**HIGH CLUSTERING PROTECTS AGAINST CATASTROPHIC COLLAPSE OF COOPERATION**

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**Motivation:**

Highly-cited Human Studies Claim:

- Topology has no impact for cooperation.
- Prisoner’s Dilemma: Gracia-Lázaro et al. [1]

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**Experiments:**

Seeding Until Catastrophic Collapse [3]

- Widely-Cooperative Network (t = 0)
- Randomly seeded with defectors

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**Results:**

A Protective Effect of Clustering [3]

- Threshold-based Conditional Cooperation: Increasing Rewiring Reduces Ability to Withstand Defection Shocks.
- Equivalently: High Clustering Increases Ability to Withstand Defection Shocks:

  - **Protective Effect above critical threshold.**
  - Consistent behavior for:
    - Small synthetic networks (50 vs. 200 nodes)
    - Variable small community sizes (20 vs. 30)
    - Non-uniform community sizes (normal dist.)
    - Large real-data example (1.421 nodes)

- **A Novel View on Suri and Watts [4]** Simple threshold-based model predicts:
  
  Catastrophic cooperation collapse was the most likely outcome across all topologies.

- **Moody Conditional Cooperation:**
  
  We study two Suites of Distributions over moody conditional cooperators:

  - **Smooth erosion of community structure:**
    - [Image]
    - Decision rules for spread:
      - **Conditional Cooperation: threshold h**
        
        At time t, node v ∈ V updates behavior depending on behavior of v’s neighbor set, \( \delta(v) \), at time \( t−1 \):

        \[ c_t+1(v) = \begin{cases} 
        1 & \text{if } \sum_{w \in \delta(v)} c_t(w) \geq h + |\delta(v)|, \\
        0 & \text{otherwise.} 
        \end{cases} \]

      - **Empirical Moody Conditional Coop [1, 2]**
        
        - threshold conditioned on own past action
        - heterogeneous population

  - **Complex parameter space:**

  - **Extra Takeaways:**
    - Networks in catastrophic collapse are nearly impossible to distinguish.
    - To refute role of topology in supporting cooperation, tests must examine a portion of the parameter space where a topology effect is truly predicted, and account for round-1 defectors.

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**References**


