⚙ More frequent commitments promote cooperation, ratcheting does not

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joint work with Axel Ockenfels[c,d] and Bodo Sturm[e,b]

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Prolog

Paris agreement
UNFCCC (2015)

> Global action plan to limit global warming to well below 2°C

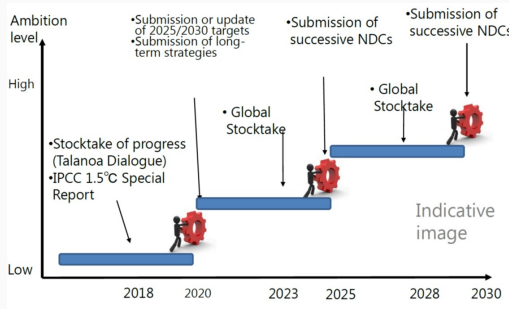❷ **Nationally determined contributions**
Falkner (2016)

> **Pros**: Eased entry into force

> **Cons**: Contributions fall short of achieving the 2°C target!

❷ **Ratchet-up mechanism**
UNFCCC (2015, Article 4)

> Gradually increase parties' contributions over time

> Achieve the 2°C target

What does the ratchet-up mechanism do?

Source: IGES

'As nationally determined contributions to the global response to climate change, all Parties are to undertake and communicate efforts [...] the efforts of all Parties will present progression over time [...]'
UNFCCC (2015, Article 4.3)

Why does the ratchet-up mechanism need an update?

UNEP (2021) ...
> Contributions are still too low to reach the 2°C target [figures ...]

Charness et al. (2011)...
> Agents strategically restrict their true capacity, because they anticipate that higher levels of output will be met with increased obligations [more lit ...]

Gallier & Sturm (2021), Alt et al. (2022)
> Ratchet-up mechanism increases agents' risk of being free ridden and decreases contributions to a public good [results ...]
> Collective minimum contributions promote contributions, only if binding [results ...]

How to update the ratchet-up mechanism?

'I hope we come out with a very good framework.
Whether it's five years (or) less, I can't tell you
today. [...] But I definitely believe it should be
as short as we can.' John Kerry

⊕ **Policy proposal**
   › Carattini & Löschel (2021): Making parties **update and review their NDCs more frequently**, e.g., every year rather than on the current five-year schedule

⊕ **Prior**
   › Schelling (1960): Small and more frequent commitments could limit the risk of being free ridden, establish trust, and foster cooperation

Many small vs. few big contribution decisions

> Do agents contribute more to a public good if they can make *many small* instead of a *few big* contribution decisions?

>> > **Voluntary contribution mechanism**: Freely decide upon their contributions to the public good

>> > **Ratchet-up mechanism**: Each contribution to the public good at least as high as in the previous round

Public goods game, w/ `details`

> multiple rounds & multiple decisions per round:

5x1 vs. *5x5*

> voluntary contribution & ratchet-up mechanism:

BASE vs. *RAT*

Simulation methods `details`

Even *low* contributions in the beginning of *5x5* could lead to cumulative contributions that are higher than in *5x1*, if ...

> some agents are willing to lead by example
> some agents have conditional cooperative preferences

☆ **Experimental results** ☆ `details`

> Contributions in *5x5* are higher than in *5x1*, in *BASE* & *RAT*

w/ multiple rounds & multiple decisions per round

- › n identical individuals, $i \in \{1, \ldots, n\}$
- › In each round $t \in \{1, \ldots, T\}$
  - › i receives an endowment: w
  - › i makes $d \in \{1, \ldots, D\}$ contribution decisions: $g_{i,t,d}$
- › At the end of each round t
  - › i´s cumulative contributions: $g_{i,t} = \sum_{d=1}^{D} g_{i,t,d}$
  - › Public good provision level: $G_t = \sum_{j=1}^{n} g_{j,t}$
  - › Payoff:

$$\pi_{i,t}(w - g_{i,t}, G_t) = w - g_{i,t} + 0.5 * G_t$$

Treatment	Mechanism		Setting	
	Voluntary contributions	**Ratchet-up**	**5x1**	**5x5**
BASE 5x1	✚	✖	✚	✖
BASE 5x5	✚	✖	✖	✚
RAT 5x1	✖	✚	✚	✖
RAT 5x5	✖	✚	✖	✚

procedure   pwr

Experimental design | VCM

BASE 5x1

> w/ $t = 5$ rounds & $d = 1$ decision per round

> w/ voluntary contribution mechanism

⊙ Players can freely decide upon their contributions

   > $0 \leq g_{i,t} \leq w$

BASE 5x5

> w/ $t = 5$ rounds & $d = 5$ decisions per round

> w/ voluntary contribution mechanisms

⊙ Players can freely decide upon their contributions

   > $d = 1 : 0 \leq g_{i,t,1} \leq w$
   > $d > 1 : 0 \leq g_{i,t,d} \leq w - \sum_{d=1}^{d-1} g_{i,t,d}$

Experimental design | Ratchet-up mechanism

RAT 5x1

> w/ $t = 5$ rounds & $d = 1$ decision per round

> w/ ratchet-up mechanism

⊙ Each contribution per round at least as high as the previous

> $t = 1$, like *BASE 5x1*

> BUT $t > 1$, $g_{i,t-1} \leq g_{i,t} \leq w$

RAT 5x5

> w/ $t = 5$ rounds & $d = 5$ decisions per round

> w/ ratchet-up mechanism

⊙ Each contribution per round at least as high as the previous

> $t = 1$, like in *BASE 5x5*

> BUT $t > 1$,

> $d = 1 : g_{i,t-1} \leq g_{i,t,1} \leq w$ and

> $d > 1 : 0 \leq g_{i,t,d} \leq w - \sum_{d=1}^{d-1} g_{i,t,d}$

Simulated contributions in t:

$$g_{i,t} = \beta \bar{g}_{-i,t-1} + (1 - \beta) g_{i,t-1}$$

where

> Contributions in $t - 1$: $g_{i,t-1}$
> Others' average contributions in $t - 1$: $\bar{g}_{-i,t-1}$

> **w/ some agents who are willing to lead by example**:
> > Heterogeneous contributors: $g_{i,1} = \texttt{runif}\{0, w\}$
> > Defectors: $g_{i,t} = 0 \ \forall t$

> **w/ some agents who have asymmetric conditional preferences**:
> > Being free ridden: $\beta = 1 \Rightarrow g_{i,t} = \bar{g}_{-i,t-1}$
> > Free riding: $\beta = 0.5 \Rightarrow g_{i,t} = 0.5(\bar{g}_{-i,t-1} + g_{i,t-1})$

5x1: BASE vs. RAT

❷ Predicted avg. cont' in RAT > BASE, if initial cont' in RAT
  are not too low `</> details`
  > Decreasing cont' in BASE
  > Increasing cont' in RAT
  > Gallier & Sturm (2021): Initial cont' in RAT lower than BASE

5x1 vs. 5x5: BASE and RAT

❷ Predicted overall cont' in *5x5* are higher than in *5x1*, if cont'
  in *5x5* do not start too small `</> details`
  > Schelling (1960): Agents start with small cont' in *5x5*
  > Decreasing cont' in *5x1*
  > Less decreasing cont' in *5x5*
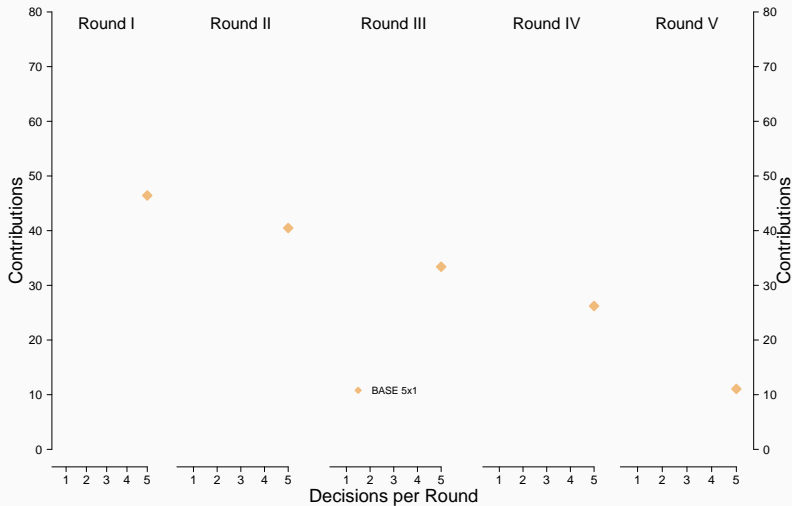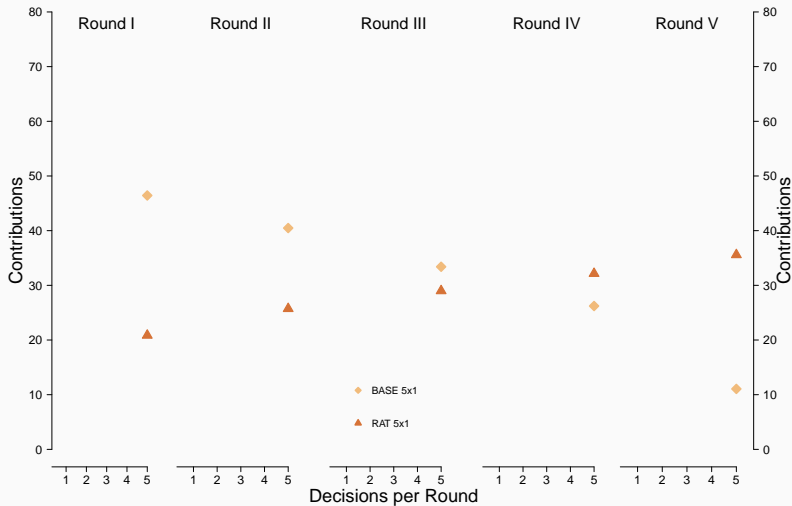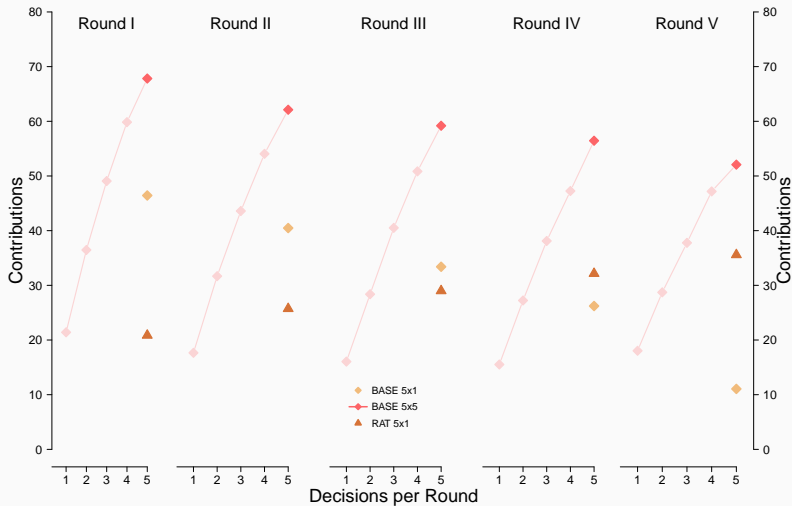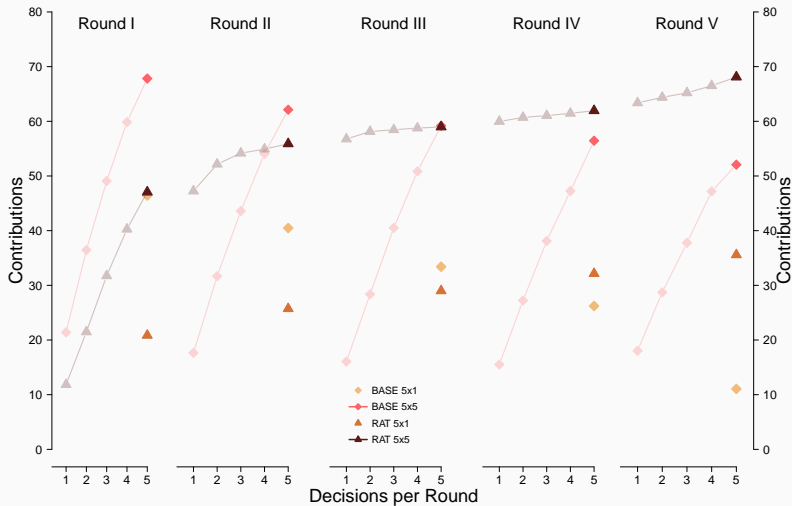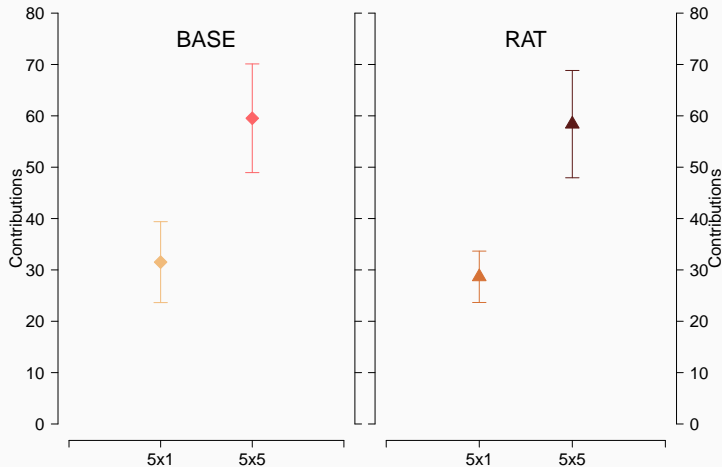
Obs 1. Contributions in *5x5* are higher than in *5x1*, both in *BASE* (p-value < 0.001) and *RAT* (p-value < 0.001)
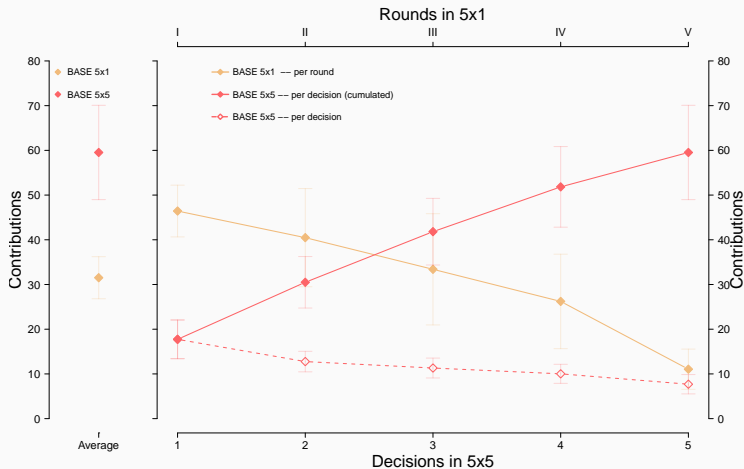
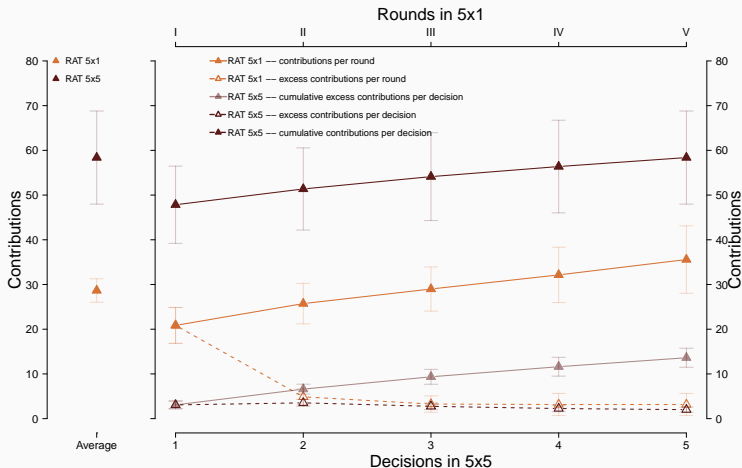**Obs 2**. In *5x5*, contributions start *lower* (p-value < 0.001) but decrease *less* (p-value < 0.001) `</> sim # 1`

Rounds in 5x1

| I | II | III | IV | V |

- RAT 5x1 — contributions per round
- RAT 5x1 — excess contributions per round
- RAT 5x5 — cumulative excess contributions per decision
- RAT 5x5 — excess contributions per decision
- RAT 5x5 — cumulative contributions per decision

RAT 5x1
RAT 5x5

Contributions

Decisions in 5x5

Average

Obs 3. In *5x5*, excess contributions start *lower* (p-value < 0.001) but decrease less (p-value < 0.001) ⟨/⟩ sim # 2

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Extent of exploitation
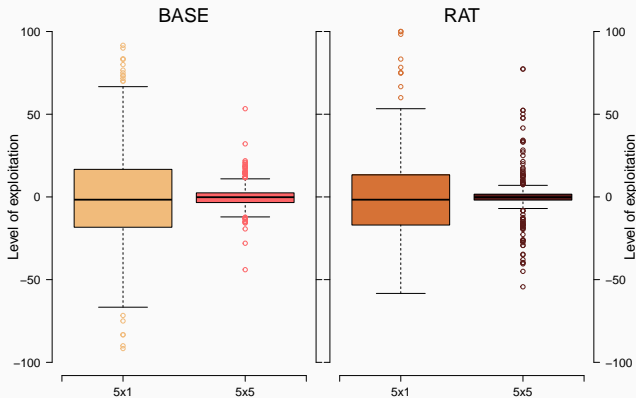
Obs 4. Extent of exploitation in *5x5* is higher than in *5x1*

Effect of exploitation
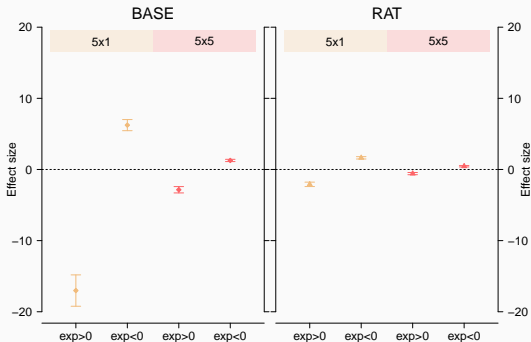
Obs. 5a. (Asymmetries): Drop after being free ridden exceeds lift after free riding

Obs. 5b. (Scaling): Effects in *5x5* are less pronounced than in *5x1*

Public goods game w/

> multiple rounds & multiple decisions per round: *5x1* vs. *5x5*

> voluntary contributions & ratchet-up: *BASE* vs. *RAT*

Experimental results

> Contributions in *5x5* are higher than in *5x1*, in *BASE* & *RAT*

> Results reflect the interplay between

> > Players who are willing to lead by example

> > Players' asymmetric conditional cooperative behavior

Thank you!
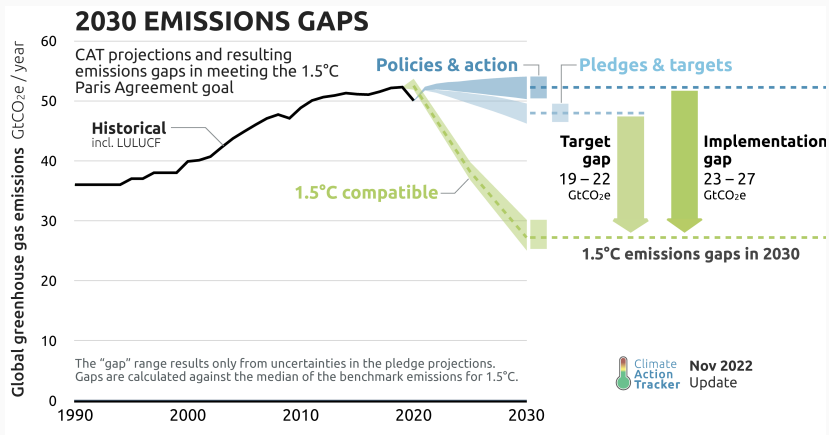
If you have questions or comments, please let me know

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🌐 https://cgallier.github.io/

Appendix

2030 EMISSIONS GAPS

Global greenhouse gas emissions GtCO₂e / year

CAT projections and resulting emissions gaps in meeting the 1.5°C Paris Agreement goal

Policies & action

Pledges & targets

Historical
incl. LULUCF

1.5°C compatible

Target gap
19 – 22
GtCO₂e

Implementation gap
23 – 27
GtCO₂e

1.5°C emissions gaps in 2030

The "gap" range results only from uncertainties in the pledge projections. Gaps are calculated against the median of the benchmark emissions for 1.5°C.
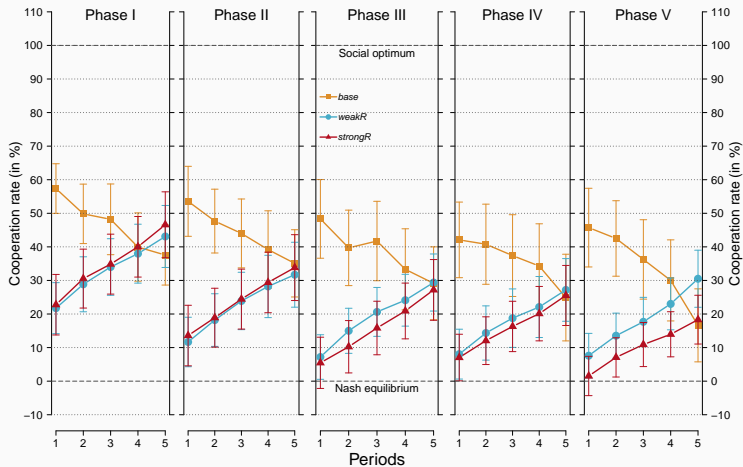
Climate Action Tracker

Nov 2022 Update

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Amano & Ohashi (2018)
➲ Firms (Japanese televisions) strategically hold back on energy efficiency to be able to continue to sell less efficient products for the foreseeable future
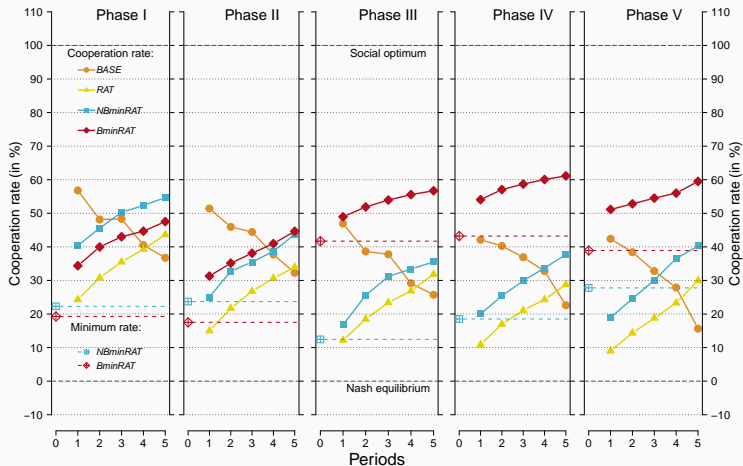
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Schelling (1960)

```
[...] if the contribution is divided into consecutive
 small contributions, each can try the other's good
faith for a small price.  [...] no one need risk more
        than one small contribution at a time.
```

Duffy et al. (2006)

> Contributions to a public good are larger in a dynamic
> multi-round game than in a one-shot game

Dorsey (1992), Kurzban et al. (2001)

> If contributions can be constantly revised, ratcheting increases
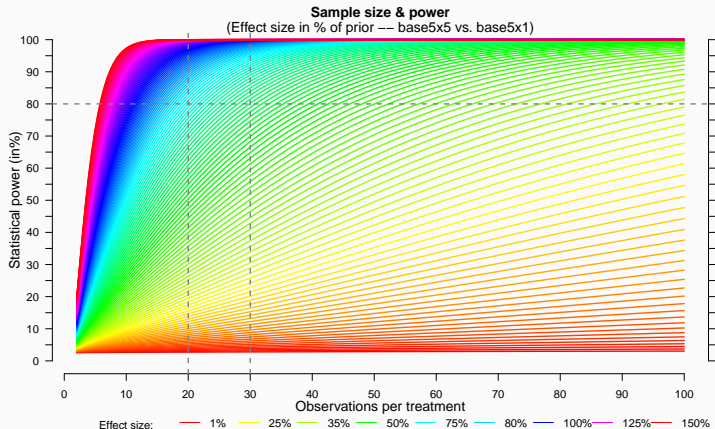> contributions to a public good

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Laboratory & software

> Protocol: online visually monitored sessions
> Cologne Laboratory for Economic Research
>> Pilot: Nov. 22
>> Sessions: Dec. 22 / Jan. 23
> `o-tree` for programming & `orsee` for recruiting

Details
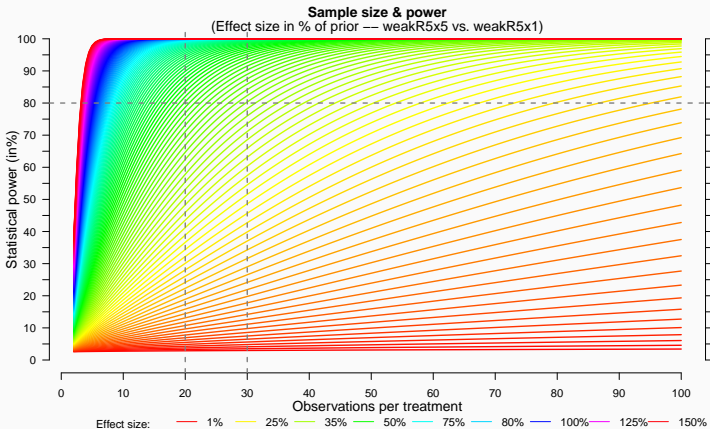
> Registration / certification: Ethics Committee of the Faculty of Economic and Social Sciences at University of Cologne
> All in all, 368 participants
> 'Five rounds à five decisions'-design (partner matching)
> Exchange rate: 60 ECU = 1 Euro
> Average payoff of 10 Euro

BASE 5x5 vs. BASE 5x1

Sample size & power
(Effect size in % of prior —— base5x5 vs. base5x1)

Statistical power (in%)

Observations per treatment

Effect size: — 1% — 25% — 35% — 50% — 75% — 80% — 100% — 125% — 150%

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RAT 5x5 vs. RAT 5x1

Sample size & power
(Effect size in % of prior — weakR5x5 vs. weakR5x1)

Statistical power (in%)

Observations per treatment

Effect size: — 1% — 25% — 35% — 50% — 75% — 80% — 100% — 125% — 150%

Conditional preferences

> Two types of players
>> Uncooperative (*DF*): $g_t = 0 \; \forall t$
>> Asymmetric conditionally cooperative (*CC*): $\beta = 0.5$ or $\beta = 1$

> Initial contributions (*aka point of departure*)
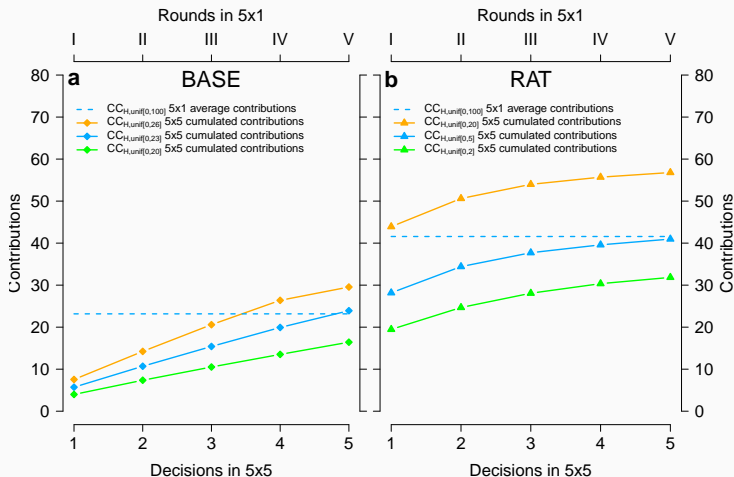>> CC_{unif}: $g_1 = runif[0, \bar{u}]$ for all CCs, where $\bar{u}$ is the upper bound

Simulated population & groups

> 1,000 random samples w/ replacement from
>> CC_L: 75% of *DF* & 25% of *CC*
>> CC_H: 25% of *DF* & 75% of *CC*

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5x1: BASE vs. RAT
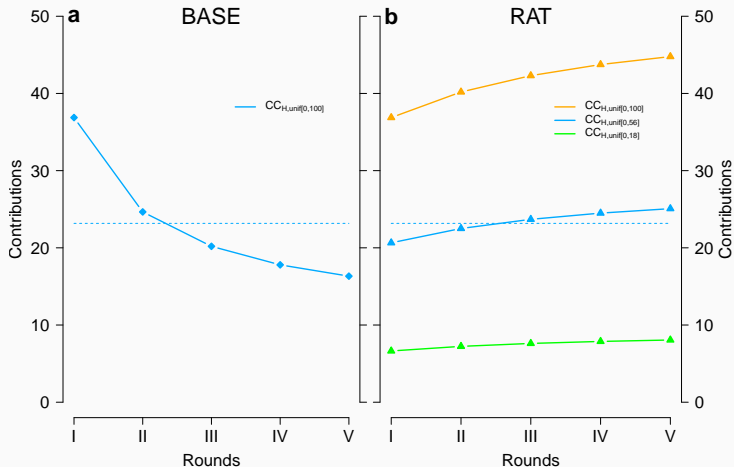
5x1 vs. 5x5: BASE and RAT

THIS IS THE END!