

⚙ Little by little: Dynamic incentives and incremental contributions to a public good

Carlo Gallier^{a,b}

joint work with Axel Ockenfels^{c,d} and Bodo Sturm^{e,b}

^a Free University of Bozen-Bolzano

^b ZEW – Leibniz Centre for European Economic Research

^c University of Cologne

^d Center for Social and Economic Behavior

^e Leipzig University of Applied Sciences

Paris agreement

UNFCCC (2015)

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

➡ **Nationally determined contributions**

- › **Pros:** Eased entry into force of the agreement
- › **Cons:** Contributions fall short of achieving the 2°C target!

➡ **Ratchet-up mechanism**

- › 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 [...]

Why does the ratchet-up mechanism need an update?

UNEP (2021) ...

- › Contributions are still too low to reach the 2°C target [figures ...](#)

Chaudhuri (1998, JEBO), Charness et al. (2011, JOLE)...

- › 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, JEBO), Alt et al. (2022, DP)

- › 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?

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

...

'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

'It's an emergency. Every five years? That's not treating like an emergency.' Saleemul Hug

...

Research question

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

- › **Voluntary contribution mechanism:** *Freely decide* upon their contributions to the public good
- › **Ratchet-up mechanism:** Each contribution to the public good per round *at least as high* as the previous

Testbed a **large number of small** contribution decisions

Public goods game

- › w/ multiple rounds & multiple decisions per round
 - › *5x1*: One contribution per round
 - › *5x5*: Five contributions per round
- › w/ voluntary contribution & ratchet-up mechanism
 - › *BASE*: Participants can freely decide
 - › *RAT*: Each contribution per round at least as high as before

Experimental results

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

Simulation models

- › Interplay of two types of players who are
 - › ... willing to lead by example
 - › ... imperfect conditionally cooperative

w/ multiple rounds & multiple decisions per round

- › n identical individuals, $i \in \{1, \dots, n\}$
- › In each round $t \in \{1, \dots, T\}$
 - › i receives an endowment: w
 - › i has to make $d \in \{1, \dots, D\}$ contribution decisions: $g_{i,t,d}$
 - › i 's cumulated contributions: $g_{i,t} = \sum_{k=1}^D g_{i,t,k}$
 - › Public good provision level: $G_t = \sum_{j=1}^n g_{j,t}$
- › Payoff in round t

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

| Treatment | Mechanism | | Setting | |
|-----------|-------------------------|------------|--------------|---------------|
| | Voluntary contributions | Ratchet-up | Static (5x1) | Dynamic (5x5) |
| BASE 5x1 | + | × | + | × |
| BASE 5x5 | + | × | × | + |
| RAT 5x1 | × | + | + | × |
| RAT 5x5 | × | + | × | + |

Static: BASE 5x1

- › w/ $t = 5$ rounds & $d = 1$ decision per round
- › w/o ratchet-up mechanism
- ➔ Players can freely decide upon their contributions
 - › $0 \leq g_{i,t} \leq w$

Dynamic: BASE 5x5

- › w/ $t = 5$ rounds & $d = 5$ decisions per round
- › w/o ratchet-up mechanism
- ➔ Players can freely decide upon their contributions
 - › $d = 1 : 0 \leq g_{i,t,1} \leq w$
 - › $d > 1 : 0 \leq g_{i,t,d} \leq w - \sum_{k=1}^{d-1} g_{i,t,k}$

Experimental design | Ratchet-up: 5x1 vs. 5x5

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

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

BASE vs. RAT

Charness et al. (2011, JOLE), Gallier & Sturm (2021, JEBO)

- › Ratchet-up mechanism increases agents' risk of being free ridden and decreases public good contributions [results ...](#)

5x1 vs. 5x5

Schelling (1960), Duffy et al. (2006), Dorsey (1992) ...

- › Small, sequential, and contingent commitments can limit the extent to which agents expose themselves to the risk of being free ridden, establish trust and, finally, foster cooperation

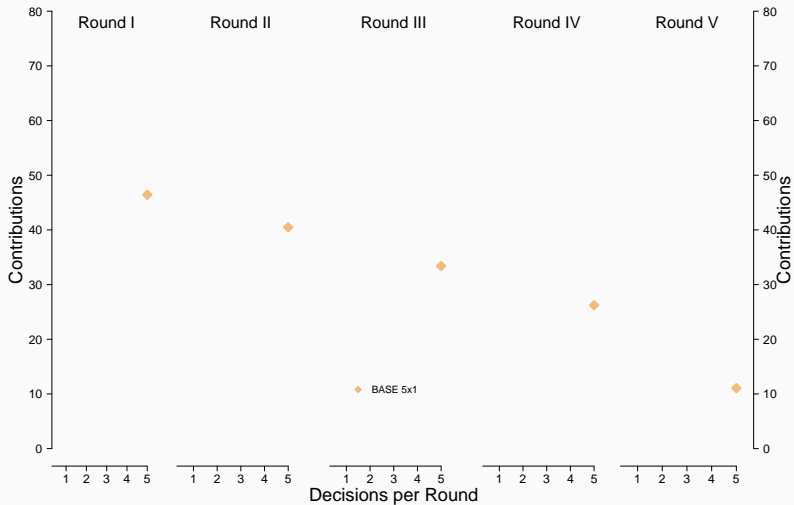
[details ...](#)

[⚙ overview](#)

[⚙ procedure](#)

[</> pwr](#)

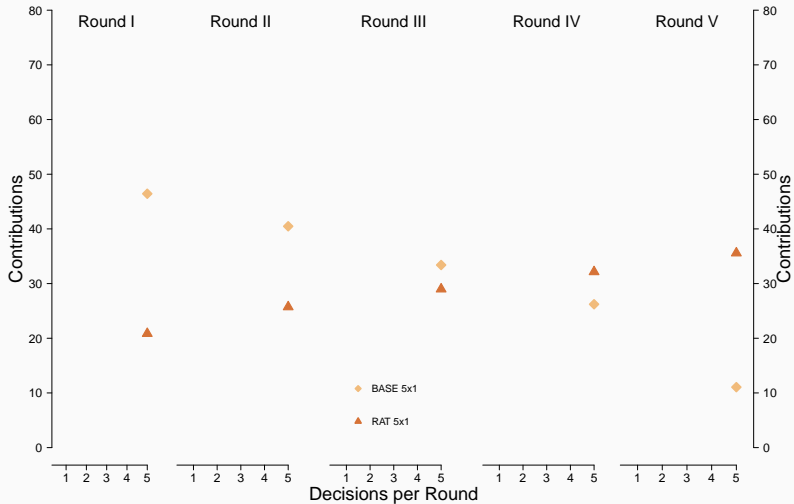
Results | How to



</> sim # 1

</> sim # 2

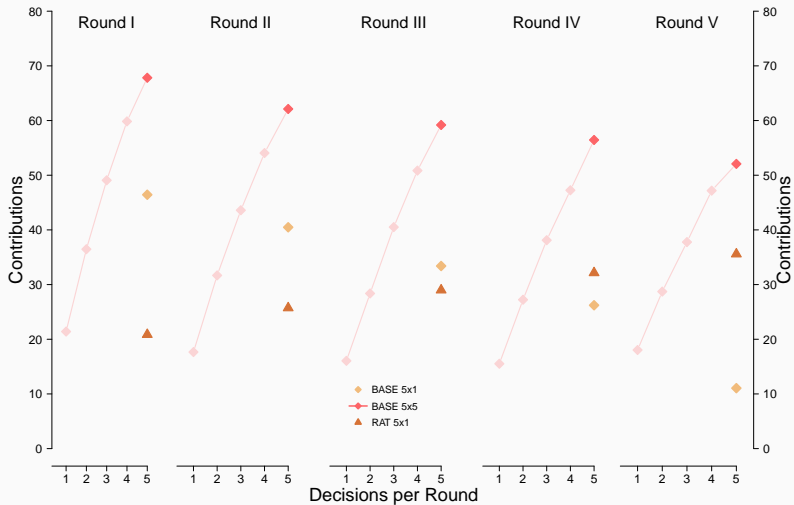
Results | Plausibility check



</> sim # 1

</> sim # 2

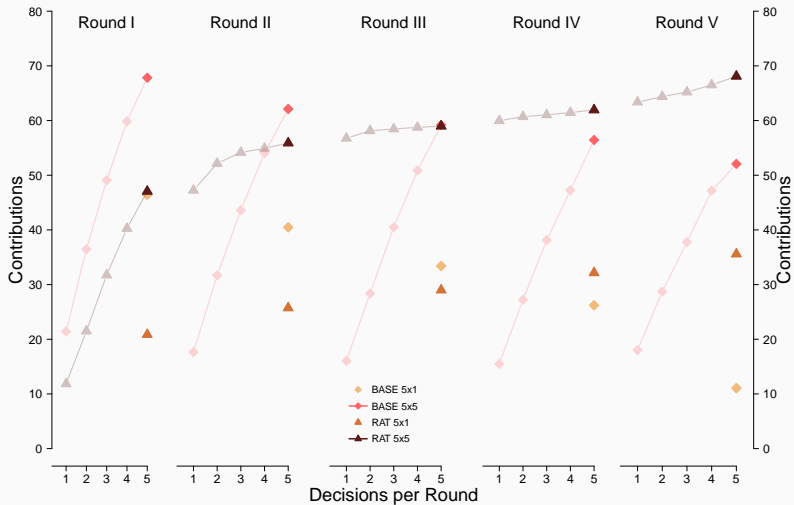
Results | Overview



</> sim # 1

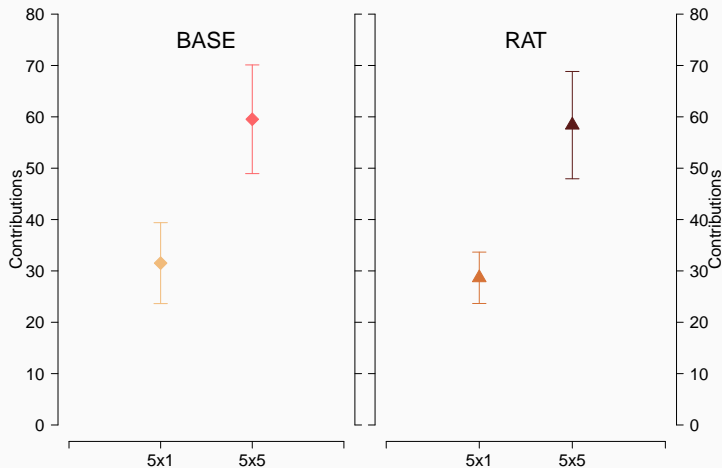
</> sim # 2

Results | Overview (con't)



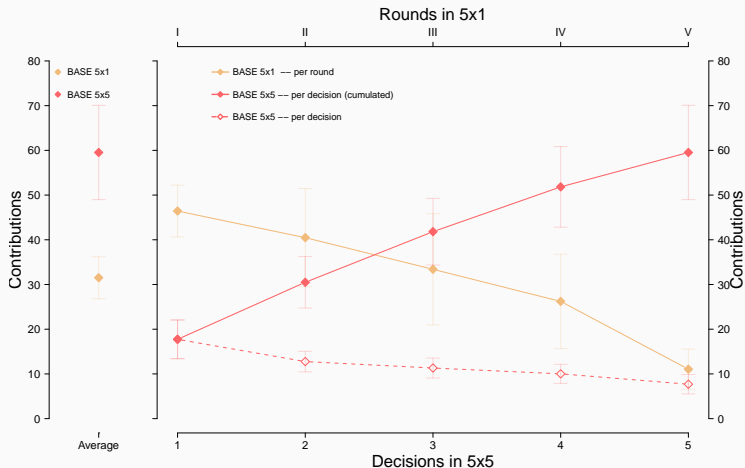
</> sim # 1

</> sim # 2



Obs 1. Contributions in 5x5 are higher than in 5x1, both in *BASE* ($p\text{-value} < 0.001$) and *RAT* ($p\text{-value} < 0.001$)

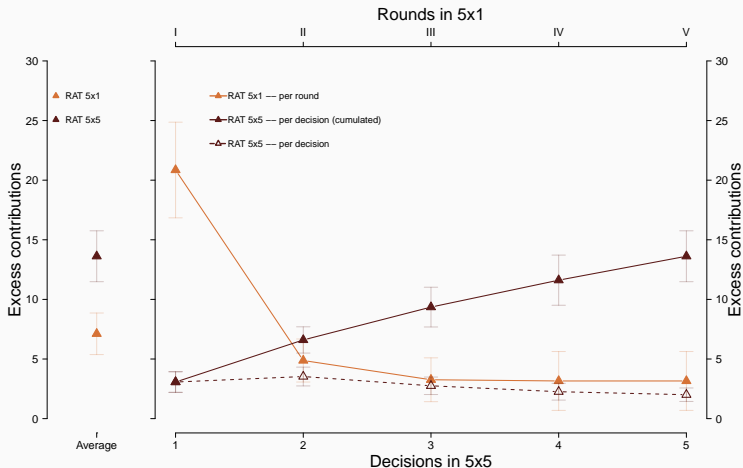
Results | Treatment effects | BASE: 5x1 vs. 5x5



Obs 2. In 5x5, contributions start *lower* ($p\text{-value} < 0.001$) but decrease *less* ($p\text{-value} < 0.001$)

</> sim # 1

Results | Treatment effects | RAT: 5x1 vs. 5x5



Obs 3. In 5x5, excess contributions start *lower* ($p\text{-value} < 0.001$) but decrease less ($p\text{-value} < 0.001$) </> sim # 2

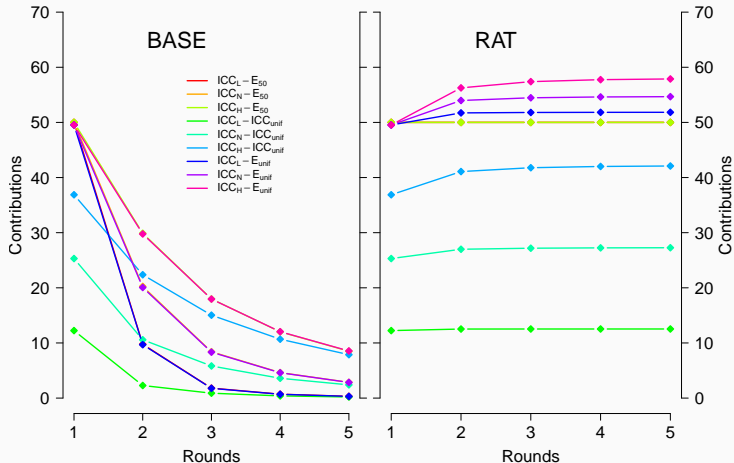
Why do participants contribute more in 5x5 than 5x1?

Simulated vs. actual contributions

$$f(\alpha_i, \phi_i(\bar{g}_{-i,t-1})) \rightarrow g_{i,t}^*$$

- › Actual contributions in t : $g_{i,t}$
- › Simulated contributions in t : $g_{i,t}^*$
 - › Initial contributions: α_i
 - › Reciprocal preferences: $\phi_i(\bar{g}_{-i,t-1})$, where $\bar{g}_{-i,t-1}$ are others' average actual contributions in $t-1$

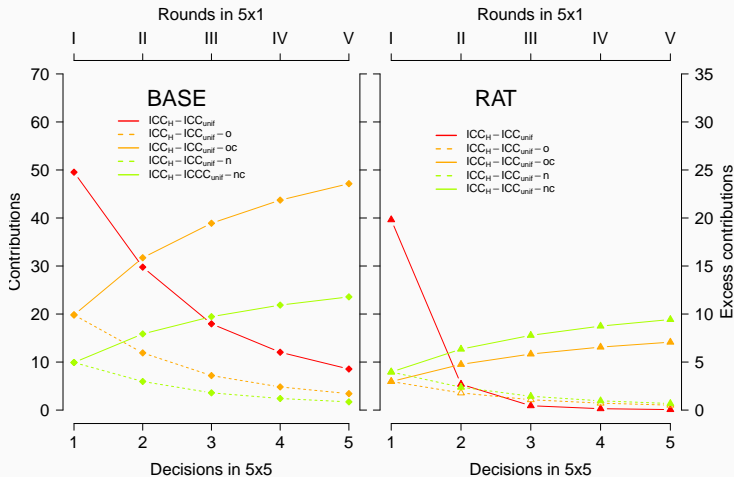
</> set-up



Obs 4. Imperfect conditional cooperation explains decline in *BASE*, but not increase and *ceiling* in *RAT*

[overview](#)

[Obs. 2](#)



Obs 5. In *BASE* 5x5, participants start *low*, but not too *low*. In *RAT* 5x5, participants start too *low*, BUT actual contributions do not decrease

Conclusion

Large number of small vs. small number of big contributions

Public goods game w/

- › multiple rounds & multiple decisions per round: 5×1 vs. 5×5
- › voluntary contributions & ratchet-up: *BASE* vs. *RAT*

Main result

- › Contributions in 5×5 are higher than in 5×1 , in *BASE* & *RAT*

Simulation models

- › Interplay of imperfect conditionally cooperative players and those who are willing to lead by example explains patterns in
 - + *BASE* 5×1 , *RAT* 5×1 , and *BASE* 5×5
 - ✗ BUT not, *RAT* 5×5

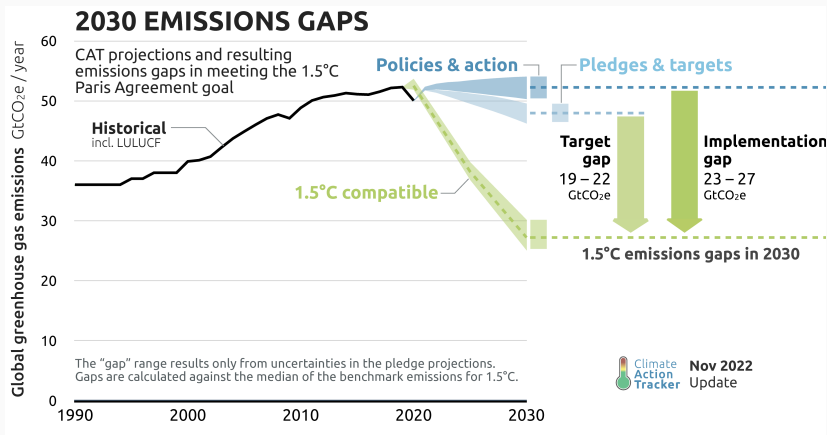
Thank you!

If you have questions, comments, critic ..., pls let me know

✉ Carlo.Gallier@unibz.it

💻 <https://cgallier.github.io/>

Appendix | Emissions Gaps



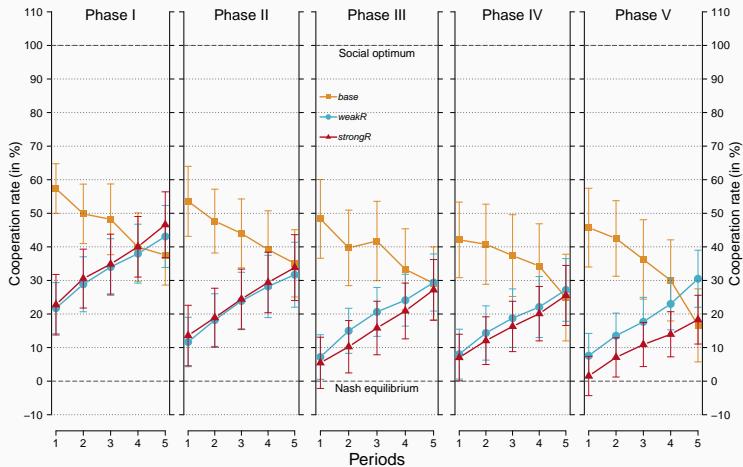
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Amano & Ohashi (2018)

➡ Firms (Japanese televisions) strategically hold back on energy efficiency to be able to continue to sell less efficient products for the foreseeable future

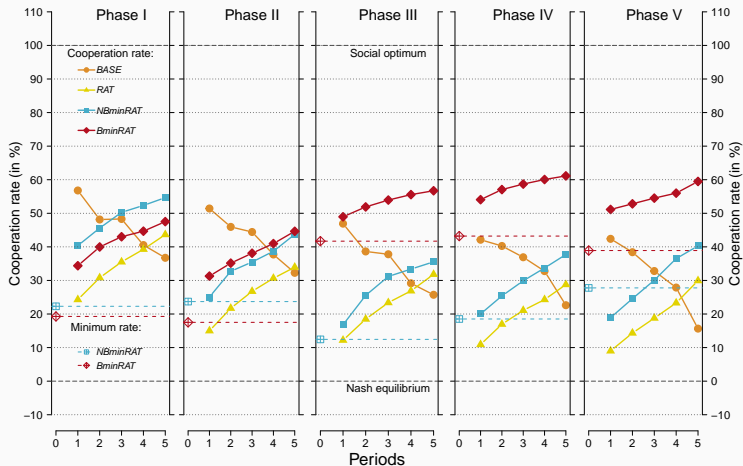
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Appendix | Gallier & Sturm (2021, JEBO)



motivation

priors



Schelling (1960)

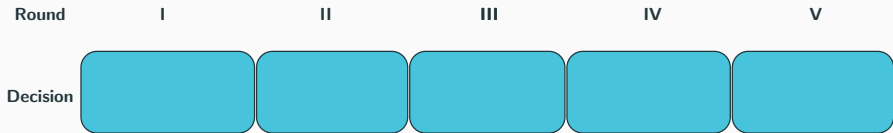
[...] if the contribution is divided into consecutive small contributions, each can try the other's good faith for a small price. [...] no one need risk more than one small contribution at a time.

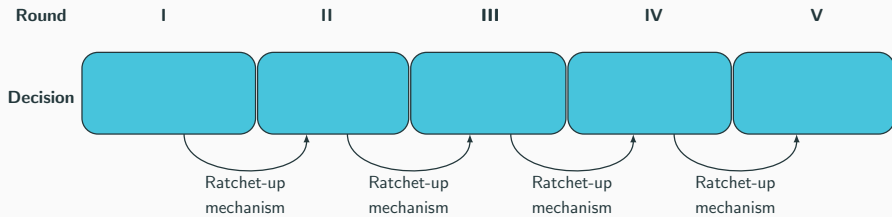
Duffy et al. (2006)

- › 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)

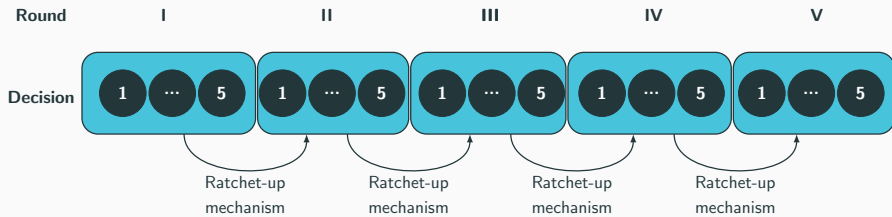
- › If contributions can be constantly revised, ratcheting increases contributions to a public good

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Appendix | Overview



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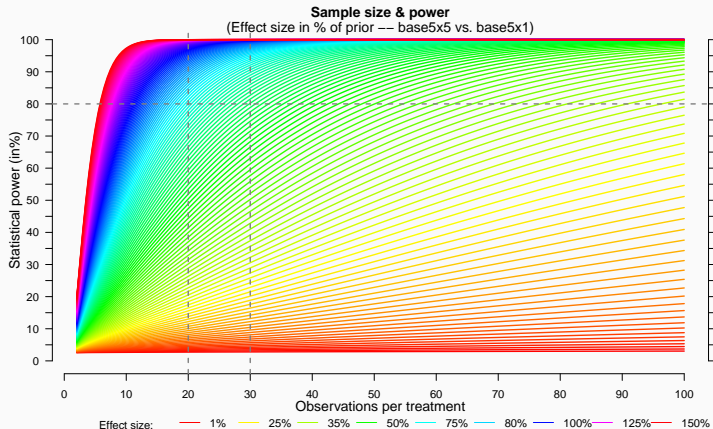
Laboratory & software

- › 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

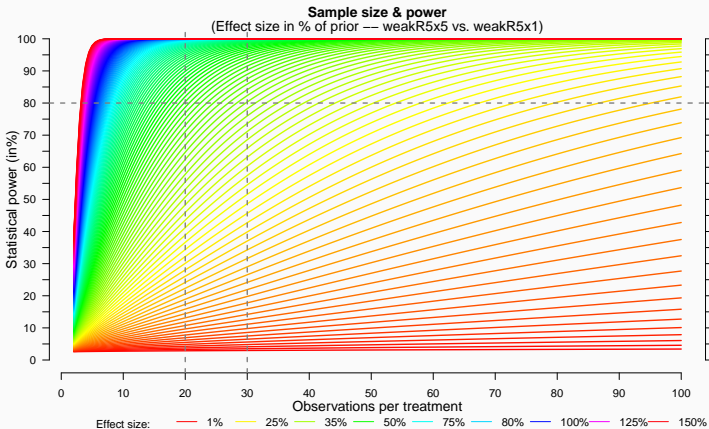
Details

- › Registration / certification: Ethical Review Board 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



RAT 5x5 vs. RAT 5x1



Conditional preferences

- › Two types of players
 - › Uncooperative (*UC*): $\phi_i(\cdot) = 0$
 - › Imperfect conditionally cooperative (*ICC*): $\phi_i(\cdot) < \bar{g}^*_{-i,t-1}$
- › Initial contributions (aka point at departure)
 - › E_{50} : 50 *ECU* for *UC* & *ICC*
 - › E_{unif} : $runif[0, 100]$ for *UC* & *ICC*
 - › ICC_{unif} : $runif[0, 100]$ for *ICC* & 0 for *UC*

Simulated population & groups

- › 1,000 random samples w/ replacement from
 - › ICC_H : 25% of *UC* & 75% of *ICC*
 - › ICC_N : 50% of *UC* & 50% of *ICC*
 - › ICC_L : 75% of *UC* & 25% of *ICC*