The evolution of inclusion mechanisms and trust in social dilemma situations

Eiji TAKAGI (Saitama Univ., Japan)
NCC00521@nifty.ne.jp

- **The selective inclusion/exclusion mechanism will evolve in a society, and solve 'relationship-type' social dilemmas.**
- **High general trust will evolve in response to the temptation to defect.**

Two types of social dilemmas

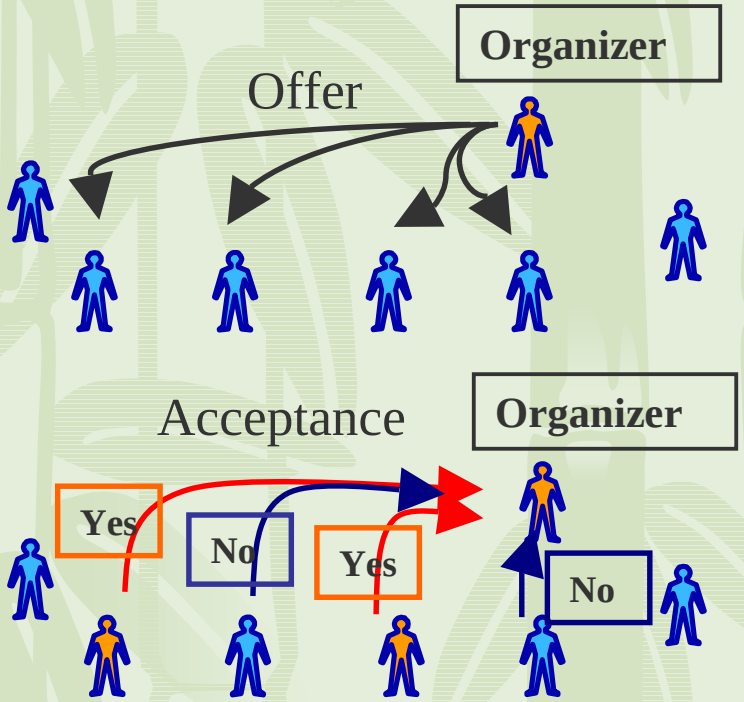
- **Societal type**
  - **Prospective defectors as well as cooperators are already included in a society. It is a hard work to solve social dilemmas.**
- **Relationship type**
  - **Some actors form a cooperative relationship. Social dilemma exists in the relationship.**
  - **It is possible to select partners on the basis of their cooperativeness. Such selective inclusion will enable us to establish cooperation in this type of social dilemmas.**

Questions

- Does such a selective inclusion mechanism emerge from the bottom up as a strategic equilibrium among interacting actors?
- Besides a selective inclusion strategy, actors must have high general trust.
  - Otherwise, actors will become too cautious to join a cooperative relationship.
  - ‘High trust’ strategies may die out, because their carrier agents might be easily exploited.
- Does high trust evolve hand in hand with selective inclusion strategies?
- By computer simulation analyses, I would like to answer to these questions as ‘yes.’

Simulation model: 'Organize cooperators game'

- Each agent is running its own business, e.g., managing the farm.
- An agent in turn becomes an '**organizer**,' and can send offers to the agents whom the organizer want to include in cooperation.
- An agent receiving offer accepts or rejects the offer.
- An agent who has accepted becomes a '**partner**.' A partner as well as an organizer can **defect** in the cooperative relationship.



Payoff structure in the simulation model

- Profits from joining cooperation basically increases as the cooperation size increases. The organization cost incurs to an organizer, and the optimal cooperation size exists.
- Organizer' profit
  - $U_o = a \cdot N_t^{1/2} - b \cdot N_t$.
  - N_t: **Relationship size**
  - $a = 3, b = ½$.
  - ***The optimal size = 9.***
- Partner's Profit
  - $U_p = a \cdot N_t^{1/2} / 10$.
- Two forms of temptation to defect
- Defection incentive
  - **Damage to the actors other than a defector: -** $a \cdot N_t^{1/2} / 6$
  - **A defecting agent gets** $(N_t - 1) \cdot w \cdot a \cdot N_t^{1/2} / 10$.
  - ***w:*** **coefficient of defection incentive**
  - **This situation is social dilemma.**
- Conspiracy
  - **An partner and an organizer can conspire to steal profits from other partners.**

Agent's strategy

- A strategy is composed by the following **5 sub-strategies**.
- **Inclusion strategy** applies in case of being an organizer. It specifies;
  - How many agents the organizer should send offers to.
  - Whether the organizer makes offers selectively or randomly.
  - The criterion in case of selective offer.
- **Acceptance strategy** applies in case of receiving an offer from an organizer. It specifies;
  - Whether the agent's decision to accept is selective or random.
  - The probability to accept in case of random acceptance.
  - The criterion of risk tolerance in case of selective acceptance.
- **Defect strategy** specifies the probability that the agent defects in the relationship.
- **Conspiracy strategy** dictates the agent to utilize or not to utilize a conspiracy opportunity.
- **Trust** is a default value of subjective probability to cooperate, which the agent attributes to any other agent whose past defection rate is not available.

Specifications

- A society is composed by 200 agents.
- Agents' strategies are randomized at the initial state.
- At the end of a generation period, agents' strategies change according to genetic algorithm (crossover & mutation). Poor strategies are replaced by superior ones.
- 7 x 2 factorial design – temptation to defect
  - Defection incentive (*w*): 7 levels (Small – Large)
  - Conspiracy: available / unavailable
  - 10 runs for each condition
  - 500 consecutive generations for each run

Simulation Results (1)

- **Except when the incentive to defect is the highest, the selective offer – selective acceptance strategy evolved among the agents.**

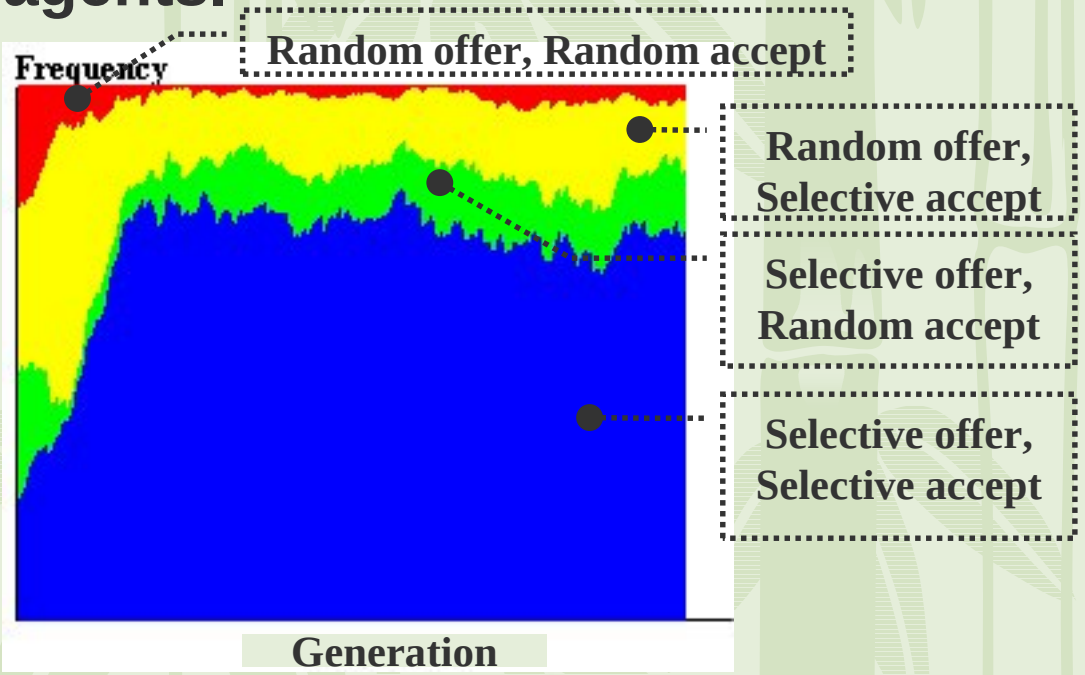


Figure 1: The Strategic evolution in a simulation run (First 250 generations)

Simulation Results (2)

- **Except when the incentive to defect is the highest, cooperation rate and trust increased as generation proceeds, followed by the increase of the cooperation size.**

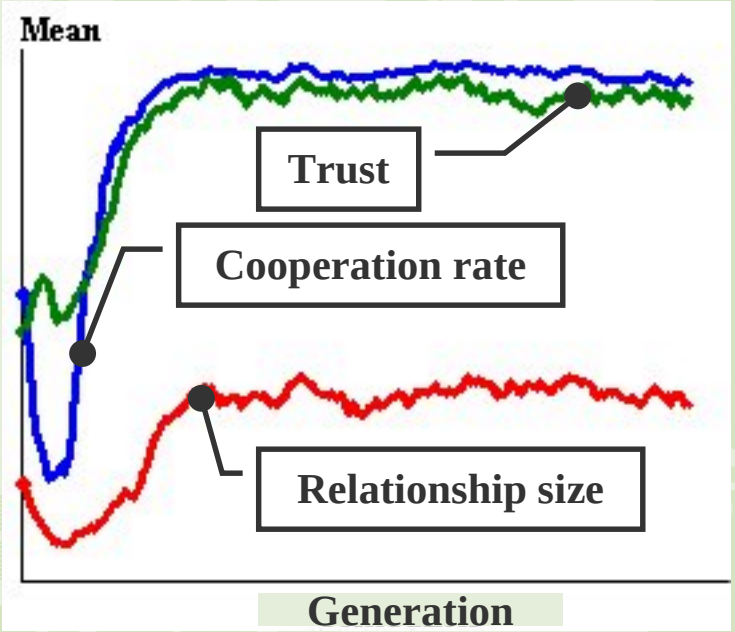
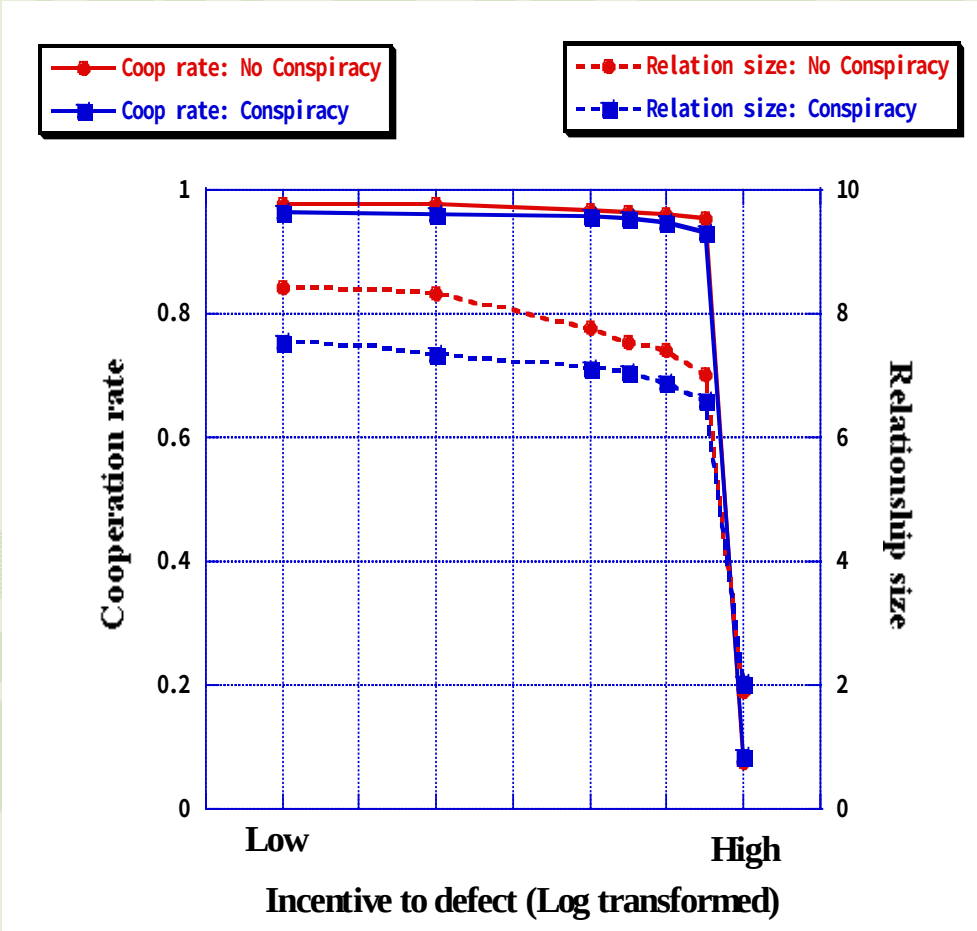


Figure 2: The evolution of cooperation in a simulation run (First 250 generations)

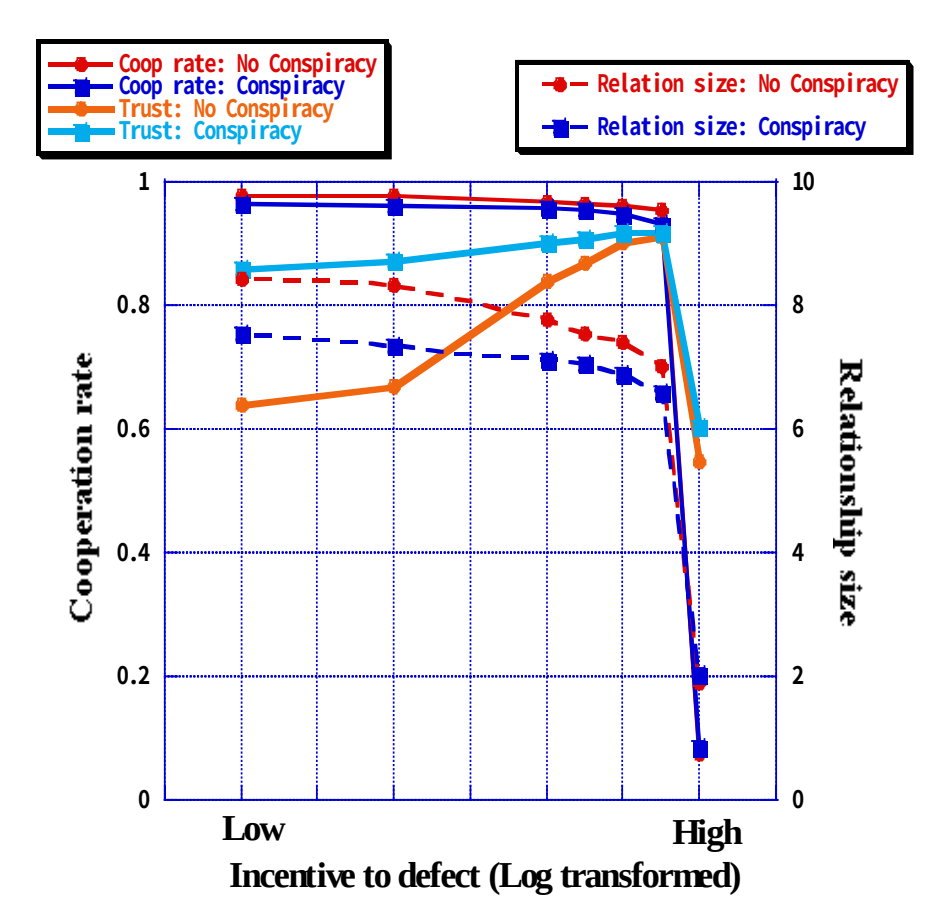
Simulation Results (3)

- As the temptation to defect increases, the cooperation level tends to decline. In the conditions where the defection incentive is the highest, cooperation disappeared.
- Cooperation rate and Cooperation size decreased
  - as the incentive to defect increased.
  - when conspiracy option was available.



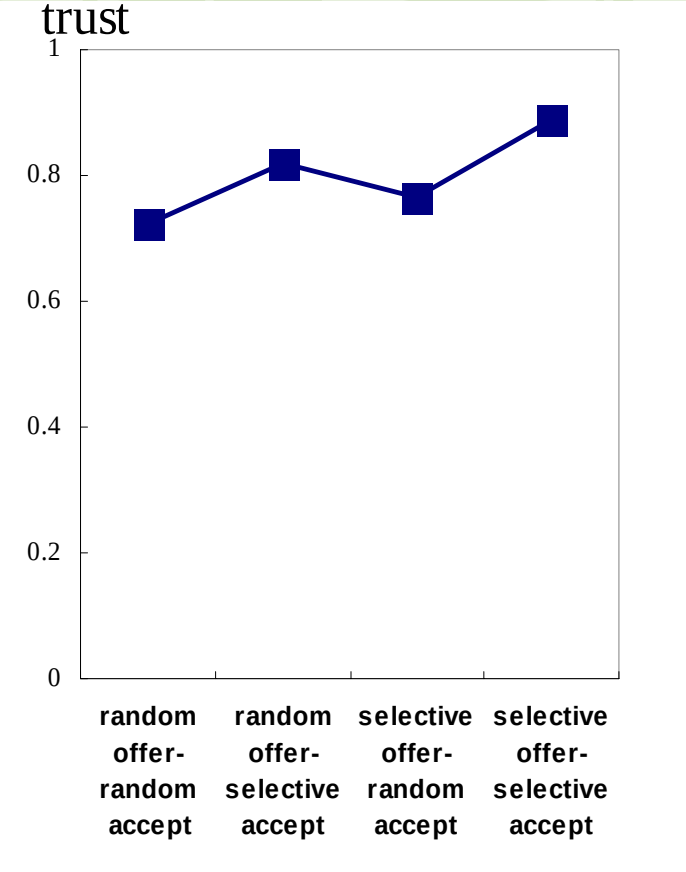
Simulation Results (4)

- However, trust level went in the opposite direction.
- Except in the highest defection incentive conditions, where cooperation collapsed, trust increased
  - as the defection incentive increased.
  - if the conspiracy option was available.
- High trust can be considered to have evolved in response to a certain level of the temptation to defect.

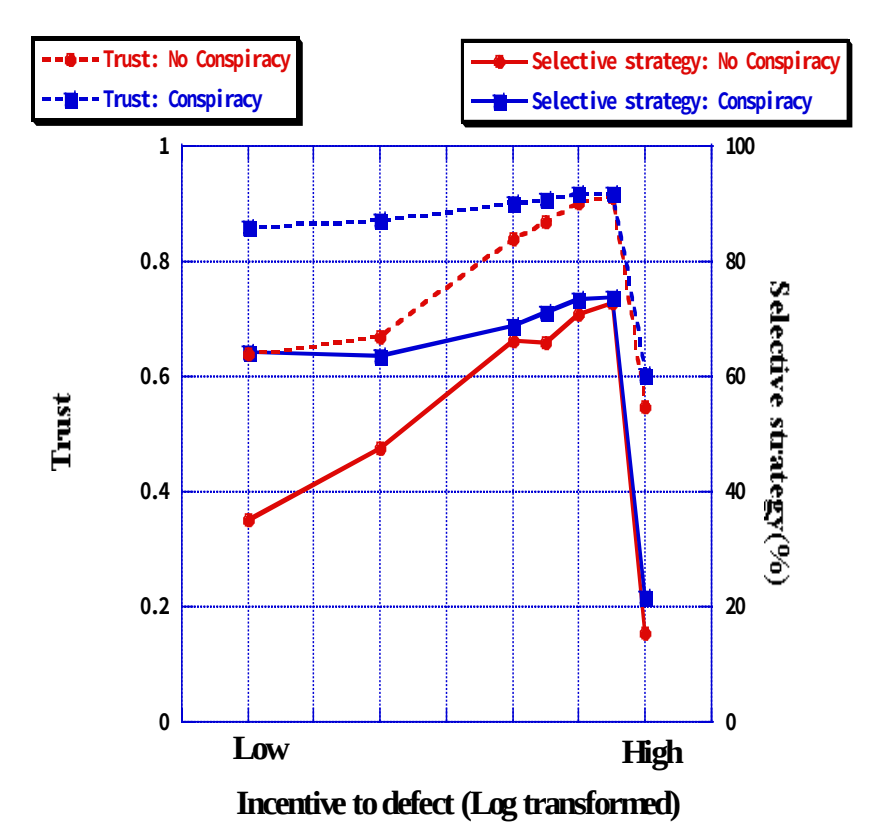


High trustor is a selective strategist

- **High trust is associated with the selective strategy.**

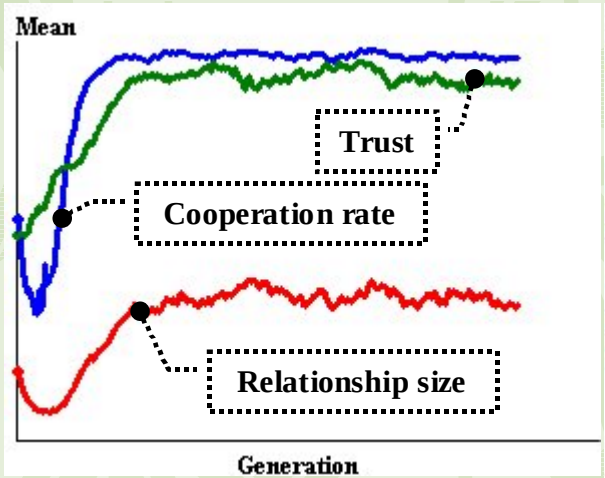


- **Therefore, in a condition where trust level is high, the frequency of the selective strategy is also high.**

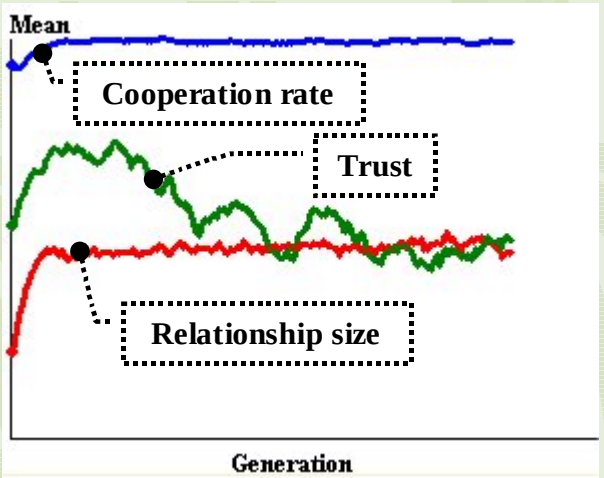


Unconditionally high cooperation rate lowers trust

- I conducted an additional simulation analysis, with the constraint that cooperation rate cannot be less than 0.875.
- The result shows:
  - As expected, a high level of cooperation was established.
  - But the trust level is reduced.
- In order for trust to be high, the agents must experience a certain level of defection at least in the early stage of strategic interaction.



(a) A simulation run (First 250 generations)



(b) When cooperation rate is constrained to be high.

Manipulating the trust level (1)

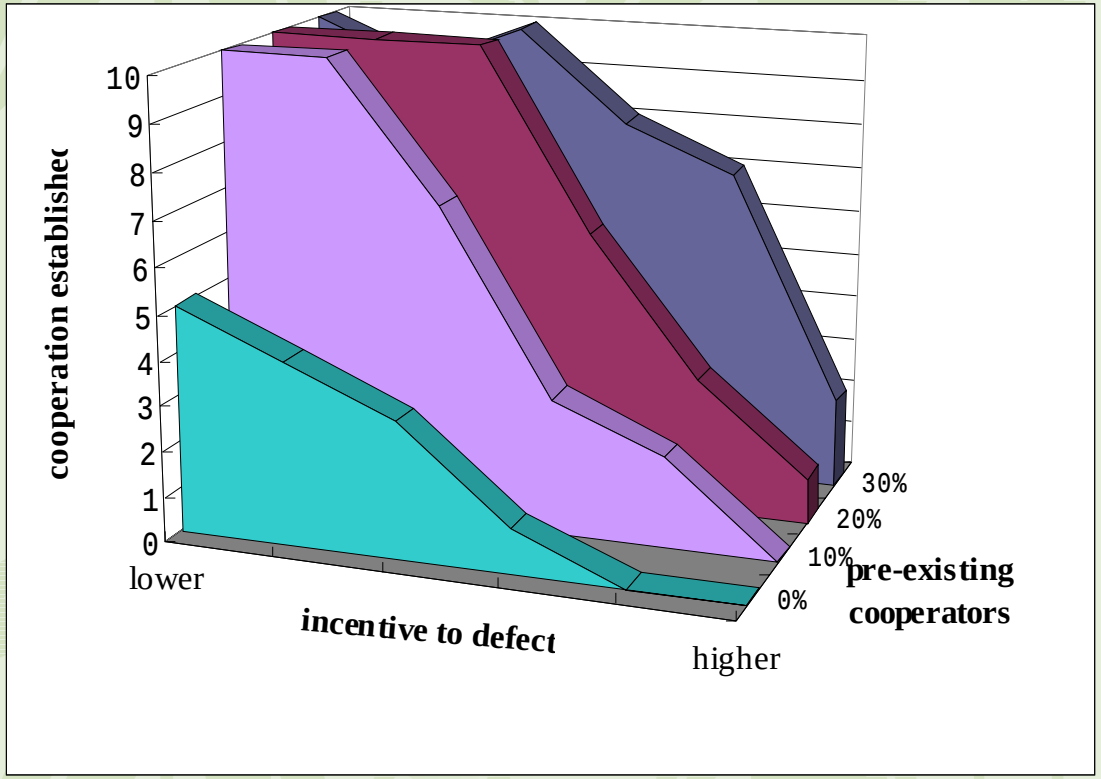
- **Even in the high defect incentive conditions where cooperation tends to collapse, agents may choose a cooperative strategy if they observe a minority group whose members are cooperating successfully.**
- **With the present simulation model, I introduced a 'cooperating minority' (10/20/30% of the agents), in order to see if introduction of such a minority can promote cooperation. The simulation was conducted in the condition that defect incentive is so high that cooperation tends to collapse.**
- **Cooperating minorities are defined in the following 3 ways.**

Manipulating the trust level (2)

1. **Minority members have high ‘specific trust’ with each others (at the initial state).**
   - **Specific trust is manipulated by introducing ‘prior successful cooperation history’ among the minority members.**
   - **No effects. Cooperation was more likely to collapse.**
2. **Minority members have high (general) trust.**
   - **No effects.**

Manipulating the trust level (3)

3. **Minority members' strategy is as follows: High trust, Low probability to defect, Selective strategy**
   - **Introduction of this minority group promoted cooperation.**
- **Merely raising trust level, general or specific, did not promote cooperation. It seems that a set of some cooperative attitudes has an effect in promoting cooperation.**



Conclusions

- **The simulation results have the following implications.**
  - **The selective inclusion strategy coupled with high trust will emerge to solve the social dilemma embedded in cooperative relationships, assuming that the temptation to defect is not too high nor too low.**
  - **High trust can be considered to evolve as an adaptive response to the temptation to defect.**
- **The combination of the selective inclusion strategy and high trust would evolve naturally, and become a selective inclusion mechanism to resolve relationship type social dilemmas.**