Rationalizing cooperation: Preferences, beliefs, and mechanisms

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Decision theory explores rationality, bringing together insights from mathematics, statistics, cognitive science, economics, psychology, sociology, management, finance, …

Normative: Perfect rationality, optimal

Descriptive: How real people think and make decisions
Often we take a decision problem from the messy real world and distill it into something as simple as possible, in such a way that it still retains the central essence of the original problem.

We strive to develop decision models that are tractable but non-trivial, and amenable to experimentation.
Research activities

• Risky decision making-
  Decision theory

• Social decision making-
  Social preferences

• Strategic decision making-
  Behavioral game theory and
  experimental economics
Focus today

• Risky decision making-
  Decision theory

• Social decision making-
  Social preferences

• Strategic decision making-
  Behavioral game theory and
  experimental economics

Why do people choose to cooperate?
Structure and outline

- Preferences (measurement)
- Beliefs (prediction)
- Mechanisms (control)
A simple strategic decision

<table>
<thead>
<tr>
<th>Player A</th>
<th></th>
<th>Player B</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Cooperate</td>
<td>Defect</td>
</tr>
<tr>
<td><strong>Cooperate</strong></td>
<td>3, 3</td>
<td>1, 4</td>
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<tr>
<td><strong>Defect</strong></td>
<td>4, 1</td>
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A simple strategic decision

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<tr>
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Social dilemma (or a commons dilemma, or a collective action problem)
Failure of the invisible hand (cf. Adam Smith)

The most exciting phrase to hear in science, the one that heralds new discoveries, is not “Eureka” but “That’s funny...”
- Isaac Asimov
Social dilemma (or a commons dilemma, or a collective action problem)
Failure of the invisible hand (*cf.* Adam Smith)

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This is a general model for resource dilemmas.
That is, any situation that pits collective interests against private interests.
Individual ``rationality” leads to collective malaise.
e.g., Taxes, work groups, investing in a new technology, how much water to use.
Postulates of rationality

• A decision maker (DM) is narrowly self-interested. His goal is to maximize personal payoffs, indifferent to other players’ payoffs.

• A decision maker believes other decision makers are also narrowly self-interested.

• These qualities are common knowledge. Everyone believes that everyone believes that...
Postulates of rationality

- A decision maker is narrowly self-interested. His goal is to maximize personal payoffs, indifferent to other players’ payoffs.

- A decision maker believes other decision makers are also narrowly self-interested.

- These qualities are common knowledge. Everyone believes that everyone believes that... ∞
Rationality

Consistency

Given two...

Preferences  Beliefs

Actions

Prediction

Engine of rationality
A decision maker is narrowly self-interested. The goal of the DM is to maximize personal payoffs, indifferent to other players’ payoffs.

Selfishness axiom, Homo economicus
A decision maker is narrowly self-interested. The goal of the DM is to maximize personal payoffs, indifferent to other players’ payoffs.

Selfishness axiom, Homo economicus

This is the foundation of a model that is: Exact, powerful, and often very wrong
Postulate of rationality

A decision maker is narrowly self-interested. The goal of the DM is to maximize personal payoffs, indifferent to other players’ payoffs.

Selfishness axiom, Homo economicus

Essentially, all models are wrong, but some are useful.

G. Box (1987)
For between the two extremes Pure Egoistic and Pure Universalistic there may be an indefinite number of impure methods; wherein the happiness of others as compared by the agent (in a calm moment) with his own, neither counts for nothing, nor yet counts for one, but counts for a fraction.

F. Edgeworth (1881)
For between the two extremes Pure Egoistic and Pure Universalistic there may be an indefinite number of impure methods; wherein the happiness of others as compared by the agent (in a calm moment) with his own, neither counts for nothing, nor yet counts for one, but counts for a fraction.

F. Edgeworth (1881)
So how can we measure this construct?

Other regarding preferences or “Niceness”
Maybe just ask:

How nice are you?

Other regarding preferences or “Niceness”
Maybe just ask:

How nice are you?

1. Not nice at all-- actually truth be told, quite selfish
2. Sometimes nice, but rather limited in scope
3. Generally nice
4. Super nice
5. Amazingly nice-- equal mix of saint and monk

Other regarding preferences or “Niceness”
Revealed preferences via a resource allocation choice task

Option 1

85 to you

85 to an anonymous random other person

Option 2

100 to you

50 to an anonymous random other person

Not a game- Only one decision maker, but that decision has an effect on both parties.
A social decision through the eyes of Homo economicus
Option 1

85 to you
85 to an anonymous random other person

Prosocial option

Option 2

100 to you
50 to an anonymous random other person

Individualistic option
<table>
<thead>
<tr>
<th>Option 1</th>
<th>Option 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>85 to you</td>
<td>100 to you</td>
</tr>
<tr>
<td>85 to an anonymous random other person</td>
<td>50 to an anonymous random other person</td>
</tr>
</tbody>
</table>

Prosocial option

Individualistic option

Chosen about 50%-60% of the time

One shot

Purely anonymous

Incentive compatible
Payoff to self

Payoff to other

Prosocial

Individualistic

Prosocial option

Individualistic option

You receive

85  87  89  91  93  94  96  98  100

Other receives

85  81  76  72  68  63  59  54  50
Payoff to self

Payoff to other

Altruistic
(50, 100)

Prosocial
(85, 85)

Individualistic
(100, 50)

Competitive
(85, 15)
In this task you have been randomly paired with another person, whom we will refer to as the other.

You receive

Other receives

Altruistic

Prosocial

Competitive

Individualistic

Instructions

After you have made your decision, you can only make one mark for each question.

Example:

You will be making a series of decisions about allocating resources between you and this other person. For each of the following questions, please indicate the distribution you prefer most by writing the resulting number in the circle on the graph.

All of your choices are completely confidential.

What the DM sees:

Murphy, Ackermann and Handgraaf (2011)
In this task you have been randomly paired with another person, whom we will refer to as the other. After you have made your decision, you can only make one mark for each question. All of your choices are completely confidential. You will be making a series of decisions about allocating resources between you and this other person. For each of the following questions, please indicate the distribution you prefer most by marking the respective position along the midline.

There are no right or wrong answers, this is all about personal preferences. You receive 50 dollars, while the anonymous other person receives 40 dollars.

SVO Slider Measure

How the DM makes a choice:

Murphy, Ackermann and Handgraaf (2011)
SVO Slider Measure
6 joint allocation choices

How the DM makes a choice:

- **Altruistic**: (50, 100)
- **Interasocial**: (100, 50)
- **Individuistic**: (85, 85)

Murphy, Ackermann and Handgraaf (2011)
Payoff to self

Payoff to other

Altruistic
(50, 100)

Prosocial
(85, 85)

Individualistic
(100, 50)

Competitive
(85, 15)
Payoff to self vs Payoff to other

- Altruistic: (50, 100)
- Prosocial: (85, 85)
- Individualistic: (100, 50)
- Competitive: (85, 15)
Payoff to self vs. Payoff to other.

- **Altruistic** (50, 100)
- **Prosocial** (85, 85)
- **Individualistic** (100, 50)
- **Competitive** (85, 15)

42° angle between competitive and altruistic strategies.
Proportion

Competitive Individualistic Prosocial Altruistic

N = 378

\[ \alpha \text{ parameter} \]

Selfishness (i.e., narrow self-interest)

Selfishness (i.e., narrow self-interest)
Part 1: Results from multiple studies measuring social preferences

![Graph showing the distribution of social preferences with SVO angle and α parameter]

- Competitive
- Individualistic
- Prosocial
- Altruistic

Proportion

N = 378

SVO angle and α parameter
Cross National Project on Trust, SVO, and Social Mindfulness (van Doesum, Van Lange, Murphy, et al., 2015)

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Cross National Project on Trust, SVO, and Social Mindfulness (van Doesum, Van Lange, Murphy, et al., 2015)
Proportion

Competitive Individualistic Prosocial Altruistic

SVO angle and $\alpha$ parameter

All

$N = 8049$
Social Value Orientation (SVO) Slider Measure

- High resolution measure of other regarding preferences
- Strong psychometric properties
- Sensitive to individual differences (and there is substantial heterogeneity)

[Diagram showing the Social Value Orientation (SVO) Slider Measure with points labeled as altruistic (50, 100), prosocial (85, 85), individualistic (100, 50), and competitive (85, 15).]

http://vlab.ethz.ch/svo/SVO_Slider/


Engine of rationality

Part 2

Rationality

Preferences
Beliefs

Actions
Rationality

Selfish \rightarrow \text{Preferences} \quad \text{Beliefs} \rightarrow \text{Selfish}

"selfishness axiom" \quad \text{"common knowledge of rationality"}

\rightarrow \text{Actions}

\downarrow

\text{No cooperation}

Engine of rationality
Tuning the engine of rationality

Can we make better predictions about choice behavior?
Can we account for cooperation?
Cooperation choices in a Public Goods game (PGG) are considered. This is a strategic interaction with 4 players and each having to decide how much to contribute to a common good. Everyone would be better off if everyone contributed, but there is always a temptation to free ride.
Part 2

- An experiment that requires players do the following:
  - Complete the SVO slider measure
  - Estimate other players’ SVO choices
  - Estimate other players’ contribution choices
  - Play a one-shot anonymous 4 player PGG (1.6x)

- N = 124 subjects in the DeSciL
- Laboratory study, fully within subjects design, fully confidential, no deception, incentive compatible, standard experimental economics setup
Rationality

Preferences
Beliefs
Actions

Predicting behavior in a Public Goods game
Predicting behavior in a Public Goods game
Predicting behavior in a Public Goods game
Rationality

Preferences
Beliefs
Actions

Predicting behavior in a Public Goods game
Rationality broadly considered

Preferences

Beliefs

Actions

Social preferences

Beliefs about others' social preferences

Beliefs about others' PG contributions

Making better predictions

Public Goods game contributions

Model R² = .60
Predicting contributions in the one-shot PGG

SVO

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<td>SVO</td>
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<td>0.26**</td>
</tr>
<tr>
<td>PG belief</td>
<td>0.71***</td>
<td>0.67***</td>
</tr>
<tr>
<td>SVO belief</td>
<td>-0.19*</td>
<td>-0.20*</td>
</tr>
<tr>
<td>SVO x PG belief</td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
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<td></td>
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<tr>
<td>SVO x SVO belief x PG belief</td>
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<td>$R^2$ square</td>
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<td>0.61</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.59</td>
<td>0.59</td>
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</table>

Bivariate correlation: $r = .32^{***}$
Predicting contributions in the one-shot PGG

PG belief

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<td>SVO x PG belief</td>
<td></td>
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<tr>
<td>SVO x SVO belief</td>
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<tr>
<td>SVO belief x PG belief</td>
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<tr>
<td>SVO x SVO belief x PG belief</td>
<td>0.11</td>
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$R$ square: 0.60 0.61
Adjusted $R$ square: 0.59 0.59

Bivariate correlation: $r = .75^{***}$
Predicting contributions in the one-shot PGG

SVO belief

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<tr>
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<td>0.59</td>
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Bivariate correlation: \( r = .09 \)
Predicting contributions in the one-shot PGG

SVO belief

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</tr>
<tr>
<td>SVO x SVO belief x PG belief</td>
<td></td>
<td></td>
</tr>
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</table>

Dependent variable: Contributions in the one-shot PGG

| R square                          | 0.60 | 0.61 |
| Adjusted R square                 | 0.59 | 0.59 |

Selfish ≠ Rationality
Part 3

Structure and outline

- Preferences (measurement)
- Beliefs (prediction)
- Mechanisms (control)
Structure and outline

- Mechanisms (control)
  - Using decision frames in strategic interactions to nudge people to be more cooperative
  - Frames- Superficial differences between fundamentally identical decision contexts

- Community game vs. Wall Street game vs. Environmental game vs. Game (baseline condition)

Liberman et al. (2004)
Frames and Strategic choice

The name of the game

- Develop a laboratory based experiment where people make choices in a Public Goods game, but frame it by different names
- Measure people’s SVO, and their beliefs about other’s choices, and then have them make potentially cooperative choices
- Mixed evidence from the existing literature and no clear evidence for why this framing manipulation might have any effect
Frames and Strategic choice
The name of the game

• Nudging decision makers toward cooperation
• Frames: Community game vs. Wall Street game vs. Environmental Game vs. Game (baseline condition)
  • Preferences pathway?
  • Beliefs pathway?
Repeated PGG with 4 players ($N=178$)
• No difference at all in social preferences between the different experimental conditions

<table>
<thead>
<tr>
<th></th>
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<th>Environment</th>
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<td>n</td>
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<td>44</td>
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• Preferences pathway
• Beliefs pathway
Strategic choice framing
Cost effective and resilient

Fehr and Gächter (2000)

Frames and Strategic choice

The name of the game

- Strategic frames can nudge decision makers toward cooperation
- These frames change decision maker’s beliefs and can serve as a way to coordinate (especially for prosocial people)
- Yields greater cooperation and does so more efficiently and resiliently than other heavy handed institutional mechanisms
Next Parts...
A simple strategic decision like before

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<tr>
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<tr>
<td>Player A</td>
<td></td>
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<tr>
<td>Cooperate</td>
<td>8, 8</td>
</tr>
<tr>
<td>Defect</td>
<td>10, 0</td>
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Next Parts...

A simple strategic decision like before

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<tr>
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<td>10, 0</td>
<td>5, 5</td>
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</table>

Player B
<table>
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<tr>
<th>Player A</th>
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<tr>
<td>Cooperate</td>
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<tr>
<td>Cooperate</td>
<td>8, 8</td>
</tr>
<tr>
<td>Defect</td>
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![Graph showing payoffs and different strategies]

**Actions**: Cooperate, Defect

**Preferences**: Altruistic, Prosocial

**Beliefs**: Individualistic, Competitive

**Payoff to self**

**Payoff to other**
### Payoff Matrix

<table>
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<tr>
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<tbody>
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<td></td>
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<td></td>
<td>Cooperate</td>
</tr>
<tr>
<td>Cooperate</td>
<td>8, 8</td>
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<td>8, 8</td>
</tr>
<tr>
<td>Defect</td>
<td>10, 0</td>
<td></td>
<td>0, 10</td>
</tr>
</tbody>
</table>

### Graph

- **X-axis:** SVO-Preferences (Alpha)
- **Y-axis:** Positive expectations - Beliefs (Beta)

- **Axes:**
  - Payoff to self
  - Payoff to other

- **Graph Legend:**
  - Altruistic
  - Competitive
  - Individualistic
  - Prosocial

- **Arrows:**
  - Arrows indicate positive expectations and beliefs.

- **Lines:**
  - Different lines represent different preferences and beliefs.

- **Points:**
  - Points on the graph represent specific combinations of preferences and beliefs.

### Preferences and Beliefs

- **Preferences:**
  - SVO
  - Altruistic
  - Competitive
  - Individualistic
  - Prosocial

- **Beliefs:**
  - Positive expectations
  - Beliefs

### Actions

- **Actions:**
  - Cooperate
  - Defect

- **Values:**
  - Payoffs (8, 8, 0, 10, 10, 5, 5)

- **Graph Interpretation:**
  - The graph illustrates the relationship between preferences and beliefs, showing how these factors influence actions in a cooperative or competitive context.

Player A

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>8, 8</td>
<td>0, 10</td>
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<td>Defect</td>
<td>10, 0</td>
<td>5, 5</td>
</tr>
</tbody>
</table>

**Postulates of rationality**

- A decision maker (DM) is narrowly self-interested. His goal is to maximize personal payoffs, indifferent to other players’ payoffs.
- A decision maker believes other decision makers are also narrowly self-interested.
- These qualities are common knowledge. Everyone believes that everyone believes that...

![Graph showing preferences and beliefs](image)

**Actions**

- Preferences
- Beliefs

![Grid with coordinates and points](image)
Player A

<table>
<thead>
<tr>
<th></th>
<th>Cooperate</th>
<th>Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperate</td>
<td>8, 8</td>
<td>0, 10</td>
</tr>
<tr>
<td>Defect</td>
<td>10, 0</td>
<td>5, 5</td>
</tr>
</tbody>
</table>

Player B

<table>
<thead>
<tr>
<th></th>
<th>Cooperate</th>
<th>Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperate</td>
<td>8, 8</td>
<td>0, 10</td>
</tr>
<tr>
<td>Defect</td>
<td>10, 0</td>
<td>5, 5</td>
</tr>
</tbody>
</table>

Payoff to self

Payoff to other

Altruistic

Prosocial

Individualistic

Competitive

−16.26

o

61.39

o

Positive expectations – Beliefs (Beta)

Optimistic

Pessimistic

SVO – Preferences (Alpha)

Preferences

Beliefs

Actions
Formal subjective expected utility modeling
Social preferences, positive expectations, and trust based cooperation in a PD game

\[ u(\pi_s, \pi_o) = \pi_s + \alpha \cdot \pi_o \quad \alpha \in [0, 1] \]

\[ u(C) = [\beta \cdot (R + \alpha \cdot R)] + [(1 - \beta) \cdot (S + \alpha \cdot T)] \]

\[ u(D) = [\beta \cdot (T + \alpha \cdot S)] + [(1 - \beta) \cdot (P + \alpha \cdot P)] \]

\[ \beta_{crit} = \frac{P - S + \alpha P - \alpha T}{P + R - S - T + \alpha P + \alpha R - \alpha S - \alpha T} \]

\[ \beta_{crit} = \frac{P - S + \alpha P - \alpha T}{P + R - S - T + \alpha P + \alpha R - \alpha S - \alpha T} \]
$$\beta_{crit} = \frac{P - S + \alpha P - \alpha T}{P + R - S - T + \alpha P + \alpha R - \alpha S - \alpha T}$$

Indeed, one hopes that the unrealistic assumptions and the resulting theory will lead to experiments designed in part to improve the descriptive character of the theory.

-Luce and Raiffa (1957) 
Games and Decisions, p. 5
### Measurement

#### Preferences

<table>
<thead>
<tr>
<th></th>
<th>Cooperate</th>
<th>Defect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperate</td>
<td>3, 3</td>
<td>4, 1</td>
</tr>
<tr>
<td>Defect</td>
<td>1, 4</td>
<td>2, 2</td>
</tr>
</tbody>
</table>

### Prediction

#### Beliefs

<table>
<thead>
<tr>
<th>Model</th>
<th>Contributions in the one-shot POG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>SVO</td>
<td>0.20***</td>
</tr>
<tr>
<td>PC belief</td>
<td>0.71***</td>
</tr>
<tr>
<td>SVO x PC belief</td>
<td>-0.19*</td>
</tr>
<tr>
<td>SVO x SVO belief</td>
<td>-0.08</td>
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<tr>
<td>SVO belief x PC belief</td>
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</tr>
<tr>
<td>R square</td>
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</tr>
<tr>
<td>Adjusted R square</td>
<td>0.59</td>
</tr>
</tbody>
</table>

### Control

#### Mechanisms

- Rationality
- Selfish ≠ Rationality

- SVO (Alpha)
- Positive expectation (Beta)
- T=10, R=8, P=5, S=4
Formal subjective expected utility modeling across different strategic situations
The diagram illustrates the payoffs to self and to others in different behavioral contexts:

- **Altruistic** (61.39°)
- **Prosocial**
- **Individualistic**
- **Competitive** (-16.26°)

The shaded area represents the distribution of payoff values, indicating the range and density of outcomes in each behavior category.