EXPERIMENTAL GAME THEORY ii/ii

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A game

Rules:

1. **Players:** All of you:
   https://scienceexperiment.online/classroom/r/G0mwhB
2. **Actions:** Choose a number between 0 and 100
3. **Outcome:** The player with the number closest to half the average of all submitted numbers wins.
4. **Payoffs:** He will receive half the average in CHF, which I will pay out right after the game.
5. In case of several winners, divide payment by number of winners and pay all winners.

A game

Structure of today's lecture

- Part 1: A "sort-of" introduction to the theory of games
- Part 2: Course admin:
  - Aims and requirements
  - Talk schedule

Acknowledgments

- Bary Pradelski (ETHZ)
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- Joergen Weibull (Stockholm, TSE)
- Andreas Diekmann (ETHZ)
- Dirk Helbing (ETHZ)

Game theory

A tour of its people, applications and concepts

1. von Neumann
2. Nash
3. Aumann, Schelling, Selten, Shapley
4. Today

John von Neumann (1903-1957)

What is game theory?

- A mathematical language to express models of, as Myerson says: "conflict and cooperation between intelligent rational decision-makers"
- In other words, *interactive decision theory* (Aumann)
- Dates back to von Neumann & Morgenstern (1944)
- Most important solution concept: the Nash (1950) equilibrium

Games and Non-Games

What is a game? And what is not a game?

Uses of game theory

- *Prescriptive* agenda versus *descriptive* agenda
- "Reverse game theory"/mechanism design:
  - "in a design problem, the goal function is the main given, while the mechanism is the unknown." (Hurwicz)
- The mechanism designer is a game designer. He studies
  - What agents would do in various games
  - And what game leads to the outcomes that are most desirable

Game theory revolutionized several disciplines

- Biology (evolution, conflict, etc.)
- Social sciences (economics, sociology, political science, etc.)
- Computer science (algorithms, control, etc.)

- game theory is now applied widely (e.g. regulation, online auctions, distributed control, medical research, etc.)

Its impact in economics (evaluated by Nobel prizes)

- 1972: Ken Arrow − general equilibrium
- 1994: John Nash, Reinhard Selten, John Harsanyi − solution concepts
- 2005: Tom Schelling and Robert Aumann − evolutionary game theory and common knowledge
- 2007: Leonid Hurwicz, Eric Maskin, Roger Myerson − mechanism design
- 2009: Lin Ostrom − economic governance, the commons
- 2012: Al Roth and Lloyd Shapley − market design
- 2014: Jean Tirole − markets and regulation
- 2016: Oliver Hart and Bengt Holmström − contract theory
- 2017: Richard Thaler − limited rationality, social preferences

Part 1: game theory

"Introduction" / Tour of game theory

Non-cooperative game theory

- No binding contracts can be written
- Players are individuals
- Main solution concepts:
  - Nash equilibrium
  - Strong equilibrium

Cooperative game theory

- Binding contract can be written
- Players are individuals and coalitions of individuals
- Main solution concepts:
  - Core
  - Shapley value

How about our initial game as a cooperative game

Cooperate or not?

- If all players submit 0, the average is 0: 0 earnings
- If all players submit 100, the average is 100: each player earns 100/2n
- Cooperatively, total earning could be 50!
- But what if all others submit 100, but one guys submits 50?
  - Then he wins and his earnings will be 50 instead of 50/n ...

Cooperative values:
$v(N) = 50$
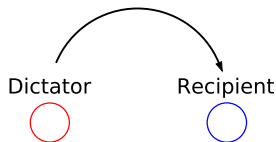$v(i) = 0$

on preference estimation and dictator game experiments

Outline

(a)

(b)

Setup I. Dictator has endowment m and makes payment $\pi \in [0, m]$. Recipient gets $p \cdot \pi$, where $p > 0$ is the multiplier of redistribution.

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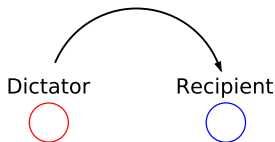
(b)

► 'Making a donation'

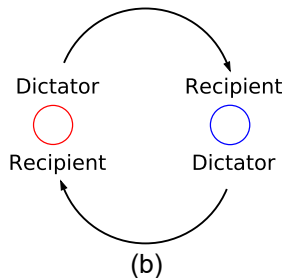**Setup I.** Dictator has endowment m and makes payment $\pi \in [0, m]$. Recipient gets $p \cdot \pi$, where $p > 0$ is the multiplier of redistribution.

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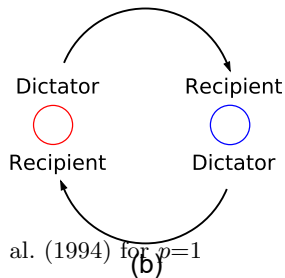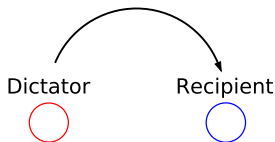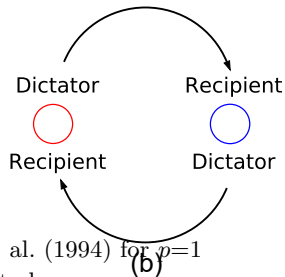

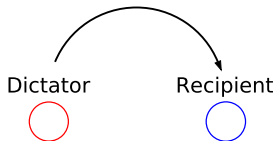
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- ‘Making a donation’
- Introduced by Kahneman et al. (1986); Forsythe et al. (1994) for $p=1$
- *Drosophila* of experimental economics in order to study
  - Cooperation
  - Negotiation
  - Donation/Helping negotiating
  - . . .

–Many but far from all people give zero

–Many between zero and half

–Few more than half

–Distributions highly sensitive to various framing effects

❖One of the most famous instances of disproving the hypothesis that humans are uniquely driven by material self-interest

–The exact shape of the giving distribution depends on many things

   oDesert of the recipient

   o"Give" versus "Take" frame

   oStakes

   oLanguage

   oEtc.

1. The dictator game as we know it?

Preference estimation

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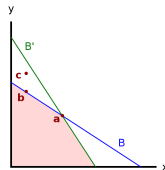
- ▶ Utility fitting allows for classification/preference estimation, e.g.
  - ▶ altruism vs. self-interest
  - ▶ efficiency vs. equality
- ▶ Widely used for characterizations

–Men are more selfish and efficiency-oriented than women (Andreoni-Vesterlund '01)

–Elites are more selfish and efficiency-oriented than normalos (Fisman et al. '15)

–Young generation more selfish and efficiency-oriented than old (Cameron et al. '13)

–Etc.

???

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> ▶ That's a proper game ≠ dictator game!

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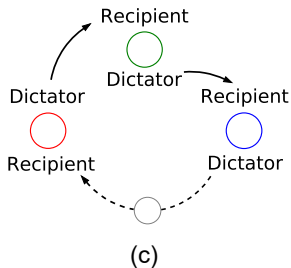

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- ▶ This gives rise to 'loops': Player 1 is the dictator of Player 2 who is the dictator of Player 3 . . . who is the dictator Player N who is the dictator of Player 1
- ▶ Player i's total payoff consists of what he keeps and what he receives, amounting to

$$m - \pi_i + p\pi_{i-1}$$

	Non-interactive	Interactive
Active players	$N = 1$	$N > 1$
Roles	Player is dictator only	Each player is dictator *and* recipient
Type of game	Degenerate	Decomposed[a]
Relevant theory	Decision theory	Game theory
Solution concept	Utility maximization	Nash equilibrium

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[a](Messick and McClintock (1968))

our contribution

– Spell the theoretical consequences of protocol changes out properly

– Run a Popperian experiment (aim is falsification) to test for protocol differences

❖ Based on a pre-registered RCT

Informal statement of rational-choice predictions:

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$\Rightarrow$ | If $c_i, c_{-i} \leq \frac{1}{2}$, 'giving nothing' are mutual best responses, i.e. $(\pi_i, \pi_{-i}) = (0, 0)$ is a Nash equilibrium.

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3. Implications
Any experimental outcome is problematic

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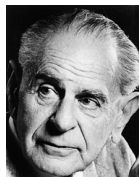

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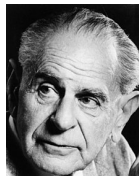

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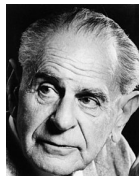*(H0)* There are no protocol differences.

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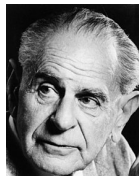

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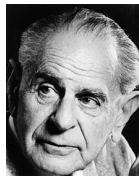

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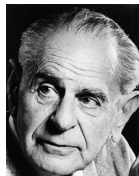> *(H1.h0)* and can be explained by rational-choice benchmarks.
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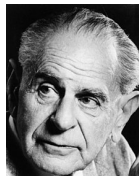
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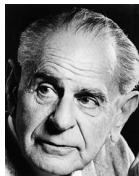> > (H1.h0) and can be explained by rational-choice benchmarks.
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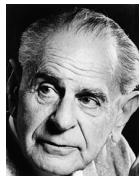
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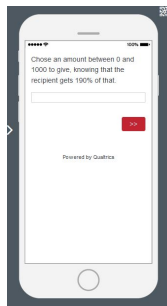- Instructions close to Andreoni-Miller

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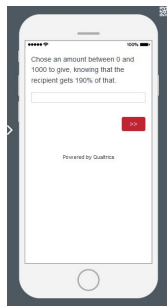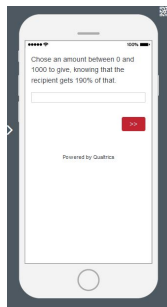- ▶ Instructions close to Andreoni-Miller

Key findings

- ▶ Significant treatment differences overall; more pronounced for small p
- ▶ Predominantly no agreement with strict rational-choice benchmark:
  - ▶ Giving lower in non-interactive case
  - ▶ Zero-payments more frequent in non-interactive case
- Xplore? ◀ Exception: subjects that thought about others when taking decision and who played interactive had significantly higher full-giving rates

Non-interactive
Interactive

Zero Giving

Half Giving

Full Giving
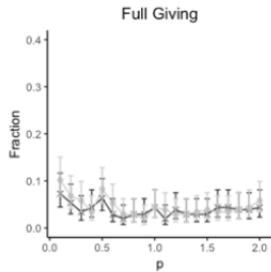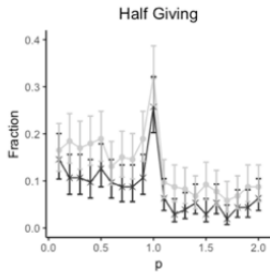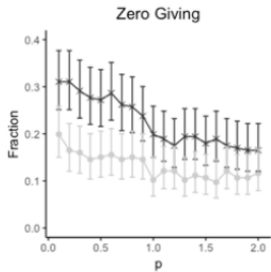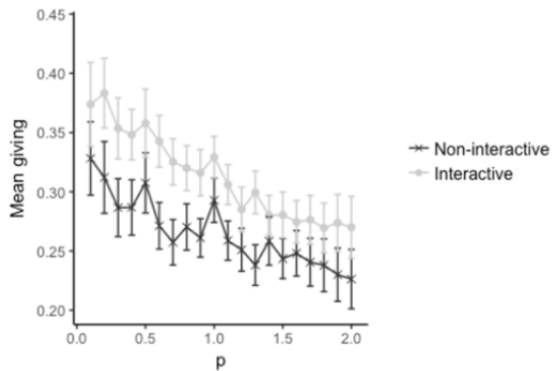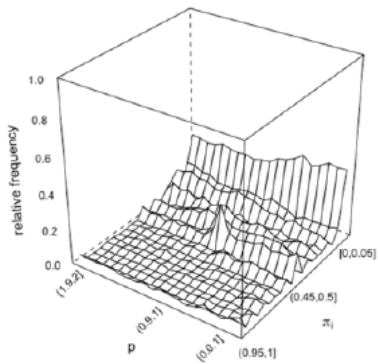
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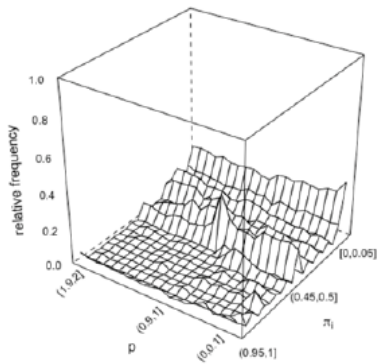
BELIEFS....

Loop size	Percentage of 1-1 correspondences	Observations	Instructions
2	56%	100	You will be paired with another participant of this study. You split a dollar. The other receives what you transfer. The other also splits a dollar, and you receive what the other transfers to you.
3	38%	108	You will be paired with two other participants of this study. The three of you will form a ring. Each of you splits a dollar. Your next neighbor to the right receives what you transfer. Your neighbor to the left receives what your neighbor to the right transfers. You receive what your neighbor to the left has transferred.
5	43%	105	You will be paired with four other participants of this study. The five of you will form a ring. Each of you splits a dollar. Your next neighbor to the right receives what you transfer. And so it continues along the ring. You receive what your neighbor to the left has transferred.
entire session[a]	40%	209	You split a dollar. The amount shared by you will be transferred to a randomly paired MTurk worker who also participates in this study. Note that all participants face the same decision, and that you will be the recipient of another randomly paired MTurk worker who participates in this study. Hence, on top of what you keep for yourself, you will receive what that other person transfers to you. The two MTurk workers you are paired with are not the same.

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- ▶ External validity

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Thank you!

	(1) Zero-giving		(2) Half-giving		(3) Full-giving	
	(Reduced)	(Controls)	(Reduced)	(Controls)	(Reduced)	(Controls)
Interactive	-0.465*	-0.424*	0.256	0.250	0.159	0.070
	[0.141]	[0.148]	[0.189]	[0.134]	[0.132]	[0.192]
	(0.001)	(0.004)	(0.052)	(0.061)	(0.401)	(0.715)
Inter.×p	-0.018*	-0.019*	-0.034*	-0.033*	-0.017	-0.018
	[0.007]	[0.007]	[0.010]	[0.007]	[0.007]	[0.010]
	(0.005)	(0.004)	(<0.001)	(<0.001)	(0.112)	(0.092)
Non-int.×p	-0.028*	-0.031*	-0.035*	-0.035*	-0.008	-0.008
	[0.005]	[0.006]	[0.011]	[0.007]	[0.007]	[0.011]
	(<0.001)	(<0.001)	(<0.001)	(<0.001)	(0.476)	(0.491)
Order		0.002		-0.002		0.003
		[0.002]		[0.002]		[0.003]
		(0.323)		(0.316)		(0.230)
Female		-0.303*		0.040		0.165
		[0.131]		[0.112]		[0.153]
		(0.021)		(0.721)		(0.281)
Age		-0.005		0.001		-0.002
		[0.006]		[0.005]		[0.008]
		(0.442)		(0.783)		(0.857)
Self-centrism		0.879*		-0.283		0.101
		[0.171]		[0.159]		[0.252]
		(<0.001)		(0.075)		(0.689)
Narrow bracketing		-0.045		0.086		0.008
		[0.151]		[0.122]		[0.175]
		(0.767)		(0.481)		(0.964)
Interactive play		0.066		-0.045		0.394*
		[0.174]		[0.123]		[0.192]
		(0.705)		(0.718)		(0.040)
(Cut)	0.467	0.301	1.044	1.099	1.689	1.848
	[0.093]	[0.278]	[0.146]	[0.216]	[0.097]	[0.339]
Log pseudolikelihood	-3763.3	-3513.3	-2725.6	-2712.4	-1423.5	-1397.8
Number of obs.	8'240	8'240	8'240	8'240	8'240	8'240
Number of ind.	412	412	412	412	412	412

* stands for p<0.05