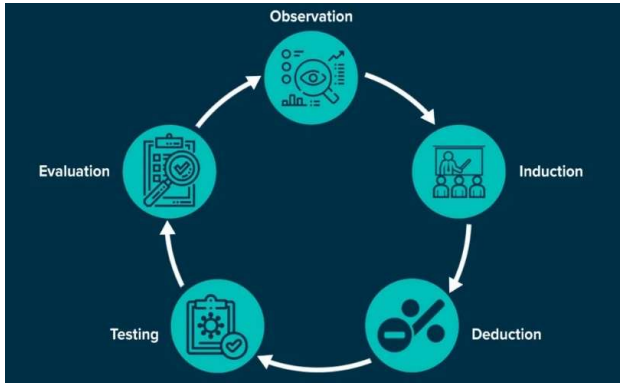
Empirical research in management and economics
Exercise

Thorsten Pachur, Linus Hof, Rebecca West, Sebastian Hellmann, Nuno Busch

Technical University of Munich
School of Management
Chair of Behavioral Research Methods



Exercise I: Scientific news in the media

Do hungry people take bigger financial risks?

https://archive.nytimes.com/economix.blogs.nytimes.com/2010/06/29/do-hungry-people-take-bigger-financial-risks/

Tasks (work in groups of 3-5)

- Find the original article (Symmonds et al., 2010; openly available online)
- Evaluate the methodology used in the study
  - Participants: e.g., How large is the sample size? How were participants recruited? Who were they?
  - Measure of risk taking: e.g., Do you find that the measure of risk taking used is adequate?
  - Experimental manipulation of hunger: e.g., Is it adequate?

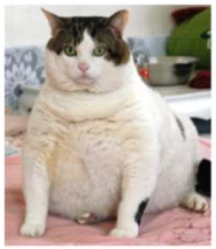
→ Discuss how these methodological aspects might affect the generalizability of the results

→ Does the media report reflect the study findings accurately?

Do Hungry People Take Bigger Financial Risks?

BY CATHERINE RAMPELL JUNE 29, 2010 2:27 PM 9

Forget the Volcker Rule, a Tobin tax, bonus caps and other Washington proposals intended to make our financial system more stable. Maybe what Wall Street's risk-loving bankers really need is a better diet.



Maybe the "Wall Street fat cats" are being kept too hungry?

That is one possible implication of a fascinating new study, which finds that people who are hungry are more risk-seeking, and people who are sated are more risk-averse.

Researchers put study subjects on different diets to affect their metabolic states, and then week after week gave them options to participate in different kinds of lotteries. Some of the lotteries were riskier than others, in terms of their expected and potential payouts. Generally speaking, when subjects were in hungrier states, they chose the riskier lottery options, and when they were full, they choose safer lotteries.

The authors suggest that this means metabolic states, and the hormones associated with them, can affect our appetite for all sorts of risks. From the study:

> Changes in metabolic state systematically altered economic decision making ...
>
> A direct comparison can be made with Prospect Theory, where changes in wealth below a reference point induce risk-seeking behaviour, while earnings above a reference point promote risk-aversion. Similar reference-dependent change in risk attitude for food rewards has also been seen in animals.

The study is based on a small sample — about 20 students — but it seems destined to inspire further research on the evolutionary advantages of financial risk-taking. You can find a full description of the study, replete with all sorts of technical, neurobiological terminology, at the PLoS ONE site.

(Hat tip: Deric Bownds)

OPEN ACCESS Freely available online

PLoS one

Metabolic State Alters Economic Decision Making under Risk in Humans

Mkael Symmonds[1*¶], Julian J. Emmanuel[2¶], Megan E. Drew[2], Rachel L. Batterham[2], Raymond J. Dolan[1]

1 Wellcome Trust Centre for Neuroimaging, Institute of Neurology, University College London, London, United Kingdom, 2 UCL Division of Medicine, Department of Metabolism and Experimental Therapeutics, University College London, London, United Kingdom

Abstract

Background: Animals' attitudes to risk are profoundly influenced by metabolic state (hunger and baseline energy stores). Specifically, animals often express a preference for risky (more variable) food sources when below a metabolic reference point (hungry), and safe (less variable) food sources when sated. Circulating hormones report the status of energy reserves and acute nutrient intake to widespread targets in the central nervous system that regulate feeding behaviour, including brain regions strongly implicated in risk and reward based decision-making in humans. Despite this, physiological influences per se have not been considered previously to influence economic decisions in humans. We hypothesised that baseline metabolic reserves and alterations in metabolic state would systematically modulate decision-making and financial risk-taking in humans.

Methodology/Principal Findings: We used a controlled feeding manipulation and assayed decision-making preferences across different metabolic states following a meal. To elicit risk-preference, we presented a sequence of 200 paired lotteries, subjects' task being to select their preferred option from each pair. We also measured prandial suppression of circulating acyl-ghrelin (a centrally-acting orexigenic hormone signalling acute nutrient intake), and circulating leptin levels (providing an assay of energy reserves). We show both immediate and delayed effects on risky decision-making following a meal, and that these changes correlate with an individual's baseline leptin and changes in acyl-ghrelin levels respectively.

Conclusions/Significance: We show that human risk preferences are exquisitely sensitive to current metabolic state, in a direction consistent with ecological models of feeding behaviour but not predicted by normative economic theory. These substantive effects of state changes on economic decisions perhaps reflect shared evolutionarily conserved neurobiological mechanisms. We suggest that this sensitivity in human risk-preference to current metabolic state has significant implications for both real-world economic transactions and for aberrant decision-making in eating disorders and obesity.

Citation: Symmonds M, Emmanuel JJ, Drew ME, Batterham RL, Dolan RJ (2010) Metabolic State Alters Economic Decision Making under Risk in Humans. PLoS ONE 5(6): e11090. doi:10.1371/journal.pone.0011090

Editor: Laurie Santos, Yale University, United States of America

Received April 29, 2010; **Accepted** May 12, 2010; **Published** June 16, 2010

Funding: This work was supported by a Wellcome Trust Programme Grant to RJD. JE is in receipt of a Medical Research Council Training Fellowship. RLB receives funding from the UCL/UCLH Comprehensive Biomedical Research Centre. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: mkaellh@doctors.org.uk

¶ These authors contributed equally to this work.

Introduction

Prospect Theory, one of the most influential descriptive theories of decision-making under risk, emphasises that risk-attitude in humans is reference-dependent [1]. When choosing between options yielding gains, humans are on average risk-averse (i.e. and energy stores in the face of this environmental variability is critical for survival and reproduction [4,5,6,7,8].

Circulating hormones report the status of body energy reserves (e.g. adipose tissue), energy requirements, and acute nutrient intake to targets in the central nervous system that regulate feeding behaviour, including brain regions implicated in human decision-

Materials and Methods

Subjects

Twenty four, healthy, normal-weight, male volunteers were recruited (mean age: 25±7 years; BMI: 22.6±1.7 kg/m2; Table S1). One subject was excluded because of baseline fasting hyperglycaemia, another dropped out after the first week, and three excluded because of technical problems. Thus, 19 subjects' data were included in the final behavioural analysis. From these, one subject had haemolysed blood samples for a relevant timepoint, which renders hormonal assay inaccurate, and is excluded from the endocrine analyses. Volunteers provided informed consent and this study was approved by the University College London Research Ethics Committee.

Study Protocol

Participants attended a preliminary session, where anthropometric measurements were taken (height with a stadiometer, weight and percentage body fat with Tanita scales (Tanita, Hoofdrrop, Netherlands), and subjects received verbal and written information familiarizing them with the experimental procedure and visual analogue scores (VAS). VAS assessed hunger, fullness, prospective food consumption, sickness and anxiety [26,27], and were 100 mm long with positive and negative text ratings anchored at each end. The day before testing sessions, subjects followed a standardization protocol [28], involving refraining from alcohol and strenuous exercise and consuming an 774 kcal meal between 19:30 and 20:30. Subjects then fasted and drank only water until attending our clinical facility the following morning. On each study day subjects arrived at 9:00 and an ante-cubital arm vein was cannulated (t = −60 min) for subsequent blood sampling. After relaxing for one hour post-cannulation, baseline blood samples were taken and subjects completed visual analogue scores (VAS) (t = 0 min). Blood samples were drawn and subjects completed VAS, every 30 minutes from t = 0 until t = 210 min. At t = 60 min subjects consumed a standardized 2066 kcal meal within 30 mins (Figure 1 and File S1).

Testing was undertaken in three different feeding states: fasted (t = 0 to t = 60 min), immediately post-meal (t = 90 to t = 150 min) and 60 minutes post-meal (t = 150 to t = 210 min). Subjects

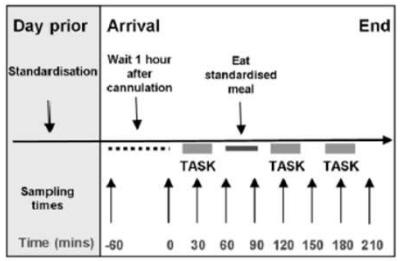


Figure 1. Sequence of each experimental session. Testing was performed at fasting (t = 0 to 60 mins), just after a meal (t = 90 to t = 150 mins), and 1 hr after feeding (t = 150 to t = 210 mins) Hormonal assays and visual analogue scale ratings were taken every 30 mins.
doi:10.1371/journal.pone.0011090.g001

performed one of three different decision-making tasks within each hour to ensure that cognitive demand was the same throughout the experimental session. Each task was performed once in each week, in randomised order. These comprised a risk-preference elicitation task using paired lotteries (see below), and two additional tasks (see File S1). Each task took approximately 30 +/−5 mins to complete. Importantly, behavioural measures were correlated with hormone levels and VAS from the nearest 30 min sampling point, ensuring that assay titres corresponded with an accurate reflection of hormonal status whilst performing the cognitive task.

Risk-preference Paradigm

We employed a multiple paired lottery choice task, presenting a sequence of 200 paired lotteries (Figure 2; Table S2), with subjects required to select one preferred option per pair [29]. Lotteries were constructed by varying the probabilities over six fixed monetary prizes (£0, £20, £40, £60, £80, £100), represented as four cards with one of these amounts displayed upon each card. Thus, the probability of each prize could be varied in 0.25 increments (0, 0.25, 0.5, 0.75, 1). Each week, subjects were exposed to the same set of lotteries. The left-right on-screen position of the lotteries, and position of the 4 cards within each lottery were randomised, to ensure attention to the task, and to avoid response habituation. On debriefing, no subject reported realising that the lottery sequences were the same across the three weeks. The lottery list was constructed on the assumption that individuals are on average risk-averse – hence most offers were between a safer lottery with lower expected value (EV), and a riskier (higher variance) lottery with higher EV, allowing us to maximise power for discriminating small but consistent state-dependent differences in risk-preference within-subjects while maintaining the same lottery set across subjects. Lotteries were presented on a laptop computer screen, and keypress responses recorded using Cogent 2000 software (Wellcome Trust Centre for Neuroimaging, London).

Behavioural analysis

Our primary measure was the percentage of riskier vs less risky choices made in each week by every subject. Risk was quantified by the variance of lottery prizes about the mean value [30,31]. This percentage measure provides an indication of any consistent changes between metabolic states across subjects. As the sets of paired lotteries are identical across subjects and sessions, any differences between states reflect changes in decision criteria. We also implemented a logistic regression model to separately analyse changes in sensitivity to EV and variance across states. This enabled us to describe changes in risk-return tradeoff, estimate absolute risk-preferences, and the degree of choice noisiness. Statistical analysis was implemented in MATLAB (version 6.5, MathWork, Natick, MA), and SPSS (SPSS for Windows, Rel. 12.0.1. 2001. Chicago: SPSS Inc.). For one subject, an extended list of 360 paired lotteries was used for the first two sessions, and the reduced list of 200 lotteries used on session three. We excluded this subject when analysing choice percentages (as these will depend upon the set of choices), but included these data in model based analyses (as model parameter estimation is possible for either choice set).

Decision-making model

In addition to the summary percentage of risky choice, we derived an absolute measure for risk-preference in each state by fitting a mean-variance logistic regression model (see Appendix S1).

Results

Metabolic state measures

Our paradigm was effective at manipulating subjective ratings of hunger and inducing significant concurrent changes in acyl-ghrelin levels (Figure 3A). There was a highly significant change in self-reported visual analogue scores (VAS) for hunger over the eight measured timepoints, before and after the meal, and across subjects (two-way repeated measures ANOVA (week, timepoint),

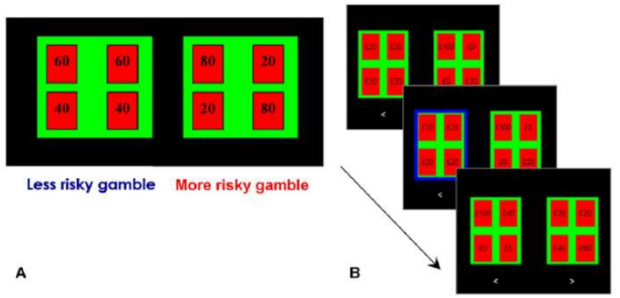
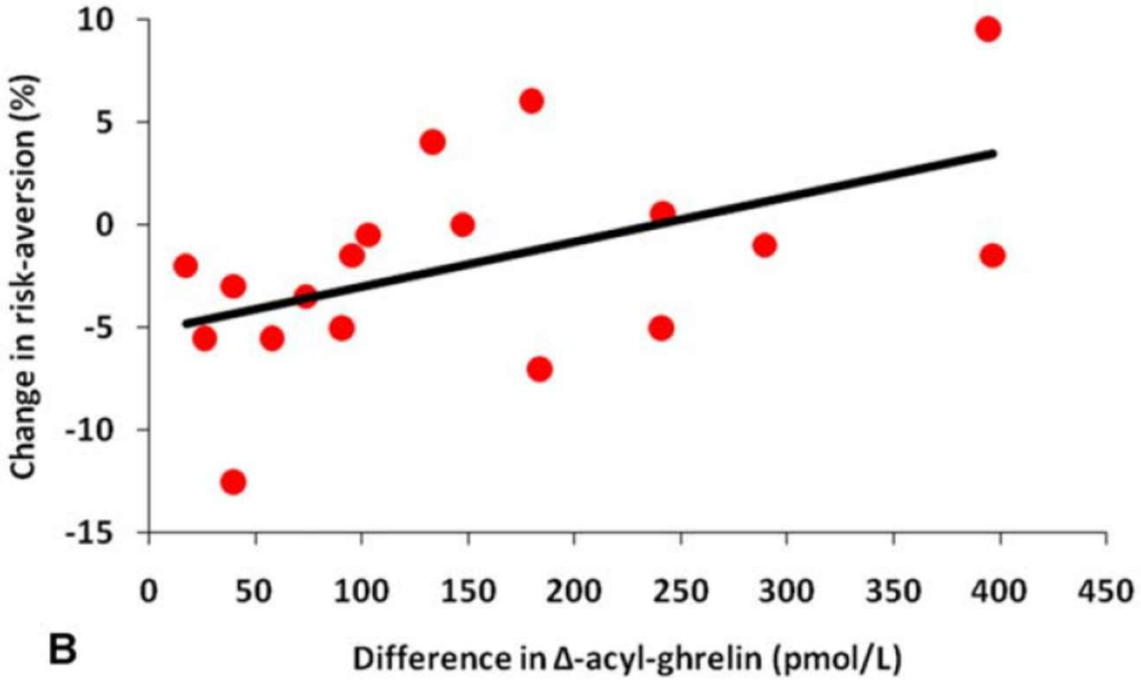


Figure 2. Risk preference task. A. On every trial, a choice between two lotteries was presented on-screen, and subjects were required to select their preferred option from each pair. Lotteries were represented as four cards, with a numerical display of one of six fixed monetary prizes (£0, £20, £40, £60, £80, £100). Each card had an equal chance of being picked. B. The same set of 200 sequential paired lotteries were presented on each visit. Subjects had unlimited time to make a button-press response – the selected lottery was then highlighted on screen with a blue border, before the next trial ensued. No feedback was given about lottery outcomes during the task.
doi:10.1371/journal.pone.0011090.g002

Effect of eating on risk aversion



Exercise II: Small group discussion

A study showed that 7 percent of “Grade A” students smoke, while nearly 50 percent of “Grade D” students do.

(a) List six factors—rank ordered by plausibility—that you think affect the grades achieved by a student. Is smoking on your list?

(b) If smoking is not a likely cause of poor grades, what might be reasons that the results from the study were nevertheless obtained?

(c) Assuming the findings of the study hold, would it be appropriate to expect that “Grade D” students who give up smoking will improve their grades? Why or why not?