

Rewiring Hypergraphs To Improve Information Propagation

Can restructuring a network, without changing what is in it, spread information further?

Author

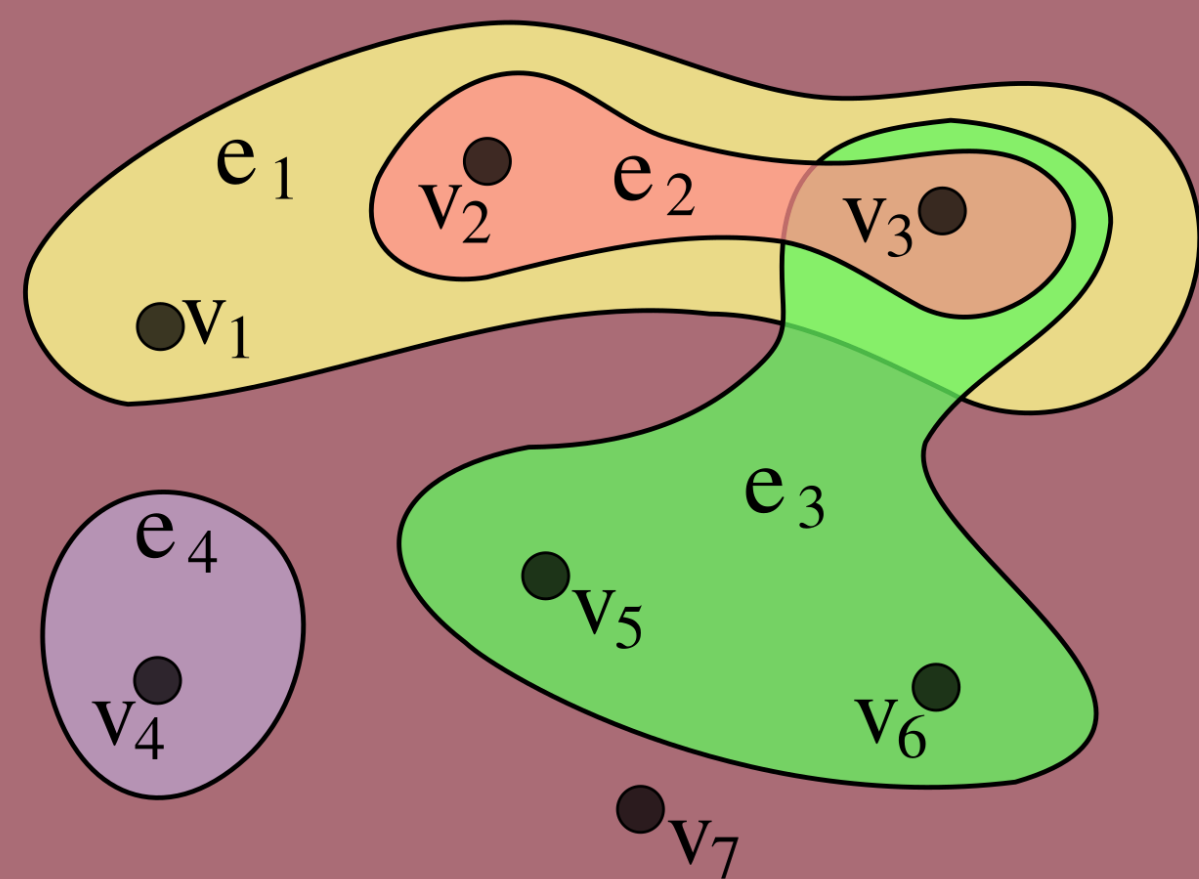
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1 Background

- **Hypergraphs** can model **real-world** relations
- **Hyperedges** can **connect any number** of nodes together



- **Degree preserving rewiring** swaps nodes between two **same-sized hyperedges**
- **SICP**: every infected node tries to spread to **all nodes** in **one** chosen connected **hyperedge**

2 Research Question

How to use degree preserving hyperedge rewiring to improve SICP spreading efficiency on hypergraphs?

3 Methodology

- **Simulate** SICP for **every single node** as possible start **seednode**
- Do **rewiring strategies** for a percentage of total size-3 hyperedges

Neighbourhood Coefficient (NC)

- The Neighbourhood Coefficient of a node is the **mean** value of the sizes of its **connected hyperedges**
- Correlated to **spreading influence**: average number of nodes the infected node tries to infect

Neighbourhood Coefficient Assortativity Strategy (NCA)

- **Assortativity**; nodes with **similar NC** are **connected**
- Rewire **greedily** to **max assortativity**

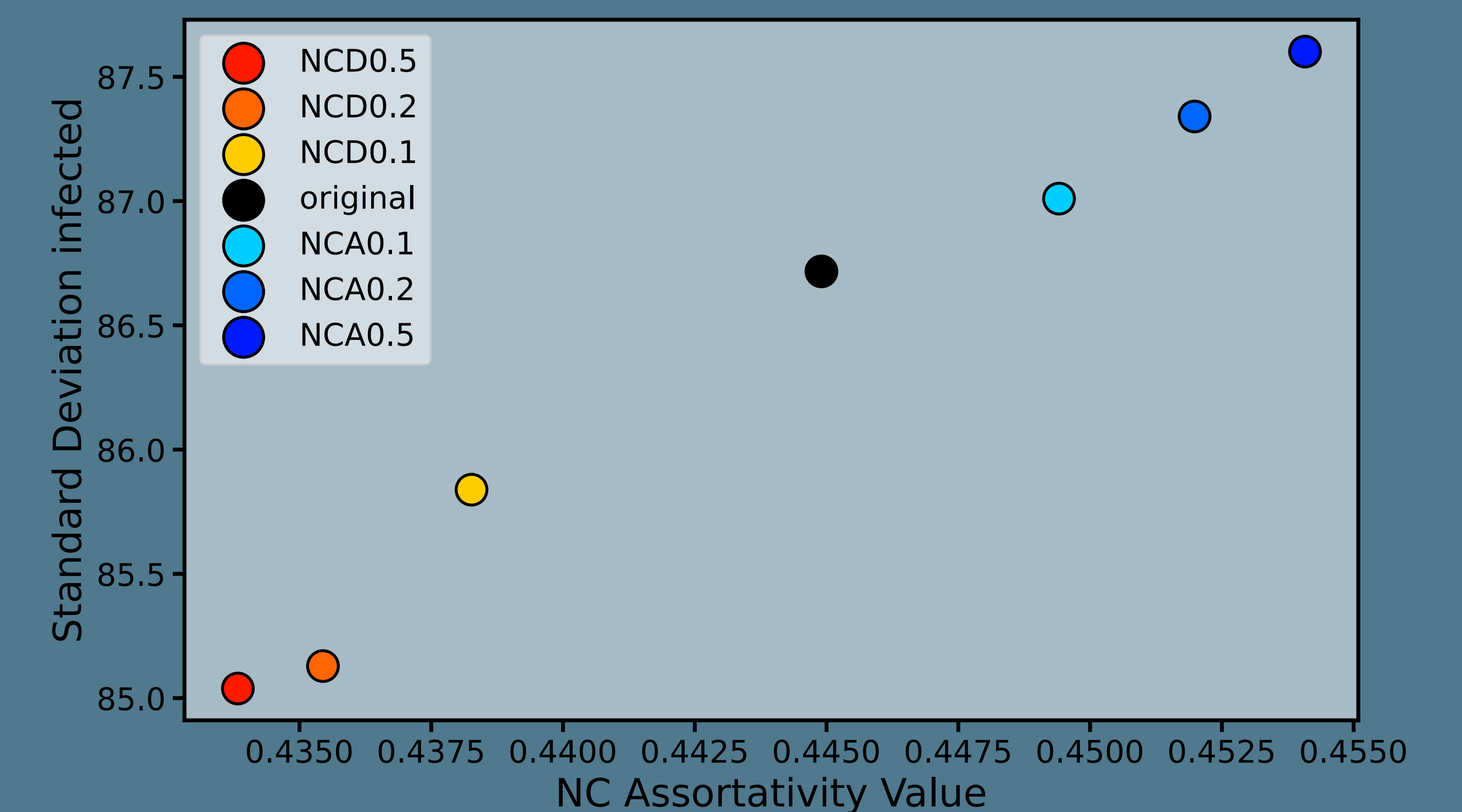
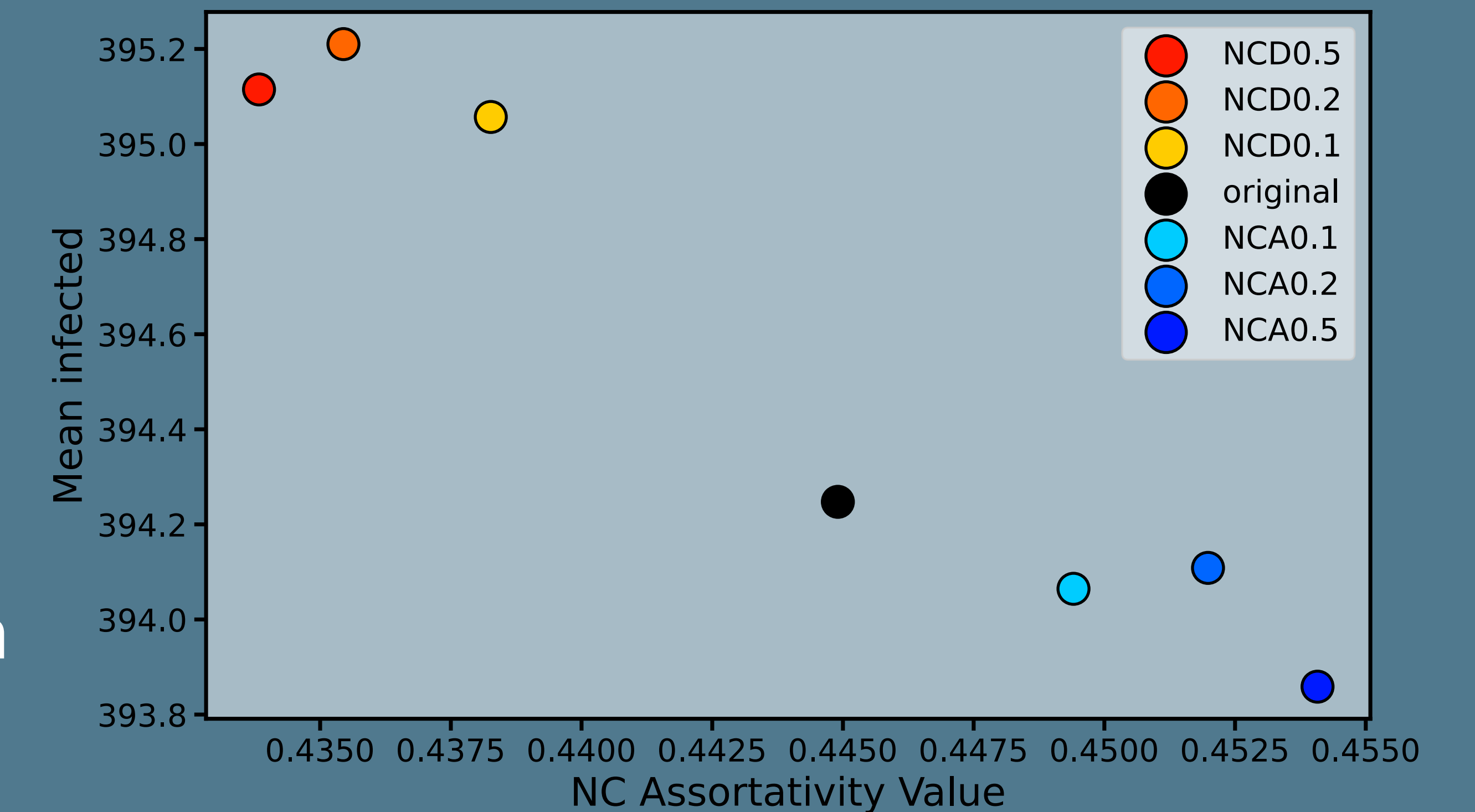
Neighbourhood Coefficient Disassortativity Strategy (NCD)

- **Disassortativity**; **opposite** of assortativity: nodes with **different NC** are **connected**
- Rewire **greedily** to **min assortativity**

NC Assortativity value of a hypergraph, in range $[0, 1]$, measures assortativity where a **higher** value means **more assortative**

4 Results

- **Mean infected nodes decreases** with **NC assortativity**
- **Strong negative Pearson correlation** across 5/6 datasets ≈ -0.95
- **Variation** between seednodes **increases** with **NC assortativity**
- **Strong positive Pearson correlation** across 4/6 datasets ≈ 0.97



5 Conclusion

- **NC disassortative** rewiring consistently **improves** SICP average **spreading**
- **NC assortative** rewiring **increases variance** between strong and weak seednodes, while **impeding average spread**
- **Only size-3** rewiring **limits results**, **unrewired hyperedges dilute the effects**