Intergenerational Dilemmas and Sequential Dictator Games

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Columbia University - Experimental Lunch

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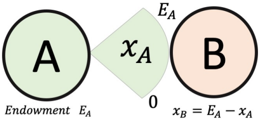
Sequential Dictator Games

- Classic Dictator Game (1 dictator, 1 receiver)



- Sequential Dictator Game (Consecutive)

- Sequential Dictator Game (Simultaneous)

Sequential Dictator Games

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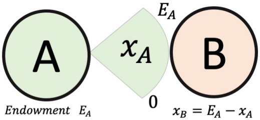

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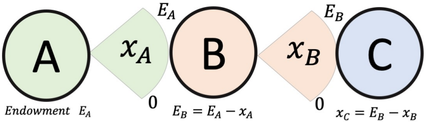

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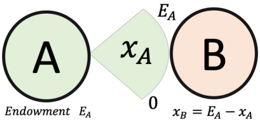

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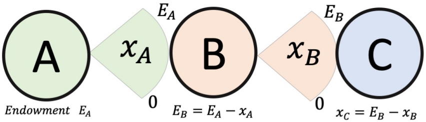

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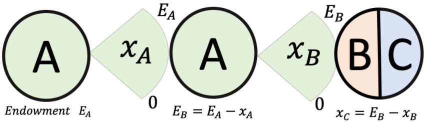

Motivating Example - Climate Change

- The economic analysis of climate change presents an incredibly difficult intellectual challenge.
- Major issues include:
  - Uncertainty and ambiguity
  - Time scale and discounting
  - Irreversibilities
  - Global public good - USA vs China
  - **Intergenerational welfare**
    Current vs future generation
    It is impossible to create a binding commitment
    Rangel (2000) Forward and backward intergenerational goods

Research Question

- **Can we characterize multiplayer allocation choices by using preferences over final distributions?**
  - If yes, effect of manipulation of the action space
  - If no, effect of manipulation of the decision process
- What can economists and moral philosophers learn in the lab?
  - Previous experimental evidence suggest that behavioral aspects including social norms (imitate others) and responsibility (credit or blame) may be relevant
- Experiment contribution: Sequential Dictator Games
- Model contribution: *responsibility* effect on dictators' choices

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- Experiment contribution: Sequential Dictator Games
- Model contribution: *responsibility* effect on dictators' choices

Today's Presentation

- Introduction: moral philosophy meets game theory
- Related literature
- Sequential Dictator Games
- Theoretical framework and predictions
- Experimental design
- Hypothesis (reduced-form)
- Current challenges

Introduction: Moral Philosophy Meets Game Theory

- Climate change is an exemplary case of conflict between generations, whose relationship is temporally and causally asymmetrical

Stephen Gardiner (2006) - A Perfect Moral Storm

The nature of the intergenerational problem is easiest to see if we compare it to the traditional Prisoner's Dilemma. Suppose we consider a pure version of the intergenerational problem, where the generations do not overlap. Call this the Pure Intergenerational Problem (PIP). In that case, the problem can be (roughly) characterised as follows:
(PIP 1) It is collectively rational for most generations to cooperate
(PIP2) It is individually rational for all generations not to cooperate

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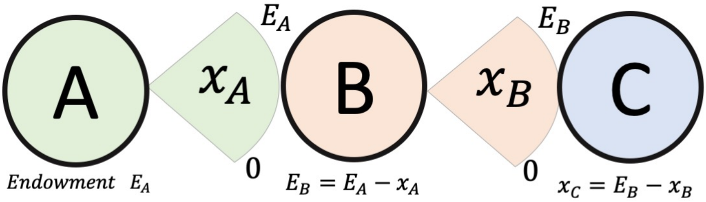
Related Literature

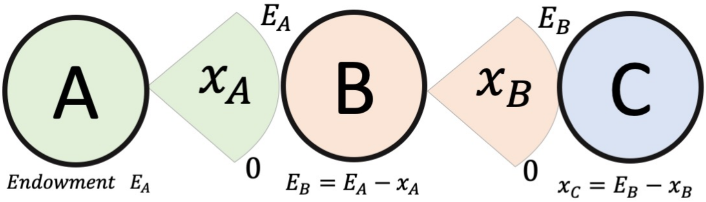
- **Social preference**
  Charness & Rabin 2002, Cason & Mui 1998, Fehr, Fischbacher & Tougarova 2002, Ferguson et al 2014, Cappelen et al 2007, Toussaert 2017, Dana et al 2007, Macro and Wessie 2016
- **Power and responsibility**
  Pikulina & Tergiman 2018, Bartling, Fehr and Herz 2014, Fehr, Herz and Wilkening 2013 (power), Blount 1995, Falk, Fehr & Fischbacher 2003, 2008, Charness 2004, Charness & Levine 2007 (intention-based preference)
- **Social norm**
  Falk, Fehr & Zehnder 2006, Fehr and Fischbacher 2004, Andreoni and Bernheim 2009, Berg, Dickhaut and McCabe 1995, Fehr, Fischbacher & Gachter 2002
- **Climate change lab experiments**
  Barrett & Dannenberg 2012, 2014, Milinski et al. 2008 (international treaty), Hauser et al. 2014 (scarce resource)

Sequential Dictator Games (SDG)



- Games A: focus on the first dictator (effect of setting)
- Games B: focus on the second dictator (effect of history)

Sequential Dictator Games (SDG)



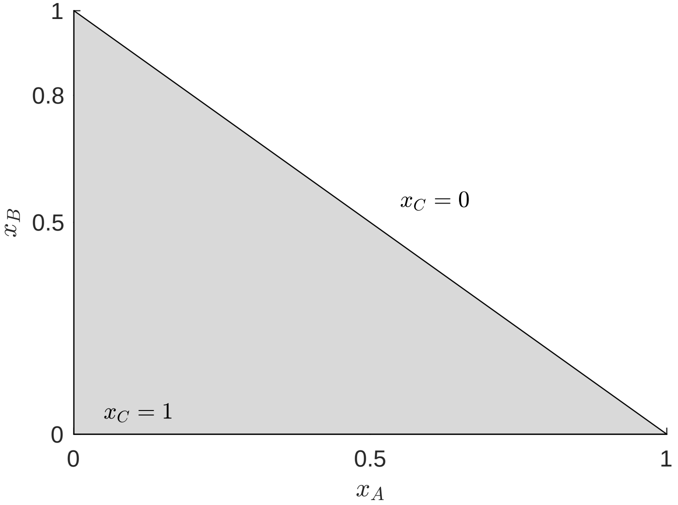
- Games A: focus on the first dictator (effect of setting)
- Games B: focus on the second dictator (effect of history)

Theoretical Framework - Simple case

- x_i is the share of Player $i \in \{A, B, C\}$
- E_i indicates the Endowment of Player i, $E_A = 1 = x_A + x_B + x_C$
- CRRA utility $u_\alpha(x) = \frac{1}{1-\alpha} x^{1-\alpha}$ if $\alpha \neq 1$, $u_\alpha(x) = log(x)$ if $\alpha = 1$
- α risk aversion coefficient
- β other regarding preference

$$x_A^* = argmax \quad U(x_A, x_B, x_C) \equiv u_\alpha(x_A) + \beta[u_\alpha(x_B) + u_\alpha(x_C)]$$

Preference over Resource Distributions



Theoretical Framework - Simple case

Simultaneous choice (A chooses for all)

$$x_A^* = E_A \cdot \frac{\beta^{-\frac{1}{\alpha}}}{2 + \beta^{-\frac{1}{\alpha}}}$$

Consecutive choice (A passes a share E_B to B)

$$x_B^* = E_B \cdot \frac{1}{1 + \beta^{\frac{1}{\alpha}}} \qquad x_A^* = E_A \cdot \frac{\beta^{-1/\alpha} \cdot \left(\left(\frac{1}{1+\beta^{1/\alpha}}\right)^{1-\alpha} + \left(\frac{\beta^{1/\alpha}}{1+\beta^{1/\alpha}}\right)^{1-\alpha} \right)^{-1/\alpha}}{1 + \beta^{-1/\alpha} \cdot \left(\left(\frac{1}{1+\beta^{1/\alpha}}\right)^{1-\alpha} + \left(\frac{\beta^{1/\alpha}}{1+\beta^{1/\alpha}}\right)^{1-\alpha} \right)^{-1/\alpha}}$$

Theoretical Framework - Simple case

Under CRRA these two cases coincide when $\alpha = 1$

$$x_A^* = E_A \cdot \frac{1}{1 + 2\beta}$$

Note that dictator A keeps for herself an higher share in the consecutive case only if $\alpha < 1$ [regardless of β]

If we use the average estimates of $\alpha = 0.54$ [from Harrison-Rutstrom 2008, Holt-Laury elicitation] and $\beta = 0.4$ [from Charness-Rabin] we get that the allocation of a unit across three agents is

- Simultaneous allocation: 0.73 / 0.13 / 0.13
- Consecutive allocation: 0.76 / 0.20 / 0.04

Theoretical Framework - More complex case

- x_i is the share of Player $i \in \{A, B, C\}$
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- α (own) risk aversion coefficient
- γ (other) risk aversion coefficient
- β other regarding preference

$$x_A^* = argmax \;\; U(x_A, x_B, x_C) \equiv u_\alpha(x_A) + \beta[u_\gamma(x_B) + u_\gamma(x_C)]$$

Theoretical Framework - More complex case

Simultaneous choice (A chooses for all)

$$\beta^{-\frac{1}{\gamma}} \cdot x_A + 2 \cdot x_A^{\alpha\gamma = E_A \cdot \beta^{-\frac{1}{\gamma}}}$$

$$x_A + 2 \cdot \beta^{\frac{1}{\gamma}} \cdot x_A^{\frac{\alpha}{\gamma}} - 1 = 0$$

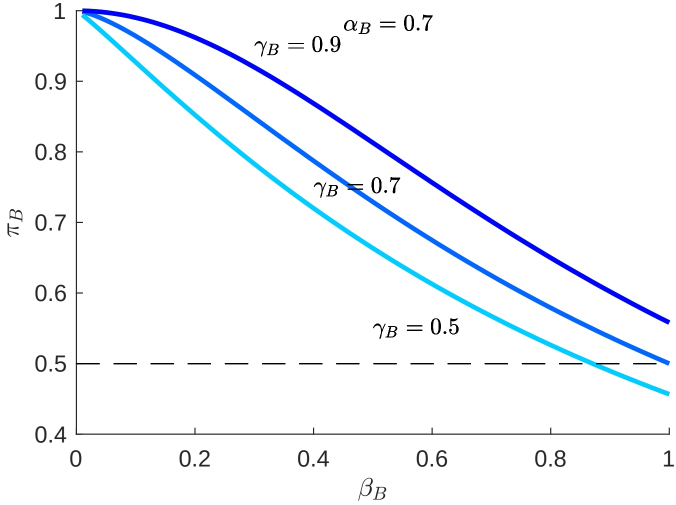
Consecutive choice (A passes a share E_B to B)

- Second stage (B chooses $\pi_B \equiv \frac{x_B}{E_B}$)

$$\beta^{\frac{1}{\gamma}} \cdot \pi_B^{\frac{\alpha}{\gamma}} + \pi_B - 1 = 0$$

- Dictator B kept share π_B depends on $\alpha_B, \gamma_B, \beta_B$

Theoretical Framework - More complex case



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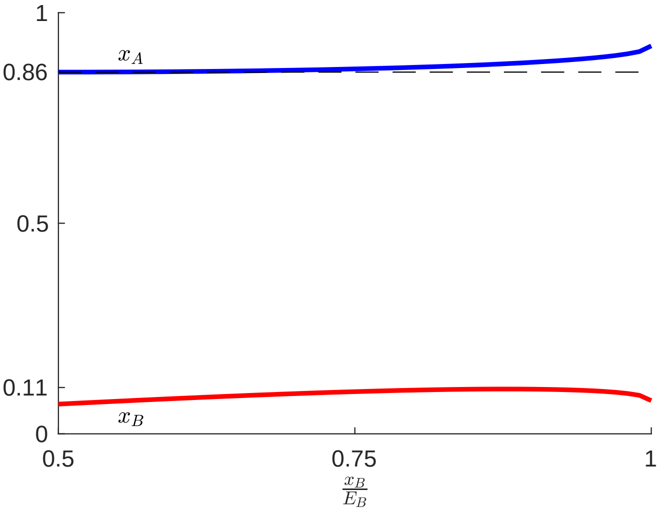
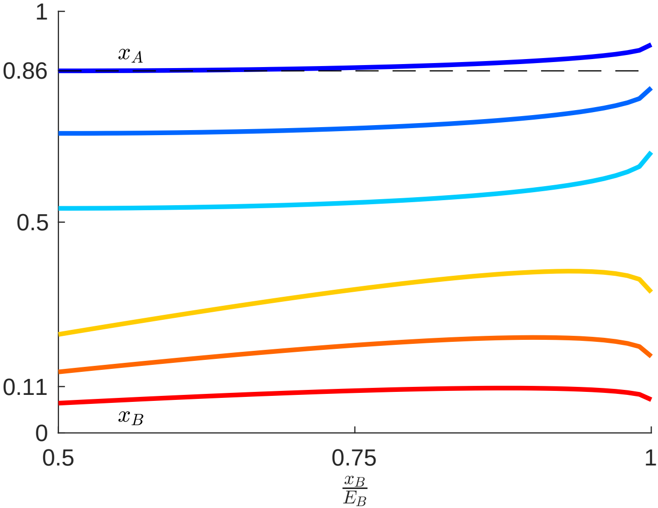


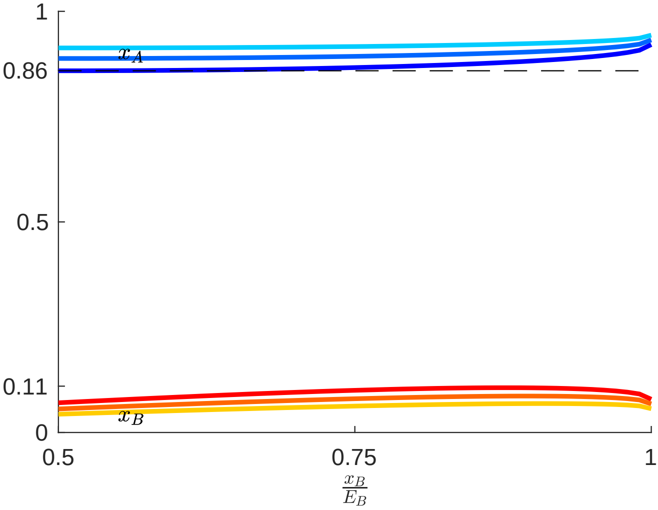
x_A selected after observing $\frac{x_B}{E_B}$. $\alpha = 0.8, \gamma = 0.5, \beta = 0.3$ (Charness Rabin 02)

SDG predictions - Different values of β



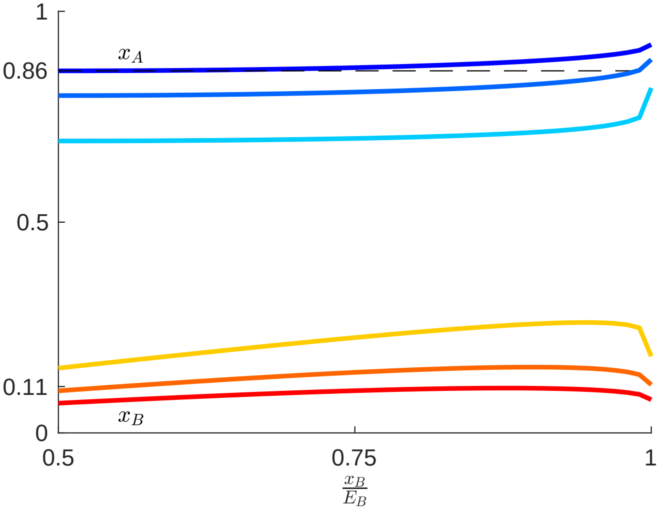
Lighter colors correspond to higher values of β

SDG predictions - Different values of α



Lighter colors correspond to higher values of α

SDG predictions - Different values of γ



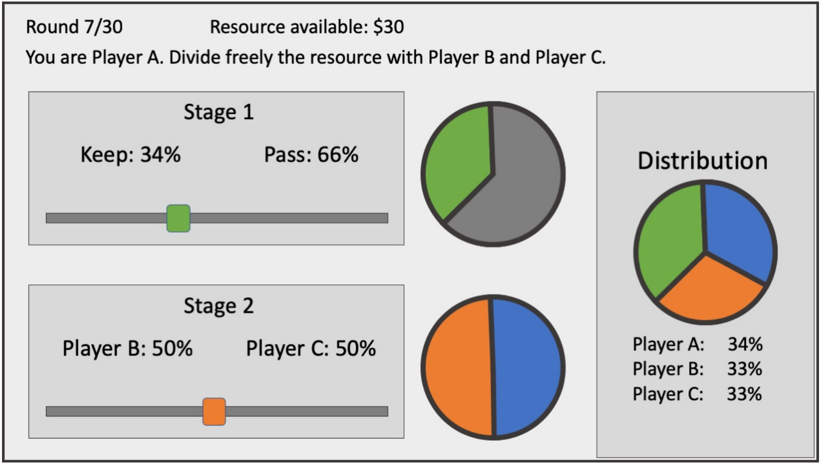
Lighter colors correspond to higher values of γ

SDG Design - Potential Concerns

We want to minimize the number of confounding factors in the experimental setting:

- **Learning**: no interaction between participants during the experiment
- **Reputation**: actions are anonymous, B cannot observe A, temporal asymmetry
- **Uncertainty** about the parameters of the problem: the only uncertainty is about other players' actions
- **Efficiency** concerns: focus on social preferences
- Intertemporal **discounting**: all future players are peers

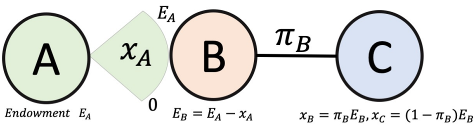
SDG Design - Interface



SDG Design - Main tasks

- Traditional 2-players DG — A $(x_A + x_B)$
- Observational DG — A $(x_B + x_C)$
- Simultaneous SDG — A $(x_A + x_B + x_C)$
- Consecutive SDG — A $(x_A + E_B)$, B $(x_B + x_C)$
- Risk attitude elicitation: Holt & Laury (2002)
  - Choices for herself + Choices for another participant
- Binary choice over distributions (tradeoff own share - fairness)
- n-players Simultaneous SDG
- n-players Consecutive SDG

SDG Design - Part 2

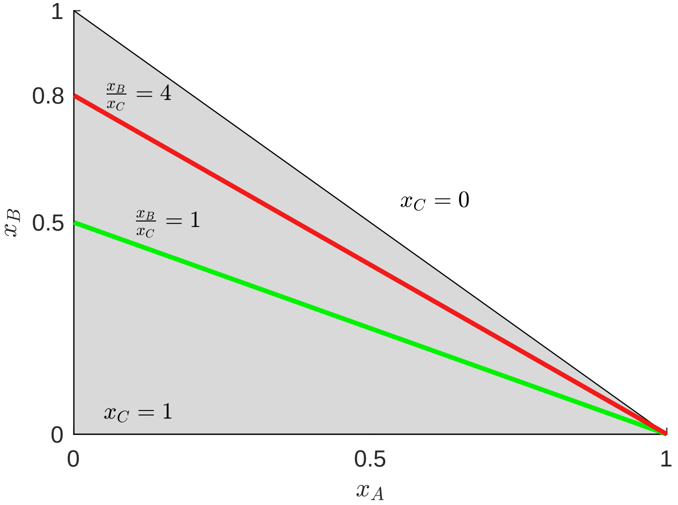


- **Consecutive SDG, but dictator B action is fixed**

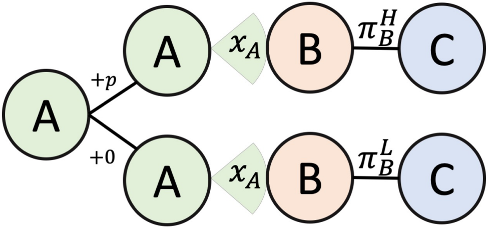
- Dictator B action is observable
- Four possible values: share of the remaining endowment that B will keep for herself
- Values: 50% (equal), 65%, 80%, 95% (unequal)

- Dictator A chooses x_A and determines the final outcome

Preference over Resource Distributions



SDG Design - Part 3

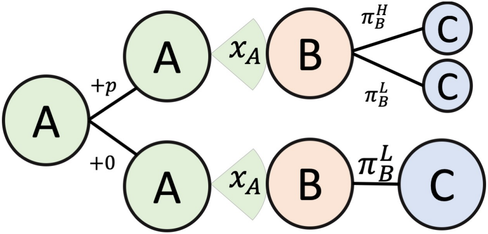


- **Consecutive SDG, dictator B action is fixed but A can change it by paying a price**

- Each trial is characterized by
  - *Default* and *Alternative* dictator B actions ($\pi_B \equiv \frac{x_B}{E_B}$)
  - Price p for changing it

- Dictator A choose whether to pay p as well as x_A
  - Default: get $x_A + p$, implement π_B^H
  - Alternative: get x_A, implement π_B^L

SDG Design - Part 4



- **Consecutive SDG, dictator B binary choice but A can lock it by paying a price**

- Each trial is characterized by
  - Two feasible dictator B actions $\pi_B^H > \pi_B^L \geq 50\%$
  - Price p for locking it

- Dictator A choose whether to pay p as well as x_A
  - Default: get $x_A + p$, implement π_B^H
  - Alternative: get x_A, implement π_B^L

Hypothesis

- Hp 0: Selfish behavior $x_A = E_A$
- Hp 1: Social preference $x_A < E_A$
  - x_A difference when x_B, x_C are also chosen
  - Preference over final distribution $x_A(\pi_B)$
- Hp 2: Preference for power - positive WTP to fix π_B
- Hp 3: Responsibility and complicity effect
  - The level x_A depends on the process

Conjecture: x_A in part 2 (no power, full responsibility) is consistent with part 3 (power, full responsibility) but lower than in part 4 (power, shared responsibility)

Current Challenges

Experimental Design

- Is this the simplest design to answer my question?
- Statistical power (lab experiment, not online)
- Order effect during the lab session

Model comparison

- Elicit preference over final distributions?
- Still not clear what is the benchmark *power* model
- Nor how I should cluster the subjects (heterogeneity)
- Avoid 6-parameters model fitting (Charness & Rabin 2002)

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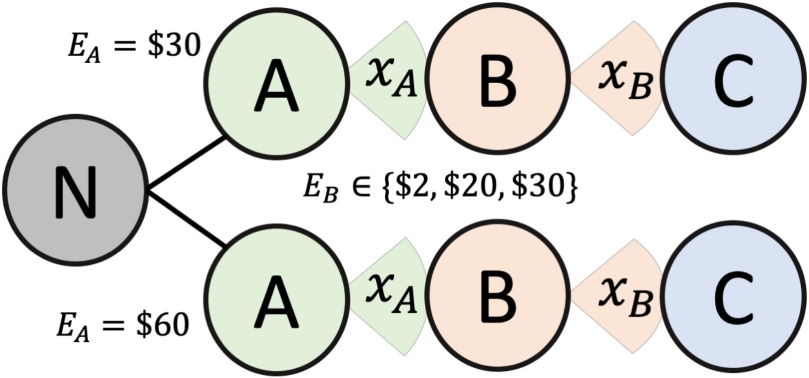
Experimental Design - Asymmetric Reciprocity



Experimental Design - Asymmetric Reciprocity

Research question: How does the history (past actions) affect the current dictator?

- Hypothesis: asymmetric reciprocity. If A is generous towards B, then B will be more generous towards C
- Design: Dictator B endowment orthogonal to Dictator A action
- Stage 0: E_A is E_A^L=\$20 or E_A^H=\$40
- Stage 1: Dictator A can pass \$2, \$10, or \$20
- Stage 2: Dictator B chooses $x_B \in [0, E_B]$
- Note that choosing E_B=\$10 is generous if E_A^L and selfish if E_A^H
- Action elicitation by strategic method (no learning)

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