

(Behavioral) Decision Making

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Bojos per l'Economia! 2026

Introduction

- ▶ Economics is built on the basis of a model of **individual behavior**
 - ▶ The atom in economics is the individual
 - ▶ Starting from a model of individual behavior, economics studies topics as diverse as industrial organization, financial markets, the monetary system, economic development, social choice, political economy, etc.

Outline

1. Rational model of choice

1.1 Principles of rationality

1.2 Utility representations

1.3 Especial domains: Risk, Time, Social preferences

2. Behavioral economics

2.1 Psychology and economics

2.2 Experimental economics

2.3 Three models:

2.3.1 Prospect theory

2.3.2 $\beta - \delta$ preferences

2.3.3 Social preferences

Part I: Rational model of choice

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 - ▶ It should guide in the optimal decision-making
- ▶ It should be falsifiable
 - ▶ We should be able to empirically falsified its predictions

Rational model of choice

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$$\max_{x \in A} U(x)$$

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- ▶ A : set of available alternatives at the time of deciding
- ▶ U : utility function, $U : X \rightarrow \mathbb{R}$, represents the preferences of the individual over all the possible alternatives X

$$U(x) \geq U(y) \Leftrightarrow xPy$$

- ▶ \max : the individual seeks the best interests that she can attain, given her own view on them

Rational model of choice (2)

$$\max_{x \in A} U(x)$$

- ▶ It respects the preferences of the individual (U), and it is difficult to conceive a simpler, more practical and operational mathematical representation of individual preferences
- ▶ It guides on how choices should be optimally made (\max), given the preferences of the individual and the restrictions
- ▶ It has sound mathematical foundations, as we will discuss next
- ▶ Is it a good description of actual individual behavior? This is an empirical question we will address in the second part of this lecture

Principles of rationality

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Transitivity:

IF [xPy and yPz] THEN

Principles of rationality

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Principles of rationality

Transitivity:

IF $[xPy \text{ and } yPz]$ THEN $[xPz]$

Completeness:

For every $x, y \in X$ either $[xPy]$ or $[yPz]$ or both

A representation theorem

A representation theorem

Theorem:

Let X be a finite set of alternatives. Preferences P on X satisfy **Transitivity** and **Completeness** **if and only if** there exists a utility function U that represents P .

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- ▶ Time: $x = (t_1, \dots, t_n; y_1, \dots, y_n)$
 - ▶ Exponential discounted utility:
 $U_{ed}(y, t) = \delta^{t_1} u(y_1) + \dots + \delta^{t_n} u(y_n)$

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 - ▶ **Exponential discounted utility:**
 $U_{ed}(y, t) = \delta^{t_1} u(y_1) + \dots + \delta^{t_n} u(y_n)$
- ▶ **Others:** strategic situations, distributive preferences, ambiguity, etc.

Wrap up Part I: Rational model of choice

- ▶ Elegant, simple model of individual decision-making
- ▶ Well founded mathematically
- ▶ Portable to very diverse situations
- ▶ Positive and normative considerations
- ▶ Empirically valid?

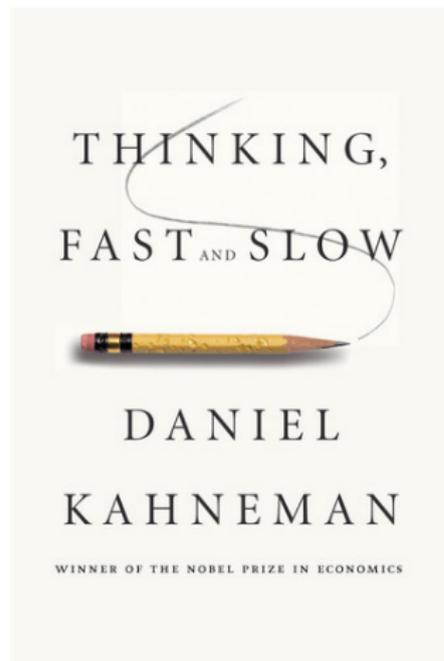
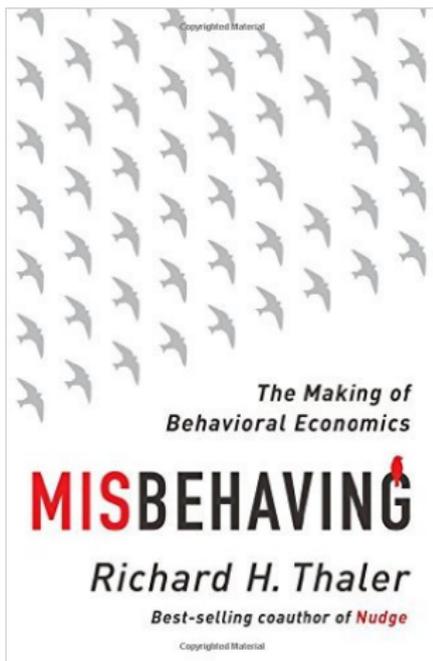
Part II: Behavioral economics

Psychology and Economics

$$\max_{x \in A} U(x)$$

- ▶ There is very little psychology in this model
- ▶ The three main elements of the model, U , A , and \max , are being challenged empirically
- ▶ Ultimate aim: to offer operational models of individual behavior, with sound psychological foundations
- ▶ Tools, approaches:
 - ▶ As in the rational economic model of choice: sound mathematical foundations
 - ▶ Empirical and experimental approaches
 - ▶ Learn from neighboring sciences: (Cognitive) Psychology, Sociology, Neurosciences, Biology, Computer Science,...

Recommended readings



Experimental Economics

Experimental Economics

- ▶ A controlled situation in which individuals take actions according to some pre-specified rules which determine their payoffs.
- ▶ Random assignment to treatment and control: causality
- ▶ Treatment and control should differ in just one dimension: avoid confounds
- ▶ Voluntary participants, economically incentivized

Prospect Theory

Prospect Theory

- ▶ Kahneman and Tversky (1979, *Econometrica*): one of the most cited papers in the history of all the social sciences
- ▶ One of the very first models that incorporates psychological phenomena into a model of decision-making, in the spirit of economic modelling
- ▶ Represents the start of behavioral economics
- ▶ Still today a very active research topic, both theoretically and empirically

Asian disease

Asian disease

- ▶ Imagine the Government is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed.
 - ▶ **Program A**: 200 people will be saved.
 - ▶ **Program B**: there is $1/3$ probability that 600 people will be saved, and $2/3$ probability that no people will be saved.

Asian disease (2)

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- ▶ Imagine the Government is preparing for the outbreak of an unusual Asian disease, which is expected to kill 600 people. Two alternative programs to combat the disease have been proposed.
 - ▶ **Program A:** 400 people will die.
 - ▶ **Program B:** there is $1/3$ probability nobody will die, and $2/3$ probability that 600 people will die.

Asian disease (3)

- ▶ Results

- ▶ Presentation 1: program A chosen by 72% of subjects (out of 152).
- ▶ Presentation 2: program A chosen by 22% of subjects (out of 155).

Experiment: Lottery choices

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- ▶ **Scenario 1:** In addition to whatever you own, you have been given 1000. You are now asked to choose between receiving 500 for sure or 1000 with probability 0.5.

Experiment: Lottery choices (2)

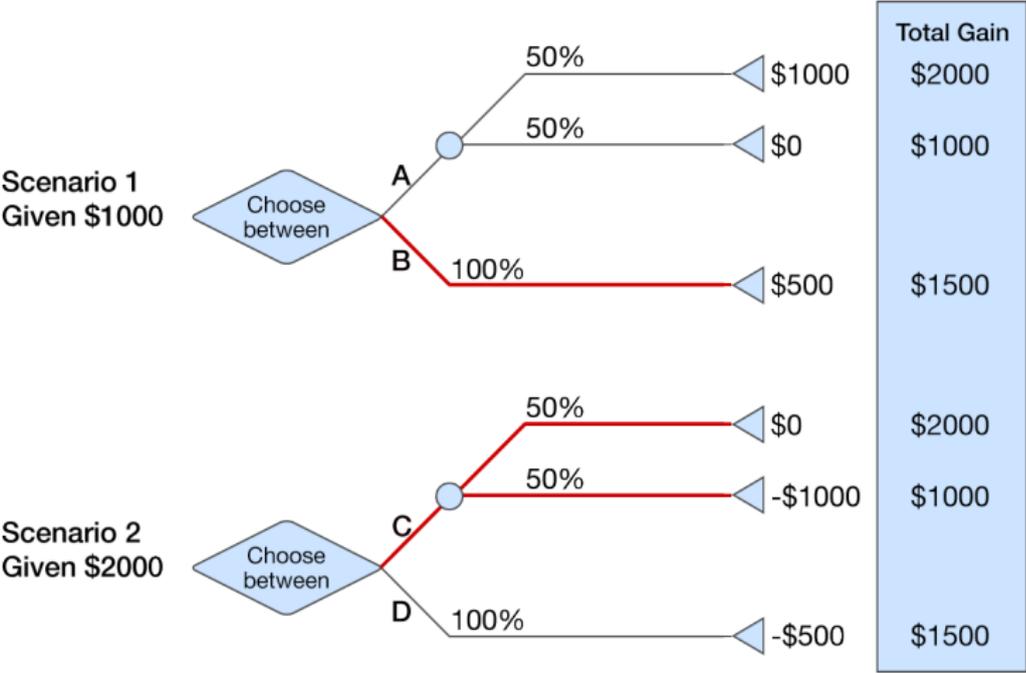
Experiment: Lottery choices (2)

- ▶ **Scenario 2:** In addition to whatever you own, you have been given 2000. You are now asked to choose between losing 500 for sure or 1000 with probability 0.5.

Experiment: Lottery choices (3)

- ▶ **Scenario 1:** In addition to whatever you own, you have been given 1000. You are now asked to choose between receiving 500 for sure or 1000 with probability 0.5. [16% choose the lottery]
- ▶ **Scenario 2:** In addition to whatever you own, you have been given 2000. You are now asked to choose between losing 500 for sure or 1000 with probability 0.5. [69% choose the lottery]

Experiment: Lottery choices (3)



Behavioral concept 1: Framing

- ▶ The precise presentation of the decision problem may matter, to a large degree.
- ▶ Framing the situation in terms of either **gains** or **losses** affect behavior in very particular ways:
 - ▶ **Gains**: induce risk aversion
 - ▶ **Losses**: induce risk loving

Behavioral concept 2: Loss aversion

- ▶ People are much more sensitive to losses than to gains of the same magnitude, and are willing to take more risks to avoid losses
 - ▶ Experiments with monkeys

Experiment: Valuation of goods

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- ▶ 50% of subjects are randomly allocated an object, a coffee mug
- ▶ The other half is allocated no object
- ▶ Ask for their evaluation of subjects (WTP/WTA)

Experiment: Valuation of goods (2)

- ▶ 50% of subjects are randomly allocated an object, a coffee mug
- ▶ The other half is allocated no object
- ▶ Ask for their evaluation of subjects (WTP/WTA)
- ▶ Results:
 - ▶ First group, with the coffee mug (WTA): \$5.25
 - ▶ Second group (WTP): \$2.25

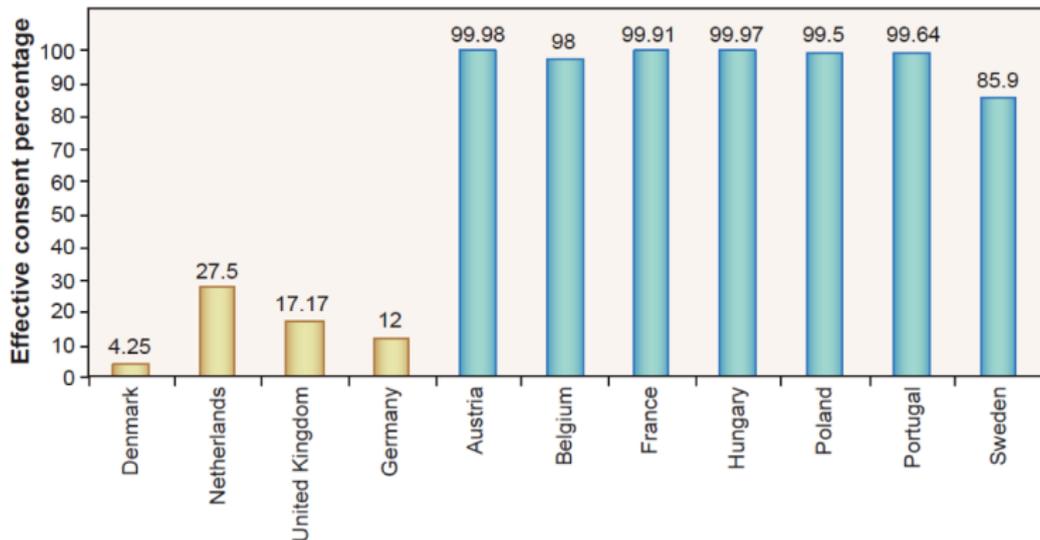
Experiment: 401(k) plans

- ▶ Most important retirement income after social security in the US
- ▶ Variation of enrollment into a plan in a given company:
 - ▶ **Automatic**, by default, to a given plan
 - ▶ **Active choice** of plan, from a menu of possible plans

Experiment: 401(k) plans (2)

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- ▶ Variation of enrollment into a plan in a given company:
 - ▶ Automatic, by default, to a given plan
 - ▶ Active choice of plan, from a menu of possible plans
- ▶ **Results:** automatic enrollment has a 50% higher enrollment rate

Empirical finding: Organ donations



Effective consent rates, by country. Explicit consent (opt-in, gold) and presumed consent (opt-out, blue).

Behavioral concept 3: Default Effects/Status Quo Bias

- ▶ The default option is the option the chooser will obtain if he or she does nothing
 - ▶ (e.g., the coffee mug, the pension plan, automatic organ donation)
- ▶ Defaults affect human choice:
 - ▶ People tend to evaluate more highly default options than other options, even when the default has been randomly allocated
 - ▶ Experiments with monkeys

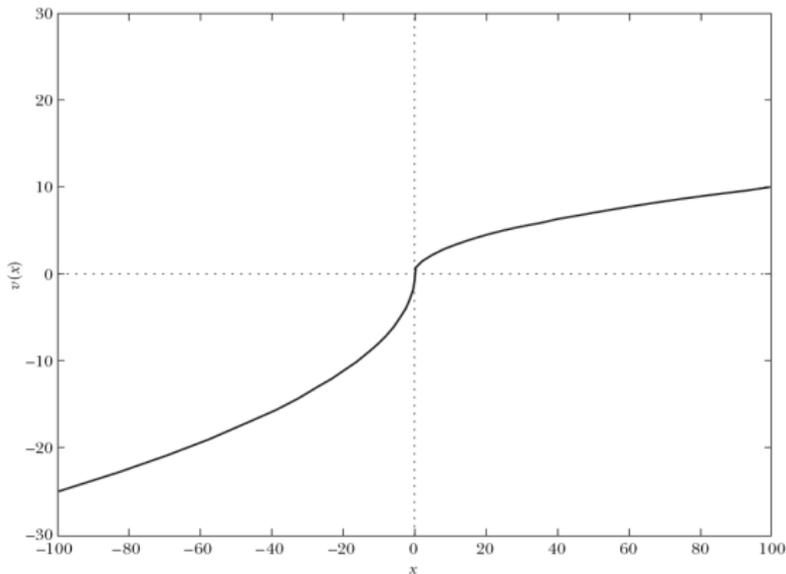
Behavioral concept 3': Reference points

- ▶ The default option acts as a **behavioral reference point** to which the other options are compared:
 - ▶ What matters are **local comparisons** with respect to the reference point, not global comparisons
 - ▶ People care about **changes** not levels

Behavioral concept 4: Diminishing sensitivity

- ▶ People's sensitivity to further changes in an outcome is smaller for outcome levels that are further away from the reference point.
- ▶ Diminishing sensitivity reflects a fundamental feature of human cognition.
 - ▶ For example, a change from getting \$0 to getting \$10 feels greater than a change from getting \$1,000 to getting \$1,010.
 - ▶ Similarly, a change from getting \$0 to getting \$-10 feels greater than a change from getting \$-1,000 to getting \$-1,010.

Behavioral Concepts 1-4: The Value Function



Notes: The graph plots the value function proposed by Tversky and Kahneman (1992) as part of cumulative prospect theory, namely $v(x) = x^\alpha$ for $x \geq 0$ and $v(x) = -\lambda(-x)^\alpha$ for $x < 0$, where x is a dollar gain or loss. The authors estimate $\alpha = 0.88$ and $\lambda = 2.25$ from experimental data. The plot uses $\alpha = 0.5$ and $\lambda = 2.5$ so as to make loss aversion and diminishing sensitivity easier to see.

More Lottery Choices

- ▶ Choose one of the following two lotteries:
 - ▶ A: A .001 probability of winning \$5000.
 - ▶ B: A 100% chance of winning \$5.
- ▶ Choose one of the following two lotteries:
 - ▶ A: A .001 probability of -\$5000.
 - ▶ B: A 100% chance of -\$5.

More Lottery Choices (2)

- ▶ Choose one of the following two lotteries:
 - ▶ A : A .001 probability of winning \$5000. [72%]
 - ▶ B : A 100% chance of winning \$5. [28%]
- ▶ Choose one of the following two lotteries:
 - ▶ A : A .001 probability of -\$5000. [17%]
 - ▶ B : A 100% chance of -\$5. [83%]

Overweight of low probability effects: people like both lotteries and insurance

Behavioral Concept 5: Probability weighting

- ▶ Measuring how people weight probabilities:
 - ▶ Steepness at 0: overweighting of small probabilities.
 - ▶ Steepness at 1: certainty effect.
 - ▶ Flatness in the middle: unresponsiveness to intermediate probabilities

Probability weighting

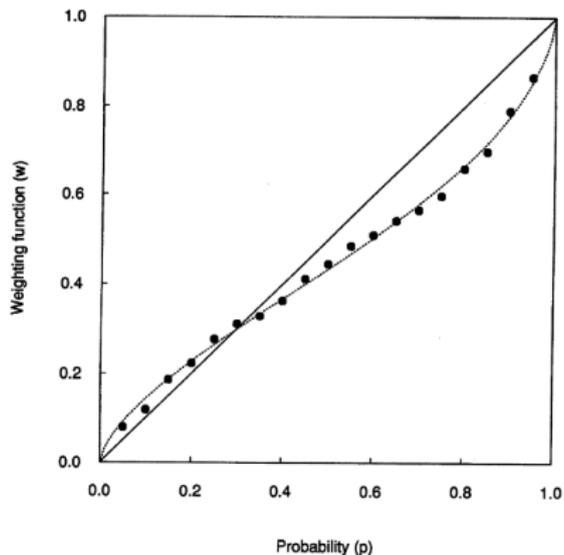


FIGURE 1.—The points represent median estimates, across subjects ($N = 40$), obtained in Tversky and Fox (1994). The smooth curve is obtained by fitting the parametric form $w(p) = \delta p^\gamma / (\delta p^\gamma + (1-p)^\gamma)$, suggested by Lattimore, Baker, and Witte (1992). The estimated values of the parameters are $\gamma = .69$, $\delta = .77$.

Expected utility and Prospect theory

- ▶ Given wealth w and a lottery $x = (p_1, \dots, p_n; y_1, \dots, y_n)$

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Expected utility and Prospect theory

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$$U_{eu}(x) = p_1 u(w + y_1) + \dots + p_n u(w + y_n)$$

- ▶ Prospect theory:

$$U_{pt}(x) = \pi(p_1) v(y_1) + \dots + \pi(p_n) v(y_n)$$

Prospect theory in the field

- ▶ **Labor supply**: aspirations on daily earnings affect labor supply of taxi drivers, bike messengers, stadium vendors, etc
- ▶ **Housing prices**: people unwilling to sell house below purchase price (reference point)
- ▶ **Tax compliance**: +/- balance (reference point 0) triggers more claiming deductions
- ▶ **Marathon runners**: round numbers as goals (reference points) affect running effort when behind the goal, but still reachable
- ▶ **Expectations on the quality of goods** affect willingness to pay after enjoyment of goods
- ▶ **Domestic violence and sports events**
- ▶ ...

Preferences over time

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https://www.youtube.com/watch?v=QX_oy9614HQ

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- ▶ Mischel et al (1989, Science):
 - ▶ 32 preschoolers from Stanford
 - ▶ $.57^{***}$ correlation between seconds to wait to eat the marshmallow and SAT scores

Experiments: Present bias

- ▶ People prefer \$100 today to \$105 tomorrow,

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- ▶ People prefer \$100 today to \$105 tomorrow,
but prefer \$105 in one year and a day to \$100 in one year

Experiments: Present bias

- ▶ People prefer \$100 today to \$105 tomorrow, but prefer \$105 in one year and a day to \$100 in one year
 - ▶ Inconsistent with Exponential discounted utility:

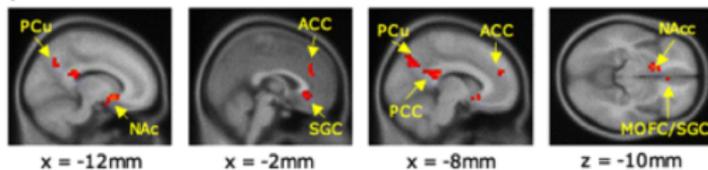
$$U_{ed}(\$100, 0) = u(\$100) > \delta u(\$105) = U_{ed}(\$105, 1)$$

\Leftrightarrow

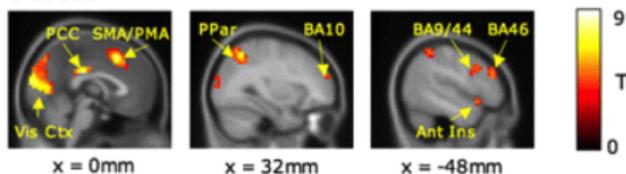
$$U_{ed}(\$100, 365) = \delta^{365} u(\$100) > \delta^{366} u(\$105) = U_{ed}(\$105, 366)$$

Neuroexperiment: McClure et al (2004, Science)

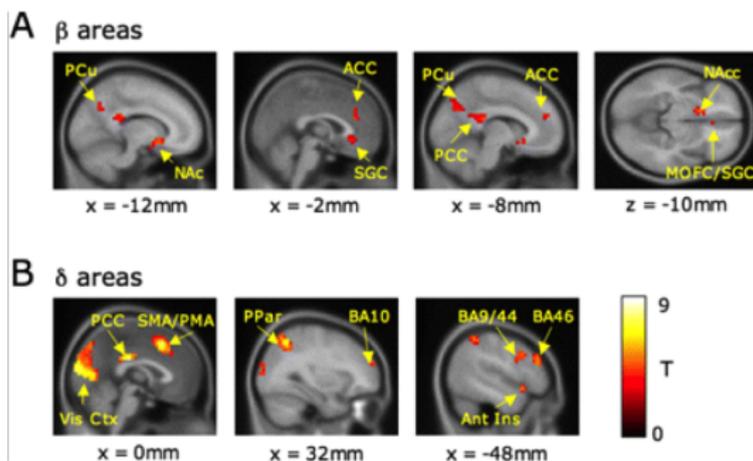
A β areas



B δ areas



Neuroexperiment: McClure et al (2004, Science)



- ▶ β areas respond only to immediate rewards
- ▶ δ areas respond equally to all rewards

Experimental evidence

- ▶ When choosing today between having **chocolate** or **fruit** as dessert in a lunch next week, 74% of people choose **fruit**

Experimental evidence

- ▶ When choosing today between having **chocolate** or **fruit** as dessert in a lunch next week, 74% of people choose **fruit**
- ▶ however, when choosing today between having **chocolate** or **fruit** as dessert in today's lunch, 30% of people choose **fruit**

Evidence: Commitment Devices

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- ▶ **Savings:** in a field experiment people could voluntary enroll in a savings product with a commitment to restrict access to their savings, subject to penalties:
 - ▶ 28.4% accepted the product
 - ▶ they increased their savings by 81%, as compared to a control group.

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- ▶ Other settings: **exercising**, **quitting smoking**, **job productivity**, etc.

Behavioral Concept 6: Present-Bias

- ▶ Over-discounting of the future when compared to the present
- ▶ Generates time inconsistent behavior, as compared to the exponential discounting model
- ▶ With crucial consequences for:
 - ▶ Retirement plans
 - ▶ Savings
 - ▶ Labor productivity
 - ▶ Health
- ▶ A behavioral model: $\beta - \delta$ discounted utility:

$$U_{\beta,\delta}(y, 0) = u(y)$$

$$U_{\beta,\delta}(y, t) = \beta\delta^t u(y)$$

when $\beta = 1$ we have the standard exponential model, when $\beta < 1$ we have present bias

Social preferences

Social preferences

- ▶ Narrow view: $U_i(x_i) = U_i(x_i, x_j)$
- ▶ However:
 - ▶ Billions of dollars donated to charity every year
 - ▶ Welfare state
 - ▶ We are all aware of instances of:
 - ▶ **altruism**: being oneself better off when someone else is made better off
 - ▶ **reciprocity**: being oneself better off when someone who has been kind to oneself is better off
 - ▶ **aversion to inequity**: we dislike inequalities in our reference group, and appreciate fairness

Ultimatum Game Experiments

Ultimatum Game Experiments

- ▶ **Player 1** offers an allocation (x_{self}, x_{other}) , such that $x_{self} + x_{other} = 5$
- ▶ **Player 2** accepts or rejects
 - ▶ If accepts: (x_{self}, x_{other}) is implemented
 - ▶ If rejects: $(0, 0)$

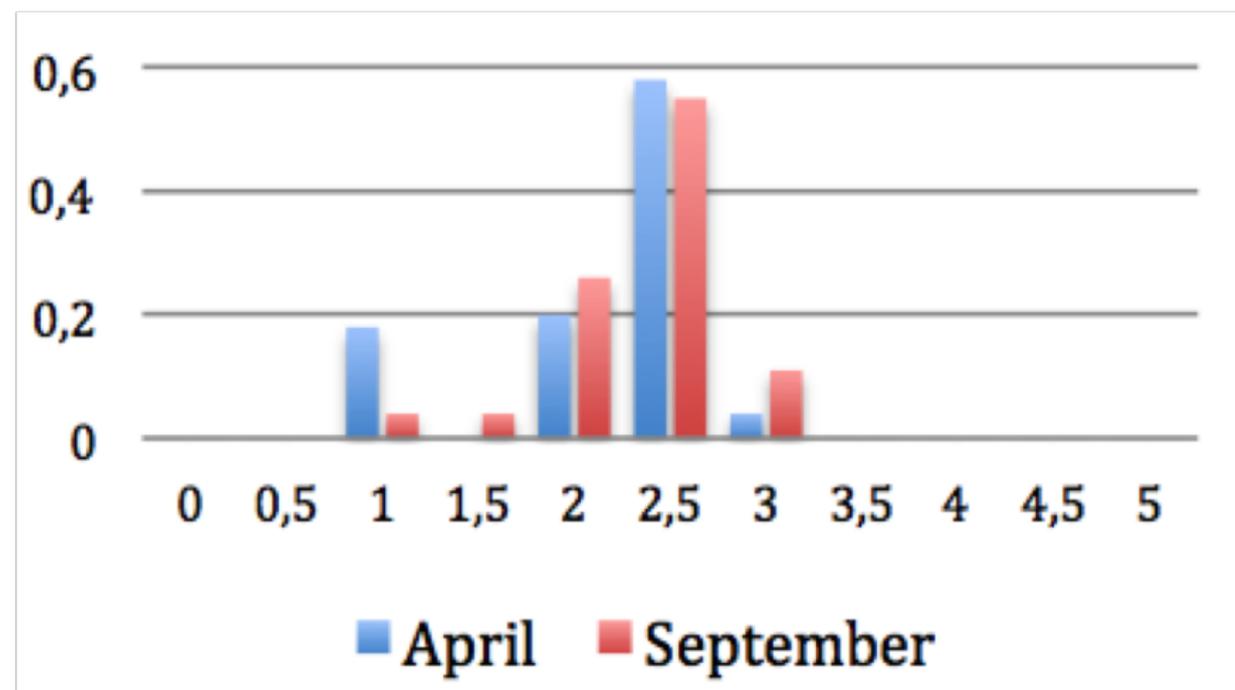
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- ▶ Standard prediction:
 - ▶ $(5, 0)$
 - ▶ And if for whatever reason $x_{other} > 0$, this is never rejected
- ▶ Typically in experimental studies:
 - ▶ About 25% of the offers are rejected
 - ▶ Average acceptance cutoff is at $1/4$ of the endowment

Ultimatum Game Experiments



Dictator Game Experiments

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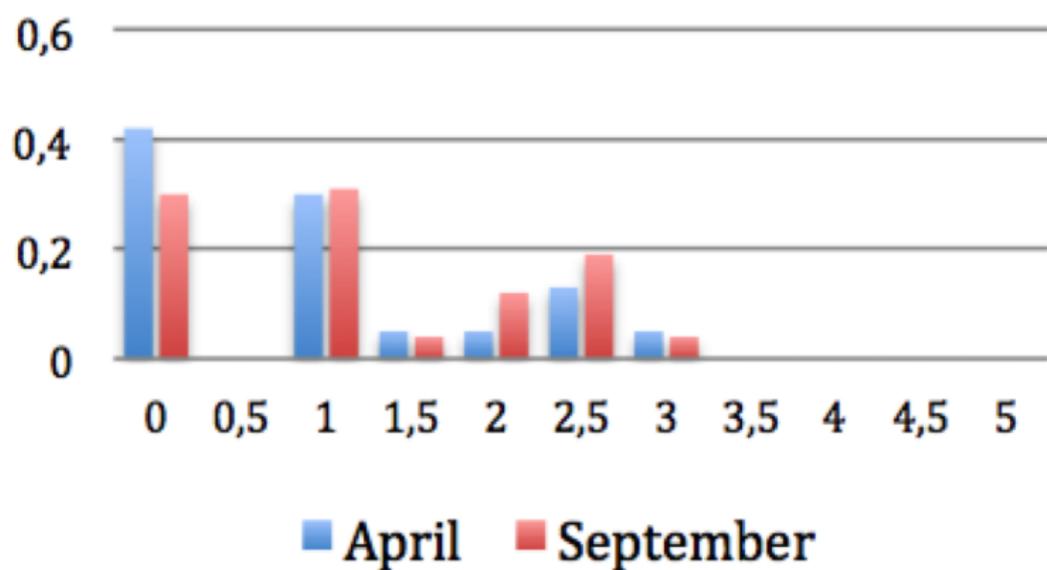
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- ▶ Typically in experimental studies:
 - ▶ Average offer of about $1/5$ of the endowment

Dictator Game Experiments



Trust Game Experiments

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- ▶ Player 1 and Player 2 endowed with 10 Euros each
- ▶ Player 1 decides how much from the 10 Euros to transfer to Player 2
- ▶ Transfer is multiplied by 3
- ▶ Player 2 decides how much of the total sum to transfer to Player 1

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- ▶ Standard Prediction:
 - ▶ Player 2 transfers back nothing
 - ▶ Player 1 anticipates this and transfers zero too
- ▶ Experimental Results:
 - ▶ Player 1 makes transfers (altruism or trust)
 - ▶ Player 2 sends back money (unconditional kindness or trustworthiness)
 - ▶ On average, Player 1 gets back the amount that is sent

Trust Game Experiments

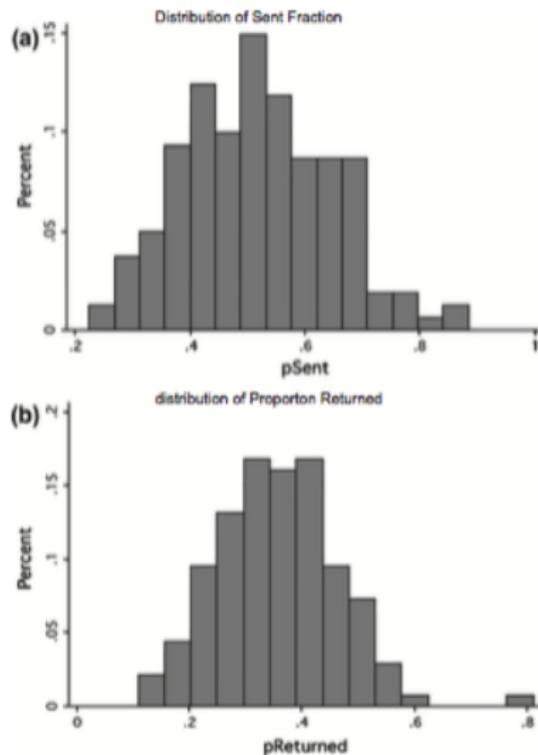


Fig. 1. Distribution of dependent variables. Notes: pSent and pReturn refer to the untransformed amount sent as a proportion of amount available by senders and the amount returned as a proportion of amount available by receivers respectively.

Public Good Experiments

Public Good Experiments

- ▶ Private endowments e_i , $i = 1, \dots, n$
- ▶ Each player chooses how much to contribute c_i to the public good, and how much to keep $e_i - c_i$
- ▶ Contributions to the public good benefit all players, at a rate of $\alpha < 1$
- ▶ Payoffs: $\pi_i = e_i - c_i + \alpha \sum_j c_j$

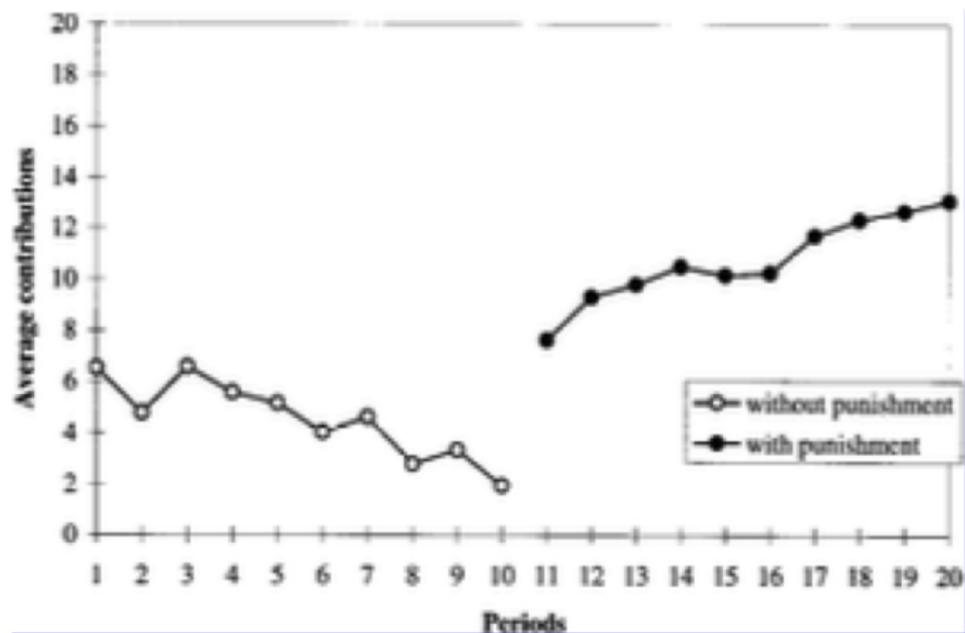
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- ▶ Payoffs: $\pi_i = e_i - c_i + \alpha \sum_j c_j$
 - ▶ Since $\alpha < 1$, incentives not to contribute
 - ▶ Nash equilibrium: zero contributions
 - ▶ Social optimum: all players contribute everything

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- ▶ Private endowments e_i , $i = 1, \dots, n$
- ▶ Each player chooses how much to contribute c_i to the public good, and how much to keep $e_i - c_i$
- ▶ Contributions to the public good benefit all players, at a rate of $\alpha < 1$
- ▶ Payoffs: $\pi_i = e_i - c_i + \alpha \sum_j c_j$
 - ▶ Since $\alpha < 1$, incentives not to contribute
 - ▶ Nash equilibrium: zero contributions
 - ▶ Social optimum: all players contribute everything
- ▶ Experimental results
 - ▶ There is a lot of heterogeneity, with many people contributing significant parts of their endowments
 - ▶ There is a clear downwards trend
 - ▶ If allow to punish others at a cost, people punish others, and cooperation is sustained

Public Game Experiments



Models of Social Preferences

- ▶ Altruism (Andreoni, 1989):

$$U = u(x_{self}) + \alpha u(x_{other})$$

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- ▶ Altruism (Andreoni, 1989):

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- ▶ Inequity aversion (Fehr & Schmidt, 1999; Bolton & Ockenfels, 2000):

$$U_i = x_i - \alpha_i \frac{\sum_{j \neq i} \max\{x_j - x_i, 0\}}{n - 1} - \beta_i \frac{\sum_{j \neq i} \max\{x_i - x_j, 0\}}{n - 1}$$

with α_i representing envy and β_i guilt

Wrap up Part II: Behavioral economics

- ▶ Aims at making economic decision-making models more realistic, with better psychological foundations,
- ▶ while trying to keep the models tractable and versatile
- ▶ Very active research area, with contributions coming from economic theory, cognitive psychology, neuro-sciences, etc