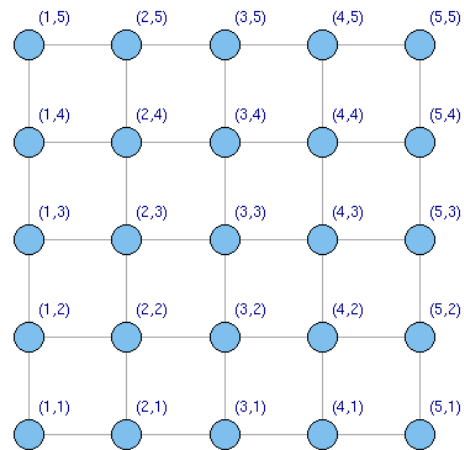# Prisoner's dilemma experiment

Jelena Grujić

GISC Workshop, 19.2.2010.

Prisoner's dilemma

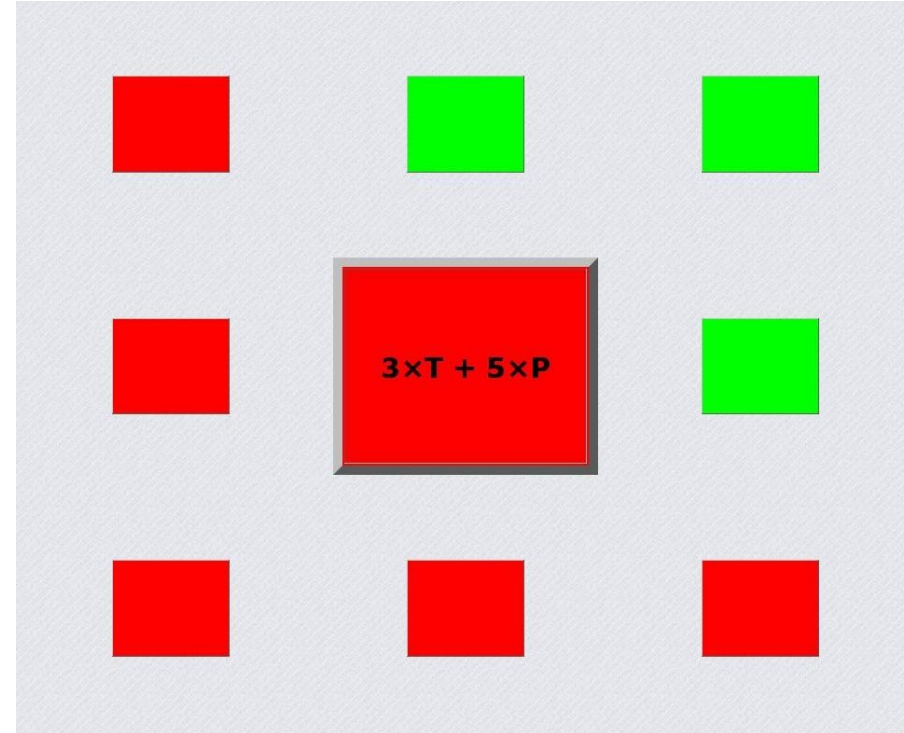|	C	D
C	**R**, R	**S**, T
D	**T**, S	**P**, P

- 2 players, 2 actions, 4 payoffs
- Cooperate or Defect
- T > R > P ≥ S or T ≥ R > P > S
- **T**emptation to defect
- **R**eward for mutual cooperation
- **P**unishment for mutual defection
- **S**ucker's payoff
- **P**unishment for mutual defection
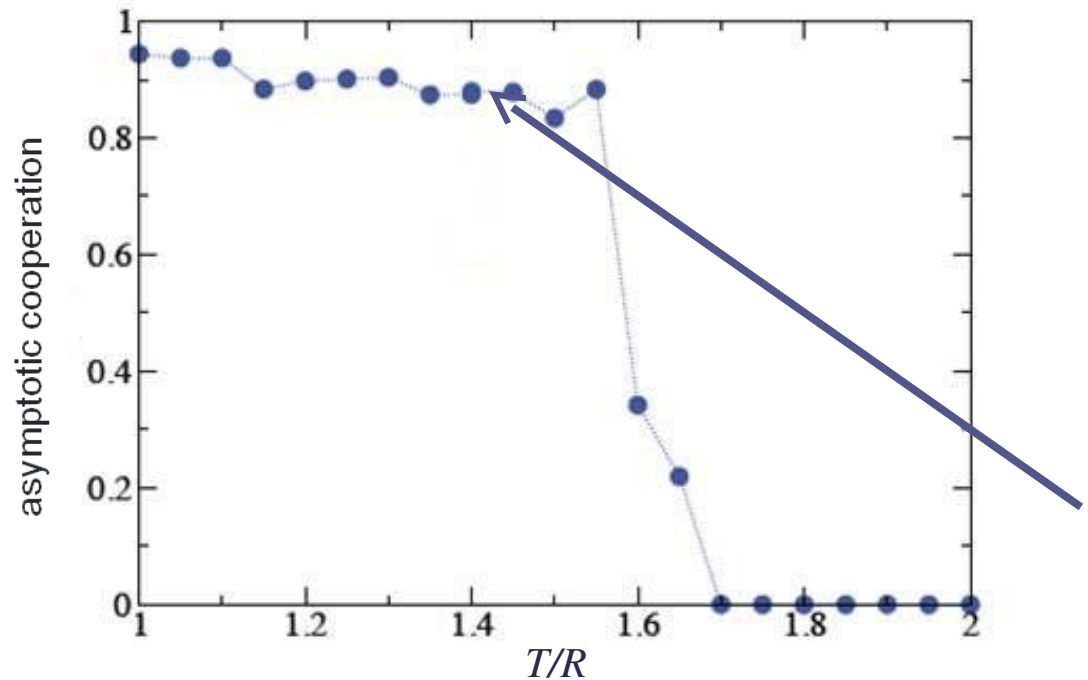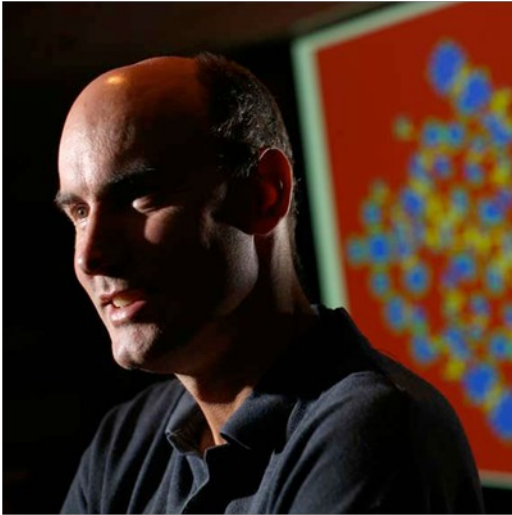- For iterated: T + S < 2 R

Spatial games

Spatial games

$3 \times R + 5 \times S$

$3 \times T + 5 \times P$
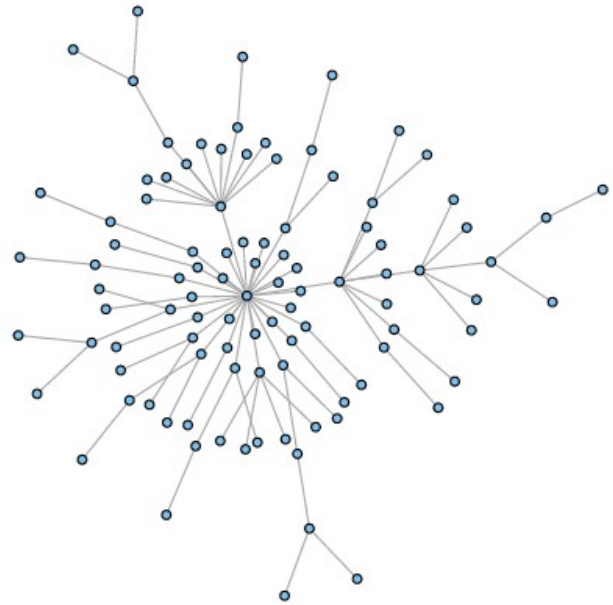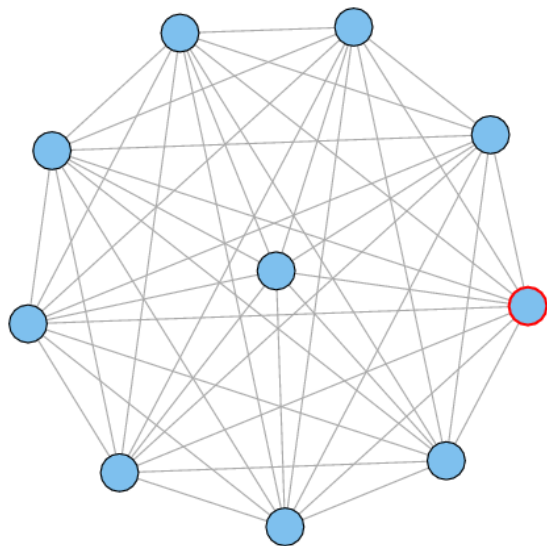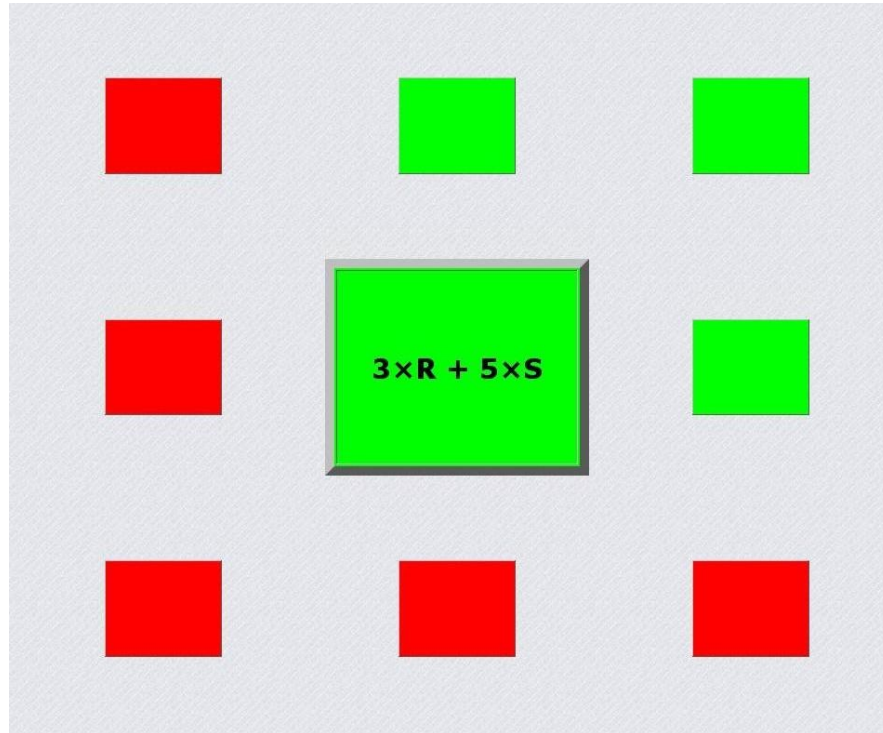
Cooperate

Defect

M.A. Nowak and R.M. May, *Nature* **359**, 826 (1992)
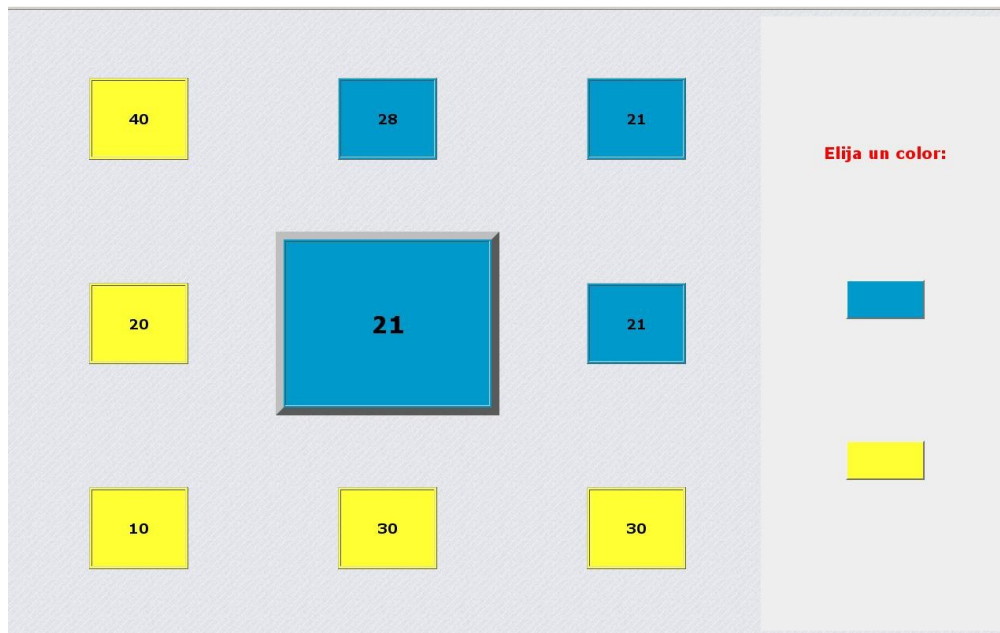

In our Experiment: T/R = 10/7
≈1,42857143

Unconditional imitation – coping the best neighbor
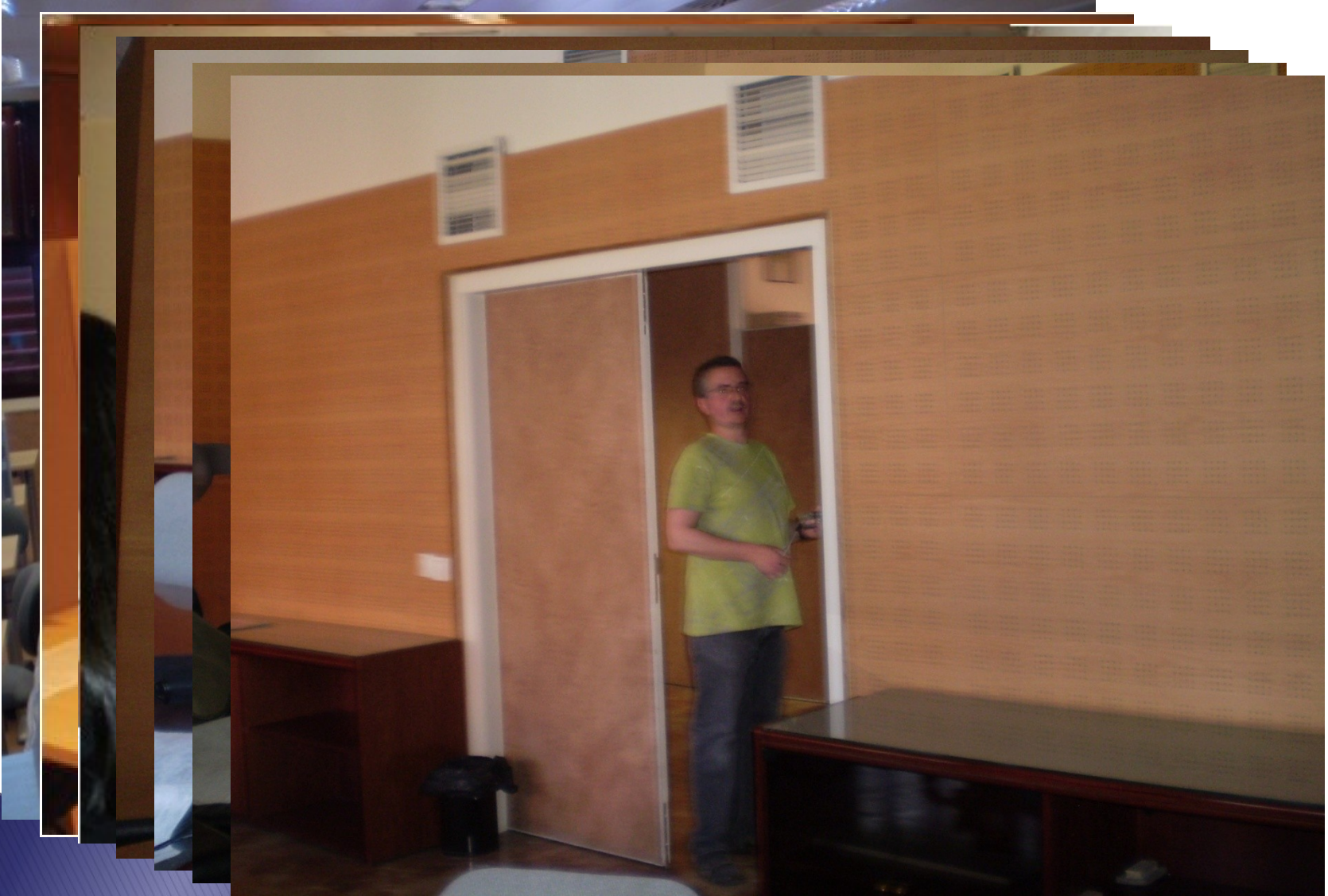
Spatial structure promotes cooperation!

Experiment

- Lattice 13x13, periodic boundary conditions
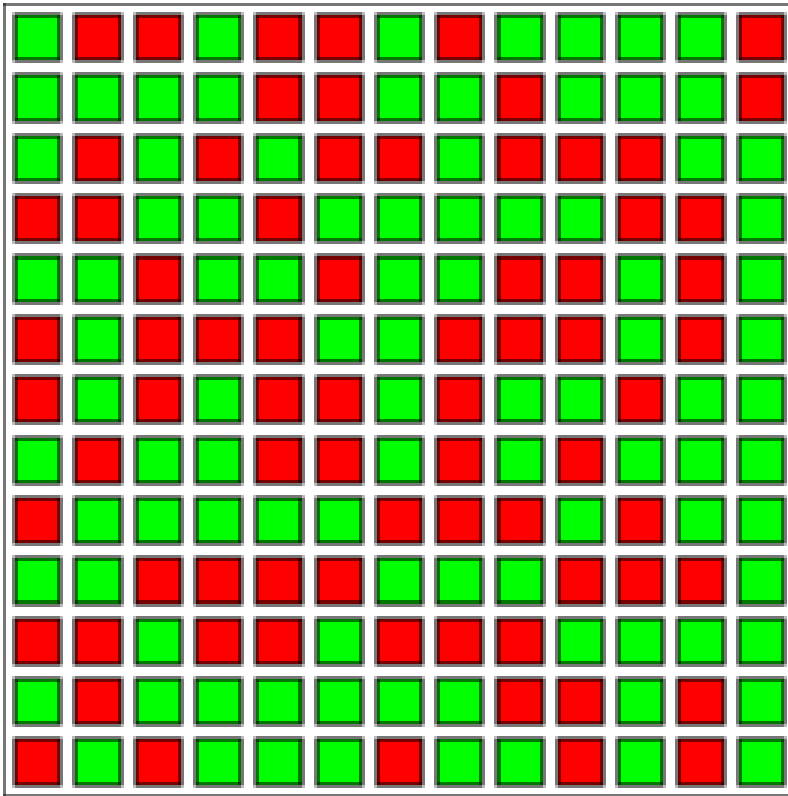- Login → Tutorial → Experiment → Control → Experiment → Questionnaire

su vecino elige

su ganancia

usted elige

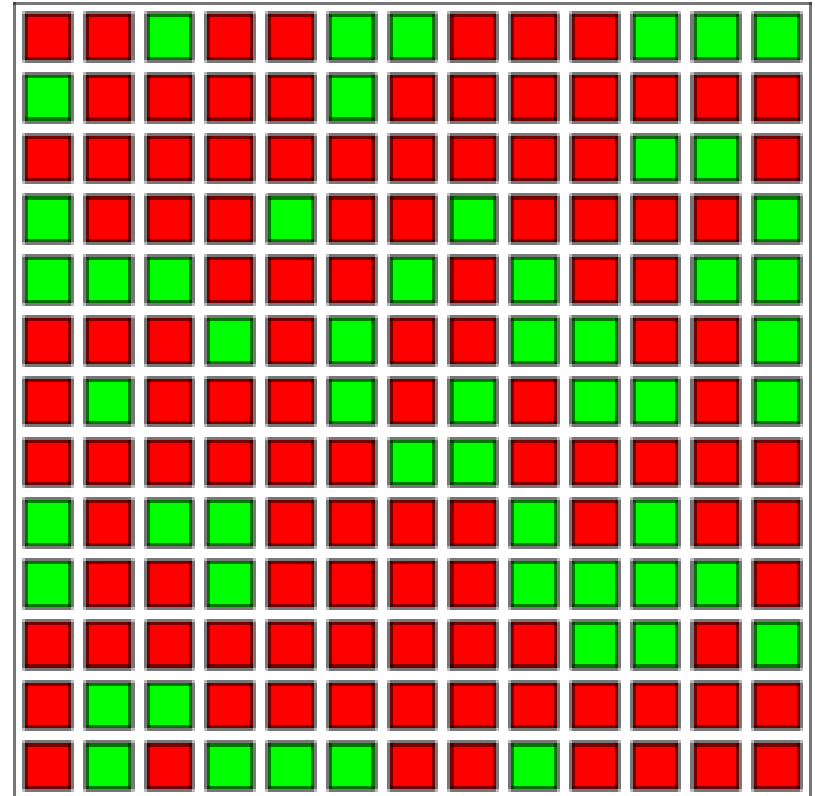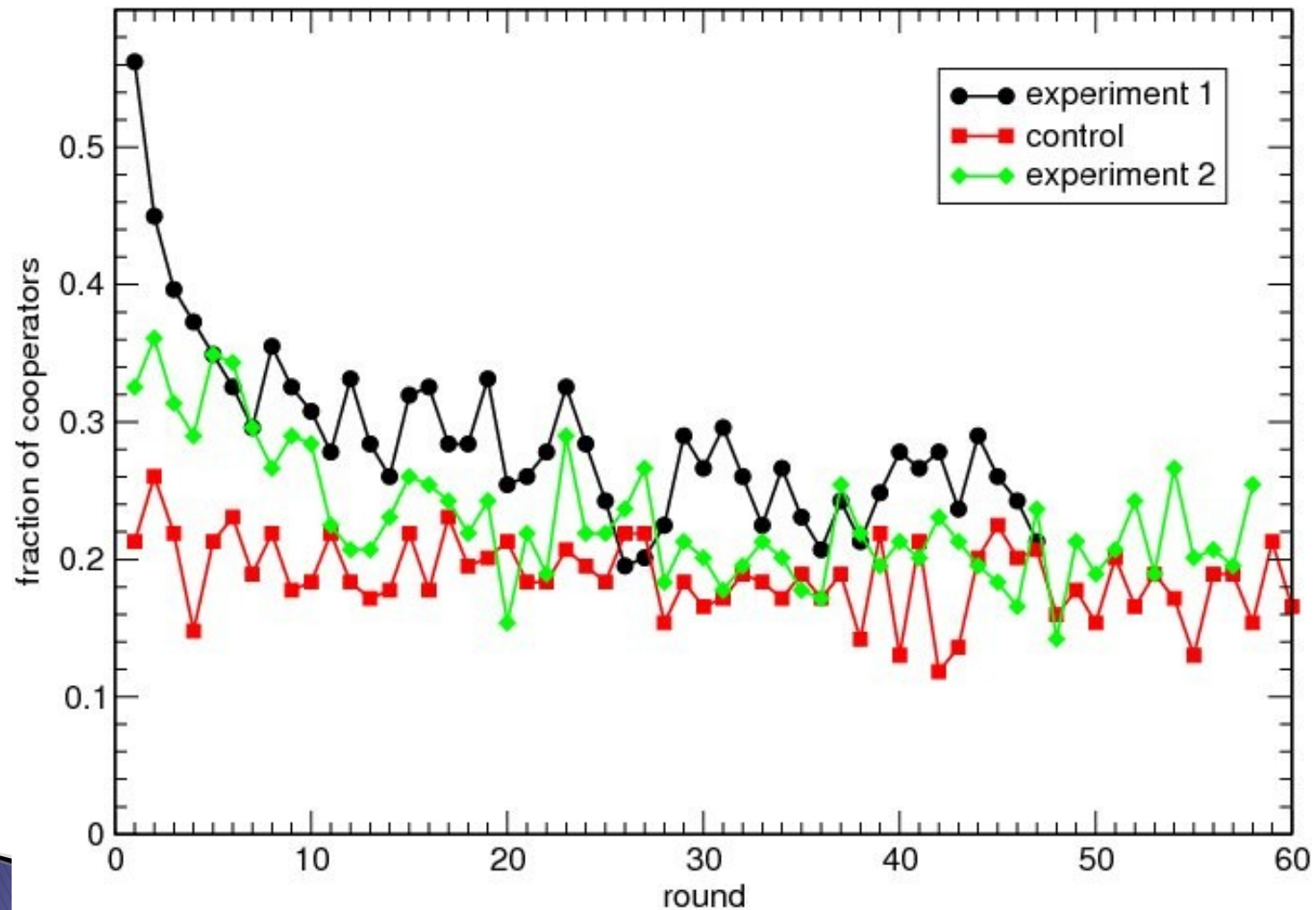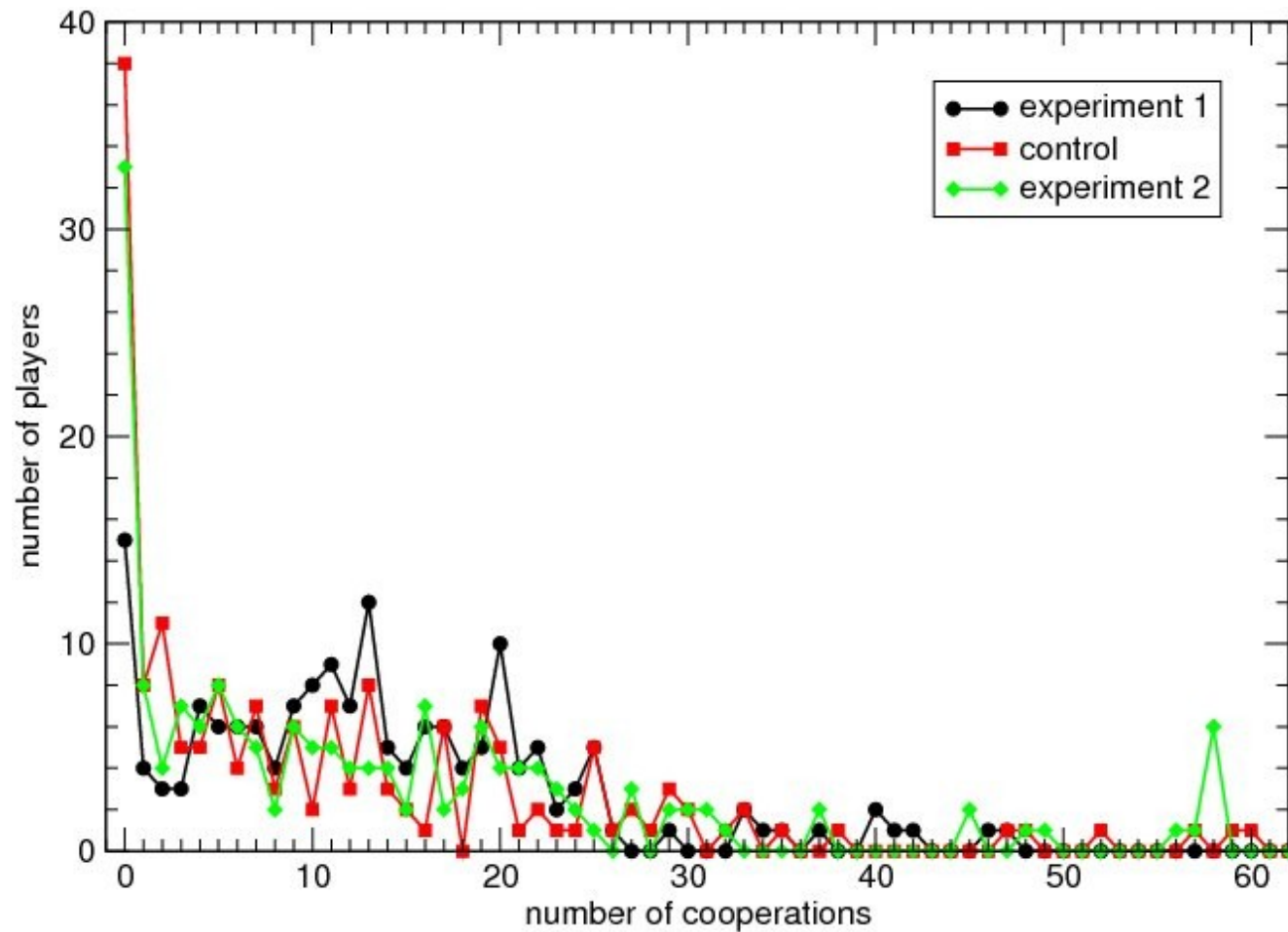|		
	7 ¢	0 ¢
	10 ¢	0 ¢

Elija un color:

Experiment
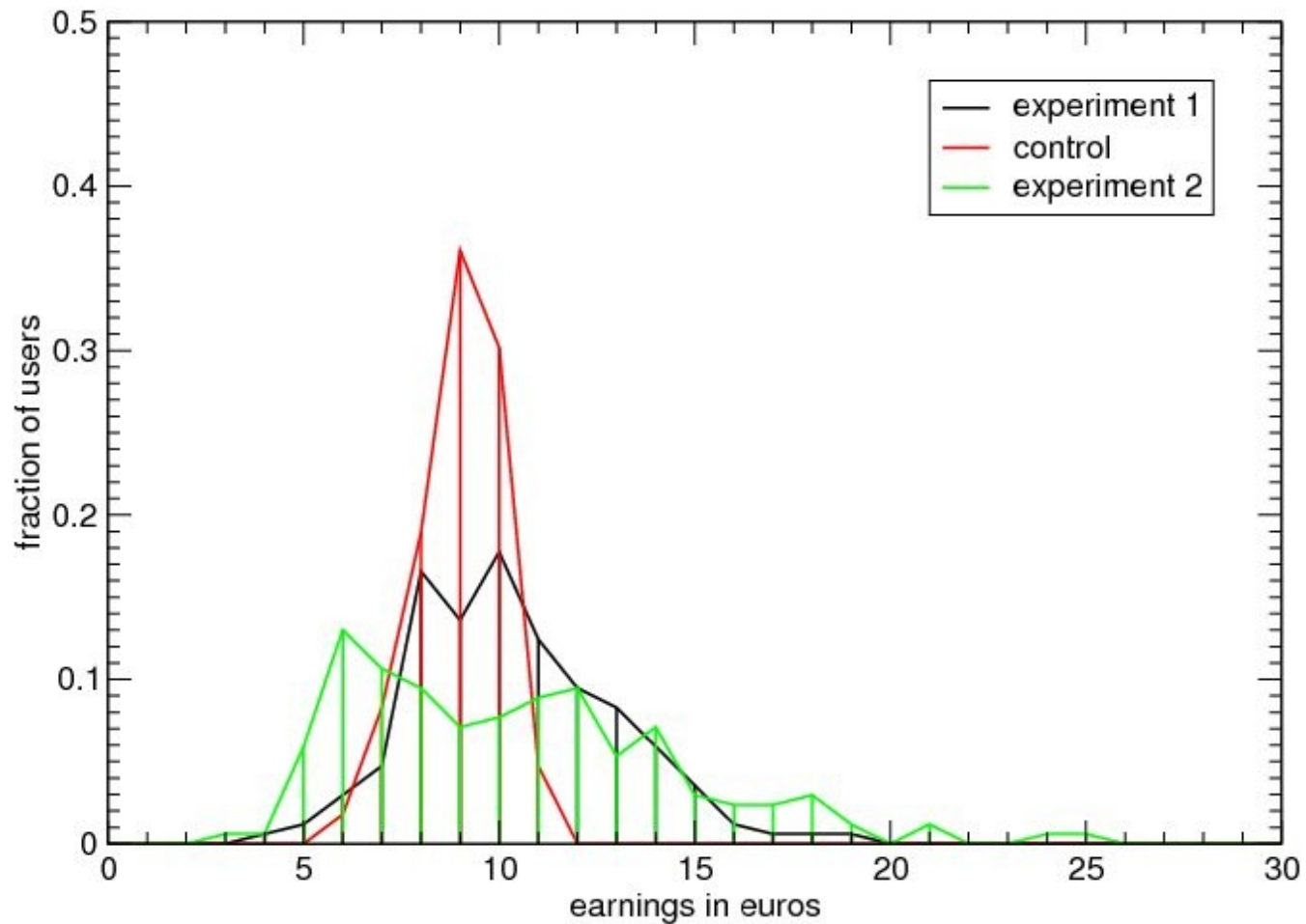
Movies

01 of 47

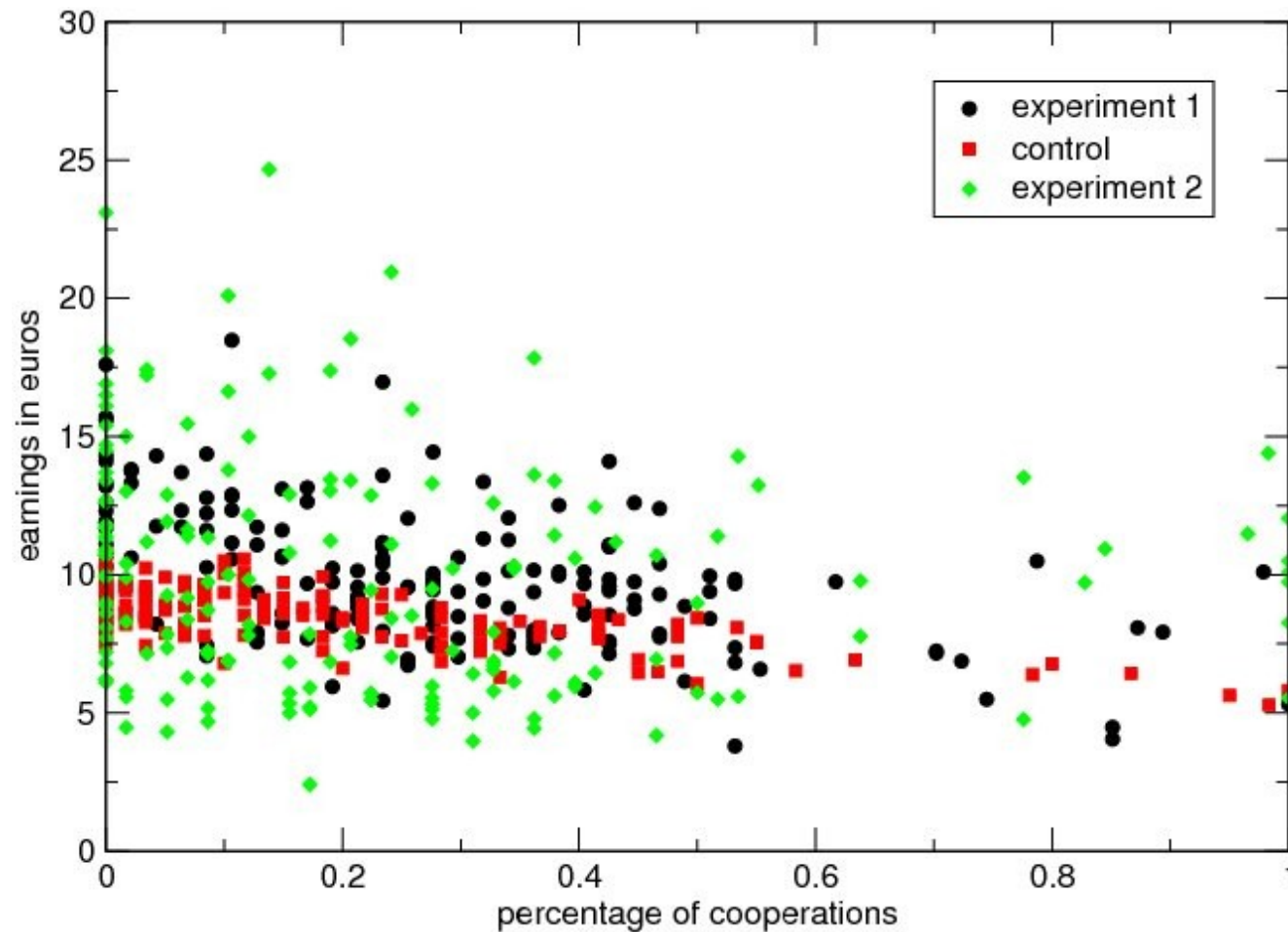01 of 58

Percent of cooperation
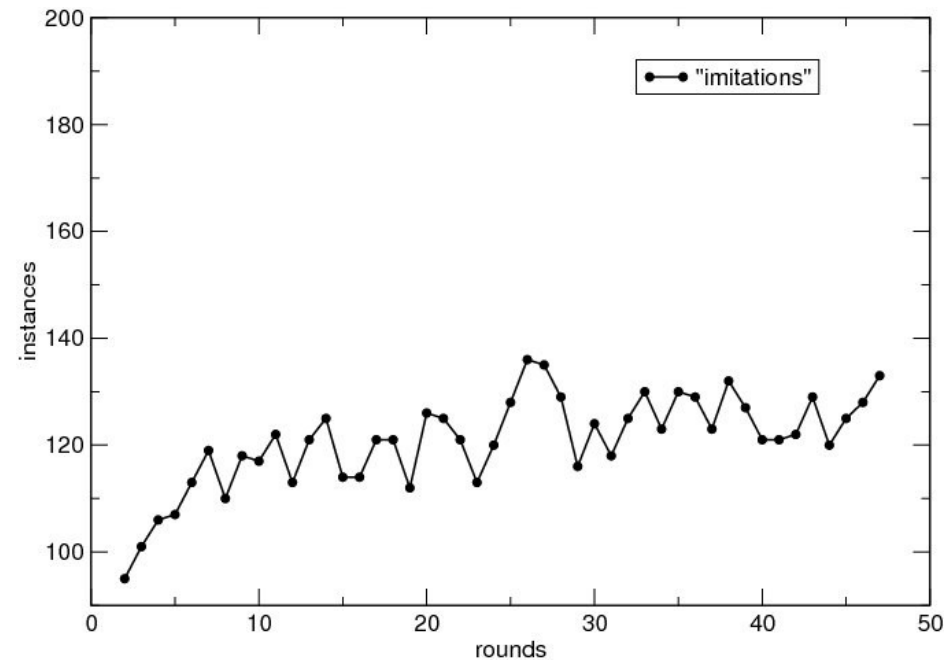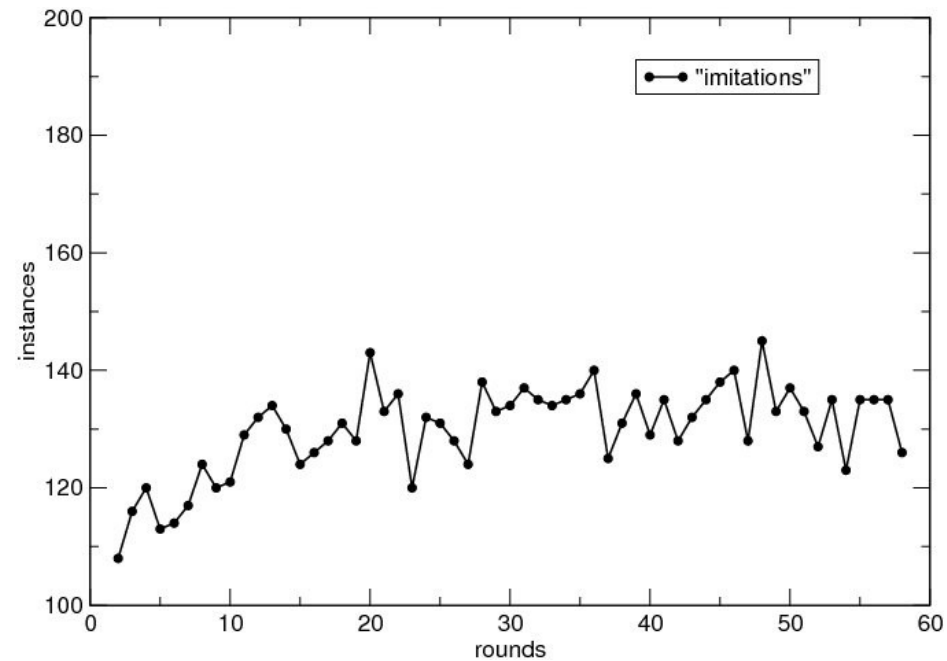
Cooperation histogram

Earnings histogram

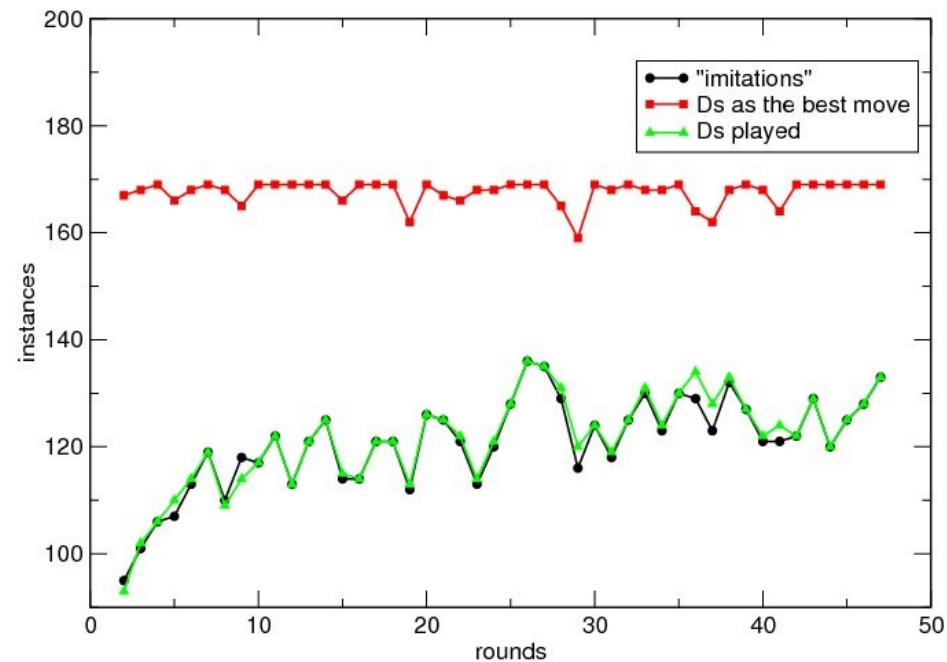# Earnings vs. Cooperation
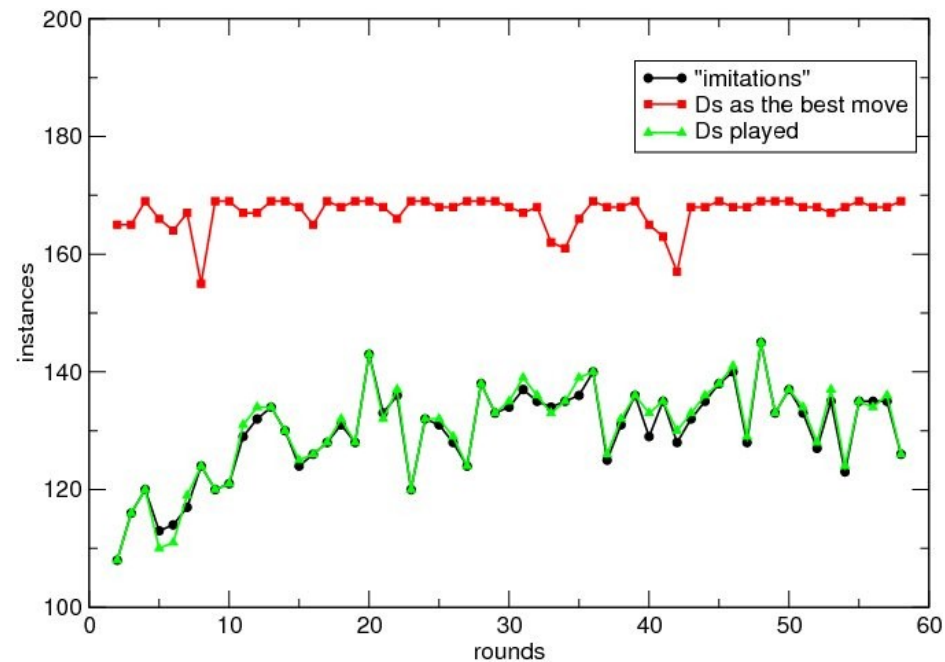
Unconditional imitation
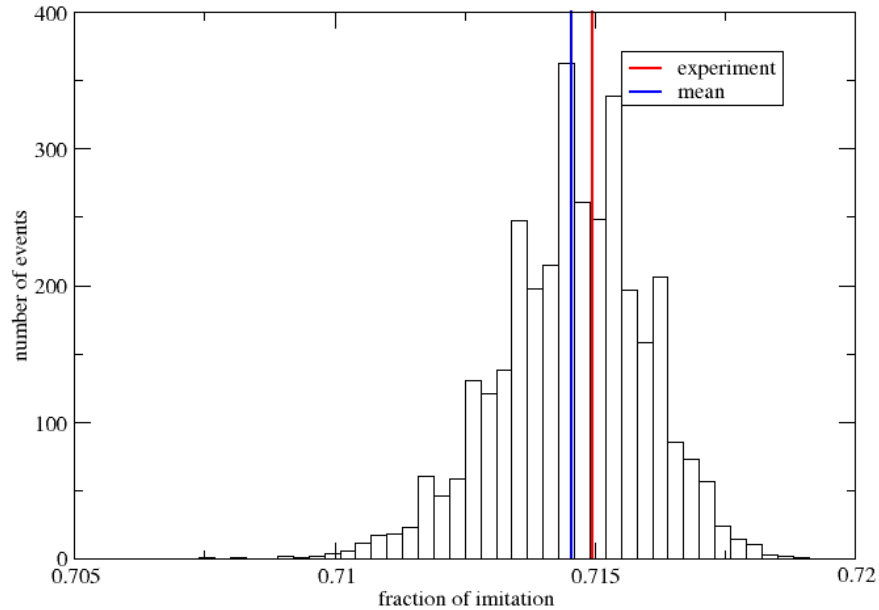

Experiment 1

Experiment 2

Unconditional imitation
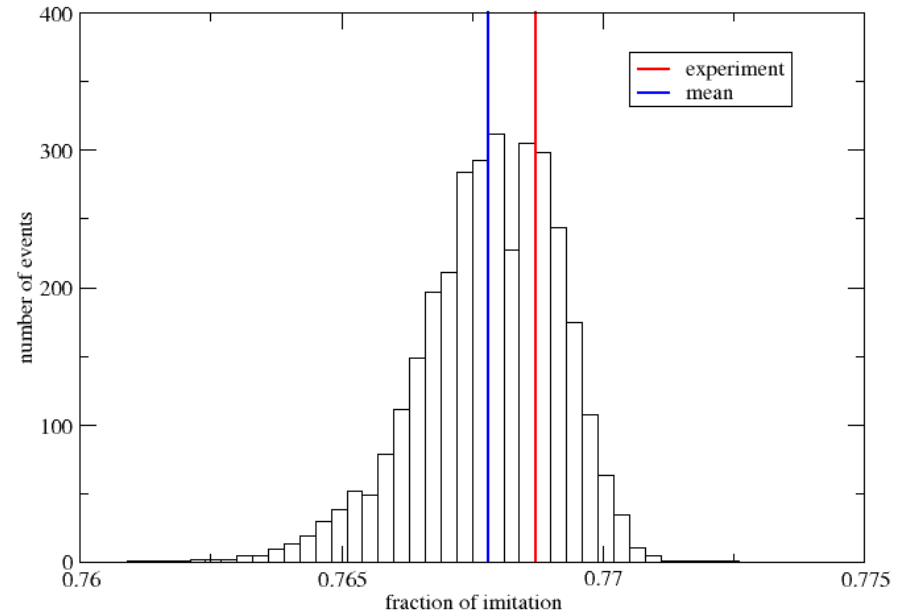

Experiment 1
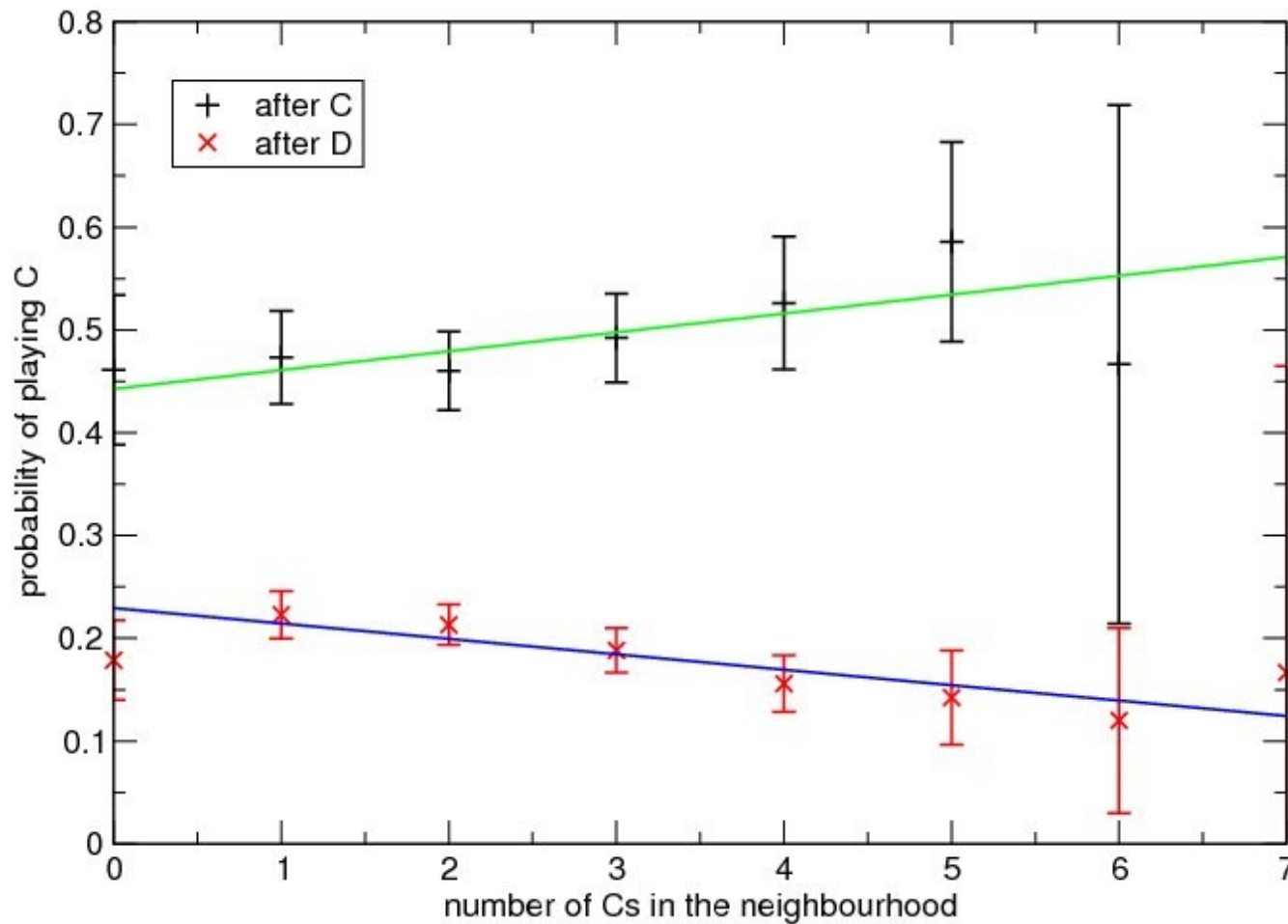
Experiment 2

Unconditional imitation

experimental = 0.7149
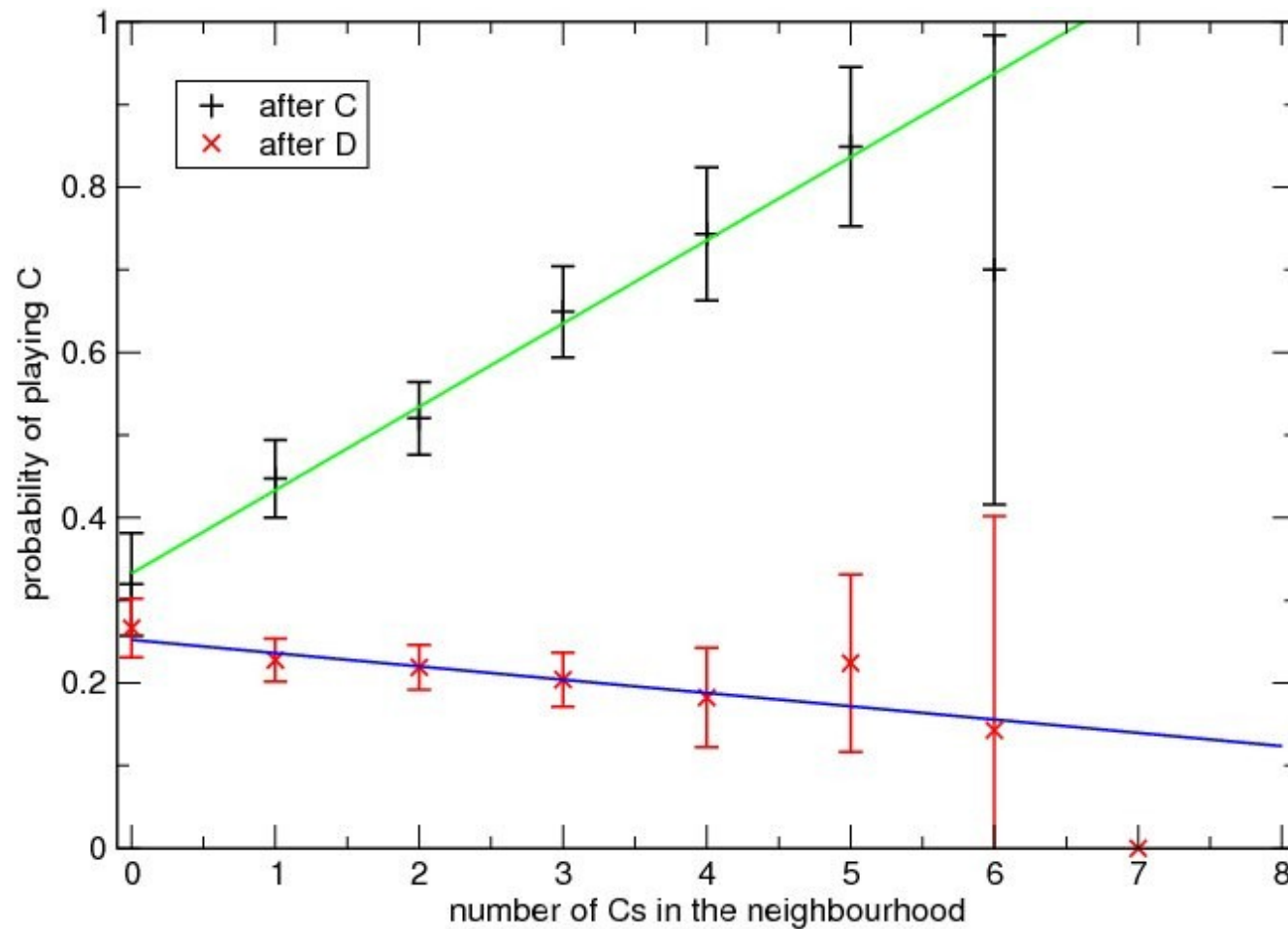random = 0.7145 ± 0.0014
p-test = 0.425

experimental = 0.7687
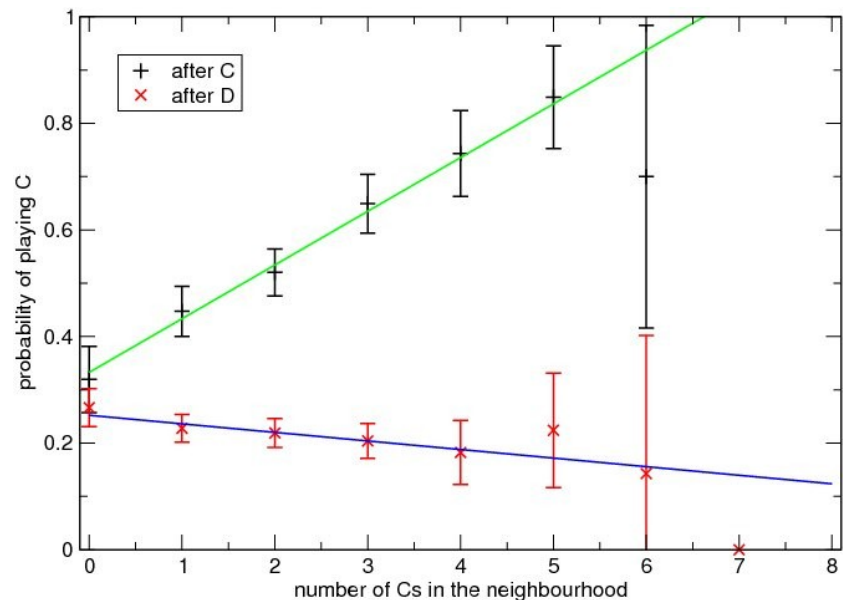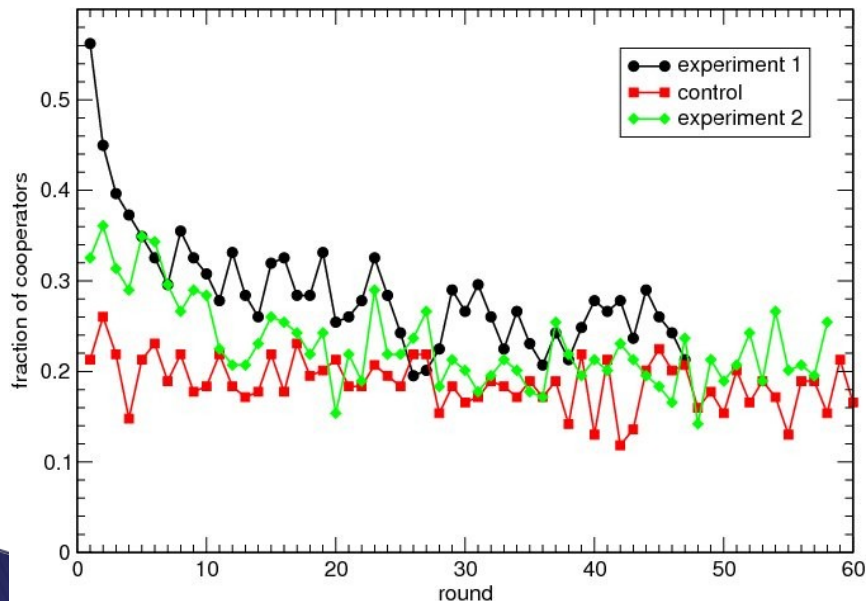random = 0.7678 ± 0.0013
p-test = 0.282

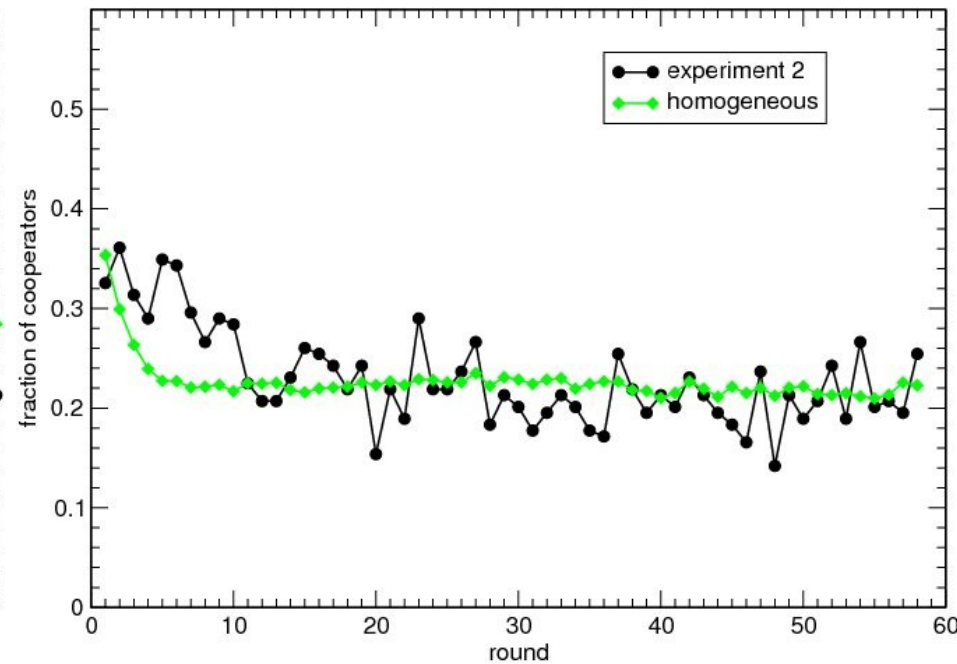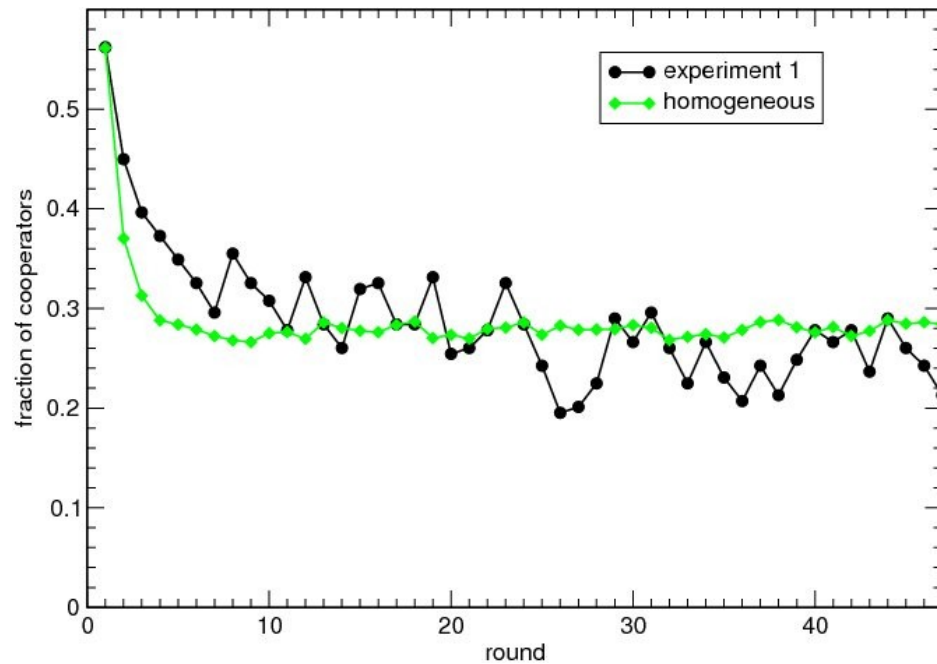# Probability of cooperation Exp1

Probability of cooperation Exp2

Homogeneous model

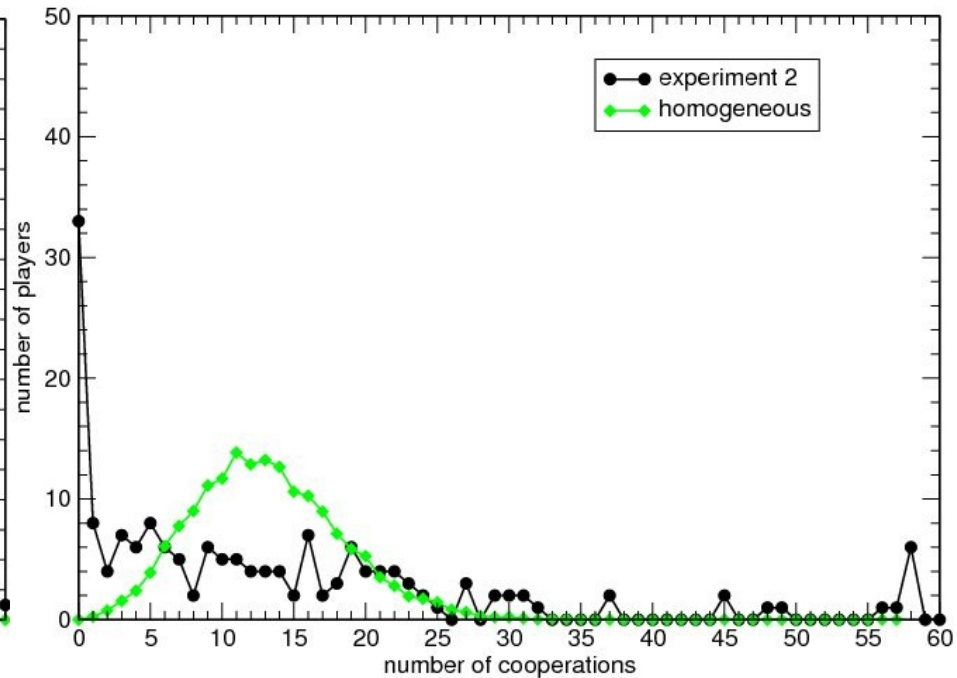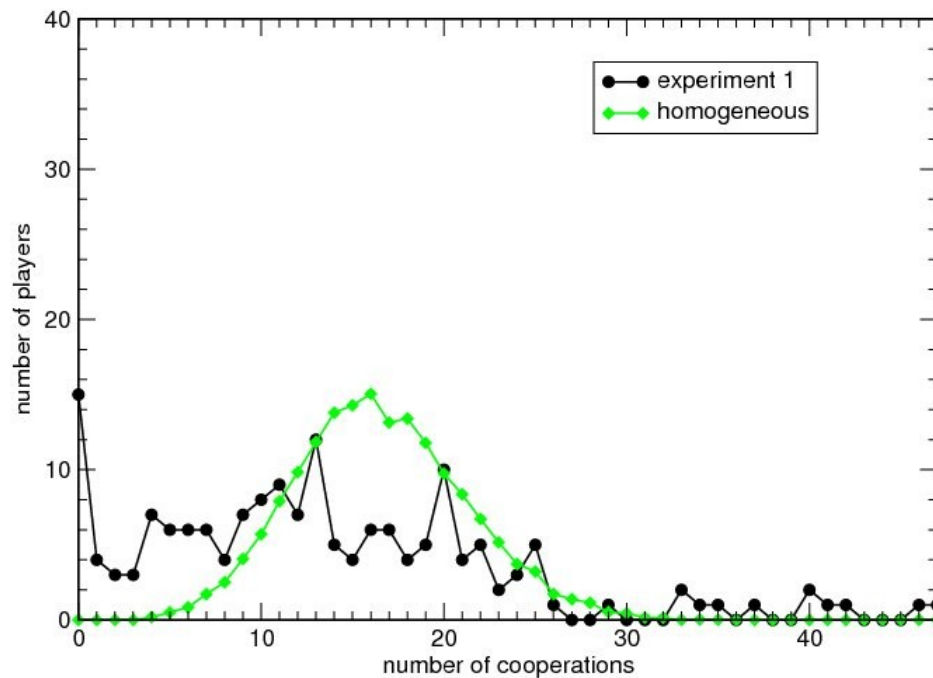- First action: C with probability P like in Exp
- *N*-th action:
  - Player's action in *N-1*
  - Number of neighbors with C in *N-1*
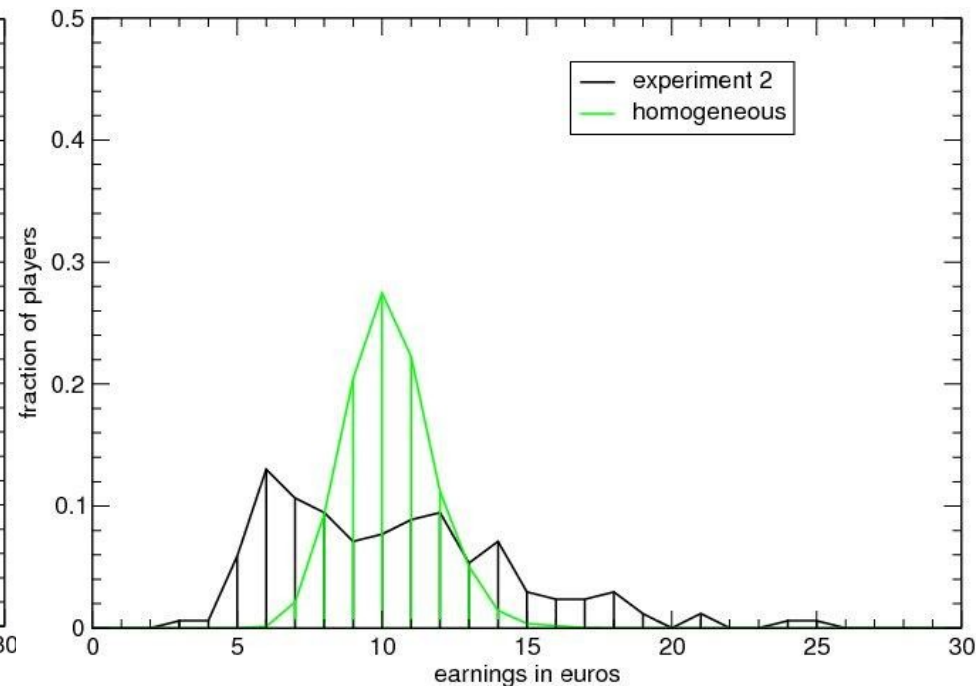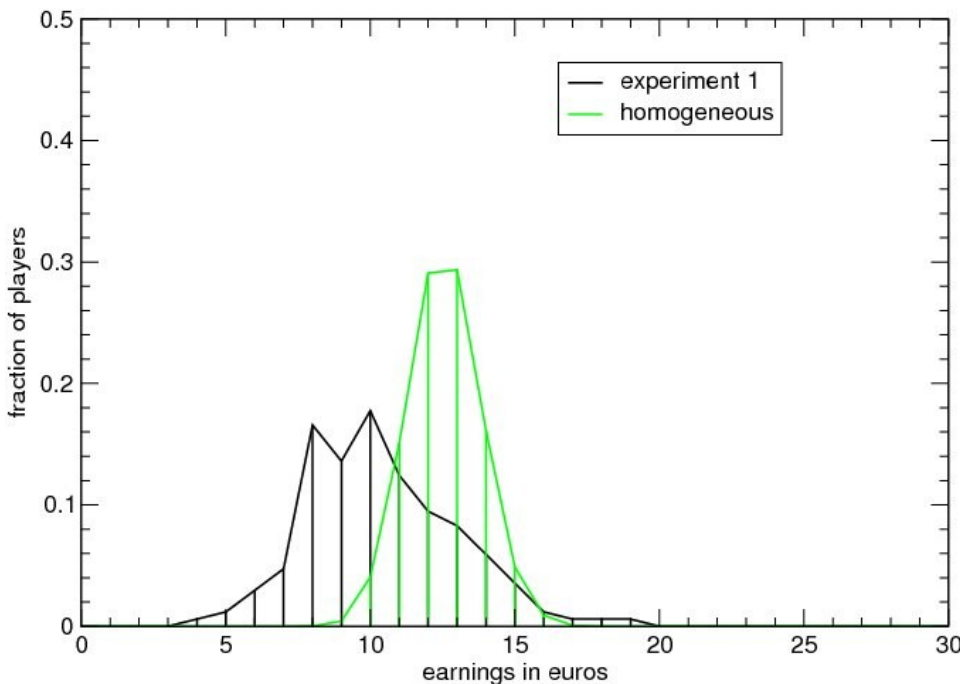
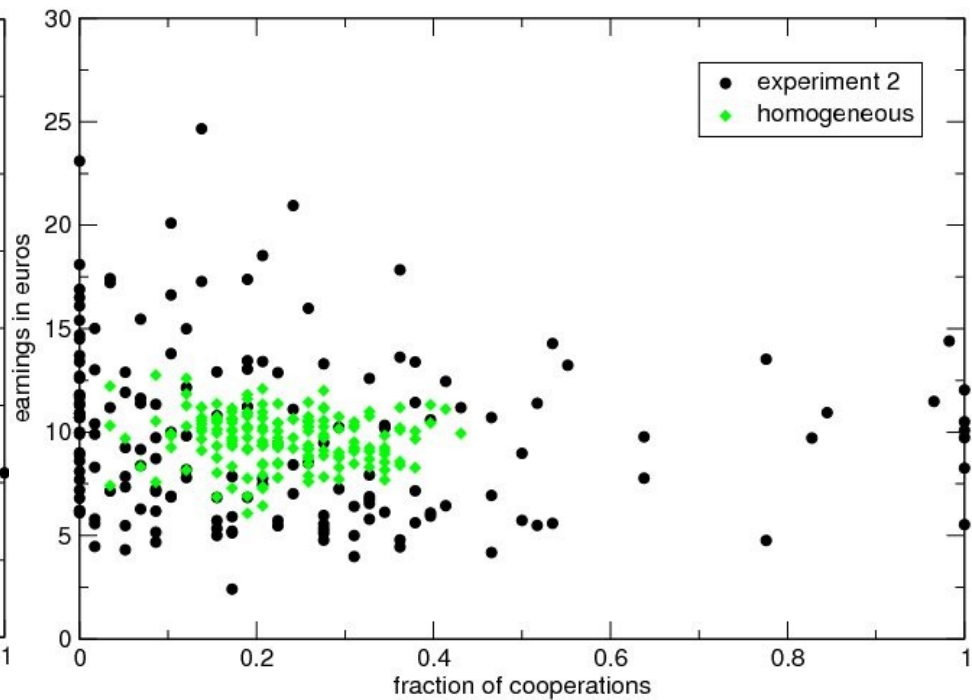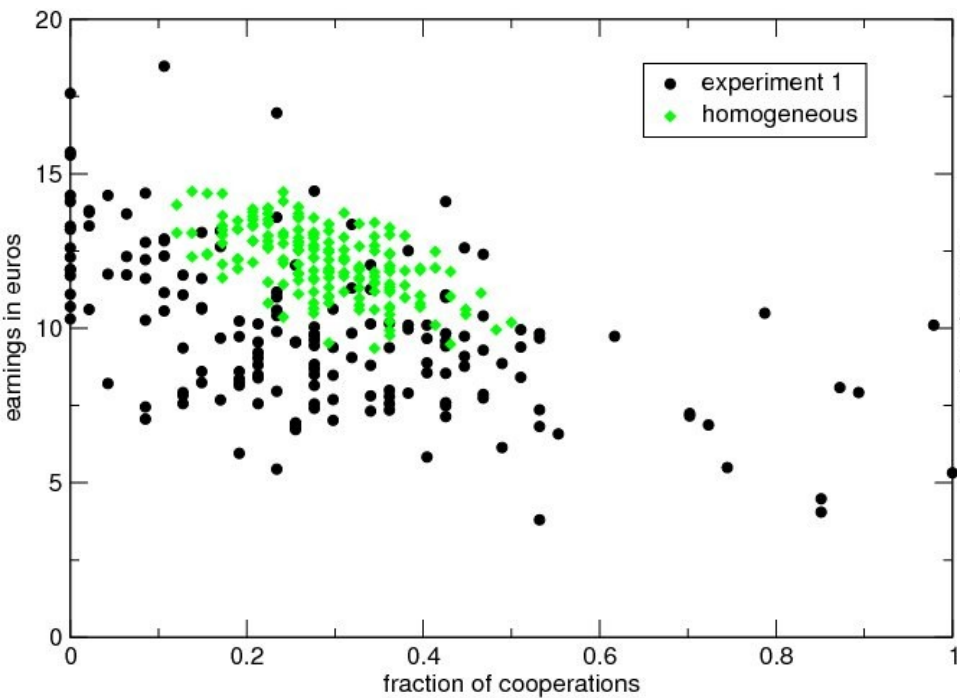# Homogeneous model – percentage of cooperation

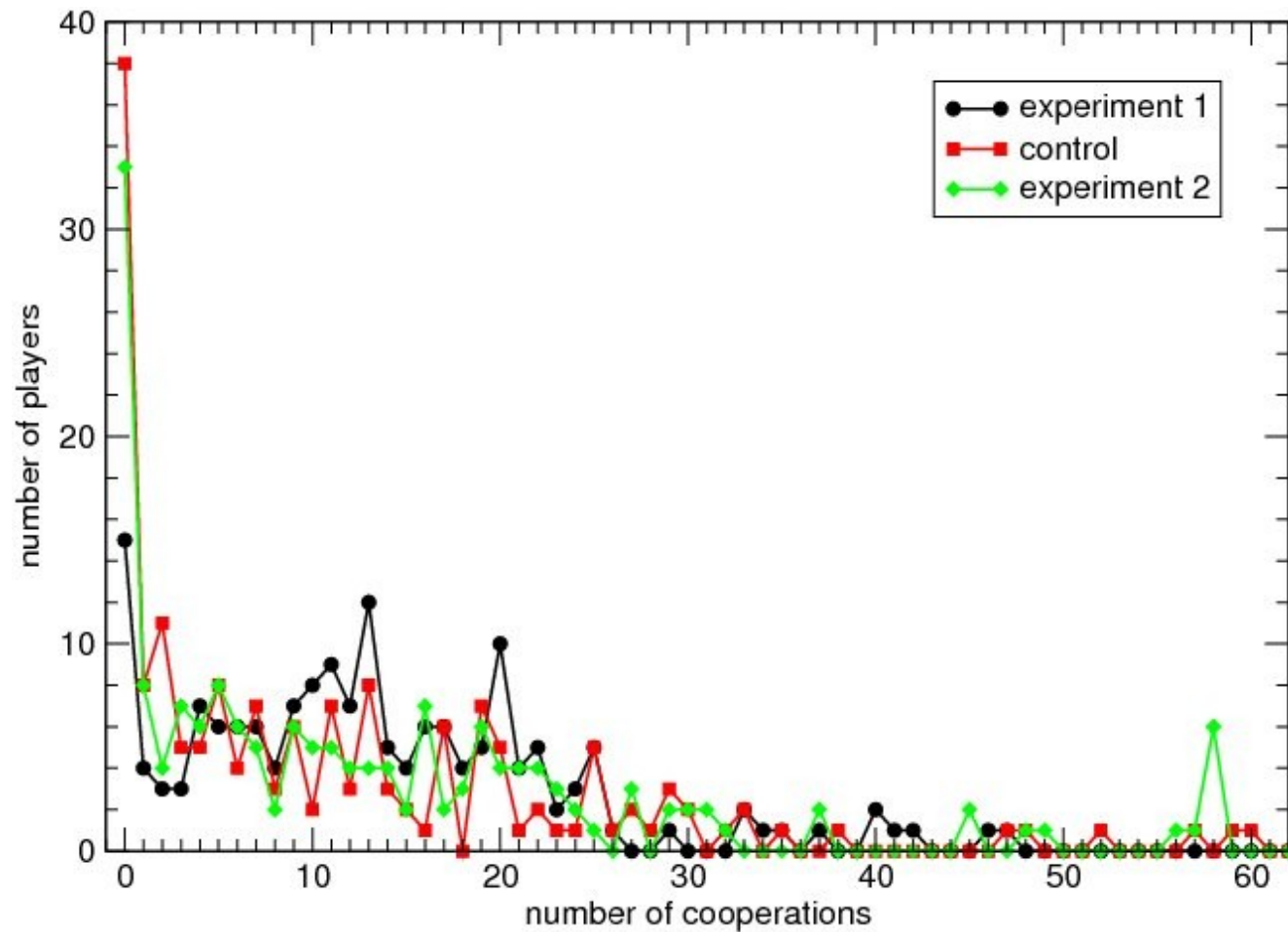# Homogeneous model – cooperation histogram

Homogeneous model – earnings histogram

Homogeneous model – earnings vs. cooperation

Looking for a new model

Looking for strategies

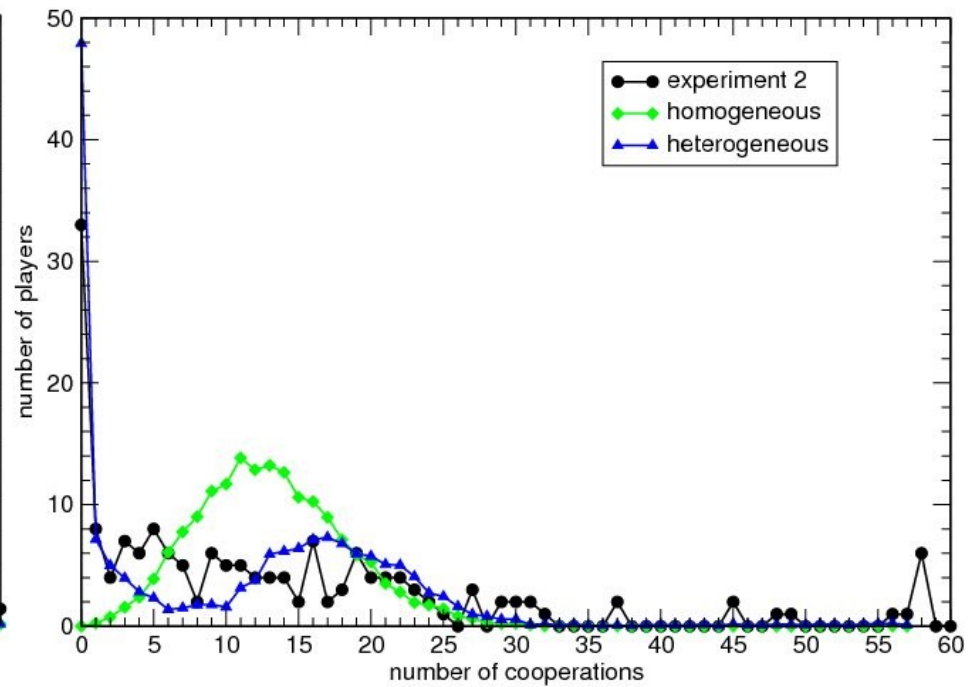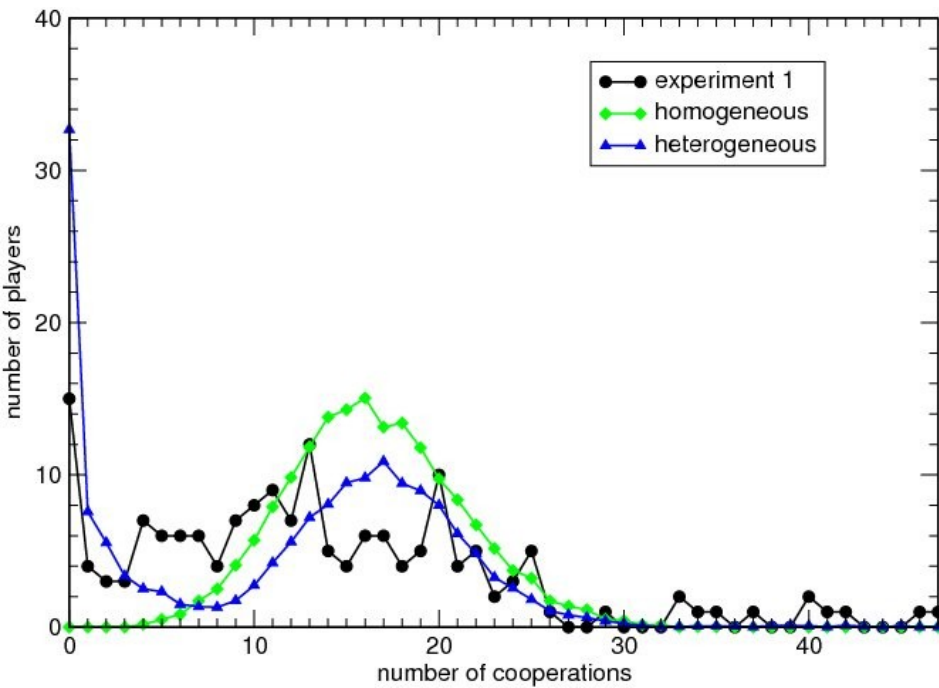| Type of player	Experiment 1	Control	Experiment 2
Pure defector	22	44	39
Mostly defector	38	40	37
Pure cooperator	2	1	6
Mostly cooperator	1	2	3
The Rest	106	82	84

Heterogeneous model!

Heterogeneous model

- Pure defectors – always defect
- Mostly defectors – D with $P > 2/3$
- Pure cooperators – always cooperate
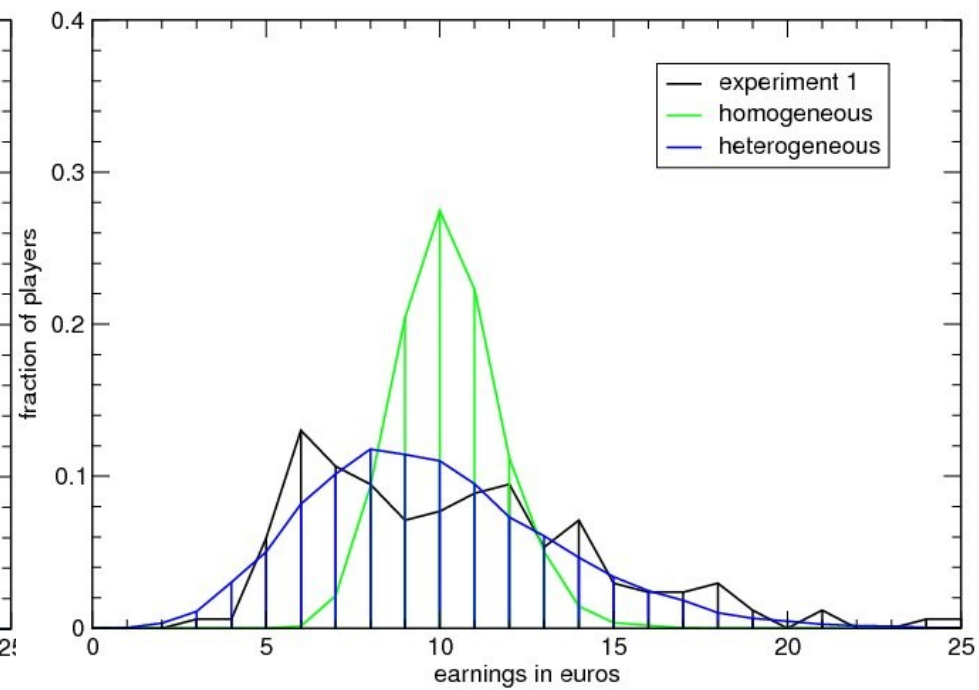- Mostly cooperators – C with $P > 2/3$
- The rest – like in homogeneous model

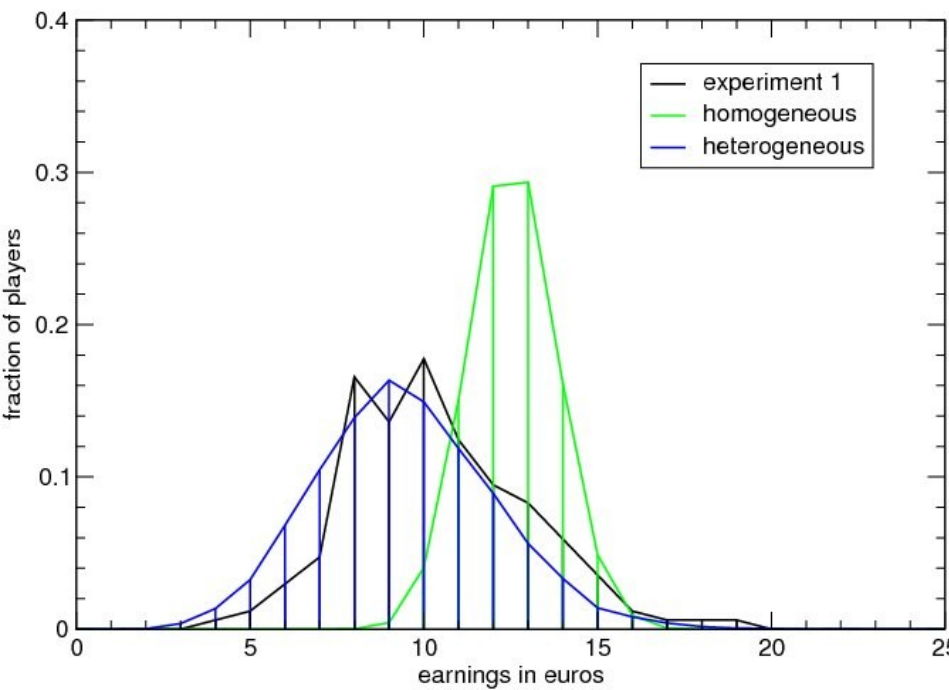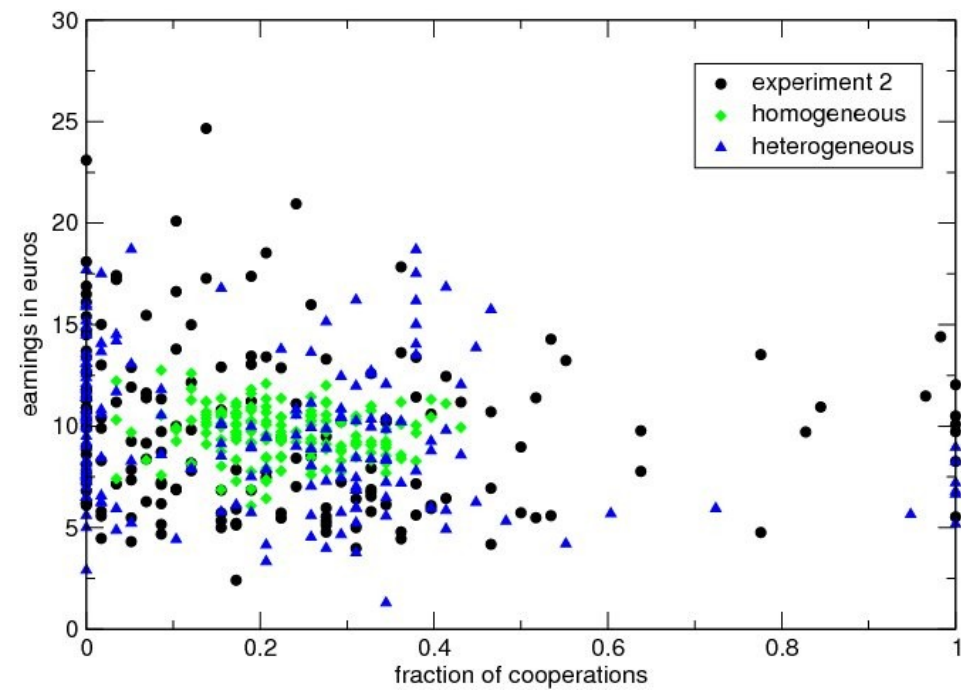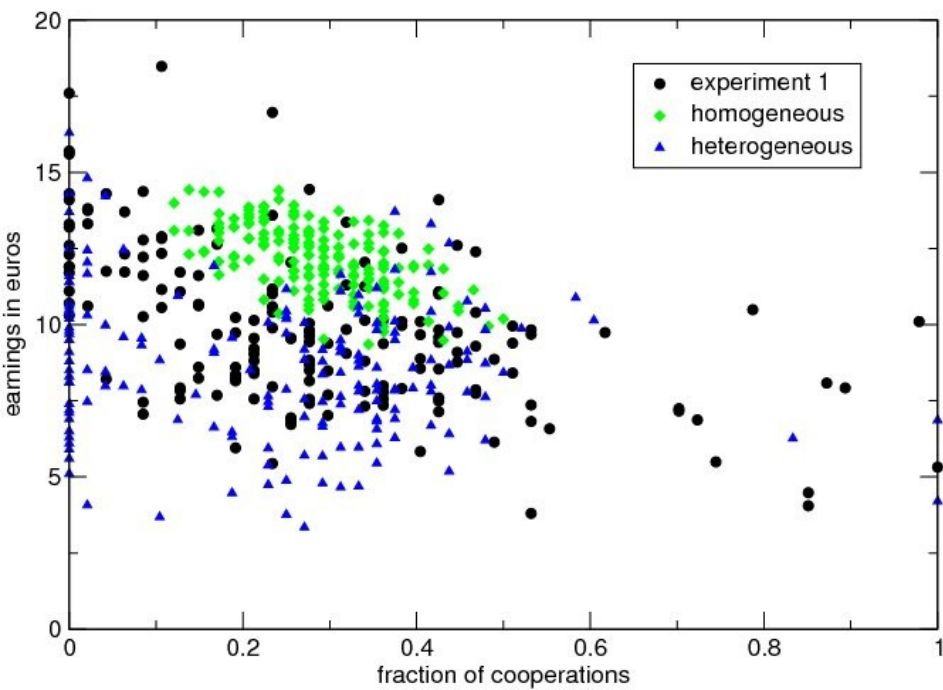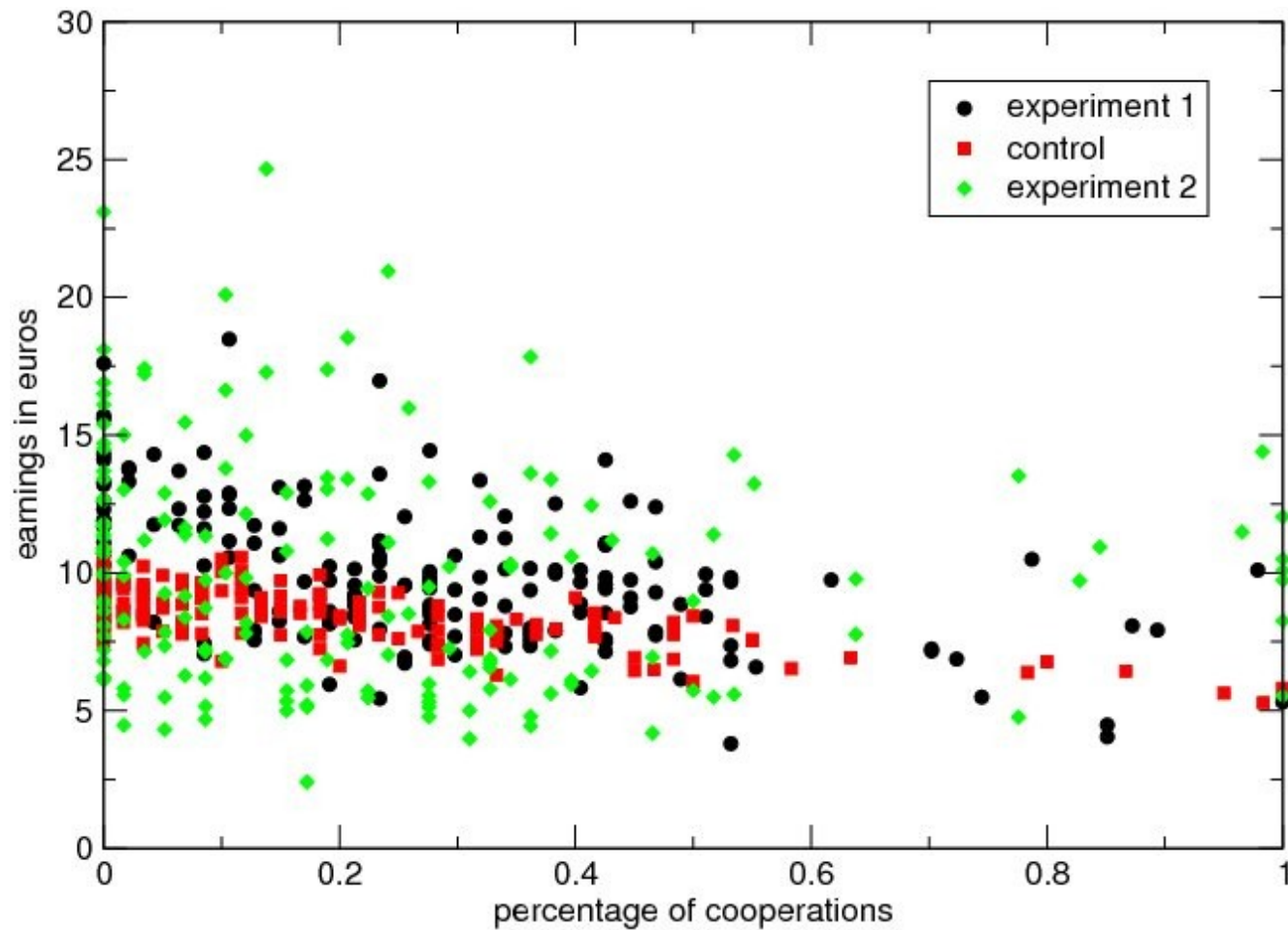# Comparison
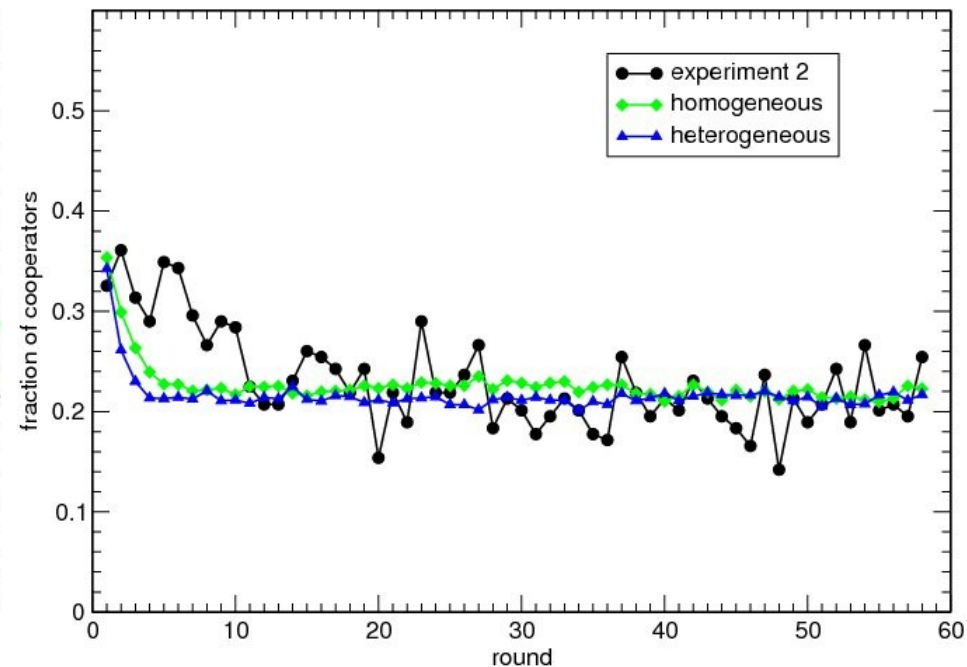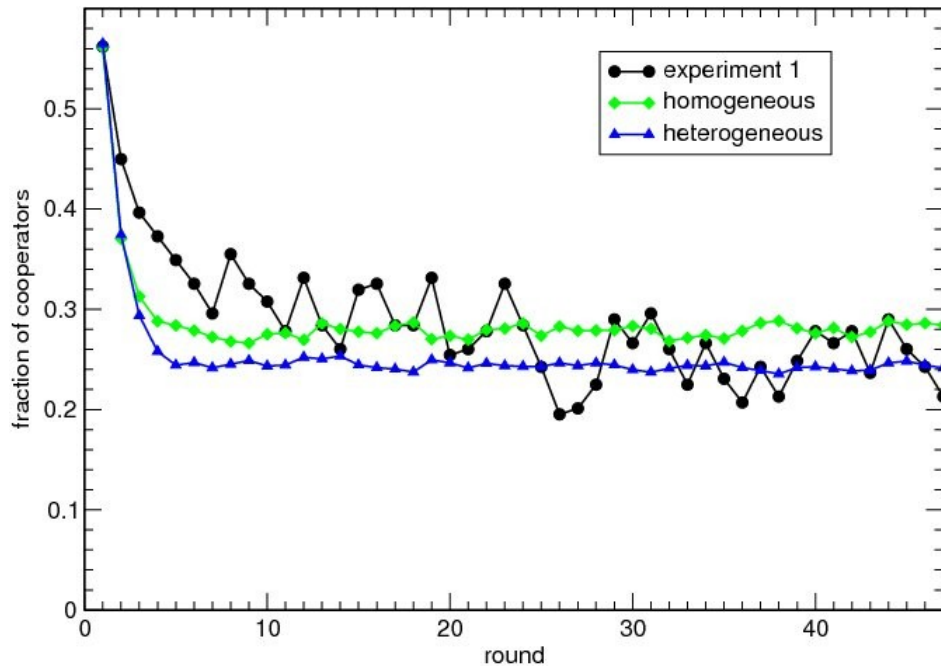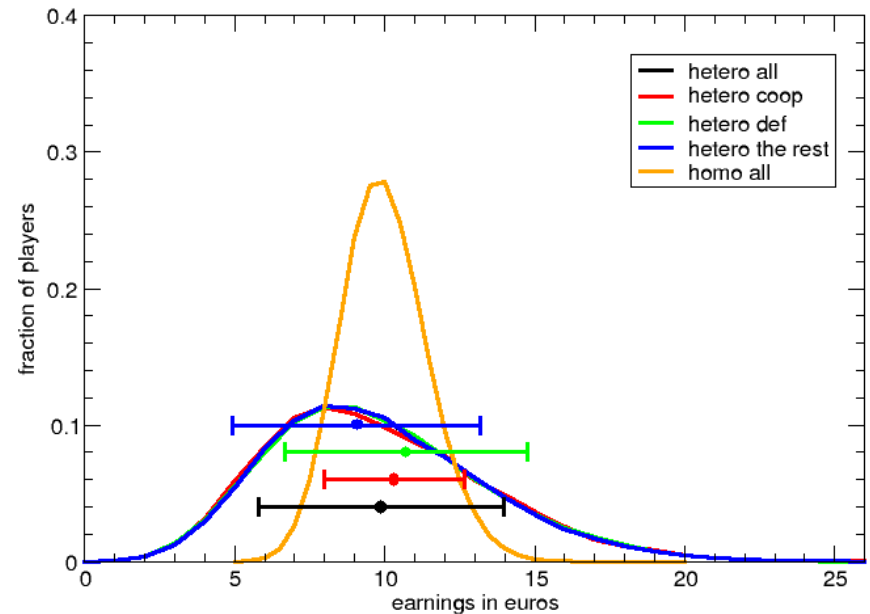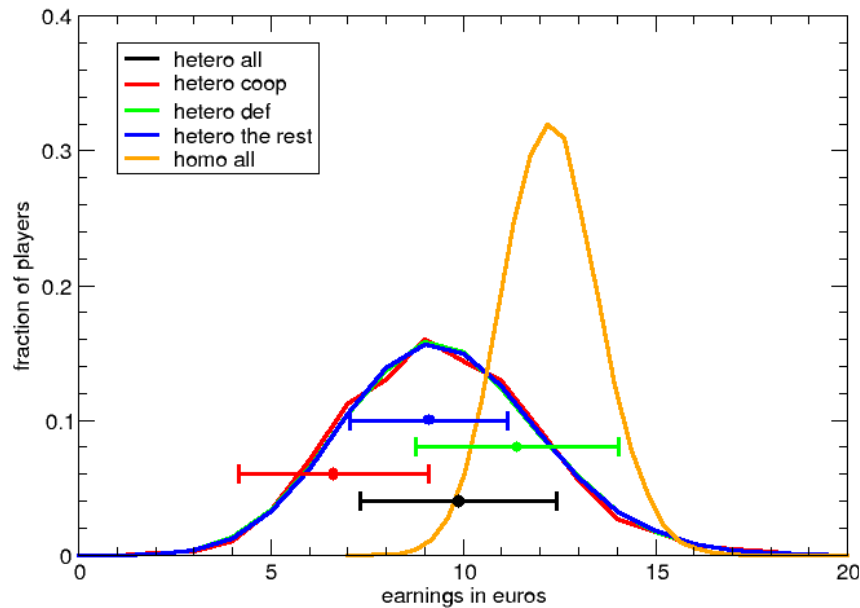
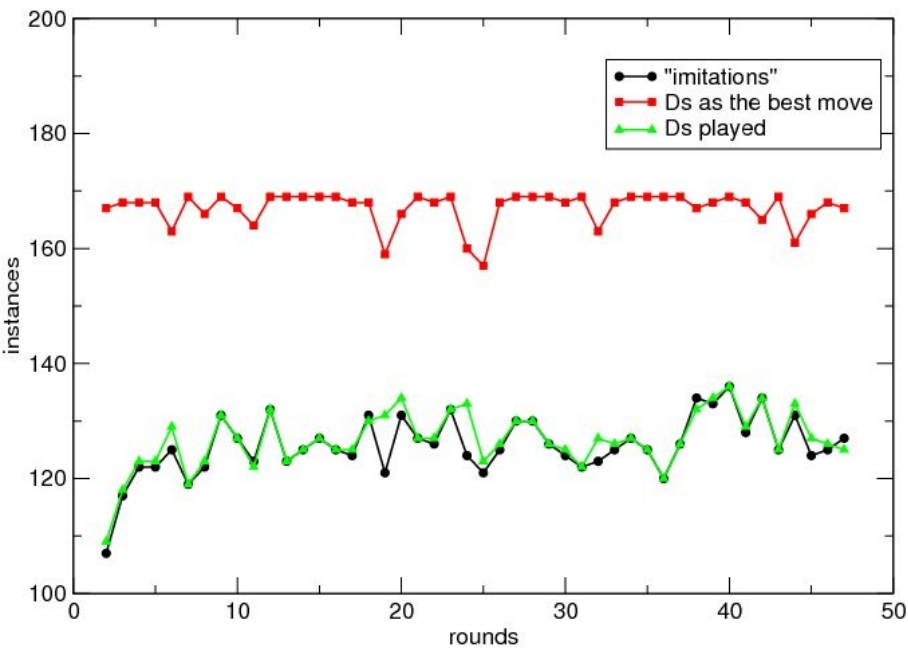# Comparison

Comparison

Comparison

Why is that?
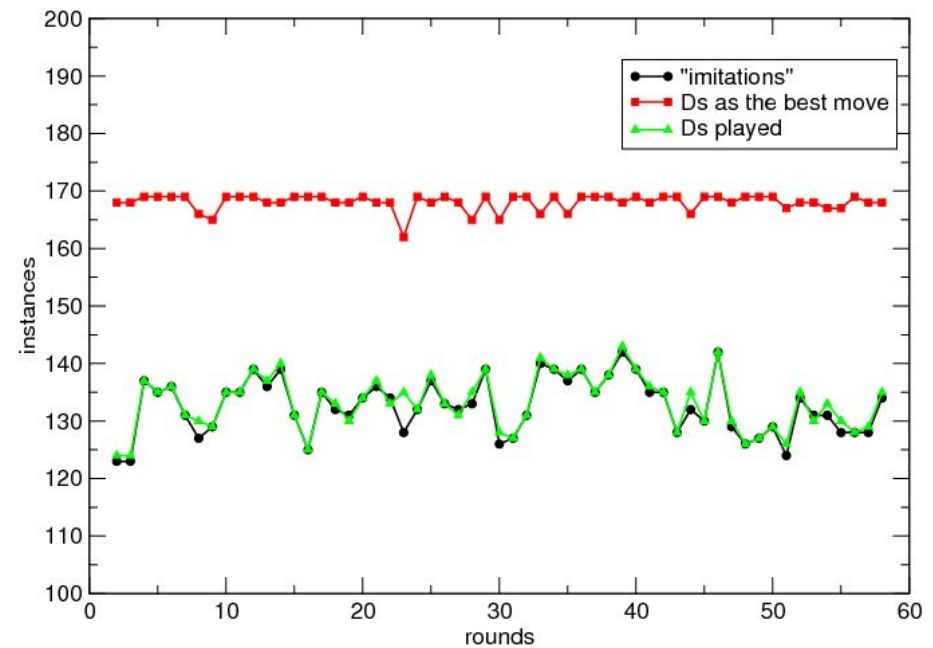
Earnings for different types of players

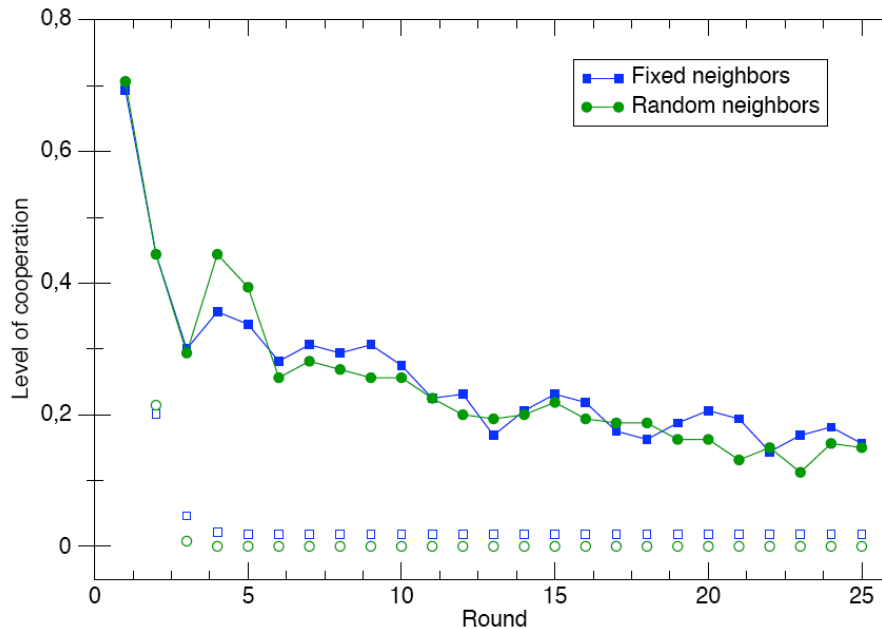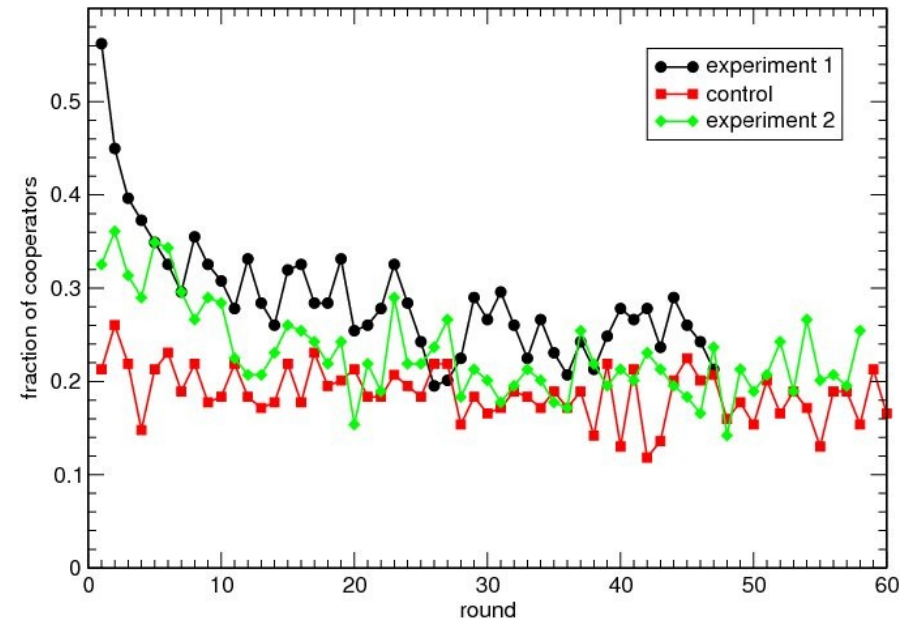# Unconditional imitation Exp 1 heterogeneous model

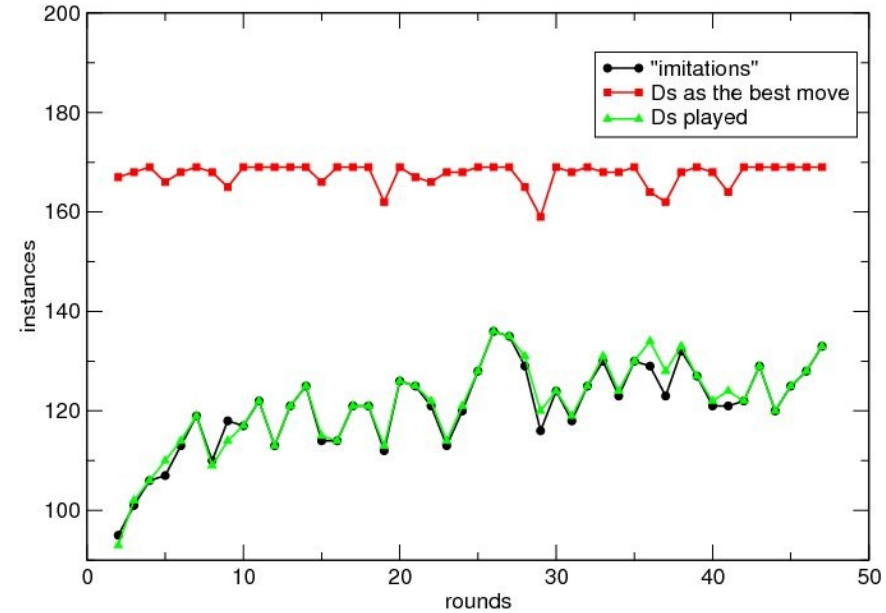Experiment 1

Experiment 2
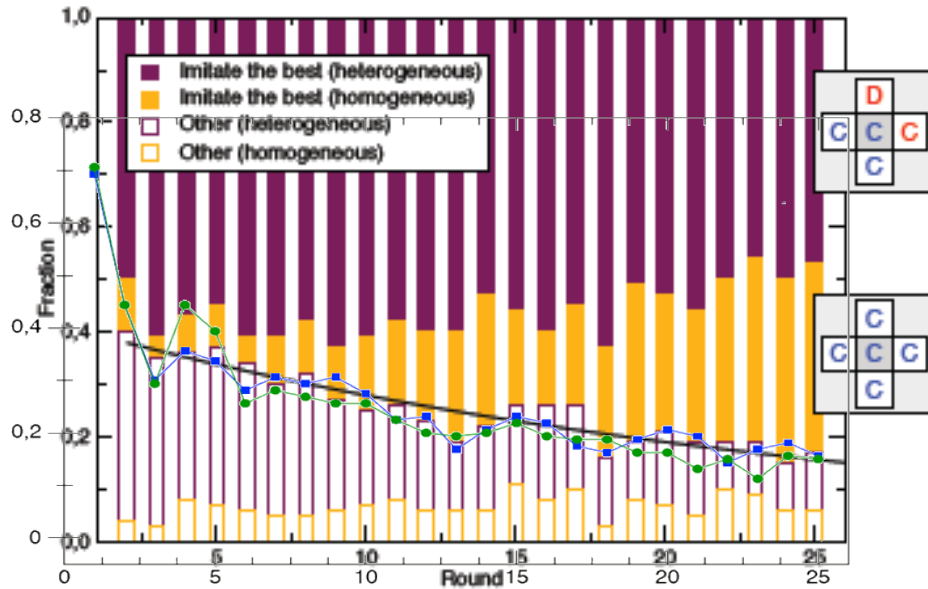
Other experiments

A. Traulsen, D. Semmann, R. D. Sommerfeld, H.-J. Krambeck and M. Milinski, *Humans Playing a Spatial Prisoner's Dilemma.* (PNAS, January 2010)
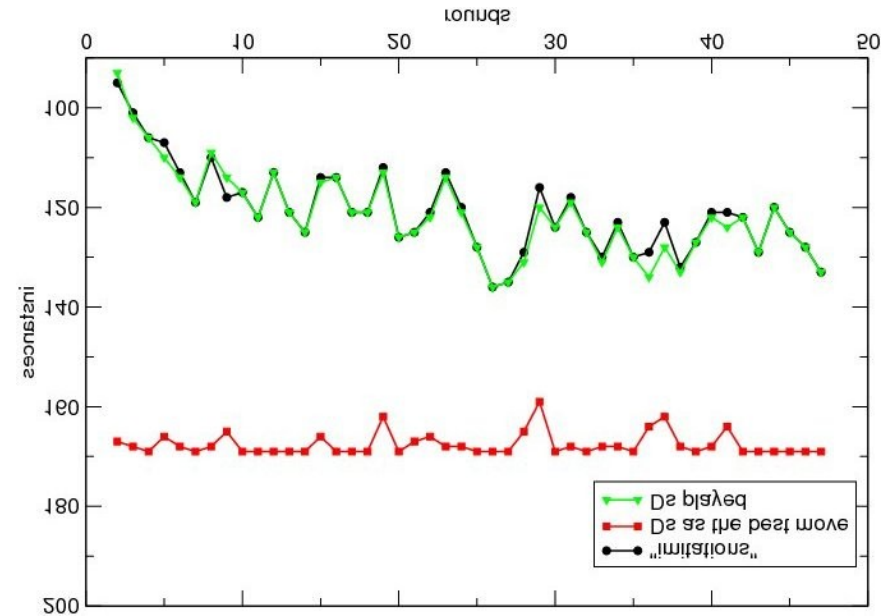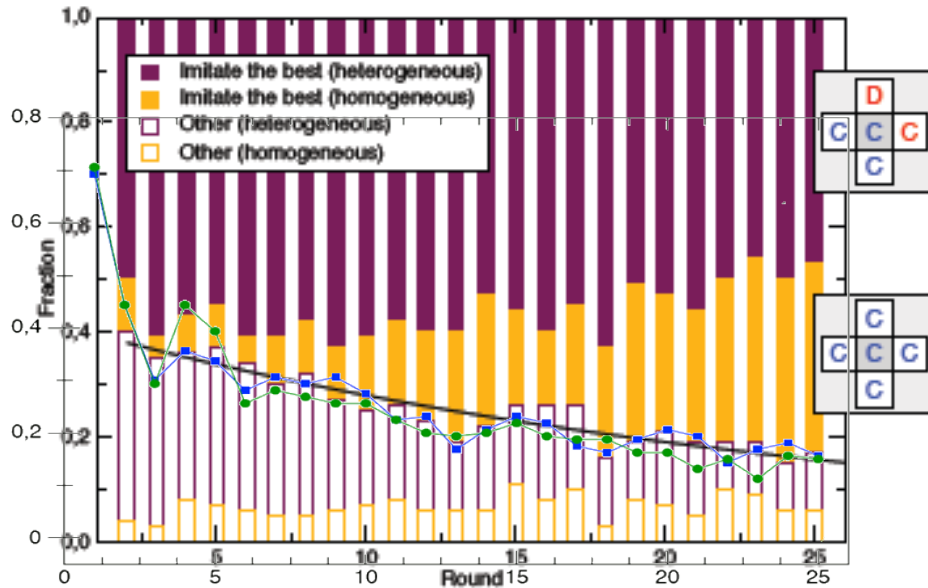**4x4 lattice, 4 neighbors, true Prisoner's Dilemma**

J. G., C. Fosco, L. Araújo, J. A. Cuesta and A. Sánchez, (In preparation)
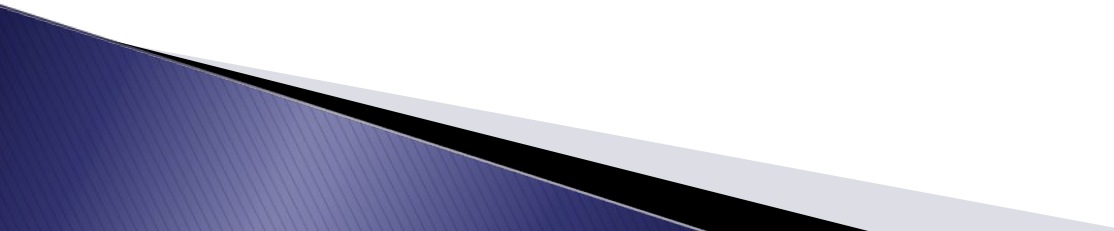**13x13 lattice, 8 neighbors, weak Prisoner's Dilemma**

Is there imitation?

Is there imitation?

Conclusion

- Largest experiment until now
- Small but non-zero cooperation
- No unconditional imitation
- After C increasing probability of C
- After D decreasing probability if C
- Homogeneous model, not enough
- Heterogeneous model
- All strategies equivalent
- Actions, not payoffs

¡Gracias!

- For your attention
- Jose Cuesta and Anxo Sánchez
- Constanza Fosco, Lurdes Araújo
- Informatics department
- All of you who helped testing the program