision maker views data as being generated by an underlying stochastic process that satisfies a condition we denote conditional exchangeability. That is, there is a sequence of random variables  $(X_t)$  that represents the realization of repeated trials of an experiment. The sequence  $(X_t)$  is said to be conditionally exchangeable if, for every  $n$ ,  $(X_1, \dots, X_n, X_{n+1})$  is distributed as  $(X_1, \dots, X_n, X_{n+2})$ . Conditional exchangeability is related to the notion of exchangeability: exchangeable random variables are obviously conditionally exchangeable. There are, however, sequences of random variables that are conditionally exchangeable but not exchangeable. In particular, conditionally exchangeable sequences of random variables may fail to be stationary. At any point  $t$  in time, the decision maker makes an assessment regarding bets whose payoffs depend on these realizations. However, the decision maker's level of awareness restricts his perception of the realized state of the world: he can only partially observe the realizations of the sequence of random variables  $(X_t)$ . As information trickles, the decision maker discovers new states. Consequently his awareness level increases and his conceivable state space expands. Moreover, as new states are discovered, probability mass is shifted from old, non-null events to the events just created. When facing the choice of how much probability mass to shift, due to the lack of familiarity with the new events, the decision maker updates his assessment by taking into consideration the largest set of probability measures that is consistent with his previous assessment. As a result, newly learned events are initially seen as ambiguous. As evidence accumulates, the ambiguity associated with those events gradually resolves and the assessment made by the decision maker converges to the true conditional probability of those events. Our contribution can thus be summarized by three core features: 1. We provide a model of learning under unawareness that, similarly to Epstein and Schneider [2007], accommodates ambiguous beliefs. 2. We explicitly model the process of inductive reasoning implied by the dynamics of growing awareness described in Karni and Vierø [2013]. 3. Because ambiguity emerges endogenously, we provide a foundation for the unanimity rule preference representation axiomatized in Bewley [2002] and Gilboa, Macheroni, Marinacci, and Schmeidler [2010].



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# Contingent Payment Schemes: Moral Hazard with Agents Concerned about Sure Wages

*Jingyi Meng*

## Abstract

We modify the classical principal-agent model with uncertainty and moral hazard by replacing the Expected Utility preferences of the agent with Chance Theory preferences (Schmidt and Zank, 2013). Chance Theory agents are primarily concerned with the sure wage they can obtain, i.e., the certain component in their contract, as they treat increments in bonuses markedly different to similar changes in sure wages. Similar to the classical predictions, our agents' optimal contracts are contingent payment schemes, however, they differ with respect to the level of the sure wage. We also contrast our predictions to those of the model of (Herweg et al., 2010), who assume agents with loss-averse preferences.



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## Financial Loss Aversion Illusion

Christoph Merkle

### Abstract

Loss aversion has been frequently documented in psychology and economics, with the conclusion that losses loom larger than gains by a magnitude of about two. In finance, loss aversion is suggested to explain, for instance, the equity premium puzzle and stock market participation. In the evaluation of gains and losses, one has to distinguish between anticipated and experienced outcomes. Most experiments on gambles or lotteries focus on the trade-off between anticipated gains and losses. However, this implies that people are able to forecast the hedonic impact of gains and losses. In contrast, recent evidence suggests that people's ability to cope with losses is much better than they predict (Kermer et al., 2006). Using a unique dataset, we test this proposition in the financial domain. In a panel survey with UK investors, participants state their subjective ratings of anticipated and experienced returns. In a time period of frequent losses and gains in investors' portfolios, we examine how the subjective ratings behave relative to expected and experienced portfolio returns. To this end, we define several potential reference points investors might use. Loss aversion is strong for anticipated outcomes. From regressions of subjective ratings on expected returns, we infer a loss aversion coefficient of about 2.2 for a reference point of zero. This means that investors react more than twice as sensitive to negative expected returns as to positive expected returns. However, when evaluating experienced returns, the loss aversion coefficient decreases to about 1.2 and is statistically indistinguishable from one (loss neutrality). Investors do not react more sensitive to losses than to gains when confronted with realized portfolio performance. The loss aversion they show ex ante seems to be a projection bias. As a second property of reference-based utility, we test for diminishing sensitivity with respect to outcomes more distant from the reference point. We indeed find that investors' reaction is strongest for returns close to the reference point. An improvement from 2% to 4% in portfolio return has a greater impact on subjective ratings than moving from 12% to 14%. This is true for expected as well as for experienced outcomes. But while for expected returns the sensitivities in each interval are far greater for losses than for gains, this is not the case for experiences. Our findings have implications for individual investing. While loss aversion can be a legitimate part of people's preferences, the financial loss aversion illusion we document clearly is not. If investors systematically overestimate their personal loss aversion when thinking about financial outcomes, their investment decisions will differ from what is justified by their experience of these outcomes. In particular, they will invest less riskily than they probably should and will avoid potential losses unless they receive a substantial compensation.



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## Effort Provision and Optimal Prize Structure in Contests with Loss-Averse Players

Ayşe Gul Mermer

### Abstract

This paper studies a multiple prize contest with expectation-based loss-averse contestants à la Koszegi and Rabin (2006). The predictions of the model are able to align the empirical evidence observed in recent laboratory experiments on effort provision of contestants. More specifically the model predicts that high-ability contestants overexert effort while low-ability contestants exert very little to no effort in comparison to predictions with standard preferences. Moreover, the optimal prize allocation in contests differs markedly in the presence of expectation-based loss aversion. In particular, multiple prizes can become optimal when the cost-of-effort function is linear or concave, where standard preferences predict the optimality of a single prize in these cases. Several unequal prizes might be optimal when the cost-of-effort function is convex.



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## Higher Order Risk Bias in Risk Aversion Elicitation

*Luc Meunier; Francois Desmoulin-Lebeault*

### Abstract

Recently, Astebro et al (2014) published a paper underlining the impact of skewness on risk aversion. They asked respondents to choose between pairs of lotteries, differing in variance. Lotteries exhibiting larger variance were picked more often when they also displayed more skewness. In another paper, Ebert (2015) showed that respondents showed risk loving over lotteries which displayed positive skewness, even though this skewness was equal for the two lotteries in a pair. Basing himself on Chiu (2010), Ebert further underlines that for binary lotteries most often used to elicit risk aversion, moment preference (over variance and skewness) parallel risk preference (Risk aversion, Prudence). He ends his paper on a call for future research on the classification of risk preference elicitation methods in the literature which could potentially be affected by this finding. Answering his question, we engage in a critical reading of the literature on the methods of risk elicitation. We name “Higher Order Risk Bias” the general impact of higher order risk on elicitation of risk aversion. For the purpose of this paper, we further classify this bias into the “Astebro effect” and the “Ebert effect” in tribute to these seminal authors. The Astebro effect is when two lotteries in a pair differ not only in their variance, but also in their skewness. The Ebert effect is when the level of skewness, equal across the pair, affects nonetheless the elicitation of risk aversion. Based on our review of the literature, the two lotteries methods for which the Astebro effect might be more prevalent are the BRET, “bomb” risk elicitation task (Crosetto and Filippin 2013) and the HL5 task (Teubner et al. 2015). The Astebro effect in these tasks will be particularly prevalent for risk lovers. Risk lovers are generally prudent (Deck and Schlesinger 2014, Ebert and Wiesen 2014). These two papers use a power utility function which cannot account for both risk loving and prudence. On the opposite, the very famous Holt and Laury (2002) task does not suffer from the Astebro effect. However, as skewness across the pairs of lotteries is not constant, some pairs being left skewed whereas other are right skewed, it may be subject to the Ebert effect. The HL5 task of Teubner et al (2015) is also prone to the Ebert effect, for the same reason. We give in this paper general rules to avoid the higher order risk bias. We also emphasize that the higher order risk bias should not be used as the sole reason to discard an elicitation technique, as there might be other biases in an experimental elicitation of risk preferences. We rather intend our paper to call attention on this potential bias, therefore enabling researchers to make informed decisions on the design or choice of the elicitation task appropriate for their needs.



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## Preference for Higher Order Moments and the Principal-agent Dilemma

*Luc Meunier; Francois Desmoulin-Lebeault*

### Abstract

The 2007 financial crisis has highlighted the importance of the impact and management of extreme risks and of the principal-agent dilemma in the investment industry. The fact that the risk and return profile of the agents differs from the one of the principals, and even more so for large risks, has been pointed out as one of the causes of the crisis. To test the importance of preferences about higher order risk and how it is impacted by agency relations, we submitted a questionnaire to a sample of 308 business school students. In it we tested for investment preferences over the first four moments of the distribution of returns in a principal-agent framework. Respondents acted successively as principals and agents, the order of such tasks being randomized. We find evidence of standard deviation aversion, skewness seeking and kurtosis seeking when investing for self. The overall kurtosis seeking of our sample as a whole is mainly driven by standard deviation lovers, standard deviation averse respondents being neutral toward kurtosis on average. These results are similar to the ones obtained by Deck and Schlesinger (2010), and corroborate their 2014 classification of mixed risk aversion. We find that preferences when investing for a firm are not significantly different at an aggregate level. However, there is a significant impact of financial literacy on preferences for standard deviation. Financially illiterate respondents were more likely to take risks when investing for their firm. We also find a marginally significant effect of gender on skewness preferences when investing for the firm, males tending to become more skewness seeking when investing for their firm whereas the opposite holds true for female. This marginal change in preference for skewness is an interesting addition to the body of knowledge on risk preference differences between male and female. Indeed, we are the first to test for such a gender based difference in higher order risk preferences (see Croson and Gneezy 2009 for a literature review on risk aversion, where a consensus is still to be reached). The change in preference for standard deviation has two implications. First, it helps explain the heterogeneity of results observed in the literature concerning risk aversion under responsibility. The fact that respondents are sometimes more risk averse (Reynolds et al 2011 or Charness and Jackson 2009) and sometimes less risk averse (Chakravarty et al 2011 or Pollmann et al 2014) when investing for others could be explained by different levels of financial literacy. Secondly, this can be connected to the 2007 financial crisis. Before the subprime crisis, the securitization process created opacity. This opacity probably lead to a lower level of relative financial literacy given the complex financial products created. In turn, this could explain why a higher level of risk taking was then observed.



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# Ellsberg Meets Allais: An Experimental Study of Ambiguity Attitudes

Bin Miao; Songfa Zhong

## Abstract

**BACKGROUND.** Ambiguity attitude along with the Ellsberg paradox have widely studied in both theoretical and experimental literature. Recently, extending Ellsberg paradox, Machina (2011; 2014) provides some thought experiments to consider situations where there are three or more possible outcomes. His examples suggest that people exhibit Allais-type behavior in the domain of ambiguity. This study aims to provide a systematic examination of Allais-type behavior under ambiguity in an experimental setting. **EXPERIMENT & RESULTS.** Our experiment consists of two treatments. Treatment 1 concerns two urns each containing 90 balls that are red, black or white. Urn 1 contains  $n$  red balls, for the rest of  $90-n$  balls, half of them are black and the other half white. Urn 2 contains  $n$  red balls,  $90-n$  balls that are either black or white with the exact composition unknown. Subjects are asked to choose which urn to place a bet on. For example, when  $n=80$ , subjects are asked to choose between Bet 1 and Bet 2 as follows. **BET 1:** Draw a ball from Urn 1 containing 80 red balls, 5 black balls and 5 white balls, and get paid  $\$x$  if the ball is red,  $\$50$  if it is black and 0 if it is white. **BET 2:** Draw a ball from Urn 2 containing 80 red balls, 10 black and white balls, and get paid  $\$x$  if the ball is red,  $\$50$  if it is black and 0 if it is white. In the experiment, we find significant proportion of subjects exhibiting a switch from Bet 1 to Bet 2 as  $x$  decreases from 50 to 0. Treatment 2 concerns one envelop with 100 tickets, each ticket numbered from 1 to 100, while the exact composition of the numbers is unknown. Subjects bet on the number on one ticket drawn from the envelope, and they can choose different sets of numbers to place different stakes on. For example, they can choose  $n$  different numbers to bet for  $\$x$  and another  $m$  different numbers to bet for  $\$y$ , while they receive nothing if the drawn number matches the rest of  $100-n-m$  numbers. In a representative choice problem, subjects are asked to choose between the following two bets. **BET 3:** 20 numbers for  $\$x$ , 10 numbers for  $\$25$ , and 70 numbers for 0. **BET 4:** 20 numbers for  $\$x$ , 5 numbers for  $\$50$ , and 75 numbers for 0. Similarly, we find significant proportion of subjects switching from Bet 4 to Bet 3 when  $x$  changes from 55 to 50. **IMPLICATION.** In treatment 1, choosing Bet 1 over Bet 2 at  $x=50$  and reversing the choice at  $x=0$  violates the independence property. As the state (red) with varying outcomes has known probabilities, such a reversal is incompatible with both subjective expected utility and maxmin expected utility. For treatment 2, choosing Bet 3 over Bet 4 at  $x=50$  and reversing the choice at  $x=55$  violates a weaker version of independence property named commonotonic independence. Thus, such a reversal is incompatible with subjective expected utility, Choquet expected utility and recursive rank-dependent utility.



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# The Complicity Game

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## Abstract

Complicity plays a part in many social and economic malpractices. Public and private institutions can unintentionally foster the conditions that could develop into a harmful "favour exchanging" culture among colleagues. For instance, corporations often use peer assessment to evaluate their employees' performance. Public sector bodies, like the police or the military, often require their personnel to perform their duties in dyads or small groups. Similar practices, which facilitate loyalties and reciprocal relations among colleagues, can provide employees the opportunity to help each other not only in the interest of the greater good, but also on immoral grounds. For example, the employers of a corporation can inflate their colleagues' performance in the anticipation that their own performance will also be inflated by others, or, policemen in patrols can turn a blind eye to partner's power abuse if they expect their 'silence' to be reciprocated. In this paper we use a novel laboratory experiment to study whether one's willingness to lie is sensitive to the presence of a potential accomplice. We use a baseline experiment (the Complicity game) and compare it with three treatments in which we control for the various motives that could affect one's willingness to engage in complicit actions (selfishness, altruism, shame and guilt). In the Complicity Game a die rolling task is combined with a coordination game with multiple Nash equilibria. Subjects are paired and asked to privately roll a die and report the outcome of their roll. The outcome they report determines their co-player's payoff. If both players of the group report 5, each gets an additional bonus of £1 and if both report 6, each gets a bonus of £2. In a first treatment, the group is formed by a die roller and a passive player. The die roller's report determines the payoff of the passive player while her payoff is determined by a draw from a probability distribution formed by the subjects playing the C.G. In a second treatment, subjects are no longer in a group but roll the die and report as single players. In a control treatment, the die-rolling task is removed so the game becomes one of coordination alone. We find i) that players lie significantly more when they have potential accomplice who can reciprocate their action (complicity effect), and ii) that players lie significantly less when a potential accomplice becomes a passive player, as compared to the *ceteris paribus* context where players act singly (audience effect).



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## Risk Taking in Groups: One Woman Is not Enough

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### Abstract

Risk taking behavior of individuals has been shown to be influenced by personal characteristics, such as gender or age, and by the decision context "for example whether a decision is taken individually or within a group. In particular, gender differences in risk taking on the individual level have been intensively discussed in the economics literature. The predominant finding is that women are more risk averse than men (e.g. Charness and Gneezy, 2012). In contrast to individual decisions, relatively little evidence exists on how the groups' gender composition influences its risk taking. This is striking as many important economic decisions are made by groups of individuals, and with the introduction of women quotas in many European countries it has been widely discussed in the public. Only a small body of literature exists related to group decisions. One strand of the literature investigates risk taking in experimental settings with mixed results on whether groups tend to take less risk (e.g. Masclet et al., 2009; Baker et al. 2008) or more risk than individuals (e.g. Sutter, 2007; Nieboer 2015). In relation to the groups' gender composition, there are some empirical studies with firm data which find evidence for better performance of mixed-gender teams, possibly related to less risk taking (Bansak et al., 2011) but not necessarily (Adams and Raganathan, 2015). There are also some field experiments which find that mixed teams perform better in business games (Apesteguia et al., 2012; Hoogendorn et al., 2013). Whether differences in risk taking in mixed or single-sex groups are the factor driving the results remains unclear. This study contributes to the literature by analyzing how the gender composition influences a groups' risk taking. We conducted an incentivized experiment in which groups of 3 subjects had to make a risky decision. We find that on average risk taking of groups increases with the number of male participants, which is in line with Nieboer (2015). Purely male groups take significantly more risk than purely female groups and mixed gender groups lies in between. Furthermore, we find that purely female and female dominated groups take less risk than the average individual decision, while purely male and male dominated groups take more risk than they would on average individually. This stands in contrast to the findings of Sutter (2007) and Nieboer (2015), who report that groups take higher risks than individuals independent of their gender composition, but supports the group polarization phenomenon (Myers and Lamm, 1976). In our sample having one woman in an otherwise male group will not significantly change risk taking of that group. Our results therefore point into the direction that if a women's quota is implemented, a 30% quota, as for example implemented in Germany in 2015 for the DAX companies, might not be enough to significantly induce a change in decisions under risk.



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## Signalling Empathy in the Healer Patient Relationship

*Disha Mitra*

### Abstract

Asymmetric information in the market for physicians is a major concern in developing economies facing unregulated healthcare sectors. Patients may not know if they are being treated by doctors or quacks. Often all they can do is trust their provider. This paper aims to examine the effect of healers sending and competing on psychological signals. A signalling model is developed where doctors and quacks send signals of reputation for empathy which can be publicly observed. Patients observe the signals and make inferences on healer quality. It is found that under an empathy signal, doctors have to over invest in psychological signals to compete with quacks thus shifting the focus away from medical treatment. Further, in some cases some quacks and doctors are indistinguishable to patients. Intuitively, empathy is thought of as a good thing, however this study shows that competing in empathy might not be. A signalling model of empathy is problematic because it may not help quacks to shade their true quality with empathy. The conclusions stress the need for regulatory reform in healthcare markets in developing economies. This piece also stresses the importance of patient psychology when judgements about healer quality are involved. It suggests that in order to improve health outcomes for those in poverty, it is not sufficient to simply provide access to healthcare and health literacy. Rather, it is also crucial to provide reliable institutions which provide accurate data on healer quality, that patients can trust.



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## Heterogeneity in Preferences for Skewness

*Peter Moffatt; Morten Lau; Daniel Maller; Lionel Page*

### Abstract

We analyse data from a risky choice experiment with 80 subjects each solving 60 binary choice problems. The lotteries were presented to subjects graphically, in the form of the probability distribution of outcomes. The lotteries vary in expected outcome, variance of outcome, and skewness of outcome. The choice data is modelled within the framework of the mean variance utility function, extended to include a skewness term. Such an approach allows estimation of risk aversion and also preference for skewness (a priori we expect agents to be skewness-loving). Our model assumes between-subject heterogeneity in both risk aversion and skewness preference, and moreover allows non-zero correlation between these two preference parameters. Estimation is performed using the Method of Maximum Simulated Likelihood (MSL), with Halton draws used for simulation. Non-nested testing procedures are used to compare the performance of the model with skewness to more mainstream models that assume probability weighting. Preliminary estimation of a homogeneous model indicates that allowance for skewness preference does not add much statistically over models that allow for probability weighting. However, of greater interest is which type of model performs better when between-subject heterogeneity is assumed.



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## Compromise and Attraction Effects in Bargaining

*Maria Montero; Fabio Galeotti; Anders Poulsen*

### Abstract

We report experimental data from bargaining situations where bargainers can make proposals as often and whenever they want, and can communicate via chat. We vary the set of feasible contracts in order to investigate the possible presence of compromise and attraction effects. Specifically, we compare situations with only two possible contracts and situations where a third contract is added. The third contract may have the effect of making one of the two original contracts appear as a compromise between two extreme options; alternatively, it may be Pareto dominated by one of the two original contracts but not by the other. If occupying an intermediate position in the contract set significantly increases the frequency of agreements on a contract, we observe a compromise effect; likewise, if adding a dominated contract significantly increases the frequency of agreements on the contract that dominates it, we observe an attraction effect. Both effects are instances of violations of the independence of irrelevant alternatives axiom. Our main findings are the following. First, if there is a contract that is both equal and maximizes total earnings, nearly all agreements are on this contract. Making the other (unequal) contract a compromise has no effect. Second, if one of the contracts is equal and the other maximizes total earnings, making the unequal contract a compromise increases its frequency. Third, there is a clear difference between contract sets that contain an equal contract and contract sets that contain only an approximately equal contract. The approximately equal contract is chosen significantly less often than the perfectly equal contract. Since it is not chosen as often to begin with, there is more room for the frequency of this contract to increase when it is a compromise, and this is observed in our data. Finally, we observe attraction effects but they are not as robust as the compromise effects. The stronger attraction effects we observe occur when there are no equal contracts available (including the dominated ones).



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## (Emotional) Reference Point Formation

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### Abstract

Investors code financial outcomes as gains or losses relative to a reference point (Kahneman and Tversky 1979; Shefrin & Statman 1985). Existing research shows that the reference point is set and updated based on the information that is integral, i.e., directly related, to the decision-making task, such as previous stock prices or expectations of future prices (Baucells et al. 2011; Shefrin and Statman 1985; Weber and Camerer 1998; Barberis and Xiong 2009; Odean 1998; Grinblatt and Keloharju 2001; Arkes et al. 2008). The purpose of our research is to examine whether incidental information that arises from situational sources unrelated to the decision-making task, and specifically incidental emotions (Lerner et al. 2015; Rick and Loewenstein 2008), affect reference point formation. More specifically, we here propose and test an emotional-attentional mechanism as a driver of reference point formation in the context of investor decision making.

To test this mechanism, we conduct an eye-tracking experiment consisting of two seemingly unrelated tasks. First, we induce incidental emotions by exposing participants to an emotional video (either fearful, joyful, or neutral; Lee and Andrade 2011) and ask them a set of questions related to the video. Next, we ask them to perform a “stock-market task”. More specifically, building on the reference point elicitation method from Baucells et al. (2011) and Arkes et al. (2008), we show participants a set of stock charts and ask them to state their neutral selling price for each stock. Our stock charts contain clearly identifiable regions of the initial (i.e., purchase), highest, lowest, and current stock prices. We use eye-tracking to measure how much attention participants allocate to each of the four price regions on stock charts as they form their reference points, indicate their likelihood to sell stocks, and predict future stock prices. Finally, using a multilevel modeling approach, we model the relationship between emotions, attention, and reference point formation.

We report several important findings. First, we find that situational factors, and specifically incidental emotions, shift the reference point: while joy shifts the reference point up, fear shifts the reference point down. Second, using eye-tracking, we find that incidental emotions influence how investors look at financial information. When looking at the stock charts, those exposed to joyful emotions look more at historic highs and less at the current price, while those exposed to fearful emotions look more at the current price and less at the purchase price. Third, we use the behavioral and eye-tracking data to model the underlying process and show that this differing attention to various stock prices mediates the effect of emotions on the reference point formation.



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# Strategies in Public Goods and Binary Games with Novel Incentive Structures

*Timothy Mullett; Rebecca McDonald; Gordon DA Brown*

## Abstract

Strategies in public goods games vary between individuals, but the most common approach when making a strategy for contributions is “conditional cooperation”. This is when an individual says they will match the average contribution of the other player(s), or shows a broadly monotonic relationship between the contributions of the other player(s) and their own planned contributions. This behaviour is widespread, despite the Nash equilibria in a linear public goods game being to contribute zero. Explanations include other regarding preferences, desires for payout fairness, or simply matching the contributions of other players to avoid difficult computation or being the “sucker”. The traditional public goods game cannot differentiate these competing hypotheses because the predicted behaviours are similar. Further, individuals who are payoff-maximising cannot be distinguished from those who are irrationally selfish, i.e. use a simple strategy of constant non-investment. We present a novel implementation of the public goods game that uses a variety of incentive structures. One is the traditional design with a linear relationship between the total amount in the “public pot” and the total amount paid back to players. The other two structures use non-linear functions to determine the total amount paid back. One has a convex shape, such that that the profit maximising strategy is to contribute all points if the other players are also contributing theirs, but to contribute zero otherwise. The other structure has a concave shape, such that the profit maximising strategy is to donate a small number of points (5) if other players are donating nothing, but to donate nothing if other players are contributing 5 or more. Crucially, the strategic characteristics associated with these three incentive structures match those of well-known binary dilemmas: prisoner’s dilemma, stag hunt, and hawk-dove. We show that these binary dilemmas are incentive equivalent to their analogous public goods game when the potential contribution levels in the public goods games are restricted to be equivalent to the “defect” and “cooperate” options in the binary dilemmas. Subjects completed fully incentivised versions of both tasks, under all three incentive structures. The results show that contributions are sensitive to the public goods incentive structure, including those subjects classified as “conditional co-operators”. The new structures also show that “free-riders” can be categorised as either “profit maximisers” or “non-investors”. Crucially, we show that although there is a significant correlation between the likelihood of an individual cooperating in each task, this appears to be indicative of an overall “pro-sociality” trait because there is no evidence of individuals employing incentive-structure-specific strategies. Despite a correlation between tasks, we still find that a large minority of subjects display full preference reversal between the two incentive equivalent task.



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# Local Prior Expected Utility: a Basis for Utility Representations under Uncertainty

*Christian Nauerz; Andreas Perea*

## Abstract

One way of avoiding the Ellsberg paradox is to relax the Independence Axiom of Anscombe et al. (1963) (AA). This approach yielded two of the most well-known models of ambiguity: Schmeidler's (1989) Choquet Expected Utility (CEU), and Gilboa and Schmeidler's (1989) Maximin Expected Utility (MEU). Under both approaches the decision maker acts as if he maximizes utility with respect to a set of priors. In this paper we identify necessary assumptions on the preference relation to obtain a representation under which the decision maker maximizes utility with respect to a set of priors, called Local Prior Expected Utility (LEU). Moreover, we show that the prior used to evaluate a certain act is equal to the gradient of some appropriately defined utility mapping. We argue that the equality is not a mere technicality but coherent with the qualitative interpretation of a probabilistic belief. Based on this result we provide a unified approach to MEU, CEU, and AA and characterize the respective sets of priors. A preference relation on acts that satisfies the standard axioms Weak Order, Monotonicity, Continuity, Risk Independence, and Non-Degeneracy can be represented by a functional  $D$  that maps vectors of statewise utilities to "overall" utilities. We show that Monotonicity of  $D$  guarantees the existence of its Gâteaux derivative almost everywhere relying on a deep mathematical theorem by Chabrilac et al. (1987). Using only the Gâteaux derivative of  $D$  as an analytical tool, we prove characterization results corresponding to LEU, CEU, MEU, and AA. Within our approach we clearly identify the structure of the set of priors needed in these environments. As a basis for our approach, we identify an axiom called Independence of Certainty Equivalents that is weaker than Gilboa and Schmeidler's (1989) C-Independence and weaker than Schmeidler's (1989) Comonotonic Independence, but together with Weak Order, Monotonicity, Continuity, Risk Independence, Non-Degeneracy, and Uncertainty Aversion induces the same restrictions on the preference relation on acts as the Gilboa-Schmeidler axioms. We then show that without assuming Uncertainty Aversion we can represent a decision maker's preferences by taking expectations of an affine utility function  $u$  with respect to a (possibly) different prior for every act, which we call LEU. The prior used is equal to the gradient of  $D$  at the vector of utilities induced by the act if the Gâteaux derivative exists. Moreover, we show that relaxing the Independence Axiom further by requiring invariance with respect to translations but not invariance to rescaling still results in a prior representation, where the gradient is taken at a possibly different location. In case the Gâteaux derivative does not exist at a particular vector, we can approximate it by the Gâteaux derivatives of nearby acts.



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# Uncertainty Regulation Theory: How the Feeling of Uncertainty Shapes Decision Making

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## Abstract

We present a theory of decision-making behavior based on the idea that when people find themselves in a situation in which they have to make a choice, they experience to some degree a feeling of uncertainty. Regulating that feeling is proposed to be a fundamental motivation in decision-making processes. We show how such an uncertainty-regulation account can explain and unify a large number of well-known decision-making phenomena that have been given diverse explanations, such as risk aversion, temporal discounting, loss aversion, ambiguity aversion, or social-influence effects. Our theory does also make unique predictions about how those phenomena are affected by the feeling of uncertainty experienced by people in decision situations. Those predictions provide guidelines to modifying decision-making patterns (sharpening or mitigating them) by influencing feelings of uncertainty. Such guidelines can have direct applications in a variety of environments in which people make choices, such as household decisions, consumer decisions, decisions made in organizations, etc. In particular, according to our theory, making consumers or members of an organization feel more uncertain when they are in situations in which they have to decide is likely to result in more risk aversion, more present-biased choices, more loss aversion, and being more influenced by other people. On the other hand, making them feel less uncertain is likely to mitigate those patterns. We also present three experiments that test some of the main ideas behind our theory and demonstrate that feelings of uncertainty do indeed play a significant role in decision-making processes. The first experiment shows that the potential to generate feelings of uncertainty of the available alternatives, and also people's sensitivity to that uncertainty, predict decision behavior in line with the theory. The other two experiments demonstrate that manipulating the feeling of uncertainty experienced by people significantly affects their decisions as predicted. The experiments touch on a variety of areas of decision making, which also demonstrates that feelings of uncertainty are a relevant explanatory factor across different types of choices. Overall, the theory and evidence presented here suggest that behind a number of the multiple decision-making phenomena and biases uncovered in the last decades may lie a fundamental human drive: the desire to avoid feeling uncertain. Our work provides a foundation to analyze decision making from that point of view.



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# Gender Roles and Bargaining Behaviour: A Laboratory Experiment in Bangladesh

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## Abstract

A vast majority of literature provides evidence of gender differences in bargaining behaviour. One possible explanation of such behaviour is Social Role Theory (SRT) which suggests that men and women behave differently in social situations and take different roles due to expectations that society puts upon them, that almost all behavioural differences are the result of stereotypes. The aim of the study is to examine (i) if there are gender difference in a bargaining behaviour and (ii) if these differences can be explained by SRT in a society where perceptions of gender roles are strongly formed.

I use a two person ultimatum game to observe bargaining behaviour among 222 university students in a laboratory experiment in Bangladesh. Subjects are randomly assigned to a control or treatment session where in the latter subjects read a small vignette about how preferences of individuals are heterogeneous and depends on a number of factors including gender. The purpose of the vignette is to prime for gender differences in behaviour. The main hypothesis is that if perceptions of gender roles are inherent and already in place, there should not be any significant difference between subjects in control and treatment setting.

The main finding is that in the session where subjects were primed, both men and women Responders ask for a higher MAO when they are partnered with a female, after controlling for personality traits, intelligence and risk preferences. Regardless of their gender, the prime influences behaviour of both men and women in a similar manner and overpowers their initial perception (if any) about gender roles. Also, consistent with the literature, I find no significant difference in the Proposer behaviour.

I conclude that there is no gender bias per se. Only when subjects are nudged or provided with additional information, they update their belief about the other persons behaviour and mostly this information or signal comes from the society. So, the findings are consistent with Social Role Theory.



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## Weighing Experts, Weighing Sources: The Diversity Value

*Klaus Nehring; Ani Guerdjikova*

### Abstract

A decision maker has to come up with a probability, preference or other judgment based on the judgments of a number of different information sources. To do so, he needs to assign weights to each source reflecting their assessed reliability. We argue that, crucially, reliability is to be understood as an attribute of sets of sources, not of sources in isolation. Specifically, we propose to view reliability as "valued diversity", reflecting both individual source quality and similarity among sources. Intuitively, larger weight should be assigned to sources of greater quality and greater dissimilarity from the others. The main contribution of this paper is to propose and axiomatize a particular weighting rule, the Diversity Value, that captures these desiderata. The Diversity Value is defined by a logarithmic scoring criterion and can be characterized as a weighted Shapley value, in which source weights are determined endogenously. Due to the central role of source similarity, the Diversity Value frequently violates Reinforcement and exhibits the No-Show Paradox.



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# Freedom, Power, and Interference

*Claudia Neri; Hendrik Rommeswinkel*

## Abstract

Freedom and power are pervasive components in any social, political, and economic interaction. Individuals interact by making decisions, affecting themselves to the extent that they have the freedom to do so, and affecting others to the extent that they have the power to do so. Thus, freedom and power are fundamentally related to the exercise of decision rights. Economics, which has traditionally considered decision rights solely for their instrumental value in achieving outcomes, has recently moved to consider decision rights also for their intrinsic value, i.e., the value beyond the expected utility associated with them. In this paper, we propose a behavioral theory of preference for decision rights, driven by preference for freedom, power, and non-interference, and we conduct a novel laboratory experiment in which the effect of each preference is distinguished. We employ the following terminology. An individual experiences freedom when his preferences over the possible outcomes influence the outcomes he achieves. An individual experiences power when his preferences influence another individual's outcomes. An individual does not experience interference when his outcomes are not influenced by another individual's preferences. Each concept captures the causal dependence of an individuals' preferences on an individuals' outcomes. In our behavioral theory, individuals have not only preferences over outcomes, which lead them to value decision rights instrumentally, but also preference for freedom, power, and non-interference, which lead them to value decision rights intrinsically. Evidence from our experiment confirms the existence of an intrinsic value of decision rights, as reported by the existing literature. Most importantly, our theoretical framework and experimental design allow to disentangle the factors generating the intrinsic value of decision rights. We highlight two main findings. First, we find no evidence of preference for power. This result suggests that preference for power, as casually observed in politics or other institutional settings, may simply be instrumental to other components of well-being, such as status recognition. Second, we find stronger evidence of preference for non-interference than of preference for freedom. This result suggests that individuals value decision rights neither because they enjoy the freedom of making a choice, nor because they enjoy having power over other individuals, but rather because they dislike letting other individuals interfere in their outcomes. Our framework and findings lead to a fundamental change in perspective on preference for decision rights. Individuals like to have decision rights in virtue of the absence of the decision rights of other individuals.



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## It Will Be Worth It, in the End

*Philip Newall*

### Abstract

We embark on ventures, investments, or other projects with the common-sense saying: it will be worth it, in the end! Anticipated outcomes are evaluated against inputs. A required rate of return, or more general rate of time preference,  $r$ , assesses the worth of anticipated future outcomes. Comparing anticipated future outcomes against inputs with a rate of time preference is formally consistent with the discounted utility model (Samuelson, 1937), but notice that the rate of time preference need never discount anticipated future outcomes to equivalent present values. "Discounted utility" conceals the flexibility of the economic logic. A rational actor need never discount for finite time horizons. A voluminous literature shows that intertemporal choice behavior cannot be unanimously described between-experiments or even within-individuals by a single "discount rate," as the rate of time preference is usually called (Frederick, Loewenstein, & O'donoghue, 2002). Numerous modeling attempts have sought to provide better descriptions of intertemporal choice behavior by modifying the parameters of the discounted utility model (Doyle, 2013). Perhaps best-known is the quasi-hyperbolic discounting model, used to describe present-biased behavior (Laibson, 1997). Although discounting models can be fitted to describe choices in an intertemporal choice task, this approach is yet to provide a unifying description of intertemporal choice behavior. (Dohmen, Falk, Huffman, & Sunde, 2012) elicited choices from 2,003 participants in three commonly-used intertemporal choice tasks. They found that, "Overall, about 65 percent of individuals are inconsistent with all discounting types." p.21. Imposing a discounting framework on descriptive theories of intertemporal choice has so far failed. Reframing our intertemporal choice models is suggested as a way of moving forward, of describing most people's intertemporal choices. People make intertemporal choices on the basis of anticipated future outcomes, and can achieve normatively appropriate results if they do so consistently. Discounted present values need never enter the equation. Of course many people do not achieve normative results, so we should model the psychological processes that undermine accurate predictions of the future.



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# Rank-Dependent Integration of Probability and Value in Evaluations of Risky Prospects

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## Abstract

The study of decision making under risk in the social sciences has been dominated by the idea that people weight the values of the decision outcomes (or a function of these values) by their probabilities (or a function of these probabilities) using multiplicative integration (an idea implemented in models such as Expected utility and Cumulative prospect theory). The goal of the present paper is to explore this assumption of multiplicative integration of value and probability. We conducted three experiments where respondents revealed their cash equivalent to a number of monetary gambles with one (Experiment 1) or two (Experiments 2-3) non-zero outcomes (cash equivalents were revealed using the method introduced by Tversky and Kahneman, 1992). All respondents were U.S.-residents, recruited through the crowdsourcing-service CrowdFlower.com and compensated by an average wage (20, 60 and 40 respondents participated in Experiment 1, 2, and 3, respectively). The data was analyzed using functional measurement, a statistical tool especially developed for exploring information integration mode. The experiments produced two key findings. (i) Principally all respondents relied on multiplicative integration of value and probability when evaluating gambles with one non-zero outcome. (ii) Though a non-negligible minority of respondents (30%) relied on systematic multiplicative integration of values and probabilities also in the evaluation of gambles with two non-zero outcomes, the majority of respondents (70%) relied on a strategy we term rank-dependent integration (RDI). RDI involves treating one outcome as focal, to initially apply multiplicative integration of probability and value for the focal outcome and subsequently take the properties of other outcomes into account by additive adjustments. Thus, RDI implements an anchoring and adjustment strategy where the judge evaluates a monetary gamble by first anchoring on the product of the value and probability of the focal outcome, and then adjusting additively for all other quantitative properties. The results from the present paper are important in at least four ways. First, they provide a psychologically plausible reconciliation of the observations that people often compute functional equivalents of mathematical expectations when evaluating simple prospects, with well-known demonstrations of biases in complex decision problems. Second, they are consistent with the large body of research on other forms of information integration, showing that people often rely on linear additive integration of externally provided quantities. Third, they highlight the importance of making basic psychological processes the focal dimensions in the study of decision making under risk. Fourth, and most importantly, they define a completely new family of models for how risky prospects are evaluated. The discussion focuses on how RDI can lead to a number of well-known, and well-documented, JDM phenomena.



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## Asymmetric Attention to Opportunity Costs Hinders Generosity

*Christopher Olivola; John Han*

### Abstract

Altruistic decisions are often thought to result from a salient internal conflict between self-serving and other-regarding motives. We show that such decisions are also governed by default “attentional” factors that operate independently of any internal motivational conflicts. In our studies, participants make a series of choices between receiving money themselves (e.g., “Option A: You receive \$4.30”) versus having a larger sum of money go to another party (e.g., “Option B: A homeless person receives \$7.50”), and we measure their overall generosity (how frequently they select the option that benefits the other party). We show that adding an “other-nothing” wording to the selfish option which highlights the fact that choosing to receive the money entails a forgone gain for the other party (e.g., “Option A: You receive \$4.30 and a homeless person receives nothing”) increases generosity. Critically, however, this effect is not symmetric: adding a “self-nothing” wording to the altruistic option which highlights the fact that being generous entails a forgone gain for self (e.g., “Option B: You receive nothing and a homeless person receives \$7.50”) does not decrease (nor increase) generosity. In other words, we demonstrate an asymmetric effect of highlighting forgone gains for self vs. other(s), such that subtle reminders of others’ forgone payoffs increase generosity, whereas equivalent reminders of one’s own forgone payoffs have no effect. We argue, and empirically show, that this asymmetric effect occurs because people are naturally attentive to their own (forgone) gains, but less so to others’ (forgone) gains. Consequently, reminding them of their potential forgone gains has no effect (since these considerations are already highly salient to them), whereas reminding them of others’ potential forgone gains increases generosity by increasing the (otherwise limited) attention given to other people’s needs. We demonstrate this “other-nothing” effect across a variety of contexts, formats, and payoff sizes. We also test the hypothesis that it operates by counterbalancing people’s natural asymmetric attention to their own (over others’) payoffs. For example, we show that the “other-nothing” wording decreases satisfaction with the selfish outcome to a greater extent than the “self-nothing” wording decreases satisfaction with the altruistic outcome. We also provide process evidence that the effect operates by “putting a break” on the default tendency to focus on one’s own outcomes. Finally, we repeatedly rule out experimenter demand as a driver of the effect. In sum, these studies provide converging evidence for a subtle, but consequential, default asymmetry in how people attend to their own vs. others’ outcomes, and they highlight a novel semantic “nudge” that increases generosity by counteracting this tendency. We conclude by discussing the implications of our results for ongoing debates about whether altruism is intuitive vs. reflective.



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## Dynamic Portfolio Choice in a Non-Expected Utility Framework

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### Abstract

This paper considers the dynamic optimal portfolio choice problem, in a discrete-time and non-expected utility setting. Standard portfolio choice models often assume that preferences are represented by a von Neuman-Morgenstern utility function and individuals choose prospects so as to maximise the expectation of the utility of possible outcomes. Although the expected utility model has long been the standard for choice under risk and uncertainty, questions have been raised concerning its validity. Behaviour patterns which are inconsistent with expected utility theory have often been observed as in Allais (1953) and Kahneman and Tversky (1979). Numerous alternatives to the expected utility model have been developed in static settings, which incorporate a non-linear treatment of probabilities. In dynamic settings, this raises the question of how such treatment of probabilities develops over time. In this paper, the optimal portfolio choice is derived for an investor who behaves according to Rank Dependent Utility Theory for all the time periods concerned. A model featuring a distinction between risk and time preferences is adopted, where intertemporal rate of substitution is captured by a general discounting function independent of probabilities and outcomes, utility of outcomes is captured by standard vNM utility independent of time, and a two-parameter probability weighting function, namely the constant relative sensitivity (CRS) probability weighting function proposed by Abdellaoui, L'Haridon and Zank (2010), captures intertemporal probabilistic risk attitudes, with one parameter being constant over time, the other being time-dependent. An index of optimism is derived that depends on both parameters, which allows to model the observed high risk tolerance for delayed prospects. The possibility of diversification depends on such index.



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# Miscalibration of Probability Intervals for Events Involving Aleatory and Epistemic Uncertainties

Saemi Park; David Budescu

## Abstract

When judges are asked to estimate probability intervals (PIs) of unknown quantities, they often do not adjust their estimates to match the prescribed probability levels. Typically the 90% subjective PIs are too narrow. This has been interpreted as evidence of over-confidence, but recent research has shown that 50% and 90% PIs are indistinguishable, and concluded that these PIs are not a proper way to diagnose over- or under- confidence. Most studies employed items involving epistemic (internal) uncertainty that reflects incomplete and imperfect knowledge of the judges, and asked for only one PI for every item. Budescu and Du (2007) asked for multiple PIs from every judge, and found better calibration. Teigen & Jorgenson (2005) predicted that judges would be better calibrated when generating intervals that evoke aleatory (external) uncertainty. We examine if the (in)sensitivity to the target confidence level (90% or 50%) varies across the two types of uncertainty (aleatory and epistemic), and whether elicitation procedures that requires multiple judgments are superior to one-shot elicitations. Participants were randomly assigned to aleatory or epistemic uncertainty conditions and were presented with yoked items. For example, in the aleatory condition judges generated 50% or 90% PIs for life expectancy across all 193 countries in the UN, and in the aleatory condition they judged PIs for the life expectancy in Brazil (the median value in this distribution). Judges provided two PIs for 20 different items: In the experimental conditions they judged 90% and 50% PIs and in the control conditions they judged 90% or 50% PIs twice. In each case they estimated, the upper and lower bounds as well as a best estimate of the target quantity. The intervals were evaluated in terms of their hit, or coverage, rate and their width and location. The analysis of the first period PIs, confirmed the judges' insensitivity to the target confidence (hit rates are 86% for 90% PIs and 82 for 50% PIs in the epistemic uncertainty and coverage rates are 76% and 73% in the aleatory uncertainty), so external uncertainty does not make judges more sensitive to the desired probability level. Results from the joint analysis of the two periods mimic the case where judges are asked to provide multiple fractiles from which one can infer simultaneously several PIs (Alpert & Raiffa, 1982). In the presence of aleatory uncertainty, judges differentiate between 90% and 50% PIs (the coverage rate of 90% is higher than the 50%) compared to the control conditions. In the epistemic uncertainty, we also find that the 90% PIs are wider and have higher hit rates than their 50% counterparts. Finally, we find that the (90% and 50%) PIs are wider under aleatory uncertainty than under epistemic. We recommend avoiding single-shot estimates and relying, instead, on multiple estimates to obtain better calibrated intervals and allow valid inferences regarding the judges' calibration.



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## Trading Off Luck and Effort

*Carmen Pasca; John Hey*

### Abstract

This research is a significant development of a line of research which will soon see the light of day in Bone et al. The central theme of this line is discovering preferences directly rather than indirectly. In Bone et al we examined a two-dimensional problem where both luck and effort influenced incomes, and elicited opinions about the fairness principles espoused in Fleurbaey (2008) concerning the appropriate distribution of social dividends. There we gave subjects a stark choice between Equal Payments and Equal Dividends. The results were mixed, and we concluded that this was a consequence of this stark choice. For example, considering the case where two individuals both provided the same effort, but one had good luck while the other had bad luck, and hence the first received a larger income, we gave subjects the choice between either of eliminating none of the difference in incomes, or of eliminating all of the difference through the use of social dividends. In this new batch of experiments, reported on in this paper, we allowed subjects to eliminate some part of the difference for three of the four cases: Bad Luck, Good Luck, No Effort and Effort. Indeed this is the question that we asked subjects: to choose three of the four cases (and hence indicate which of the four is least important to them) and indicate what proportion of the difference they wanted to eliminate. This indicates the subjects' trade-offs over luck and effort. We note that this helps us understand the subjects' social preferences in a general sense rather than in a specific context. This is the feature that marks our earlier research and distinguishes our research from that of others.



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# Consistency in Choices from Linear Budget Sets: Reconciling Contradicting Experimental Evidence

*Dotan Persitz; Dino Levy*

## Abstract

Three types of methodologies are used in laboratory experiments to provide individual level data on choices from linear budget sets in settings that invoke preferences over goods, risk preferences or other-regarding preferences. In the Verbal methodology subjects are asked to complete a sentence that describes their preferred bundle. The Graphical methodology requires subjects to choose their preferred bundle from a budget line that is visually presented and describes the set of feasible alternatives. The Discrete methodology (which is not in the focus of this work) asks the subjects to choose from a set of images that represent the available bundles. The data provided by studies that use these methodologies is similar. For every subject, each observation includes a description of the budget set and a chosen bundle. Since these methods study a similar question and produce similar data it is reasonable to expect that they would also provide similar conclusions regarding individual choice behavior. However, the percentage of subjects that satisfy GARP when the verbal methodology is implemented is significantly higher than when the graphical methodology is used. In addition, the inconsistency measure is much closer to consistency when using the verbal methodology compared to the graphical methodology. We find this discrepancy puzzling and this work is an attempt to reconcile these results. We suggest three aspects for the differences between the methodologies. First, each methodology might frame subjects differently. The other two aspects are related to the power of these experiments - the number of choice problems each subject is required to solve and the span of price ratios each subject encounters. We designed a series of experiments, in the context of other-regarding preferences, where in each decision problem, a subject is given a number of tokens and is asked to allocate them between herself and an anonymous other. Each token that she allocates to herself is multiplied by a parameter  $a$ , while every token she allocates to the other is multiplied by a parameter  $b$ . Each subject is confronted either with an implementation of the verbal methodology or with an implementation of the graphical methodology. Irrespective of the methodology she is facing, the subject is randomly assigned with a number of rounds and with an upper bound to the price ratio. The existing literature predicts that a subject that will be assigned to the verbal methodology with few trials and small span of price ratios will probably demonstrate consistent choices. However, a subject that will be assigned to the graphical methodology with many trials and large span of price ratios will be expected to demonstrate inconsistent choices. This design induces large variation in the three main aspects described above. We intend to run these experiments between January and April 2016 so that by June 2016 the project will be ready for presentation.



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## Behavioural Data Analytics

Ganna Pogrebna

### Abstract

Big Data analytics is an established methodology used primarily by statisticians and computer scientists to analyse large masses of data. While the Big Data methodology is helpful for *describing* data patterns as well as for *determining the main trends* in the data, it is hard to apply existing Big Data techniques to predict human behaviour observed in the field. In this paper we introduce the concept of *behavioural data analytics* and show how decision theoretic approach can be combined with Big Data methodology to *analyse* and *predict* human behaviour using large datasets. All behavioural data analytics methods used in the paper are supported by the real-world examples.



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# Belief Formation and Updating in a Signalling Game without Common Prior: An Experiment

Alex Possajennikov

## Abstract

The paper investigates the formation and the evolution of beliefs in strategic interaction between two players, modelled as a signalling game. In the game one player (Sender) has private information, represented by type. Sender sends a message to the other player (Receiver). Receiver observes the message but not the type of Sender and chooses an action. The payoffs of the players depend on the type of Sender, the message and the action in such a way that there are two pure strategy equilibria of the game where different types of Sender send different messages and Receiver takes appropriate actions. Depending on the probabilities of different Sender's types, either one or the other equilibrium is more efficient. In the experiment, the game is played for a number of rounds with random partners. In some sessions the underlying probability distribution of two Sender's types is not revealed to the experiment participants while in others it is. Along with playing the game, subjects are asked to report their beliefs about the prior probability of Sender's type (in sessions where this probability is not revealed), about the posterior probability of Sender's type (after receiving a message) and about the action of Receiver (after sending a message). Belief elicitation is incentivized using a quadratic scoring rule (as in e.g. Nyarko and Schotter, 2002; see also the discussion in Offerman et al., 2009). The result of the experiment show that experimental subjects often start with diffuse beliefs about types and about choices of the other player, centred on 50% probabilities of each of the two possible outcomes ("principle of insufficient reason", see e.g. Sinn, 1980). Subjects then update the beliefs in view of experienced outcomes (learning-from-experience, e.g. Hertwig et al., 2004; Yechiam and Busemeyer, 2005). For some parameter values, initial beliefs centred on 50% have a medium-run effect compared with the case where the probability of Sender types is revealed: the frequency of the efficient equilibrium is lower if an asymmetric probability distribution is not revealed although subjects report beliefs closer to the underlying distribution as play progresses. The results also indicate that the speed of updating beliefs is different for events involving objective uncertainty (Sender's types) and events involving strategic uncertainty (player's choices). Fitting a model of belief updating that incorporates a strength of initial belief and a forgetting parameter, the estimated initial belief strength is higher for beliefs about Sender's types than for beliefs about players' choices. It thus appears that beliefs about strategic uncertainty are updated faster than beliefs about objective underlying distribution. Comparing the results with those from a previous experiment on the same game but without belief elicitation, we also show that eliciting beliefs does not significantly affect the play itself.



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# Income in Jeopardy: How Losing Employment Affects the Willingness to Take Risks

*Malte Preuss; Clemens Hetschko*

## Abstract

The willingness to take risks strongly affects economically important outcomes such as entrepreneurial activity, migration and households' allocation of financial assets. Some part of individual risk attitude is rooted in genetic dispositions, socialisation and personality development. Beyond that, life experiences such as poverty, child birth, being exposed to violence, the Great Depression or natural disasters shape people's willingness to take risks. We analyse the risk-taking effect of another source of substantial individual risk concerning the vast majority of employees in market economies: losing one's job. As approaching and experiencing job loss places, first and foremost, workers' current and future income in jeopardy, this event facilitates a natural experiment for studying the impact of an extensive income shocks on risk attitude. To the best of our knowledge, Sahm (2012) provides the only existing study on the impact of job loss on risk attitudes. Besides various other insights pointing to time-invariant risk-taking, she does not find that elder workers in the US change risk attitude in the wake of being dismissed. In contrast to her, we focus on job losses due to the closure of a complete plant or firm and thus on a much more specific type of dismissal. To the extent that workers cannot completely insure the income risk associated with such a non-controllable job loss, its impact on risk attitude will be that of a background risk. As a result, we argue that increasing risk of job loss will cause workers to avoid other controllable risks more often as decreasing absolute risk aversion (DARA) characterises their utility function. To test this notion by estimating the causal effect of loss of work on risk attitude, we apply a difference-in-differences approach based on German Socio-economic Panel data (SOEP). We assign workers who experience job loss due to the closure of the complete plant or company to the treatment group and similar employees who do not lose their jobs to a control group. As a behaviourally valid measure of general risk attitude, we use the stated willingness to take risks. It turns out that exogenous job loss indeed decreases the willingness to take risks. The effect already begins to manifest itself before the job loss event ultimately occurs, as workers may perceive that employment is increasingly at risk. Pre-treatment hourly wage as proxy for the losses of earnings and nonwage benefits associated with job loss amplifies the negative impact of job loss on risk-taking. This confirms that the losses of current income and the fear of losing future income are driving forces behind the impact of job loss on risk-taking. In the aftermath of the event, the willingness to take risks gradually returns to its initial level as workers become reemployed. Additional empirical analyses point to the behavioural validity and economic significance of our findings.



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## Higher Intelligence Groups Have Higher Cooperation Rates in the Repeated Prisoner's Dilemma

*Eugenio Proto*

### Abstract

Intelligence affects social outcomes of groups. A systematic study of the link is provided in an experiment where two groups of subjects with different levels of intelligence, but otherwise similar, play a repeated prisoner's dilemma. The initial cooperation rates are similar, it increases in the groups with higher intelligence to reach almost full cooperation, while declining in the groups with lower intelligence. The difference is produced by the cumulation of small but persistent differences in the response to past cooperation of the partner. In higher intelligence subjects, cooperation after the initial stages is immediate and becomes the default mode, defection instead requires more time. For lower intelligence groups this difference is absent. Cooperation of higher intelligence subjects is payoff sensitive, thus not automatic: in a treatment with lower continuation probability there is no difference between different intelligence groups.



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## Imprecise Preferences: A Model and a Measurement

*Jianying Qiu*

### Abstract

Imprecision in preferences has been used to explain a broad range of anomalies. Surprisingly, there are no measures with proper material incentives and formal models with a rigorous structure are rare. In this paper I propose a model of imprecise preferences with an axiomatic foundation. Imprecise preferences are captured by individuals having not a single but a set of utility functions. Individuals perform standard expected utility calculations given any specific utility function and take subjective expectation a concave transformation of the standard expected utilities as to the set of utility functions. Based on the model, an incentive compatible mechanism to measure imprecision in preferences is developed. It can be shown that two empirical puzzles - the willingness-to-pay and willingness-to-ask (WTP-WTA) gap as well as the present bias - are natural consequences of imprecise preferences.



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## Implicit Preferences Inferred from Choice

*Jonathan de Quidt; Tom Cunningham*

### Abstract

A longstanding distinction in psychology is between implicit and explicit preferences. Implicit preferences are ordinarily measured by observing non-choice data, such as response time. In this paper we introduce a method for inferring implicit preferences directly from choices. We ask subjects to state preferred sentences for two criminals whose cases are presented side by side. We find that there is a negligible difference in average sentence given to black and to white defendants, when the defendant is presented alongside someone of the other race. However black defendants receive 1-year longer sentences when the defendants are presented alongside someone of the same race. We interpret this data as demonstrating two facts: the absence of any explicit racial preference, but the existence of an implicit racial preference (against black defendants). Data on order effects and response time are consistent with this interpretation. The necessary assumption is that implicit preferences toward an attribute (e.g. gender, race, sugar) have a stronger effect when the attribute is mixed with others, and so the decision becomes less "revealing" about one's preferences. We discuss reasons why preferences would have this property, advantages and disadvantages of this method relative to other measures of implicit preferences, and application to measuring implicit preferences in racial discrimination, self-control, and framing effects.



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## Skewness and Preferences for Non-Instrumental Information

*Collin Raymond; Yusufcan Masatlioglu; Yesim Orhun*

### Abstract

Psychologists have long recognized that the desire to regulate anticipatory emotions regarding an uncertain outcome in the future, such as hope, anxiety and suspense, may influence what people want to learn, and when they want to learn it, even in the absence of their ability to condition their actions on that information. Anecdotal evidence, such as from medical testing, also suggests that try to avoid situations that make them feel anxious about a future event and cultivate instances of hope at the face of uncertainty, even when doing so is costly. We present experimental results from a broad investigation of preferences for non-instrumental information. Most earlier work investigated whether people have preferences that would lead them to obtain non-instrumental information. However, more generally, individuals may care not only about whether they observe information or not, but also about what kind of information they observe. For example, even if they reveal the same amount of information overall, certain information structures eliminate more uncertainty about the undesired outcome conditional on generating a bad signal, but are unlikely to generate a bad signal (i.e., they are negatively skewed). Yet others eliminate more uncertainty about the desired outcome conditional on generating a good signal, but are unlikely to generate a good signal (i.e., they are positively skewed). This paper, in addition to studying whether people prefer more information to less when information is non-instrumental, specifically explores i) whether people prefer negatively skewed information or positively skewed information, and ii) how individual preferences over the skewness and the degree of information relate to one another. Exploring a wider range of non-instrumental information preferences allows us to assess existing models in this domain including Kreps and Porteus (1978), Grant, Kajii and Polak (1998), Caplin and Leahy (2001), Brunnermeier and Parker (2005), Koszegi and Rabin (2009), Dillenberger (2010), Dillenberger and Segal (2014) and dynamic extensions of Gul (1991) and Quiggin (1982). Although existing evidence, both empirical and experimental, cannot distinguish between predictions of these models, these models make different predictions regarding preferences for skewness. Therefore, we can assess the extent to which existing models can accommodate the data, and identify ways in which they can be modified to capture these behavioral patterns. We find that individuals exhibit a strong preference for positively skewed information structures as well as Blackwell more informative information structures. Moreover, we find that preference for Blackwell more informative information structures dominate preferences for right-skewed signals. These results provide the strongest support for the class of preferences introduced by Kreps and Porteus (1978).



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# The Value of Nothing: Asymmetric Attention to Opportunity Costs Drives Intertemporal Decision Making

*Daniel Read; Christopher Olivola; David Hardisty*

## Abstract

We propose a novel account of intertemporal choice based on asymmetric attention given to opportunity costs. We argue that the costs of delayed consumption are more salient than the costs of earlier consumption. This produces a bias in favor of smaller, sooner rewards over larger, later ones. Our account implies that highlighting the opportunity costs of choosing smaller, sooner rewards should lead people to become more patient, whereas highlighting the opportunity costs associated with delayed gratification should have little or no effect (since people are naturally aware of these latter costs). Patience is measured through choices between smaller, sooner (SS) and larger, later (LL) payments, such as "\$100 today OR \$150 in one year." The opportunity cost of choosing LL is that you will receive \$0 instead of \$100 today, while the opportunity cost of choosing SS is that you will receive \$0 instead of \$150 in one year. In several studies we show that reminding people of the SS opportunity cost increases patience, while reminding them of the LL opportunity cost has no effect. We do this primarily by extending a design introduced by Magen, Dweck and Gross (2008) who found that eliciting choices in the Explicit zero frame below produced greater patience: Hidden zero: \$100 today OR \$150 in one year Explicit zero: \$100 today and \$0 in one year OR \$0 today and \$150 in one year We show that this effect is due to adding the zero to the SS item. We will report on eight experiments. The first five reproduce the SS zero effect, and show that it is robust to outcome sign (it works for losses), for outcomes of varying magnitude, for delayed outcomes, and even when the wording of the options deviates from the "Zero" frame just described. We next show that the asymmetric opportunity cost effect holds when people are reminded of these costs in a different way - by being given a strong reminder that (for example) if they choose the later of two options, they will not get the earlier option. Finally we show the effect occurs for non monetary goods such as lives saved, air quality, and chocolates.



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## Random Utility Without Regularity

*Michel Regenwetter; Johannes Mueller-Trede*

### Abstract

Classical random utility models (Falmagne, 1978; Barbera and Pattanaik, 1985) imply a consistency property called regularity. Decision makers who satisfy regularity are more likely to choose an option  $x$  from a set  $X$  of available options than from any larger set  $Y$  that contains  $X$ . In light of ample empirical evidence for context-dependent choice (e.g., Huber, Payne and Puto, 1982) that violates regularity, some researchers have questioned the descriptive validity of all random utility models. We show that not all random utility models imply regularity. We propose a general framework for random utility models that accommodate context dependence and may violate regularity. Our framework's mathematical foundations lie in polyhedral combinatorics. The virtues of a geometric perspective on decision-theoretic models have long been recognized (e.g., Iverson and Falmagne, 1985). Only recently has the geometry of decision theory garnered increased attention, however, as mathematical advances have widened the scope for its applications (e.g., Cavagnaro and Davis-Stober, 2014; Fiorini, 2004; McCausland, Marley, 2013, 2014; Myung, Karabatsos and Iverson, 2005). Our treatment shows that, viewed through the lens of polyhedral combinatorics, classical and context-dependent random utility models are virtually indistinguishable: Both are characterized by convex polytopes. Their descriptive performance in empirical settings may thus be assessed and compared using methods of order-constrained inference (Davis-Stober, 2009; Klugkist and Hoijtink, 2007).



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# An Axiomatisation of Discrete Possibilistic Choquet Integrals

*Agnès Rico; Didier Dubois*

## Abstract

Necessity (resp. possibility) measures are special cases of Shafer belief functions (resp. plausibility measures) that are infimum-preserving (resp. supremum preserving). They are very simple representations of epistemic uncertainty due to incomplete knowledge. In the present work, a characterization of Choquet integral with respect to a possibility or a necessity measure is proposed, understood as a criterion for decision under uncertainty. This kind of criterion has the merit of being very simple to define and compute. It has been used already in signal processing, and in multiple-stage decision-making. To get our characterization, it is shown that it is enough to respectively add an optimism or a pessimism axiom to the axioms of the Choquet integral with respect to a general capacity. This additional axiom enforces the maxitivity or the minitivity of the capacity and essentially assumes that the decision-maker preferences only reflect the plausibility ordering between states of nature. The class of functions with respect to which Choquet integral is additive is enlarged, as any act is provably indifferent to some other act that is comonotonic (in the pessimist case) or anti-comonotonic (in the optimistic case) with the plausibility ordering between states of nature. The obtained pessimistic (resp. optimistic) criterion is an averaged maximin (resp. maximax) criterion of Wald across cuts of a possibility distribution on the state space. The pessimistic attitude of the decision-maker expresses the idea that the consequence of a decision in a state is never more attractive than the least attractive consequences over states that are more plausible than this state. An axiomatisation of these criteria for decision under uncertainty is also proposed in the setting of preference relations among acts. Our work differs from the one of Reille, which proposes a possibilistic counterpart, to the comparison of necessity measures, of Von Neumann-Morgenstern approach. Our results can be compared with the axiomatic approach to max-min ordinal possibilistic criteria proposed in the early 2000's.



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## Testing Manski's Theory of Satisficing

*Nuttaporn Rochanahastin; Yudistira Permana; John Hey*

### Abstract

Way back in 1955 Herbert Simon made a call for a new kind of economics stating that: “the task is to replace the global rationality of economic man with a kind of rational behavior that is compatible with the access to information and the computational capacities that are actually possessed by organisms, including man, in the kinds of environment in which such organisms exist”. Since this call, many economists have tried to produce theories of ‘satisficing’ behaviour – as Simon called it – but most have failed. The trouble is that the expression ‘rational behaviour’ covers virtually all forms of behaviour, as long as it is motivated by some ‘rational’ objective function, and the decision-maker has all relevant information available to him or her. A ‘rational’ objective function is one that is not internally inconsistent, though it may not be complete. In recent years economics has started seeing theories of behaviour with incomplete preferences; these are a step in the right direction. There has also been an outburst of theoretical work on decision-making under ambiguity – which is a situation where probabilities do not exist or are not known. Some of these make the decision-makers task complicated – for example the Smooth Model of decision-making under ambiguity assumes that, while the decision-maker (DM) does not know the probabilities, he or she can specify the set of possible probabilities and can attach probabilities to each member of the set. The computational problems are enormous – but usually economics assume that the DM can solve any task, however complex. But this is not true: numerous experiments have shown that there is noise in human behavior (Caplin et al., 2011; Guth and Weiland, 2011; Reutskaja et al., 2011): that given the same problem more than once, decisions change. Is this simple error in decision-making, or is it a sign that the decision-maker cannot or does not want to find the best decision? The problem may simply be too complicated. The economist would argue that the DM realises that it is not worth thinking about the problem, and that he or she is simply trading off costs and benefits. But we have to be careful here: if we want to argue that there are costs of working out the optimal solution, we need to admit that there must also be costs associated with working out whether it is worth working out the optimal solution, and that there must be also costs associated with working out whether it is worth working out whether it is worth working out the optimal solution, and so on ad infinitum. There is no end to this infinite regression. But admitting that there are costs to thinking is a first step in the right direction. Such costs are the crucial component of a new theory advanced by Charles Manski in “Optimise, Satisfice or Choose Without Deliberation?”. In this he incorporates the first cost – the cost of thinking. It is just the first step as these costs are given. We report on an experiment testing Manski's theory.



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## Intertemporal Choice - Discounting and Projection Bias

Kirsten I.M. Rohde; Chen Li

### Abstract

Intertemporal choices concern tradeoffs between optimal sizes of outcomes and their optimal timing. A popular model to describe such tradeoffs is the discounted utility model. Discounted utility evaluates an outcome to be received in the future by multiplying its utility by a discount factor. Utility captures the expected attractiveness of an outcome irrespective of its distance to the present. The discount factor captures the attractiveness of the timing of the outcome irrespective of its expected utility. Utility refers to the psychological process where people project themselves to the future and imagine how valuable an outcome will be to them once consuming it. Discounting refers to the value one derives today from foreseeing to experience the value of the outcome once consuming it. Traditional measurements of discounted utility assume that utility is constant over time. Thus, it is commonly assumed that the value one derives from an outcome today equals the value one expects to experience in the future once consuming the outcome. The difference between the value of receiving an outcome today or at a later point in time, it thereby entirely attributed to the discount factor applied to future values. Yet, it is well possible that the value one derives from an outcome today is different from the value one expects to derive from it in the future. If individuals, for instance, project themselves to the future and expect their future consumption level to be higher than their current one, it is well imaginable that they expect the value of an outcome in the future to be different from its value today. In this paper we study intertemporal decisions and disentangle discounting and the expected changes in utility. We measure whether people expect their utilities to change with time. This allows us to measure discounting independently from utility and expected changes in utility. We employ a methodology from measurements on subjective well-being to assess strength of preferences. This allows us to assess the extent to which subjects expect their utilities to remain constant over time. We also assess the extent to which the expectations about future utilities are correct. That is, we assess the extent of projection bias in predicting future utility.



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# It Is the Monotonicity Axiom!

*Berend Roorda; Reinoud Joosten*

## Abstract

We identify the monotonicity axiom as a problematic cornerstone of normative theory on decision making, and propose sequential consistency as an alternative, weaker axiom, that is still strong enough to induce uniqueness of updates, yet sufficiently flexible to rationalize the Allais and Ellsberg preferences. It is generally believed that the monotonicity property is an indispensable feature of a normative preference ordering. Phrased as 'if A is better than B in all states tomorrow, it must be better now', its intuitive appeal is immediate. We also take it for granted, in case A and B are acts, or lotteries, that actually pay out in each state tomorrow. In other words, we adopt monotonicity in real monetary outcomes. Its extension to the general case, however, with A and B not yet resolved in tomorrow's states, is less innocent than this phrasing suggests. At closer inspection, the word 'better' comes in two different forms: better if it comes to obtaining (often the tacit assumption), and better if it comes to the opposite perspective (returning, delivering, writing). We argue that the discrepancy between both perspectives, also referred to as endowment, or the gap between willingness to pay and accept, or the bid-ask spread, is inherent in most common preference orderings in the first place, rather than the effect of additional psychological phenomena. Now this undermines the seemingly absolutely compelling nature of the monotonicity axiom (see [2] for an elaborate discussion). Inspired by [1-3], we propose an alternative axiomatic framework for complete continuous preference orderings on finite state acts, in which the standard (conditional) monotonicity axiom is replaced by the much weaker axiom of sequential consistency ([2], mainly Def 4.1 and axioms A1-6). This extra flexibility gives room to combine uniqueness of updates, consequentialism, and dynamic choice consistency in a such a way that it accommodates the Allais and Ellsberg preferences without giving up a normative claim.



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## Climate Change Catastrophes and the Effect of Ambiguity

*Sara le Roux*

### Abstract

There is very little research conducted to test whether ambiguity affects individuals' decisions to insure themselves against catastrophic effects of climate change. The aim of this study would be to find out: How do individuals respond to the availability of an insurance that would give them immunity to a climate change catastrophe? Moreover, if such an insurance is available to them, do they insure themselves sufficiently? In addition, the policy implications for insurance companies will be ascertained by investigating whether an increase in the availability of information regarding the probability of such a catastrophic event, leads to an increase in insurance subscriptions? We would also investigate policy implications for the State - Can State intervention help in ensuring that individuals have better insurance cover for climate change catastrophes?



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# Strategic Substitutes, Complements and Ambiguity: An Experimental Study

*Sara le Roux*

## Abstract

We report the results from a set of experiments conducted to test the effect of ambiguity on individual behaviour in games of strategic complements and strategic substitutes. We test whether subjects' perception of ambiguity differs when faced by a local opponent as opposed to a foreign one. Interestingly, though subjects often choose an ambiguity safe strategy (not part of a Nash equilibrium), we do not find much difference in the ambiguity levels when faced by foreign subjects.



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# Uncertainty and Binary Stochastic Choice

Matthew Ryan

## Abstract

Experimental evidence suggests that decision-making has a stochastic element and is better described through choice probabilities than preference relations. Binary choice probabilities admit a strong utility representation (SUR) if there exists a utility function  $u$  such that the probability of choosing  $a$  over  $b$  is a strictly increasing function of the utility difference  $u(a) - u(b)$ . Debreu (1958) obtained a simple set of sufficient conditions for the existence of a SUR when alternatives are drawn from a suitably rich domain. Dagsvik (2008) specialised Debreu's result to the domain of risky prospects (lotteries) and provided axiomatic foundations for a SUR in which the underlying utility function conforms to expected utility. This paper presents a general SUR theorem for mixture set domains, along with several applications of this general result. We first strengthen Dagsvik's theorem by weakening one of his axioms. We then consider binary choices between uncertain prospects of the Anscombe-Aumann variety. We give sufficient conditions for a SUR with respect to a utility function for invariant biseparable preferences (Ghirardato et al., 2004). The SEU, CEU and MEU models all fall within this class, and a specialised SUR theorem is provided for each.



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# A General Equilibrium Theory of Firm Formation under Optimal Expectations

*Luis Santos-Pinto; Michele Della Era*

## Abstract

We extend Lucas (1978) general equilibrium model of firm formation by assuming that fraction  $\lambda$  of the workforce has optimal expectations of entrepreneurial ability and fraction  $1-\lambda$  has rational expectations, with  $\lambda \in (0,1]$ . Optimal expectations are modeled according to Brunnermeier and Parker (2005). At  $t=1$  an individual with optimal expectations of entrepreneurial ability observes his ability and chooses his expectation so as to maximize the undiscounted sum of the anticipatory payoff of being an entrepreneur at  $t=2$  and the material payoff of being an entrepreneur at  $t=3$ . We show that individuals with optimal expectations choose to be optimists about their entrepreneurial ability. Being optimist about entrepreneurial ability leads to first-order gains due to increased anticipatory utility of entrepreneurship and to second-order costs in realized profits due to distorted labor choices. We also show that the degree of optimism in the economy is increasing with the weight of anticipatory utility and with the level of decreasing returns to scale. The competitive optimal expectations equilibrium has the following key features. First, the lowest ability entrepreneurs are less talented at running a firm than the highest ability workers. Second, when the fraction of individuals with optimal expectations is neither too high nor too low, the majority of entrepreneurs are optimists and the majority of workers are realists. Third, an increase in the fraction of the workforce with optimal expectations raises the equilibrium wage, lowers number of entrepreneurs, the material payoffs of entrepreneurship, and welfare.



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## Birth order and risk preferences

Ulrich Schmidt

### Abstract

In the last decades birth order effects have been widely discussed in the psychological literature (e.g. Schooler, 1972; Sulloway, 2007) and in recent years also economists got interested in this topic (e.g. Björklund & Jaentti, 2012) as fertility rates and higher order birth rates decreased in industrialized countries. Looking at birth order effects, first parents' behavior is important. Studies by Yeung et al. (2001) and Price (2008) show, that parent spend different amounts of time with their children favoring e.g. first born children. Additionally Hertwig et al. (2002) show that although parents treat their children equally at any given point in time, this yields an unequal distribution of investment or time if they have three or more children. Secondly, the child's behavior matter. Sulloway (1995, 1996) assumes that siblings tend to maximize their differences to avoid direct competition and make it more difficult for parents to compare their offspring's. Both behaviors result in possible birth order effects. Many psychological studies concentrate on birth order differences in personality, whereas economists are more interested in differences in economic preferences, e.g. risk taking behavior. While the birth order effect on personality is unclear (see Rohrer et al, 2015 for a recent study), many studies find robust results for differences in risk taking (e.g. Sulloway & Zweigenhaft, 2010; Lampi & Nordblom, 2013). The key finding of these studies is that later born or middle born children are less risk averse. One problem of all these studies is that they use survey questions or look only at field behavior. Our study is therefore the first which investigates the influence of birth order, number of siblings and sibling's sex composition on risk preferences in the school context with pupils aged on average around 16, who are still close to the family context, and with experiments which were incentivized, so that each subject was paid according to her or his choices. The field study was conducted between March and May 2015 in schools in Schleswig-Holstein, Germany with a total of 525 pupils all in the 10th grade. The experiments were conducted during school hour which helped us to minimize dropouts and self-selection. We elicited risk preferences through the choice task by (Eckel & Grossman, 2002) which is easy to understand and has been shown to yield good results over all social-economic groups. We find no effects for the number of siblings. However, we find that only boys are more risk averse than all other boys with siblings. Looking at birth order effects we also find that middle born boys are more risk seeking, or in general, that second born boys are more risk seeking than first born boys. A single-sex environment seems to play only a role for boys in this context with boys having brother being more risk averse than all other boys with siblings. For girls we find no significant results.



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## Income Inequality and Risk Taking

*Ulrich Schmidt; Levent Neyse; Milda Aleknonyte*

### Abstract

Standard economic theory assumes that individual risk taking decisions are independent from the social context and therefore also independent from the income distribution. Recent experimental evidence however shows that the income of peers has a systematic impact on observed degrees of risk aversion. In particular, subjects strive for balance in the sense that they take higher risks if this gives them the chance to break even with their peers. The present paper is, to the best of our knowledge, the first systematic analysis of income inequality and risk taking. We perform a real-effort field experiment where inequality is introduced to different wage rates. After the effort phase subjects can invest (part of) their salary into a risky asset. Besides the above mentioned possibility of higher risk taking of low-wage individuals to break even with high-wage individuals, risk taking can be influenced by an income effect consistent with e.g. decreasing absolute risk aversion and a house money effect of high-wage individuals. Our results show that the dominant impact of inequality on risk taking is what can be termed a social house money effect: high-wage individuals take higher risks than low-wage individuals only if they are aware of the inequality in wages.



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# Allais at the Horse Race: Testing Models of Ambiguity Aversion

Florian H. Schneider; Martin Schonger

## Abstract

Since Ellsberg pioneered the concept of ambiguity aversion, both theorists and experimentalists have taken a keen interest in the concept. Ambiguity aversion is usually studied in the Anscombe-Aumann framework. Anscombe-Aumann proposed a Monotonicity axiom, which is widely used in models of ambiguity aversion. Indeed, apart from basic choice theoretic axioms like Transitivity and Continuity, Monotonicity seems to be the most common axiom models of ambiguity aversion satisfy. Within the Anscombe-Aumann framework, models of ambiguity aversion that satisfy Monotonicity include Multiple priors (Gilboa/Schmeidler, 1989), Choquet Model (Schmeidler, 1989), Smooth ambiguity preferences (Klibanoff et al., 2005), Variational preferences (Maccheroni et al., 2006), Vector Expected Utility (Siniscalchi, 2009), MBA-preferences (Cerreia-Vioglio et al., 2011), and Hedging preferences (Dean/Ortoleva, forth.). Models that do not satisfy Monotonicity include the recursive models (Segal, 1987; Abdellaoui/Zank, 2015), and mean-dispersion preferences (Grant/Polak, 2013). The descriptive validity of the Monotonicity axiom is the focus of this paper. We know of no prior method to test the Monotonicity axiom, let alone experimental work that actually does so. This paper provides a thought experiment that fills this gap. Our thought experiment adapts the classical Allais paradox to a setting where there are both objective and subjective sources of uncertainty. The so-modified Allais paradox tests Monotonicity, and we call it the Allais Horse Race. The Allais Horse Race serves two roles: first it allows for introspective "testing" of Monotonicity, and second, it paves the way for experimental tests of Monotonicity. In the incentivized experiment we find that about half of all participants violate Monotonicity, and overwhelmingly do so in a specific, non-random way. The hypothesis that violations are due to random error is easily rejected. Therefore models of ambiguity aversion that satisfy Monotonicity cannot describe the behavior of about half of all subjects. In the experiment we also confront participants with the original Allais paradox. It turns out that violating Independence strongly predicts violating Monotonicity. To provide some insight into this empirical correlation, we establish theoretically that for probabilistically sophisticated decision-makers, Monotonicity and Independence are equivalent. This might explain why decision-makers in general tend to either satisfy both Independence and Monotonicity or violate both. For most decision-makers the axioms, while not equivalent, are probably similar. The working paper is available at: [www.econ.uzh.ch/static/wp/econwp207.pdf](http://www.econ.uzh.ch/static/wp/econwp207.pdf)



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# Dynammmically Consistent Beliefs Must Be Decomposable

*Daniel Schoch*

## Abstract

It has been argued that, as long as both dynamic consistency and consequentialism are imposed in sufficient generality and the valuation is independent of the form of the decision tree, the decision maker's beliefs are represented by additive measures. In particular, valuations of Savageian acts are linear and beliefs are updated by the Bayesian rule, which amounts to Subjective Expected Utility (SEU). However, these studies are either within the framework of Choquet Expected Utility (CEU) (Eichberger and Kelsey IER 1996, Sarin and Wakker JRU 1998), or presume a variant of Savage's P4 axiom, which implies beliefs to be ordinaly representable by probabilities (Machina and Schmeidler *Econometrica* 1992, Epstein and Le Breton JET 1993). Moreover, under a certain condition on null events, dynamic consistency implies the Sure Thing Principle, excluding both Allais and Ellsberg paradoxa. In this paper we present a (weakly) dynamically consistent and consequentialist decision model in a Savagian framework. We drop the condition on null events, leave the CEU framework, and weaken Savage's P4, and impose dynamic consistency. One example, Maximal Possibilistic Utility (MPU), allows representation of risk aversion in the sense of Allais's Paradox. It induces Bayesian belief update and excludes Ellsberg Paradox. Beliefs are represented by possibility fuzzy measures (capacities). MPU has a preference representation similar to a Sugeno Integral, but with cardinal utilities on a ratio scale. SEU and MPU are among the many cardinal decision models, which satisfy the following three axioms: Weak dynamic consistency says that all ex ante best plans remain best plans ex post. Consequentialism claims independence of conditional preferences on counterfactual/bygone events. The third axiom is on belief update; it states that conditionalization on an event ordinaly preserves belief degrees of subevents. In general, belief is shown to be represented by a capacity, which is decomposable ("additive") over a continuous t-conorm, which again turns out to be representable as an ordinal sum of pseudo-additions. When restricted to binary acts, the first two axioms translate to similar conditions for belief update. All three conditions for belief update are altogether equivalent to a single axiom expressing a kind of backward induction consistency and implies the absence of Ellsberg Paradoxa.



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## A Decision-Theoretic Diagnosis of Attitude toward Debt

Marc Scholten; Daniel Read; Daniel Walters; Carsten Erner; Craig Fox

### Abstract

People greatly differ in their attitude toward debt, or their feelings about acquiring debt, and about prolonging debt once acquired. We define debt as an obligation to pay an amount of money in the future, and develop a diagnostic device, the debt battery, to assess people's attitude toward debt. The debt battery facilitates the emergence of four debt-attitude groups: (1) the debt prone, who discount delayed payments, and both acquire debt (prefer to make a payment in the future rather than now) and prolong debt (prefer a payment later in the future rather than sooner in the future); (2) the debt holders, who combine discounting with a future bias, so that they do not acquire debt, but prolong debt once acquired; (3) the debt averse, who amplify delayed payments, and neither acquire nor prolong debt; and (4) the debt takers, who combine amplification of delayed payments with a present bias, so that they acquire debt, but do not prolong it once acquired. Our focus is on a contradiction. One of the presumably most robust phenomena in intertemporal choice is the magnitude effect: Implied discount rates decrease with the magnitude of the outcomes. Recently, Hardisty et al. (2013) confirmed the magnitude effect for earnings, but found a reverse magnitude effect for payments: Implied discount rates increase, from negative (debt aversion) to positive (debt proneness) with the magnitude of payments. The authors ascribed their results to biases operating in addition to discounting: Present bias for earnings, and future bias for payments. The contradiction is that, in repeated applications of the debt battery, the debt holders, who combine discounting with future bias, either do not emerge, or, as in the experiment that we report, emerge only as a small group. To resolve the contradiction, we propose a framework of arithmetic discounting and amplification. We show how arithmetic discounting yields the magnitude effect for earnings and payments, and how arithmetic amplification yields a reverse magnitude effect for payments. In an experiment on decisions about whether to acquire debt, we obtain the same aggregate results as Hardisty et al. (2013). However, the reverse magnitude effect is largely carried by a small group of debt holders, who combine discounting with future bias, and by a large group of debt averse, who, according to our framework, engage in arithmetic amplification of delayed payments. In both groups, negative implied discount rates (debt aversion) become less negative as payments become larger. Among the debt prone and the takers, positive implied discount rates (debt proneness) only show a dip for very small payments, which might be a peanuts effect. Overall, the debt battery accurately captures heterogeneity in debt attitude, and the framework of arithmetic discounting and amplification improves our understanding of intertemporal decisions about payments as well as earnings.



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# Are Monetary Fines in Germany Equitable and Determinate? A Critical Analysis

*Christian Seidl*

## Abstract

Following Scandinavian imagination, German criminal law has adopted the idea that the value of a unit of money is less for richer perpetrators than for poorer ones. This led German criminal law to adopt the concept of fines calculated on day fines (by and large equivalent to daily net incomes), obviously in order to establish a notion of equality. But monetary fines calculated on the day fines in fact come up to total progression causing richer perpetrators to be more severely punished than poorer ones. However, assuming a utility function of money increasing at decreasing rates should consequentially have entailed adoption of economic equal sacrifice principles, which place equal burden on perpetrators equally guilty of comparable misdeeds. Instead of leading to total progression, equal sacrifice principles lead to monetary fines which are proportional or progressive with respect to income. However, in the last years the fines of criminal law, which had at least a rudimentary connection with the commands of equality and determinateness, were eclipsed in favor of termination of lawsuits by penalty payments without restrictions for the courts, which is largely at variance with the commands of equality and determinateness. In addition to that, rationality postulates of monetary fines are formulated and studies for some spectacular cases which were recently reported by the press. This paper also compares actual monetary fines for some recent spectacular misdeeds and provides indicators of the severity of the respective misdeeds based on backward calculation of the monetary fines.



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## The Power of Uncertainty

*Luxi Shen; Christopher Hsee; Ayelet Fishbach*

### Abstract

Suppose that from time to time you get a coffee from a local cafe. In one scenario (certain), every time you buy a coffee, you receive a \$1 discount. In the other scenario (uncertain), every time you buy a coffee, you receive a \$1 or \$0.50 discount. In which scenario will you buy more coffees from this cafe? There are good reasons to predict that the certain discount is a more effective incentive. For one, you would save more money under the certain discount than under the uncertain discount. For another, if you are like most normal consumers, you would prefer certainty to uncertainty. Yet we predict the opposite. We predict that you will repeat the purchase more if the discount is uncertain than if it is certain. We propose that outcome uncertainty can increase activity persistence due to uncertainty resolution. Uncertainty resolution is a unique mental reward which reinforces the corresponding behavior. We tested this uncertainty effect and its mechanism in diverse contexts, and found that uncertainty in payment (Study 1) increases willingness to repeat in work, uncertainty in discount (Study 2) and uncertainty in price (Study 3) increase willingness to repeat in purchase, and uncertainty in prize (Study 4) increases willingness to repeat in study. All our studies involved real consequences to participants. In Study 3, for example, we ran a sales program for Reese's Peanut Butter Cups with three versions of pricing: certain low price (10c each), certain high price (15c each), and uncertain price (10c or 15c with equal chances). Each buyer encountered one version and made purchases one by one. In either certain price program, the buyer who decided to purchase drew a cup from a bag and paid its price. In the uncertain price program, the buyer who decided to purchase drew a cup from a bag and paid the price indicated by the cup. We found that (a) adding uncertainty into a price can generate a larger demand than lowering the price, and that (b) price magnitude may influence the initial purchase, but price uncertainty drives purchase along the way. In other studies, we found that (c) people are willing to repeat an activity when they have the opportunity to resolve uncertainty after each outcome but not when they don't have such an opportunity, (d) they do not decide to repeat because the outcomes they receive are varied, and (e) in prospect, they do not expect they would enjoy uncertain outcomes. In sum, the findings on the positive uncertainty effect are counterintuitive and counter-normative, and they shed light on the intricate relationship between uncertainty and decision-making.



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## A Brief Experiment on Attitudes toward Ambiguous Time

*Anisa Shyti; Corina Paraschiv*

### Abstract

Many entrepreneurs and managers make business decisions based on transactions that involve cash inflows and outflows, which timing is uncertain. This paper focuses on the uncertainty aspect of the timing in which expected outcomes materialize. We isolate the effect of ambiguous time on individual preferences, and we theoretically justify the simplification of utility over time.

In this paper we report results of a field experiment with MBA students, who were assigned a term-long class project in Spring 2015 at a top European business school. Students were asked to make decisions on financing options that would provide them cash in the future to develop their term-project on a larger scale. Students faced binary options that consisted in a precise-time and a time interval, or ambiguous time, for the same cash inflow. Specifically, a precise-time financing option meant that the cash would be received at the stated future date, and an ambiguous-time option meant that the cash would be received at a future unknown date within a known time interval. Students were randomly assigned to two between-subject experimental conditions, one in which the timing of the cash inflow was determined by chance, and one in which the timing of the cash inflow was determined by the quality of the project. Students were explained that better quality projects would receive the cash inflow earlier than worse quality projects. Subsequently, students made decisions on precise-time or ambiguous-time financing options before receiving formal feedback on their projects. Two additional experimental treatments included distance from the present (i.e., near or far), and duration (i.e., short or long time intervals). Given the nature of the class project and the duration of the term (14 weeks), the time unit used in the experiment was in days.

Preliminary results show that when the timing of cash inflows depend on project's quality, decision makers prefer ambiguous time. For short time intervals, disregarding distance from the present, decision makers are indifferent between precise or ambiguous time options, hence exhibiting ambiguity neutrality. However, for long time intervals, decision makers for whom outcomes depend on the quality of their projects, exhibit strong preferences for ambiguous time, or ambiguity seeking. Decision makers for whom outcomes are randomly determined exhibit strong aversion to ambiguous time. To summarize, decision makers for whom quality matters are most ambiguity seeking for outcomes located further from the present; whereas, decision makers in the control group are ambiguity averse, and more so for long time intervals. These findings shed light on how the feeling of control over outcomes may impact time-related decisions. Time preferences of entrepreneurs or managers and elements that influence decisions over time are under-investigated topics in current research.



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## Intuition and Deliberation in Giving and Punishment

*Andrew Siu*

### Abstract

I study why individuals differ in their tendencies to give altruistically and punish norm violators. An online experiment investigates the role of dual systems of processing information, using a 40-item self-report questionnaire to measure (1) individual reliance on unconscious, intuitive feelings and (2) personal tendency to engage in effortful, deliberate thinking. I find that people who think more deliberately tend to resist the impulse to punish. Moreover, a higher cost of punishing reduces both punishment and giving. Lastly, higher reliance on intuitive feelings is associated with greater sensitivity of punishment to a cost increase than to a cost decrease; this asymmetry of sensitivity might be explained by loss aversion.



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## Trust, Risk and the Repeated Trust Game

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### Abstract

Trust is an important element of most social and economic transactions. For example, an employer assigns responsibilities to an employee based on trust, spouses will trust each other to be faithful and citizens will trust the elected officials to champion their interests. The problem is that quite often, we cannot be sure if our trust is being exploited or reciprocated. In this paper I run an experiment that first disentangles trust choices from risk preferences - the confounding of trust choices and risk preferences has not been accounted for in the literature. Secondly, my design helps to understand the link between declared trusting dispositions and trust choices in an infinitely repeated trust game with hidden action. Trusting attitudes are found to be an important motivator when playing trust in a trust game even after controlling for risk preferences, hence indicating that inherent trust is indeed identified when studying the trust game. Moreover, the likely mechanism through which intrinsic trust operates in guiding trusting individuals to play trust more often is investigated. I find that more trusting individuals are more likely to forgive or offer the benefit of the doubt to others after a disappointing outcome. This forgiving nature of more intrinsically trusting individuals appears to be the reason for the divergence in behaviour between more and less trusting individuals, since in the initial rounds there is no distinction between the two groups. Additionally, the effect of intrinsic trust appears to be operating independently from the formation of beliefs. This suggests that trusting is additionally rewarding for more intrinsically trusting individuals and is not due to different sets of beliefs on the likelihood of reciprocation from others.



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# Does Overprecision Correlate with Trading Tendency? Alternative Approach

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## Abstract

The experimental evidence regarding the link between tendency for overprecision (Moore and Healy, 2008) and excessive trading is mixed. Glaser and Weber (2007), for instance, show that overplacement ("better than average") significantly correlates with trading frequency, while various measures of miscalibration do not exhibit such link. Deaves et al. (2009), on the contrary, find significant correlation between task-relevant miscalibration scores and frequency of trading in experimental asset markets, also claiming a negative overconfidence effect on trading performance. Fellner-Röhling and Krügel (2014) recently illustrate that the tendency to overweight private information in signal detection tasks predicts trading intensity in experimental asset markets. This intriguing result motivates further examination of the link between overprecision and trading. The proposed paper introduces an innovative overprecision task and tests its predictive power for personal trading in framed-field experimental tasks. MBA students and traders recruited in financial Web forums were first instructed to submit median predictions for the future performance of leading stocks ( $r$ ). Subjects subsequently assessed the likelihood that the uncertain future return would be higher than ( $r$  plus some constant  $k$ ) and similarly assessed the probability that the uncertain return would be smaller than ( $r$  minus constant  $k$ ). The likelihood assessment tasks were incentivized using binary quadratic scoring rules that have proved to prevent the bias that standard QSR may induce. The tail-events likelihood assessments were normalized to capture personal tendency for informational confidence (Sonsino and Regev, 2013). The experiment was run in two phases, few weeks apart. Subjects submitted point predictions and tails likelihood assessments for 3 familiar stocks at the first phase. This was followed by a second questionnaire consisting of 3 framed-field stock trading assignments. Again, the tasks were carefully designed to neutralize the effect that personal risk preference or diversification concerns may exhibit on the tendency to trade. The results of the experiment, in terms of the correlation between informational confidence and trading, were basically weak, but the disappointing findings could follow from too ambitious aspects of the design (random drawing of the stocks for the assignments, on individual basis, to enhance ecological validity). The hypotheses would be tested again in a followup (less ambitious) experiment, attempting to control noise and gain more power for testing the link between overprecision and inclination to trade stocks.



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## A Social-psychological Explanation of the Variation in Risk-taking Behavior

*Oded Stark*

### Abstract

Combining standard measures of low relative wealth and relative risk aversion yields a novel, analytically-based explanation of the variation in relative risk aversion. Holding individuals' wealth constant, we show that individuals' concern at having low relative wealth systematically affects their relative risk aversion and, consequently, their propensity to resort to gambling and other risky behaviors. We present a causal link between distaste for low status and risk aversion. We measure low status by the index of relative wealth deprivation, and we quantify distaste for risk by the index of relative risk aversion. We uncover variation in relative risk aversion that does not emanate from a change in one's own wealth. We show how attitudes towards risk-taking are shaped by concern over falling behind others in the wealth distribution. Shifting the explanation of an individual's attitude to risk-taking from his own wealth to the wealth of others, and to the weight accorded by the individual to the excess wealth of others acknowledges the social dimension of the formation of risk-preferences and risk-taking behavior. We find that individuals with the same level of wealth who belong to populations that differ in their distribution of wealth, and individuals who, perhaps for social-biological or cultural reasons, attach a different degree of importance to relative wealth, exhibit different risk-taking behavior. We sign these differences and illustrate how our analytically-derived findings explain anew several observed behaviors.



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## Measuring the impact of social relationships: the value of oneness

*Chris Starmer; Simon Gaechter; Fabio Tufano*

### Abstract

Social relationships affect many variables that naturally interest economists yet they barely feature at all in conventional economic analysis. In an extensive bank of experiments, we examine the predictive power of a simple and portable tool, developed in social psychology, for the purpose of measuring social relationships. This is the so-called oneness scale. We deploy the tool in an experiment where groups of subjects who vary in the extent of pre-existing social relationships, also play weak-link coordination games. Our results are striking. Despite no possibilities for communication, groups with high oneness are very likely to coordinate on highly Pareto-ranked equilibria while groups with low oneness never do; hence, sufficiently high oneness appears a necessary condition for coordination success. While oneness co-varies, as expected, with various objective characteristics of groups, surprisingly, in the presence of oneness no other factors are ever significant. The effects of oneness are also large when benchmarked against the impact of financial incentives. We view our results as providing significant proof of concept for oneness measurement as a potentially highly productive tool for economic research.



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# Participants in Ultimatum Bargaining Games Have Individualistic Preferences After All

*Jack Stecher; Todd Kaplan*

## Abstract

What explains behavior in ultimatum games? Experimenter demands? Insult penalties? Fairness? We argue that, instead, ultimatum game proposer and responder behavior is well explained by (noisy) expected wealth maximization. After adjusting for random noise and learning, we find that the best predictor of behavior in ultimatum games is the subgame perfect Nash equilibrium. The key is that the type of learning involved is not learning about the game. Rather, it is learning about the mean and variance in a random utility shock. Our structural estimates show that, in our experiments, the mean of responders' utility shock is 0. That is, responders do not impose an insult penalty on low offers or demand offers that appear fair, at least not systematically. We find that our proposers systematically underestimate the variance in responder behavior, initially believing that responders are more sensitive to proposal amounts than the data suggest. Additionally, we find that proposers initially believe the mean of the utility shock is positive, further causing them to raise their proposals. Our estimated parameters fit both our initial round data and those in the original study of Guth et al. (1982). Indeed, after adjusting for currency translations and inflation, our mean initial round proposal was within a fraction of a penny of the amount predicted by fitting our parameters from the Guth et al. data. Our design has proposers and responders play ultimatum games several times, each with perfect strangers, in order to isolate the effects of learning from feedback without introducing confounds from repeated interaction. In each round, starting with a prior fitted from the Guth et al. data, our proposers' mean offer is 95% efficient, compared with the optimal offer given Bayesian updating based on the prior rounds. In the last round, our mean offer is within a few pennies of the wealth-maximizing amount. To control for fairness norms, we manipulate the claims of each player to the pie. In one treatment, the participants bargain over whether to allow the proposer to keep his or her show-up fee. In this treatment, the proposer has a chance to transfer some of his or her show-up fee to the responder, who then decides whether to accept the transfer and allow the proposer to keep the remainder, or who can destroy the proposer's show-up fee. In a second treatment, the participants instead bargain over the responder's show-up fee. In this treatment, the proposer has a chance to demand a transfer of some of the responder's show-up fee. The responder can either agree to the transfer, keeping only the remainder, or can refuse, at the cost of surrendering the show-up fee. This is similar to the dictator games of List (2007), in which dictators can take some of a citizen's show-up fee. We find no difference in responder behavior across treatments, and no difference in mean proposals across treatments in any given round.



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# The Influence of Experience on Bidders' Cognitive Biases in Public Procurement

*Timo Tammi; Jani Saastamoinen; Helen Reijonen*

## Abstract

Although cognitive biases as deviations of rationality are well-known and empirically identifiable phenomena in many decision-making environments, only a bit, if anything, is known about cognitive biases among firms in the context of public procurement and about how they are associated with firm behaviour in tendering for procurement contracts. According to the so-called discovered preferences hypothesis (Plott 1996; Cubitt et al. 2001; Bardsley et al. 2010) cognitive biases will disappear in situations where incentives are salient, decisions are made repeatedly and decision-makers get feedback. Competitive bidding in public procurement is, clearly, an environment where firms are able to learn due to repetition, feedback and salient incentives. Consequently, we may hypothesize that experienced bidders exhibit less cognitive biases than non-experienced bidders do in public procurement. In this paper, we study loss aversion, overconfidence bias (in the form of 'better than average effect') and risk attitudes among firms who have participated in competitive bidding in public procurement for different time periods and have therefore different levels of experience of bidding in this particular context. The analysis is based on survey data of nearly four hundred firms registered in the most-widely used electronic tendering management system in Finland, which have made one or several bids, or have planned to do so. We analyze how loss aversion, confirmation bias and risk attitudes differ and are distributed among firms having various levels of experience of bidding in public procurement. The survey data is being currently (December 2015) collected by with an electronic questionnaire. Loss aversion is measured by using a multiple price list format (MPL) along the lines of Fehr and Goette (2007), Gaechter et al. (2010) and Koudstaal et al. (2015). Concerning overconfidence, we employ instruments used by Szyszka (2013) (see also Stotz and von Nitsch 2005) in asking firms to self-evaluate their competencies in bidding in public procurement. In the measurement of risk attitudes, we use two instruments. The first is the survey-based measure used by Dohmen et al. (2011), Koudstaal et al. (2015) and Vieider et al (2015). Respondents were asked to express their self-perceived willingness to take risk in general and in more specific domains of driving, finance, leisure and sport, occupation, health and faith in other people. Another measuring tool is a choice based risk elicitation task applied in Menkhoff et al. (2006). The analysis provides preliminary information on evaluating the discovered preferences hypothesis in a natural environment outside a laboratory setting. It also gives guidelines regarding pooling the survey data with the bidding data available via the electronic tendering management system. As a practical application, the findings of this study can help to attenuate cognitive biases in tendering.



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# Repeated Search in Variable Environments and the Role of Post-decision Search

*Kinneret Teodorescu; Ke Sang; Peter Todd*

## Abstract

People often search for information about alternatives after they have already chosen an option, even if the choice is irreversible. While previous studies on post-decision search focused on "one shot" decisions and highlighted its irrational aspects, here we explore the possible long-term benefits of post-decision search. We focus on two (rational) motivations to conduct post-decision search in repeated settings: (1) to better understand the payoff distribution when future decisions are expected in the same environment, and (2) to improve one's search strategy: even when future decisions are not expected in the same environment, post-decision search could be used to obtain feedback on one's search strategy- e.g. learning that searching stopped too soon can help set a better stopping rule for future choices. To test these potential benefits, we used a simple repeated search task. In each round, a deck of cards is presented and one can choose whether to flip over the next card in the deck, or to stop the search and select the current card. In the first experiment, post-decision search was voluntary: After selecting a card, participants could continue flipping cards and see what cards would have been available if they had continued to search. Two variables were manipulated within subject: information about the distribution of values (Full Information/No Information) and repetition of the same deck in later rounds (Repeated/Unique decks). Results show people search less when provided with information about the distribution of values, highlighting the first motivation for post-decision search "collecting additional information about the environment. Repetition, on the other hand, had no significant effect, and post-decision search was significantly above zero in all conditions, which both support the second motivation "to obtain feedback about one's own search strategy. Using a median split on the length of pre-decision search, we found that post-decision search in early rounds was correlated with improved performance later on only for "Low Searchers": only people who initially searched little but conducted post-decision search learned to adjust their strategy appropriately. In two follow-up experiments, post-decision search was manipulated directly between subjects (Mandatory search/No search) in a no-repetition no-information environment. Results show larger improvements for subjects who were forced to conduct post-decision search, particularly for Low Searchers. When learning about the distribution was separated from setting stopping thresholds, post-decision search helped Low Searchers, mainly by increasing their learning about the distribution before generating thresholds. To conclude, although post-decision search might appear irrational, especially if one does not expect to encounter the same environment in the future, our results suggest that it can help Low Searchers to modify their data collection behaviors and improve performance.



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# The behavioural Economics of Attention and the Implications for Choice

*Stefano Testoni*

## Abstract

I model choice using a two-stage framework. The first stage of information processing involves allocating attention over alternative channels, while the second stage of decision-making consists of maximising preferences over alternative choices conditionally on attention allocation. To model attention, I follow the dual-system paradigm in psychology, which posits that information processing is jointly regulated by the fast, automatic System 1, which does not consume attentional resources, and by the slow, deliberate System 2, which does consume resources. An agent allocates fluency and effort over System 1 and System 2 channels, respectively. The allocation of fluency is produced by a combination of exogenous contingencies and of the associative properties of System 1, and it takes place without the agent's deliberation. The agent chooses the allocation of effort subject to scarcity constraints and processing costs, conceived both as opportunity costs and as psychological aversion to the exertion of effort. In equilibrium, effort is mobilised up until utility and cost equal at the margin. The choice of effort is though conditional on fluency, due to the influence that System 1 exercises over System 2. The allocation of attention then defines the preference ordering of alternative choices in the stage of decision-making, de facto selecting one set of preferences among an entire family of possible sets of preferences. The model of attention offers a psychologically grounded account of the processes of choice, and it can be extended to notions of welfare other than preference satisfaction.



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# Voluntary Contributions to Real-Life Public Goods - Strategic Considerations and Contextualization

*Yossi Tobol; Yuval Arbel; Ronen Bar-El; Mordechai E. Schwarz*

## Abstract

From the early dawn of their existence, Homo sapiens have relied on voluntary contributions to their communities for gathering, hunting, planting, harvesting, establishing settlements and building religious monuments to increase their own prospects of survival (see Harari, 2014). Thus, through the evolutionary process of tens of thousands of years, contributing to achieve common goals became a "rule of thumb" for humankind (see Aumann, 1997). In this paper we address the relation between economic theory and experimental evidence. We construct a simple and tractable benchmark model examining the dynamics of contributions among individuals selfishly and strategically contributing to a public good. A unique feature of our paper is an experimental test of the theoretical model utilizing contribution game experiments to a real-life public good. We conducted four types of contribution game experiments among religious Jewish students (Orthodox and ultra-Orthodox) of the Jerusalem College of Technology (hereafter: JCT). In each of the experiments, subjects were handed an initial endowment of ECU (Experimental Currency Units) to be divided between themselves and a contribution to a real public good they value and use on a daily basis in their campus synagogues. Each participant was randomly assigned to only one of the four experiments. Experiment 1 is a five-round contribution game where contributions are dedicated to the procurement of sustainable supplies for the campus synagogue. Experiment 2 is a single-round contribution game where contributions are dedicated to the procurement of sustainable supplies for the campus synagogue. Experiment 3 is a single-round contribution game where contributions are dedicated to the ongoing operation of the campus synagogue. Experiment 4, similar to experiment 2, is a single-round contribution game where contributions are dedicated to the procurement of sustainable supplies for the campus synagogue with the difference that the participants were informed that 20% of contributions would be utilized to finance the ongoing operation of the synagogue. The results of the experiments support the model's main theoretical predictions. We find evidence that the pattern of contributions of individuals contributing to a public good to which they attribute high intrinsic value is fairly predicted by the open-loop Nash equilibrium. In particular, we find that total contributions to the procurement of sustainable supplies increase with the time limit for collecting contributions and with group size and decrease with ongoing operating costs. We also find that average per-round contributions increase over rounds. In addition, we find evidence that individuals prefer to contribute to sustainable supplies rather than to ongoing operations, despite the assurance of contributor anonymity - that is, in real life, where contributors to buildings, facilities and the like are publicly honored, the problems of financing the ongoing operations



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## Social Ambiguity

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### Abstract

Ellsberg (1961) showed that people treat ambiguity in a fundamentally different way than risk. A big field of application for decision making under ambiguity is game theory, where the uncertainty concerns the action of an opponent who interacts with the decision maker, and may have common or opposite interests. Game theory has traditionally used probabilities to model such uncertainties, primarily through mixed strategies. However, in applications the probabilities of opponents' actions are virtually never available, and game theory typically concerns situations of strategic ambiguity. But also if there is no strategic interaction, ambiguity about moves of an optimizing decision maker with a free will may be perceived differently than ambiguity about moves of nature, which has no interests. In strategic ambiguity there is always a social component. We use the term social ambiguity to distinguish this component. Differences between social situations and nature may be due not to the strategic nature of the uncertainty, but to the mere presence of social ambiguity. To assess strategic ambiguity attitudes, it is warranted to control for social ambiguity attitude. This paper measures subjects' attitudes to two different sources of social ambiguity and compares these to their attitude toward ambiguity generated by an Ellsberg-urn-type mechanism. We find that subjects are averse to Ellsberg-urn-type mechanical ambiguity, preferring risk to ambiguity of this type. Attitudes toward social ambiguity, however, are reversed: subjects prefer social ambiguity to risk. Thus, we find ambiguity aversion toward mechanical ambiguity but ambiguity seeking toward social ambiguity. Moreover, the observed difference in ambiguity attitudes is wholly attributed to the difference in the motivational (preference) component. When we compare the cognitive (sensitivity) component, we find no difference. This underscores that people have a preference for social ambiguity.



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# Expected Subjective Value Theory: A representation of Decision in Time under Risk

*Agnieszka Tymula*

## Abstract

Over the past few years there has been growing interest in the notion that a representation involving divisive normalization (a canonical neural computation in sensory systems) normatively encodes option value in the brain. The divisive normalization algorithm has been shown to rationalize behaviors previously labeled as anomalous in economic theory, including violations of the independence of irrelevant alternatives (Louie, 2013). There is growing understanding that such anomalies in decision-making are in fact a result of an efficient value coding by a system that has limited neural resources (Glimcher, 2010; Woodford, 2012, 2014; Hunt et al, 2014). The implications of the efficient value coding through the divisive normalization algorithm have, however, not yet been carefully considered with respect to the decision making under risk. This paper presents a near-normative model of choice under risk that incorporates neurobiological constraints and costs into a traditional economic framework via divisive normalization. It yields an expected utility-like model that captures many of the behavioral phenomena around which prospect theory was built, but without recourse to a completely descriptive approach. The model defines the reference point as an adaptive mechanism that optimizes precision at expectation. It captures the same 'representative agent' choice behavior as prospect theory but unlike prospect theory also captures single agent behavior. It accounts for such behavioral phenomena as lack of a reflection effects on the individual level and the non-independence of loss aversion and risk seeking in individuals. It makes novel predictions about how risk attitudes and loss aversion depend on the history of experienced rewards - their timing, value and variation in a more normative fashion. It also captures heterogeneity in individual preferences related to individual differences in neural constraints (such as those present in aging or illness), thus allowing us to unify numerous previously observed associations between a host of brain changing variables and risk attitudes and loss aversion.



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## Repeated games in structured populations

*Matthijs van Veelen; Stefan Jagau; Julián García*

### Abstract

We explore evolutionary dynamics in repeated games, where matching is not necessarily uniformly random, but can also be assortative. In Van Veelen et al., PNAS, 2012 we have looked at repetition and assortment, restricting attention to pure equilibria and repeated prisoners dilemma's with "equal gains from switching". In García & Van Veelen, JET, 2016, we have looked at repetition only, allowing for finite mixtures and prisoners dilemma's with unequal gains from switching, but no assortment. Considering a richer set of stage games "also including coordination and anti-coordination games" and allowing for assortment gives a richer landscape of equilibria and dynamical behaviours, including cases where infinite mixtures become relevant as benchmarks, even for dynamics in finite populations.



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# Subjective Expected Utility Representations for Savage Preferences on Topological Spaces

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## Abstract

Economic decisions under uncertainty are often constrained by the restrictions imposed by their environment. For instance, consider a farmer who must make planting decisions without knowing the future temperature, rainfall, or sunshine. The outcomes of his various planting strategies, in terms of crop yields, are thus uncertain at the moment of choice. But furthermore, slight variations of the meteorological conditions will only result in slight variations in yields. Put differently, technological feasibility constraints impose continuous production plans: the farmer can only supply crop quantities that depend continuously on the meteorological conditions. Other examples where continuity with respect to uncertainty emerges as a technological constraint include the production of drinking water, hydroelectricity or solar power; the design of supply networks; the adoption of climate change policies or pollution abatement technologies. We study such situations of decision-making under uncertainty where feasibility constraints impose continuity restrictions on the available alternatives. More specifically, we provide an axiomatic treatment of Subjective Expected Utility (SEU) that is adapted to these situations. The uncertainty that affects a decision problem is given by a topological space of states of the world. The various possible consequences of decisions are given by a topological space of outcomes. Furthermore, we assume an exogenously given collection of continuous functions, or acts, from the state space onto the outcome space. This collection describes the set of all the theoretically conceivable alternatives that conform to the continuous technological constraints. The preferences of a decision-maker only rank these feasible acts. Thus, the classical Savage (1954) approach to SEU does not apply to such a restricted domain of acts. In this context, we identify a system of axioms on these preferences that characterize the existence and uniqueness of an SEU representation. In the representation, behavior is explained in terms of tastes and beliefs. Tastes take the form of a continuous utility function on the space of outcomes, thereby capturing the intuition that “similar outcomes” are assigned “similar utility levels”. Meanwhile, the specific form of beliefs depends on the topological assumptions made on the state space. For instance, if it is Hausdorff and compact, then beliefs are represented by a Borel probability measure. But, in general, beliefs take the form of what we call a credence. A credence on a topological state space is a finitely additive probability measure on a specific subdomain of the topology; namely, the Boolean algebra of regular events. Despite the restrictions we impose on both acts and events, we obtain an SEU representation where the utility function is unique up to positive affine transformation, and the credence (or Borel probability measure) is uniquely defined.



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## Job Search Behaviors under Risk and Ambiguity: An Experimental Test

*Isabelle Vialle; May Attalah; Olivier L'Haridon*

### Abstract

Most of the experimental literature on job search deals with decisions under risk (Braustein and Schotter, 1981, 1982, Cox and Oaxaca, 1989, 1992). Nishimura and Osaki (2004) show however that ambiguity might have non-trivial effect on search decisions. In this paper we use a laboratory experiment to study how risk and ambiguity impact search decisions. Our within-subject design is based on the standard job search model (Lippman and McCall (1976) and aims at eliciting both search durations and reservation wages. In order to explore job search behaviors under risk and ambiguity, we run two treatments that differ in the information about the probability of receiving an offer. For decisions under Risk subjects perfectly know this probability, while under Ambiguity there is an uncertainty about the probability of receiving an offer. By comparing behaviors between both treatments, we are able to determine if subjects behave differently under Ambiguity and under Risk. On average, we find subjects behave as ambiguity neutral agents, suggesting that ambiguity has not a strong impact on search decisions.



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## Certainty Preferences, Random Choice, and Loss Aversion

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### Abstract

I revisit recent evidence uncovering a preference for certainty in violation of dominant normative and descriptive theories of decision making under risk. I explore two alternative explanations of the preference patterns found: i) systematic noise; and (ii) reference dependence activated by salient outcomes. I develop choice lists that allow to disentangle these different explanations, and test them on rural subjects in southern India. The results reject explanations based on a preference for certainty in favor of explanations based on random choice. The estimates are further distorted by response mode effects, with loss aversion leading to an over-estimation of risk aversion.



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## What You See Is What You Bet

*Dmitri Vinogradov; Angela Izah; Ceri Watkins*

### Abstract

Decisions under uncertainty and risk depend on surrounding factors such as weather conditions, outcomes of sport competitions, TV shows (see, e.g. Baillon et al., 2014; de Martino et al., 2006; Edmans et al., 2007; Kamstra et al., 2003). Supposedly these factors affect people's mood and/or emotional state, and through that the decision-making process. Can exposure to a particular computer interface produce similar effects? A typical interface of a stock trading software uses black background, colourful fonts and graphical charts. We show that interface and context (investment task) differently affect attitudes to risk and attitudes to uncertainty. Remarkably, mood does not appear to channel the impact of environment on decisions; instead, this impact is likely to be channelled by cognitive abilities. The results come from three online random assignment experiments, in which subjects perform tasks traditionally used to measure their attitudes to risk (willingness to pay and willingness to accept) and ambiguity (standard 2-colour Ellsberg task is used to classify subjects into ambiguity-averse, -neutral and -seeking). The control group faces neutral questions (referring to lotteries and balls in the two urns) in a black font on a white background (neutral interface). In the first experiment, the treatment group faces questions that are numerically identical to those in the control group, yet formulated as an investment task and presented in the interface that mimics the colours used in security trading platforms (aggressive interface). In the second and the third experiments, there are two treatment groups: one faces investment-styled questions in a neutral interface (investment treatment), and the other one faces neutral question in the aggressive interface (aggressive treatment). In all experiments we ask subjects to assess their mood in the beginning and in the end of the experiment, using a five-point scale (from bad via neutral to good). In experiment 3 we additionally run a cognitive reflection test (CRT, see Frederick, 2005, and extension by Sinayev and Peters, 2015). Exposing subjects to investment framing produces a decline in risk aversion: an average subject is going for riskier options; the fraction of risk-averse subjects becomes about one third smaller. Aggressive interface alone has no effect on risk attitudes, however it reduces the fraction of ambiguity-averse subjects, whilst investment framing reduces the fraction of ambiguity-seeking participants. Both types of treatment raise the fraction of EU-compatible subjects (all significant at  $p < 0.05$ ). In this sense what people see does affect what they bet. The observed impact is linked to cognitive abilities but not mood. Neither the aggressive interface nor the investment framing impact mood; instead, treatments impact cognitive abilities, as measured by both the time spent on the survey and the CRT scores.



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## How Do Personality and Preferences Affect Complex Problem Solving?

*Benedikt Vogt*

### Abstract

I investigate the decision-making process during a cognitive test in a laboratory experiment in which students have to solve Raven matrices. The design allows me to distinguish between when someone knows the correct answer to a Raven matrix from submitting this answer. I find that openness to experience, neuroticism and an individual's risk preference are related to the speed of thinking during a test. Only an individual's discount rate is associated with the timing of an answer. This implies that there is potential to improve test performance by changing behavior.



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## Preference Reversal: a Common Behavior rather than an Individual Abnormal Conduct

*Bodo Vogt; Shi Xing Han*

### Abstract

This study aims to re-exam the preference reversal phenomenon individually of each subject rather than regard the subject group as a whole. The lottery pairs used in the elicitation questions include a P-bet and a \$-bet however with the value to win in \$-bet to be defined by the subject him/herself. The result indicates that although with large difference in frequency, every participant had a certain degree of preference inconsistency, which leads to the conclusion that preference reversal may be a common behavior rather than an individual abnormal conduct. Future research should aim to discover which personal characteristic has an impact on the extent of reversal.



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## Ambiguity Attitudes, Framing and Consistency

*Alex Voorhoeve; Ken Binmore; Arnaldur Stefansson; Lisa Stewart*

### Abstract

We use probability-matching variations on Ellsberg's single-urn experiment to assess both the sensitivity of ambiguity attitudes to framing and the consistency with which subjects display these attitudes within a single frame. Contrary to most other studies, we find very little change in ambiguity attitudes due to a switch from a gain to a loss frame; we also find that making ambiguity easier to recognize has little effect. Regarding consistency, we find that 28% of subjects are highly inconsistent choosers; roughly the same share are highly consistent. Ambiguity attitudes depend on consistency: ambiguity seeking is much more frequent among inconsistent choosers; consistent choosers are much more likely to be ambiguity neutral.



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## Measuring Ambiguity Attitudes for All (Natural) Events

*Peter Wakker*

### Abstract

Ambiguity attitudes have so far been measured only for artificial events, where subjective beliefs can be directly derived from symmetry arguments. For natural events such symmetry arguments are usually not available, creating a difficulty in calibrating subjective beliefs for them and, hence, for measuring ambiguity attitudes with respect to them. This paper introduces a control for subjective beliefs even when they are unknown, allowing for the measurement of ambiguity attitudes for all events, including natural ones. We introduce indexes of ambiguity aversion and ambiguity perception (or understanding) that generalize and unify many existing indexes. Our indices are theoretically founded, and easy to elicit in practice. In an experiment on ambiguity under time pressure, we obtain plausible results: time pressure affects people's perception and understanding of ambiguity but not their aversion. Our indexes are valid under many ambiguity theories and do not require expected utility for risk, which is desirable for empirical purposes.



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## Meta Analysis of Loss Aversion in Risky Context

*Lukasz Walasek; Neil Stewart; Tim L. Mullett*

### Abstract

Recent research has shown that the magnitude of loss aversion is highly dependent upon the environment in which choices and judgements are made (Walasek & Stewart, 2014). People exhibit large loss aversion when the typical values on offer are skewed such that the average gains are twice as large as the average losses. However, when there is no such skew people are loss neutral and when the skew is reversed people actually exhibit loss seeking behaviour. This has important implications for existing findings. We are presenting a meta-analysis of loss aversion in risky context. We collected data on choices and valuations of mixed gambles in an effort to estimate the loss aversion parameter using the same functional form of the Prospect Theory. Our findings indicate that the majority of papers examining loss aversion used values with a significant skew in the distribution of gains and losses. In addition, there is a significant correlation between the size of this skew and the degree of loss aversion reported. By taking this design characteristic into account, we were able to determine what is the average level of loss aversion reported in the literature. A critical finding is that the magnitude of loss aversion is partially driven by the distributions of gains and losses used in the elicitation task. Consistently with our earlier experimental work, studies that used asymmetric distributions of gains and losses (wide range of losses and a narrow range of gains) found a higher level of loss aversion. Our work offers an important review of the loss aversion literature. Numerous researchers simply assume that losses loom twice as large as gains, and use loss aversion to explain a range of behavioural phenomena. We point out to the limited evidence for this assertion. We find that the asymmetric weighting of gains and losses in risky context may be much weaker and that loss aversion can be partially a product of the experimental design.



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## Who to Hire, Optimists or Pessimists?: Optimal Contract Under Ambiguity

Qizhi Wang

### Abstract

Under ambiguity, where probabilities are unknown, Savage's model is not applicable for describing a decision maker's behaviour. Since no valid distribution can be obtained, ambiguity perception and ambiguity attitude are introduced to account for the decision maker's choice. In this paper, we use the Choquet Expected Utility (CEU) model with neo-additive capacity to study the optimal contract in an employment relationship. We find that 1) optimistic employees could bring more profit to the employer because they are more easily motivated; 2) any optimal contract may fail if ambiguity factors are neglected and 3) ambiguous monitors can be introduced to reduce the negative impact from pessimists. In our model, there is a principal who actually knows the objective success probability of a project and wants to hire agents to exert efforts into it. However, the principal may obtain such objective probability by rule-of-thumb or it is indeed tacit knowledge, which makes her unable to provide solid evidence to convince her employees (agents). Therefore, the employees are not fully convinced by this prior distribution and only put limit confidence in it, which makes it an ambiguous situation for them. Knowing the employees' ambiguity perception, the principal tries to maximize her expected profit by designing an optimal contract. In this paper, we analyse the consequences of the presence of ambiguity and provide some possible solutions to it. The intuition can be briefly summarised as follows. Firstly, since pessimists consider more about the worst situation which, in this case, is that their efforts do not increase the success probability very significantly, if outcome contingent wage scheme is used, they do not think their efforts can induce sufficient amount of increase in expected wages to cover the costs, so they would provide insufficient efforts. On the contrary, optimists consider more about the best situation and therefore more easily to be motivated. Secondly, as we have shown, personalities (e.g. ambiguity perception and ambiguity attitude) are too important to be omitted in optimal contract. If such factors are ignored by the employer, any contract will be vulnerable to some kinds of people. Thirdly, we propose a possible solution to motivate pessimists. If the employer initiates a regulator department which inspects employees irregularly and punish those who are found shirking, all employees will take such punishment as ambiguous as well. By creating such a threat, pessimists would try to avoid being caught shirking and be motivated consequently. This solution is interesting because more ambiguities are introduced to solve the problems brought by ambiguity. Based on these findings, further discussions are made. We explain why positive attitudes such as optimism are often praised in corporate cultures and provide a potential reason for why some start-ups have satisfying earnings in the beginning but then fail as they grow bigger.



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# How Real Is 'Hypothetical Bias' in the Context of Risk and Time Preference Elicitation?

*Reinhard Weisser*

## Abstract

This paper presents experimental evidence to which extent specific types of hypothetical risk and time preference questions are suitable to induce individuals to unveil their effective decision patterns. My work contributes to the literature in several ways: First, I calculate size and sign of hypothetical bias in the context of stated risk and time preferences. Second, I identify subject-specific factors which allow predicting magnitude and direction of this bias. Third, the previous step enables me to develop bias correction measures and to evaluate their effectiveness. Within the underlying experimental study, all groups have been asked to fill in simple and identical risk (gain and loss dimension) and time preference elicitation items at two points during the session. Whilst for the control groups all associated payoffs remained purely hypothetical, the decisions of participants in the treatment groups at the second point became payoff-relevant. Around the group-level findings I develop a bias model, consisting of four components: a random component, one resulting from task unfamiliarity, another one due to social desirability considerations, and the fourth as hypothetical bias in the narrower sense. I argue that social desirability does not play a prominent role since the study's designs ensures a sufficiently high level of anonymity, additionally the incentive-compatible payoff for the treatment groups should disperse this component. Those considerations yield the central equation for the estimation of within-subject bias, based on explanatory variables capturing the ability to cope with unfamiliar tasks (thus expected to reduce bias), and a second subset of explanatory variables, likely to exert a certain influence on decisions in an incentivised setup. One can observe the following tendencies: more conscientious individuals with an academic background overstate their degree of risk-affinity in a one-shot hypothetical question. Individuals with a larger available budget tend to understate their risk attitude. The size of an individual's budget exerts a significant effect on bias in the context of time preference elicitation, too. Financially less restricted subjects tend to underreport their switching point, which implies they actually discount more heavily or have a higher degree of present bias than stated in a one-time, hypothetical framework. The same holds true for respondents who are less self-reliant. This within-subject analysis allows the identification of subject-specific bias predictors, which can be used to test the effectiveness of potential bias correction measures as strategy to improve item reliability. Evaluated bias correction procedures do not yield a gain in precision for stated time preferences and the loss domain in the case of risk attitude. However, there results a substantial increase in precision in the gain domain, which underscores respondents' sensitivity to the framing of presented items.



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## Experimental Evidence about Local Adaptation to Background Risk

*Marc Willinger; Charlotte Faurie; Clément Mettling; Mohammed Ali Bchir; Danang Sri Hadmoko; Michel Raymond*

### Abstract

Recent experiments on risk-taking found that most student-subjects are risk-vulnerable (Beaud & Willinger, 2015) in support of the risk-vulnerability (RV) hypothesis. According to the RV hypothesis, individuals who are exposed to an unfavourable background risk take less risk than individuals who are unexposed to such risk. RV might also prevail outside the lab, i.e. most people may treat independent risks as substitutes rather than as complements (Gollier & Pratt, 1996). We provide new field evidence about the RV hypothesis by eliciting risk preferences of respondents who are exposed to an active volcanic background risk, in an area where eruptions frequently arise (nearly every 5 years on average over the last centuries). We elicited risk-aversion on the basis of a simple portfolio choice task (Gneezy & Potters, 1997) for which the respondents had to allocate their endowment between a safe and a risky asset. We also asked respondents to provide (on a voluntary basis) a saliva sample which was used to identify an eventual local genetic adaptation to the risky area. Specifically, we focus on the dopamine receptor gene (DRD4) associated with attitude toward risk. The experiment was replicated in a “safe” area which we use as a control. Humans have colonized extremely diverse environments, in which genes specifically adapted to these environments are most likely to have evolved. These genes could be adapted to the physical environment through a permanent physiological change, e.g. high altitude adaptation (Beall, 2006; Yi et al. 2010). Alternatively, a behavioural change “often expressed in specific contexts” could also trigger local adaptation. There are numerous genes known to influence behaviours, such as alleles at the dopamine receptor locus D4 (DRD4) associated with the attitude toward risk in experimental settings (Dreber et al., 2009). Yet, no selection acting on such genes has been described so far. We demonstrate the existence of a local adaptation in natural environments with a sharp variability in background risk: the surroundings of Mount Merapi, an active volcano of Central Java (Indonesia). We found that in the exposed area the ancestral and major DRD4 allele 4R is at a lower frequency and the minor 2R allele at a higher frequency as compared to the close-by non-risky area, while we found no genetic differentiation for 5 microsatellite loci. Behavioural tests confirmed that individual genotypic composition at the DRD4 locus is linked to experimentally measured risk tolerance. This is the first evidence in humans that local adaptation occurred for a behavioural trait with a genetic basis.



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# Estimating a Structural Model of Smooth Ambiguity Aversion: a Joint Maximum Likelihood Approach

*Hong Il Yoo; Morten Igel Lau; Jimmy Martínéz-Correa*

## Abstract

Several theories address decision making under ambiguity (e.g., Machina and Siniscalchi, 2014 and references therein). Ambiguity refers to cases where the true probability distribution of outcomes is unknown to the decision maker, and "risk" refers to cases where it is known. Most popular models of ambiguity aversion assume that the decision maker has multiple prior beliefs regarding the true distribution of outcomes from an uncertain event, and acts from a set of multiple subjective probability distributions instead of one distribution. The smooth ambiguity aversion model (SAAM) of Klibanoff et al. (2005) has attracted a lot of attention, for its intuitive appeal and analytic tractability. But only a few studies have estimated this model structurally (e.g. Conte and Hey, 2013) despite the growing interest in structural estimation of other ambiguity aversion models that consider a particular subset of prior beliefs (Hey et al. 2010, Hey and Pace 2014, Kothiyal et al. 2014, and Stahl 2014). The SAAM assumes that the decision maker forms a second-order probability distribution over the full set of prior beliefs. S/he first evaluates the expected utility from each belief, and then forms a subjective probability distribution over expected utilities from the full set of beliefs. Estimating the SAAM requires disentangling ambiguity aversion from other latent parameters that influence decision making under ambiguity, and may be confounded with ambiguity aversion. These include the measures of "risk" aversion, and the subjective second-order probability distribution. We develop an empirical approach that can, together with the experimental design of Abdellaoui et al. (2015), identify ambiguity aversion and other latent parameters of the SAAM. Their design features a series of decision tasks involving simple risk, compound risk (with variation in complexity), and ambiguity. Our approach builds on the joint maximum likelihood approach to disentangle risk and time preferences (Andersen et al., 2008). Since the different types of tasks are better (or uniquely) suited to identifying different latent parameters in the SAAM, the joint use of those tasks allows one to estimate the model under less restrictive assumptions than previously made. For example, one can avoid equating ambiguity aversion with compound risk aversion, and also avoid experimentally induced second-order probability distributions. We use maximum simulated likelihood to allow for unobservable preference heterogeneity. Our preliminary results using the dataset of Abdellaoui et al. (2015) look plausible and promising. When ambiguity entails complete lack of information on the true outcome distribution, the average decision maker behaves as if s/he assigns almost identical second-order probabilities to all outcomes in the decision task. S/he also is averse to ambiguity and high complexity compound risk, and is less averse to simple risk and other types of compound risks.



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## Trust and Verify: The Informational Value of Early Trust

Michael Yu; Cleotilde Gonzalez

### Abstract

Knowing who to trust helps us to capture the benefits of trusting while avoiding the costs of betrayal. Learning who to trust, however, is often confounded with the decision to trust. When interacting with a new person, concerns of betrayal could lead us to avoid trust and forgo information on whether the person is trustworthy. In relationships defined by repeated interactions, early avoidance of trust could lead to delays in trust development. Across two studies, we examine the impact of initial trust behaviors in a repeated Trust Game using simulated partners who are either always return points or always keep points and who are paired with photographs that are pretested as either appearing trustworthy or untrustworthy. In Study 1, participants required to engage in initial trust made participants more sensitive to their partner's behavior early in the repeated interactions than participants who were free to choose. These findings were driven by participants matched with partners who returned points but had an untrustworthy appearance. Study 2 focused on partners who returned points but had an untrustworthy appearance. Participants asked to "find out" about such partners' behavior in their initial interactions were more likely to send points to their partners early in repeated interactions than participants who were free-to-choose. However, these participants were no more likely to expect their partners to return points. In contrast, an intervention in which participants were asked to take the perspective of their partner resulted in less significant increases in the likelihood to send points and did significantly increase expectations of their partner returning points. Our results suggest that a simple information-seeking intervention can promote trust development without changing expectations of trustworthiness. This form of intervention might be useful in environments where new trust-based partnerships may need to be formed and could better reflect the goals of developing trust rather than simply increasing it.



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# Aspiration Levels, Probability of Winning and Positive Skewness in Choices under Risk

*Francesco Zaffuto; Giorgio Coricelli; Enrico Diecidue*

## Abstract

This paper describes an experiment designed to study the effect of aspiration levels on individual choices under risk. Aspiration levels are values greater than a threshold that divides the outcomes in gains or losses. Our experimental conditions can be divided in two groups. In the first group there are conditions with pair of prospects having the same expected value but different probabilities of winning and losing. In one condition both prospects are mixed. In another condition one prospect is mixed and the other one has a probability of winning equal to zero. In a third condition, one prospect is still mixed while the other one has a probability of winning equal to one. Comparing these conditions we observe a preference reversal effect explained by the overall probability of winning. In the second group there are conditions with pair of prospects having the same expected value but different possibilities of achieving aspiration levels. There are conditions where both prospects provide the possibility to achieve aspiration levels, conditions where only one prospect can lead to aspiration levels and other conditions where in both prospects it is not possible to achieve aspiration levels. In conditions where only one prospect provides the possibility to achieve aspiration levels, we observe preferences for that prospect. The resulting choice patterns characterize a heuristic for reducing the complexity of risky decisions. In cases where aspiration levels are not predictive, choices can be explained by preferences for positive skewness. Our results confirm the efficacy of a two-pronged approach that includes both compensatory (e.g. preferences for positive skewness), and simplifying strategies (e.g. aspiration levels) for choosing among risky prospects. Our model fitting suggests that among the standard models of choice under risk, cumulative prospect theory best fits our experimental data.



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## The Loss Attitude Function

*Horst Zank*

### Abstract

A two-stage model for aggregating choice behavior over the gain component of a prospect with the choice behavior over the corresponding loss component is proposed. Choice behavior among pure gain prospects and that among pure loss prospects is similar to prospect theory using corresponding probability weighting functions and a pure utility function for outcomes. A mixed prospect, which includes both gains and losses, is treated as a two-stage object of choice that gives a conditional pure loss prospect and a conditional pure gain prospect at stage two. Mixed prospects are evaluated recursively: prospect theory is applied to each conditional component, leading to a reduced one-stage simple prospect giving positive probability to one gain and positive probability to one loss; this simple prospect receive a second application of prospect theory. The resulting model is a recursive extension of prospect theory that accounts, among other aspects of behavior, for attitudes towards the overall probabilities of losing and of gaining. Additionally, the loss attitude function is introduced, which formally models loss aversion by combining the pure utility for gains with the pure utility for losses when evaluating mixed prospects.



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# Intertemporal Consumption with Risk: A Revealed Preference Analysis

*Songfa Zhong; Joshua Lanier; Bin Miao; John Quah; Songfa Zhong*

## Abstract

**Motivation:** Many important economic decisions involve agents choosing among risky consumption streams. The canonical way of representing preferences in this context is to combine the expected utility and discounted utility models into what is known as the discounted expected utility (DEU) model. DEU functions are additive across dates and across states. While this model has the advantage of simplicity, it has a strong implication: the coefficient of relative risk aversion is the reciprocal of that of intertemporal substitution. Partly because this relationship has been repeatedly confounded by data, alternative models have been proposed by various authors (for example, Selden (1978), Epstein and Zin (1989), Chew and Epstein (1990) and Halevy (2015)). These models depart from DEU either by dispensing with separability across states or separability across time. In this paper, we report a new experiment that was designed to elicit preferences of subjects over risky consumption streams. Our objective is to cast light on the precise ways in which agents depart from the DEU model and to adjudicate among various alternative hypotheses on the structure of individual preferences. **Experimental Design:** Every subject in our experiment is allocated 100 tokens with which to purchase four commodities, where each commodity pays out in state  $s$  at time  $t$ , where there are two equiprobable states and two time points corresponding to one week and nine weeks later. By varying the prices of these commodities, we obtain more than 40 different budget sets, and every subject makes an allocation decision for each budget set. **Analysis:** Eliciting preferences from budgetary decisions is not an uncommon experimental practice, but ours is the first experiment in which subjects choose among affordable alternatives where payoffs vary in both state and time. At the most general, we can ask whether the subject is maximizing some utility function defined over the four state-time commodities. The most stringent hypothesis is to require the utility function to have the DEU form. Between these two extremes, one could posit that the utility function is separable over time or over states and (maybe) impose structural assumptions on the sub-utility functions or on the aggregator function. Throughout the paper, we apply (non-parametric) revealed preference methods to test these alternative hypotheses. Afriat's Theorem provides the basic test of consistency with utility-maximization while more recently developed methods are employed to test for further restrictions on the utility function, such as separability (Quah, 2014) or additive separability (Quah, Polisson, Renou, 2015). Our results broadly support the separation of preferences across states but not across time. Furthermore, restricting the sub-utility function (defined over intertemporal consumption) to be the same in the two states and to display positive time preference is also consistent with the data.



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