Kindness Matters: A Theory of Reciprocity

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Motivation

- A typical economic assumption that decision makers are rational and selfish material payoff maximisers can be unforgiving because of numerous examples of deviations
- Psychological factors, such as reciprocity, become a persistent motive in social interactions that involve non-rational behaviour
- This motive on decision maker's non-rational behaviour can be
  - positive because they are willing to sacrifice their own material payoffs to reward the kindness of other decision makers
  - negative because they are willing to sacrifice their own material payoffs to punish the unkindness of other decision makers
- It is of importance for us to understand the concept of kindness

Motivation (Cont.)

- Consider the following decision-making problems
- There are two types of players: P-proposer who chooses offer (a, 10-a) and R-responder who chooses either to accept: (a, 10-a) or reject: (0, 0)
- Now there are two situations that you need to make your choice as the role of R:
  - Situation A: proposer faces two feasible offers (8, 2) and (5, 5), and **chose the offer (8, 2)**
    - accept □ reject □
  - Situation B: proposer faces two feasible offers (8, 2) and (2, 8), and **chose the offer (8, 2)**
    - accept □ reject □

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  - Situation B: proposer faces two feasible offers (8, 2) and $(2, 8)$, and **chose the offer** $(\mathbf{8}, \mathbf{2})$
    - accept ☑ reject ☐

Motivation (Cont.)

- The consideration of kindness is reflected in the situations encountered by all decision makers
- Thus, the idea of reciprocity is intuitively connected to the possible payoffs of all decision makers (sequential prisoner's dilemma, ultimatum games, etc.)
- Despite the obvious intuitive connection, there is a lack of formalization of this connection

This Paper

- answers a fundamental question
  - How does kindness consideration promote positive/negative reciprocal behaviour?
- answers this question by
  - proposing a new concept of efficient strategy to exclude strategies that should not be considered in kindness evaluation
  - developing a theoretical framework of reciprocity with two aspects: intentional kindness and consequential kindness

The Literature

- Theoretical studies:
  - Reciprocity: Rabin, 1993; Dufwenberg and Kirchsteiger, 2004; Falk and Fischbacher, 2006; Jiang and Wu, 2019; Sohn and Wu, 2022
  - Inequity aversion: Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000
  - Altruism: Becker, 1976
- Experimental studies:
  - Sequential prisoner's dilemma: Ahn et al., 2007; Orhun, 2018; Gächter et al., 2022; Schneider and Shields, 2022
  - Ultimatum game: Falk et al., 2003; Castillo et al., 2019
  - Dictator game: Andreoni et al., 2009

Contribution

- We offer a psychologically plausible account (i.e. efficient strategy) of how reciprocal kindness can explain mutually beneficial behaviour
- We incorporate both intentions and consequences of all decision makers' actions into the decision maker's kindness consideration, and then provide a better explanation and prediction on a host of experimental games

Theory: baseline framework

- Two-stage extensive games, complete and perfect information
- N={1,2} denotes the set of players
- Let H_i denote the set of nodes (or histories) of player $i \in N$, and A_i denote the set of behavioural strategies of player i
- With $a_i \in A_i$, $h \in H$, $a_{i,h}$ denotes the strategy that prescribes the same choice as a_i, **except for the choice that decides history h that is made with probability 1**
- The material payoff of player i is given by $\pi_i : A \to \mathbb{R}$
- Let $B_{ij} \in A_j$ be player i's first-order belief and $B_{ij}(h)$ be the **updated first − order belief** that describes player j's actual behavioural strategy that leads to history h
- Let $C_{iji} \in A_i$ be player i's second-order belief and $C_{iji}(h)$ be the **updated second − order belief** that describes player j's actual behavioural strategy that leads to history h

Efficient strategy

- **It is unavoidable that there are some strategies never happen**
- Consider the following decision-making problems
- Two types of players: P-proposer who chooses allocation and R-responder who chooses either to accept the allocation or reject
- Now there are two situations:
  - Situation A: proposer faces two feasible offers (8, 2) and (8, 2)
  - Situation B: proposer faces two feasible offers (8, 2) and (10,0)
- If you are R, what do you think P believes you will choose after (10, 0)
- Then, whether R should consider the offer (10, 0) as a viable option from P

PWO as a sequential rationality refinement

- We consider a three-step method: **potential worst outcome** (PWO) to define special second-order belief C^{pwo}_{iji}
  - step (i): find the most advantageous strategy $a_i \in C^{pwo}_{iji}(a_{j,h})$ for player i that should be unique at $h \in H$ (by sequential rationality)
  - step (ii): if a_i does not satisfy (i), player i will adopt the strategy that brings player j "the worst outcome"
  - step (iii): if a_i does not satisfy (ii), player i will choose randomly.
- **Efficient Strategy**: according to C^{pwo}_{iji}, we define a_j as a wasteful strategy if and only if there exists at least one a'_j which describes the choice that leads to Pareto-superior outcomes.

▸ Formal expression

Kindness: intentional kindness

- All potential material payoffs of both players can influence the perception of kindness
- Two aspects: what people can get (determined by decision maker's own material payoffs) and *what people should get* (determined by material payoffs of others)
- **Reference Point Standard**: if player's material payoffs exceed this reference point, they will be intentionally kind. Otherwise, they will be intentionally unkind.
- Definition:

$$\pi_i^r = \sum_{a_{j,h} \in E_j^{pwo}} \vartheta(a_{j,h}) \cdot \pi_i(C_{iji}, a_{j,h})$$

- $\vartheta(a_{j,h})$ is **intention function** that has the following four properties:
  - (i) $\vartheta(a_{j,h})$ is non-decreasing in $\pi_j(a_{j,h})$, $\frac{\partial \vartheta(a_{j,h})}{\partial \pi_j(a_{j,h})} \geq 0$ where $a_{j,h} \in E_j^{pwo}$, and non-increasing in $\pi_j(\tilde{a}_{j,h})$, $\frac{\partial \vartheta(a_{j,h})}{\partial \pi_j(\tilde{a}_{j,h})} \leq 0$ where $\tilde{a}_{j,h} \in E_j^{pwo} / \{a_{j,h}\}$
  - (ii) if $\pi_j(a_{j,h}) > \pi_j(\tilde{a}_{j,h})$, then $\vartheta(a_{j,h}) \geq \vartheta(\tilde{a}_{j,h})$ must hold
  - (iii) $\vartheta(a_{j,h}) > 0 \ \forall a_{j,h} \in E_j^{pwo}$
  - (iv) $\sum_{a_{j,h} \in E_j^{pwo}} \vartheta(a_{j,h}) = 1$.

Intentional kindness

Player i's utility from the intentional kindness at history $h \in H$ is defined by:

$$\Psi_i = \beta_i \cdot \delta_{ji} \cdot \pi_j(a_i, B_{ij}(h), C_{iji}(h))$$

where $\delta_{ji} = \pi_i(a_i, B_{ij}(h), C_{iji}(h)) - \pi_i^r(h)$, and β_i is an exogenously given non-negative number, which measures how sensitive player i is to the intention concerns with respect to player j.

Kindness: consequential kindness

- Without intentional kindness (i.e. $\Psi_i = 0$), we notice that people may still sacrifice to punish others
- An appropriate explanation is that they dislike that other people gain more than themselves
  - we may reject the (8, 2) offer but never reject (2, 8) offer

Consequential kindness

Player i's utility from the consequential kindness at history $h \in H$ is defined by

$$\Phi_i = \alpha_i \cdot \{L_{ij}(a_i, B_{ij}(h)) - \hat{L}_{ij}(B_{ij}(h))\}$$

where α_i is an exogenously given non-negative number, which measures how sensitive player i is to the consequence concerns with respect to player j.

- $L_{ij}(a_i, B_{ij}(h)) = \min\{\pi_i(a_i, B_{ij}(h)) - \pi_j(a_i, B_{ij}(h)), 0\}$
- $\hat{L}_{ij}(B_{ij}(h)) = \max\limits_{a_i' \in A_i} L_{ij}(a_i', B_{ij}(h))$

The utility function and equilibrium

- The utility function:

$$U_i(a_i, B_{ij}(h), C_{iji}(h)) = \pi_i(a_i, B_{ij}(h), C_{iji}(h)) + \Psi_i + \Phi_i$$

- Expected reciprocity equilibrium:
  - The profile $\{a^*, B^*_{ij}(h), C^*_{iji}(h)\}$ is an expected reciprocity equilibrium (ERE) if for all $i \in N$ and for each history $h \in H$ it holds that
    - (i) $a_i^* \in \arg\max_{a_i \in A_{i,h}} U_i(a_i, B_{ij}(h), C_{iji}(h))$
    - (ii) $B^*_{ij}(h) = a_j^*$ for all $j \neq i$
    - (iii) $C^*_{iji}(h) = a_i^*$ for all $j \neq i$

Theorem

An expected reciprocity equilibrium always exists

PREDICTION				
Applications	Authors	Consequence-based models [1]	Intention-based models[2]	Our model
Ultimatum game	Falk, Fehr, and Fischbacher (2003)			✓
Sequential prisoner's dilemma	Ahn et al. (2007)	✓	✓	✓
SPD with punishment	Orhun (2018)			✓
Trust game	Isoni and Sugden (2019)			✓

[1] Becker, 1976; Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000
[2] Rabin, 1993; Dufwenberg and Kirchsteiger, 2004

Main takeaways

- What we know...
  - Reciprocity plays a crucial role in motivating players to overcome selfish and rational behaviour
  - Wasteful strategies have no impact on the evaluation of others' intentions
  - Material payoffs associated with all players are able to significantly influence the perception of kindness
  - It can be widely tested by lab experiments (SPD, UG, DG, etc.)
- What would we like to know more about?
  - What happens if more players join the game?
  - Can the concept of reciprocity be better tested in the lab? (ongoing project)

Thank you!

APPENDIX

Special Second-order Belief

For any $a_{j,h} \in A_j$, let $\hat{A}_i(a_{j,h}) \equiv argmax_{a_i \in A_i} \pi_i(a_i, a_{j,h})$ and define $C^{pwo}_{iji}(a_{j,h}) \subseteq \hat{A}_i(a_{j,h})$ as follows:

$$a_i \in C^{pwo}_{iji}(a_{j,h}) \begin{cases} \text{if either (i) } \pi_i(a_i, a_{j,h}) > \pi_i(a'_i, a_{j,h}) \; \forall \; a'_i \in \hat{A}_i(a_{j,h})/\{a_i\} \\ \text{or if (ii) } \pi_j(a_i, a_{j,h}) < \pi_j(a'_i, a_{j,h}) \; \forall a'_i \in \hat{A}_i(a_{j,h})/\{a_i\} \; \textit{such that } \pi_i(a_i, a_{j,h}) = \pi_i(a'_i, a_{j,h}) \\ \text{or if (iii) } \pi_k(a_i, a_{j,h}) = \pi_k(a'_i, a_{j,h}) \; \forall \; k \in \{i,j\} \; \forall a'_i \in \hat{A}_i(a_{j,h}) \end{cases}$$

Efficient Strategy

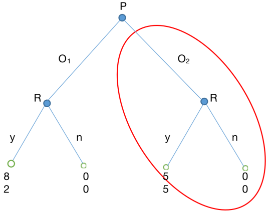
Define efficient strategy set for $j \in \{1, 2\}$ as follows:

$$E^{pwo}_j = \left\{ a_j \in A_j \;\middle|\; \begin{array}{l} \text{if } \nexists \; a'_j \in A_j \text{ such that:} \\ (i) \pi_k(a'_j, C^{pwo}_{iji}(a_{j,h})) \geq \pi_k(a_j, C^{pwo}_{iji}(a_{j,h})) \; \forall k \in \{i,j\} \text{ and} \\ (ii) \; \pi_k(a'_j, C^{pwo}_{iji}(a_{j,h})) > \pi_k(a_j, C^{pwo}_{iji}(a_{j,h})) \;\; \text{for some } k \in \{i,j\} \end{array} \right\}$$

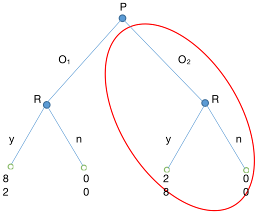
Back

Ultimatum game

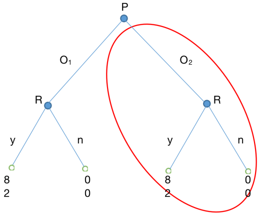
- An experimental study from Falk, Fehr, and Fischbacher (2003)



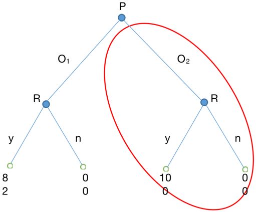
Game (a): ultimatum game-(5,5)



Game (b): ultimatum game-(2,8)



Game (c): ultimatum game-(8,2)



Game (d): ultimatum game-(10,0)

Our prediction

- **Result 1**. *"O_1" is the efficient strategy in game (a), game (b), game (c), and game (d); "O_2" is the efficient strategy in game (a), game (b), and game (c) but not in game (d).*

- **Result 2**. *In game (a) and game (b), if the proposer chooses "O_2", the responder will accept the offer (by choosing "y") in ERE.*

- **Result 3**. *In game (a) and game (b), if the proposer chooses "O_1", the responder will reject the offer (by choosing "n") if $\alpha \geq 1/3$.*

- **Result 4**. *In game (a), suppose $\alpha < 1/3$. If the proposer chooses "O_1", the responder will accept the offer (by choosing "y") if $\beta < \frac{(2-6\alpha)(1+e^5)}{40e^5}$, will reject the offer (by choosing "n") if $\beta > \frac{(2-6\alpha)(e^8+e^5)}{24e^5}$, and will choose randomly if $\frac{(2-6\alpha)(1+e^5)}{40e^5} \leq \beta \leq \frac{(2-6\alpha)(e^8+e^5)}{24e^5}$.*

- **Result 5**. *In game (b), suppose $\alpha < 1/3$. If the proposer chooses "O_1", the responder will accept the offer (by choosing "y") if $\beta < \frac{(2-6\alpha)(1+e^2)}{64e^2}$, will reject the offer (by choosing "n") if $\beta > \frac{(2-6\alpha)(e^8+e^2)}{48e^2}$, and will choose randomly if $\frac{(2-6\alpha)(1+e^2)}{64e^2} \leq \beta \leq \frac{(2-6\alpha)(e^8+e^2)}{48e^2}$.*

Our prediction

- **Result 6**. *More responders are willing to accept (by choosing "y") the (8,2) offer (when the proposer chose "O_1") in game (b) than in game (a) given a uniform distribution over the population.*

- **Result 7**. *In game (c) and (d), if the proposer chooses "O_1", the responder will accept the offer (by choosing "y") if $\alpha < 1/3$, will reject the offer (by choosing "n") if $\alpha > 1/3$, and will choose randomly if $\alpha = 1/3$.*

- **Result 8**. *More responders are willing to accept (by choosing "y") the (8,2) offer (when the proposer chose "O_1") in games (c) and (d) than in games (a) and (b).*

- Experimental results
  - Empirical results show that the rejection rate of the (8,2) offer decreases from (a) to (d): in (a) it is 44.4%, in (b) 26.7%, in (c) 18%, and in (d) 8.9%. However, the difference between game (c) and game (d) is not statistically significant
  - Our prediction is consistent with the experimental findings of Falk, Fehr, and Fischbacher (2003)

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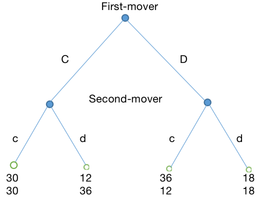
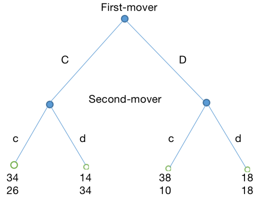
Sequential prisoner's dilemma

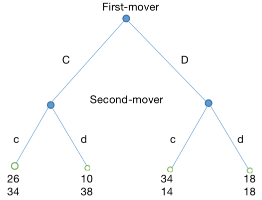
- An experimental study from Ahn et al. (2007)



SPD-treatment 1



SPD-treatment 2



SPD-treatment 3

Our prediction

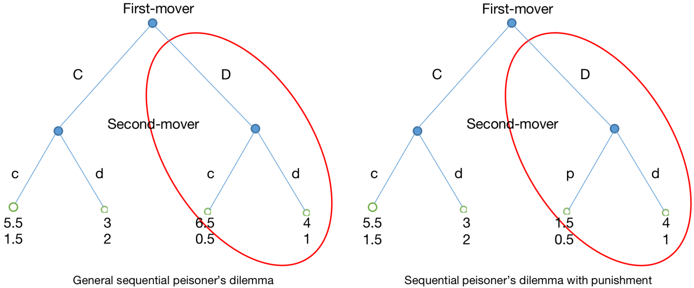
- D-path
  - **Result 1**. *In all treatments, "C" and "D" are both efficient strategies. If player 1 defects (by choosing "D"), player 2 will always defect (by choosing "d") as a response in ERE.*
- C-path
  - **Result 2**. *In treatment 1, if player 1 cooperates (by choosing "C"), the following hold in ERE:*
    (i) *If* $\beta > \frac{e^{30}+e^{18}}{36e^{18}}$, *player 2 will cooperate (by choosing "c").*
    (ii) *If* $\beta < \frac{e^{12}+e^{18}}{54e^{18}}$, *player 2 will defect (by choosing "d").*
    (iii) *If* $\frac{e^{12}+e^{18}}{54e^{18}} \leq \beta \leq \frac{e^{30}+e^{18}}{36e^{18}}$, *player 2 will cooperate (by choosing "c") with probability p that satisfies* $3\beta(18-6p) \cdot \frac{e^{18}}{e^{18p+12}+e^{18}} = 1$.
  - **Result 3**. *In treatment 2. If player 1 cooperates (by choosing "C"), the following holds in ERE:*
    (i) *If* $\beta > \frac{(e^{34}+e^{18})(\alpha+1)}{20e^{18}}$, *player 2 will cooperate (by choosing "c").*
    (ii) *If* $\beta < \frac{(e^{14}+e^{18})(1+\alpha)}{40e^{18}}$, *player 2 will defect (by choosing "d").*
    (iii) *If* $\frac{(e^{14}+e^{18})(1+\alpha)}{40e^{18}} \leq \beta \leq \frac{(e^{34}+e^{18})(\alpha+1)}{20e^{18}}$, *player 2 will cooperate (by choosing "c") with probability p that satisfies* $20\beta(2-p) \cdot \frac{e^{18}}{e^{20p+14}+e^{18}} = 1+\alpha$.

Our prediction

- C-path (Cont.)
  - **Result 4**. *In treatment 3. If player 1 cooperates (by choosing "C"), the following holds in ERE:*
    (i) *If* $\beta > \frac{e^{26}+e^{18}}{64e^{18}}$, *player 2 will cooperate (by choosing "c").*
    (ii) *If* $\beta < \frac{e^{10}+e^{18}}{80e^{18}}$, *player 2 will defect (by choosing "d").*
    (iii) *If* $\frac{e^{10}+e^{18}}{80e^{18}} \leq \beta \leq \frac{e^{26}+e^{18}}{64e^{18}}$, *player 2 will cooperate (by choosing "c") with probability p that satisfies* $4\beta(20-4p) \cdot \frac{e^{18}}{e^{16p+10}+e^{18}} = 1$.
- Comparison
  - **Result 5**. *More player 2s are willing to cooperate (by choosing "c") given player 1's cooperation (player 1 chose "C") in treatment 3 than treatment 1 and treatment 2; and more player 2s are willing to cooperate (by choosing "c") given player 1's cooperation (player 1 chose "C") in treatment 1 than treatment 2.*
- Experimental results
  - 43% of players cooperate after cooperation in treatment 3, 35% cooperate after cooperation in treatment 1, and only 21% will cooperate after cooperation in treatment 2.
  - Our prediction is consistent with the experimental findings of Ahn et al. (2007)

Back

- Many experiments on sequential prisoner's dilemma find that some second movers would like to cooperate after first-mover's cooperation (known as conditional cooperation). But the proportion of conditional cooperator differ given different situations.
- An experimental study from Orhun (2018)



Our prediction

- D-path
  - **Result 1 (GSPD)**. *"C" and "D" are both efficient strategies. If first-mover defects (by choosing "D"), second-mover will always defect (by choosing "d") as a response in ERE.*
  - **Result 2 (PSPD)**. *"C" and "D" are both efficient strategies. If first-mover defects (by choosing "D'), defection (by choosing "d") for second-mover is not the unique ERE.*
- Let's define second-mover's choice "c" after "C" as p and "c"/"p" after "D" as q.
- So q=0 in GSPD and $q > 0$ in PSPD
- In experiment, q=4% in GSPD while q=25% in PSPD

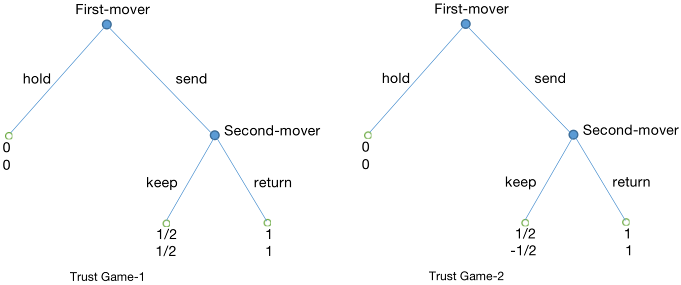
- C-path
  - **Result 3 (GSPD)**. *If first-mover cooperates (by choosing "C"), the following holds in ERE:*
    (i) *If* $\beta > \frac{(2+12\alpha)(e^{5.5}+e^{4}))}{5e^{4}}$, *second-mover will cooperate (by choosing "c")*
    (ii) *If* $\beta < \frac{(2+12\alpha)(e^{3}+e^{4})}{10e^{4}}$, *second-mover will defect (by choosing "d")*
    (iii) *If* $\frac{(2+12\alpha)(e^{3}+e^{4})}{10e^{4}} \leq \beta \leq \frac{(2+12\alpha)(e^{5.5}+e^{4}))}{5e^{4}}$, *second-mover will cooperate (by choosing "c") with probability p that satisfies* $2 + 12\alpha = 5\beta(2 - p)\frac{e^{4}}{e^{5.5p+3(1-p)}+e^{4}}$
  - **Result 4 (PSPD)**. *If first-mover cooperates (by choosing "C"), the following holds in ERE:*
    (i) *If* $\beta > \frac{(2+12\alpha)(e^{5.5}+e^{1.5q+4(1-q)})}{5(1+q)e^{1.5q+4(1-q)}}$, *second-mover will cooperate (by choosing "c")*
    (ii) *If* $\beta < \frac{(2+12\alpha)(e^{3}+e^{1.5q+4(1-q)})}{5(2+q)e^{1.5q+4(1-q)}}$, *second-mover will defect (by choosing "d")*
    (iii) *If* $\frac{(2+12\alpha)(e^{3}+e^{1.5q+4(1-q)})}{5(2+q)e^{1.5q+4(1-q)}} \leq \beta \leq \frac{(2+12\alpha)(e^{5.5}+e^{1.5q+4(1-q)})}{5(1+q)e^{1.5q+4(1-q)}}$, *second-mover will cooperate (by choosing "c") with a probability p that satisfies* $2 + 12\alpha = 5\beta(2 - p + q)\frac{e^{1.5q+4(1-q)}}{e^{5.5p+3(1-p)}+e^{1.5q+4(1-q)}}$

Our prediction

- Comparison
  - **Result 5**. Second-mover is more likely to cooperate (by choosing "c") given that first-mover's cooperation (first-mover chose "C") in GSPD than in PSPD
- In experiment, 56.52% second-movers chose cooperation after cooperation in GSPD while 34.55% in PSPD

Back

- Isoni and Sugden (2019) propose a paradox of trust when studying reciprocity with existing models



- **Result 1** . *"hold" is not the efficient strategy. No matter what the value from (send, keep) is, "return" is the unique ERE and the value of intentional kindness will be the same.*

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