
Volatility of Weak Ties

Co-evolution of Selection and Influence in Social Networks

Fang-Yi Yu

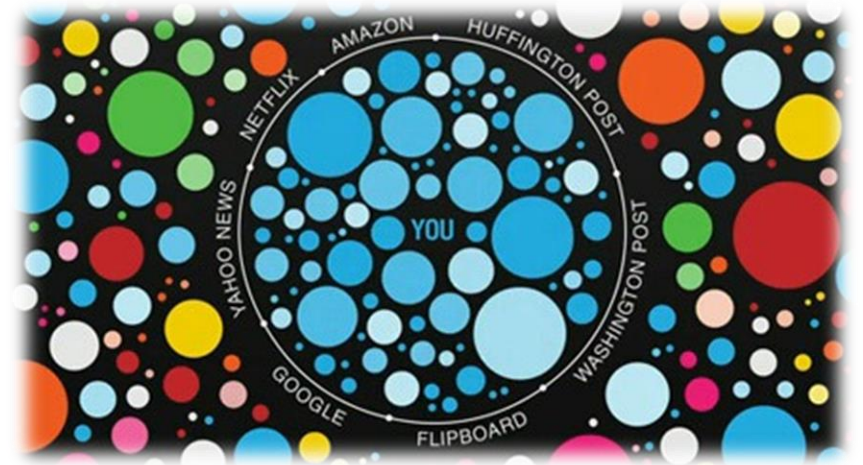
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Co-evolution of Selection and Influence in Social Networks

Jie Gao, Grant Schoenebeck, **Fang-Yi Yu**

Co-evolution of Selection and Influence in Social Networks

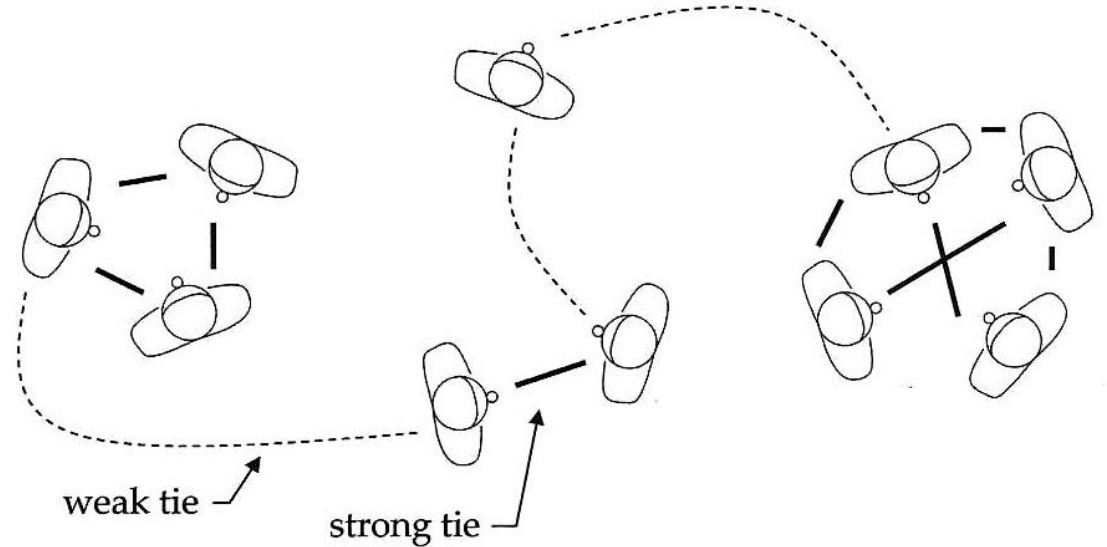
VOLATILITY OF WEAK TIES



An Experiment by Granovetter [1970]

- Weak Ties and Changing Jobs

Tie strength	Frequency	Found jobs
friend	1/week	16.7%
acquaintance	1/year	55.6%
stranger	less	27.8%



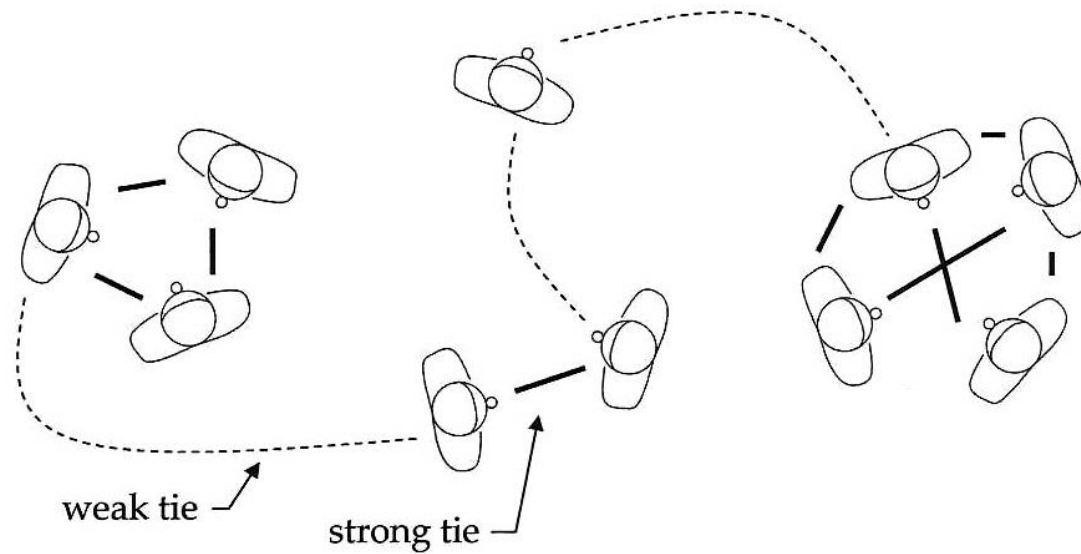
Volatility of Weak Ties

Changing Jobs

- bring fresh information to a social group

Bubble Filters

- unfriending disproportionately affect weak ties as compared to strong ties.

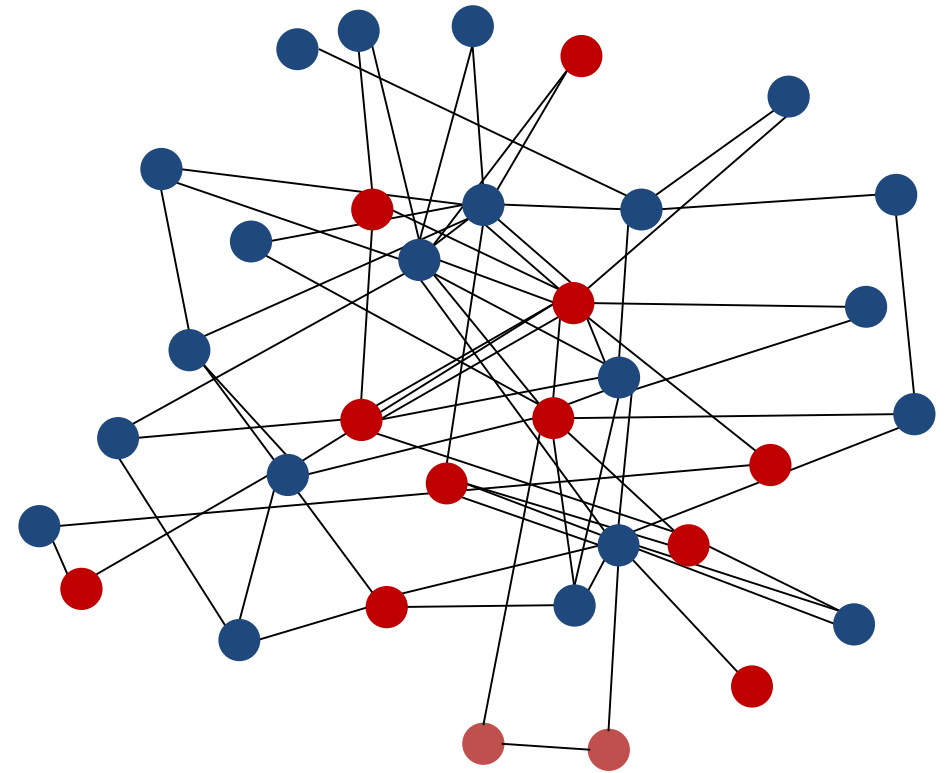


Outline

- Model
 - Opinion formation: Influence and Selection
 - Network: Strong and Weak Ties
 - Simulation Results
-

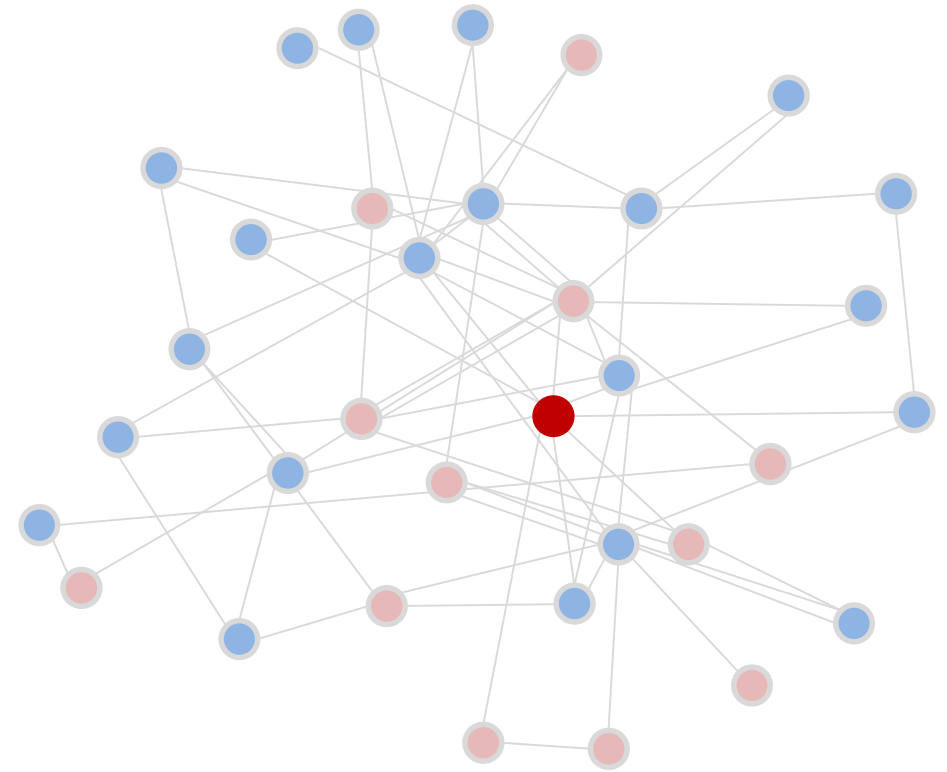
Opinion Formation

- Influence
- Selection



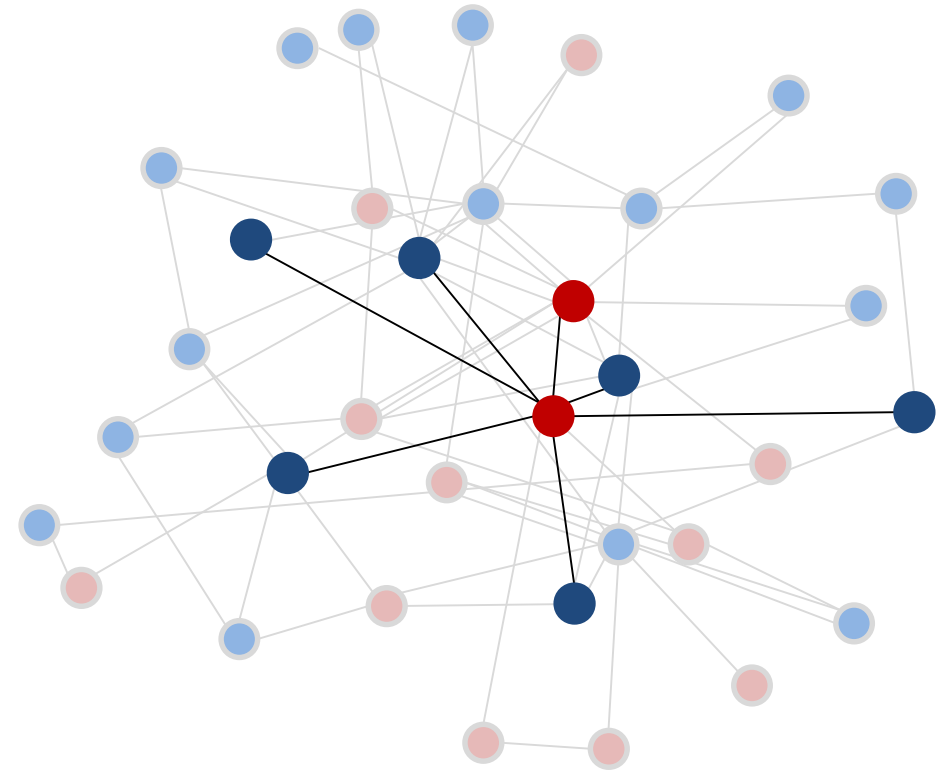
Influence

- Influence
 - agents changing their opinions to match their neighbors



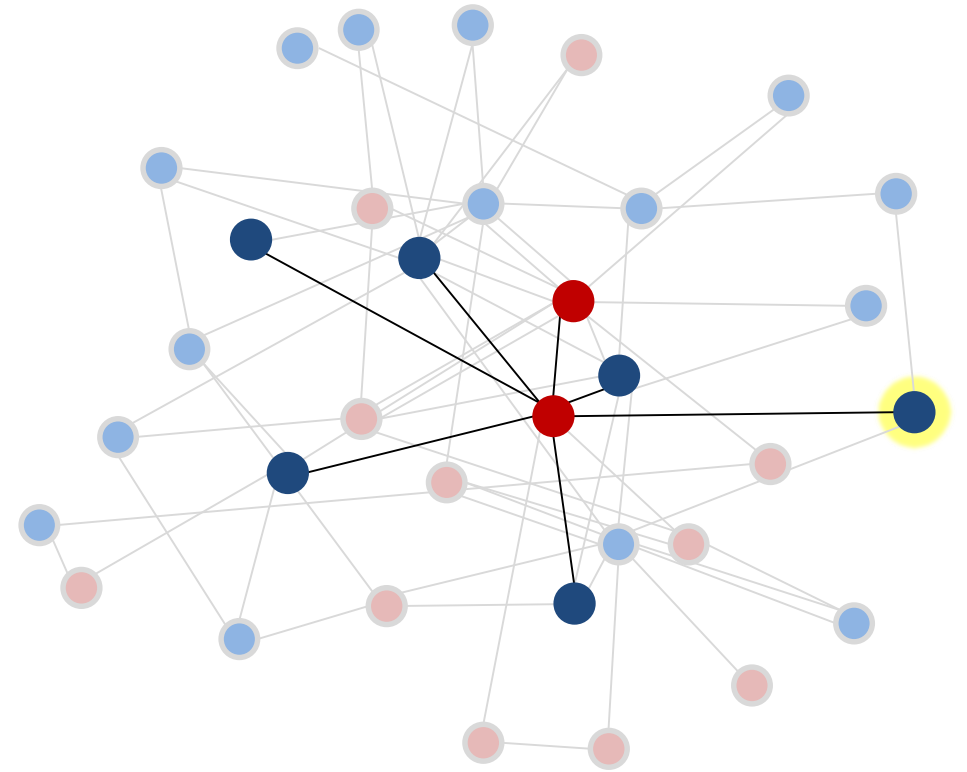
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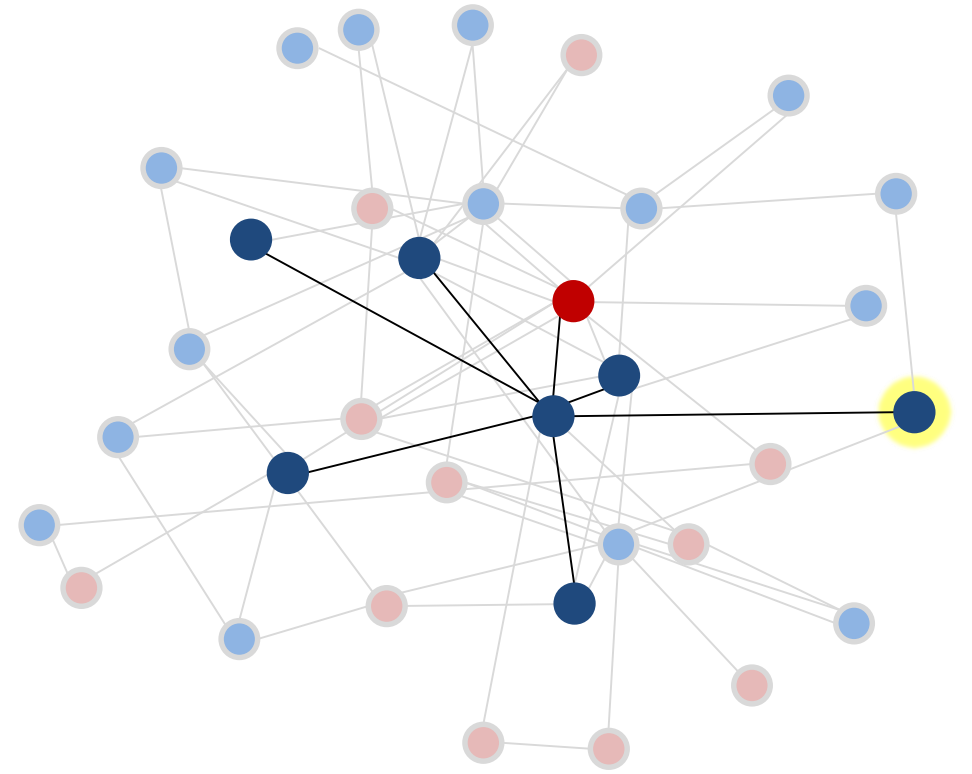
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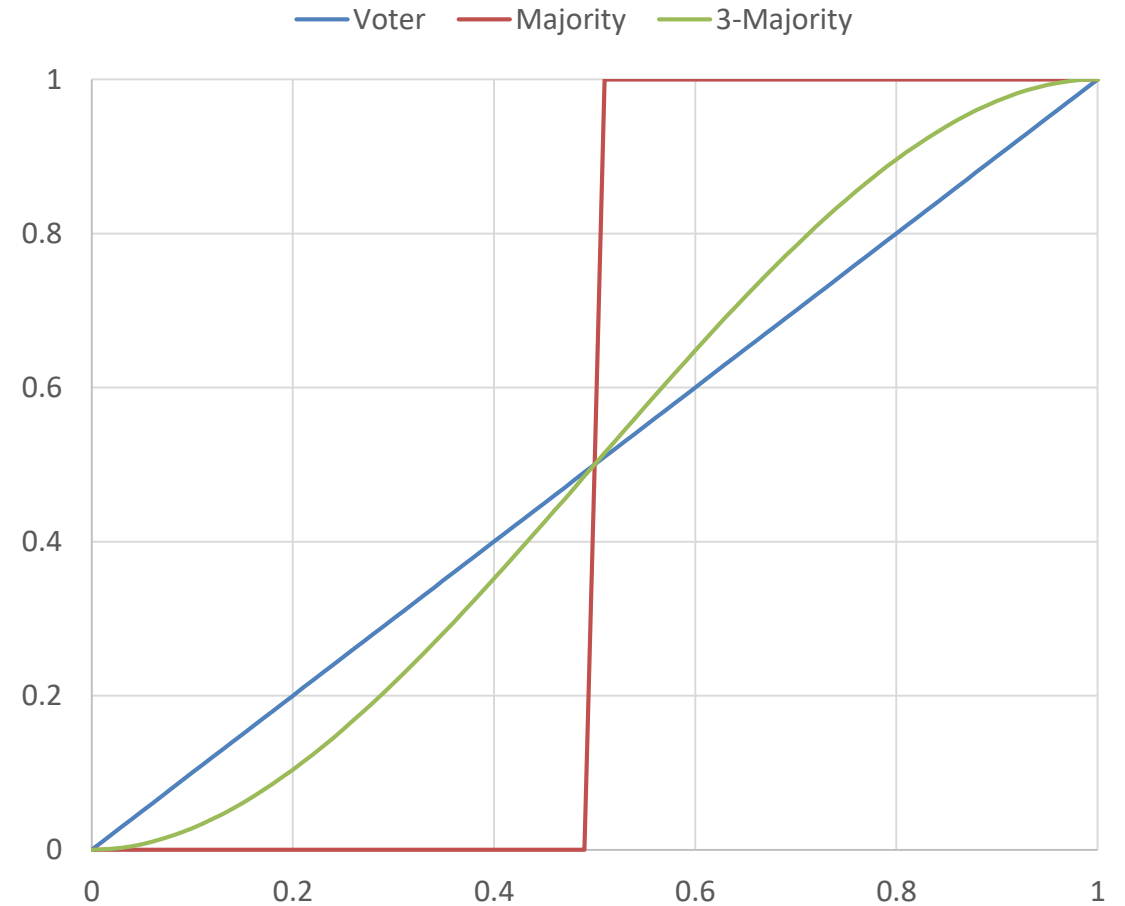
Influence f_{inf}

- Influence
 - agents changing their opinions to match their neighbors
 - $\chi^{t+1}(v) = 1$ w.p. $f_{inf}(R^t(v))$



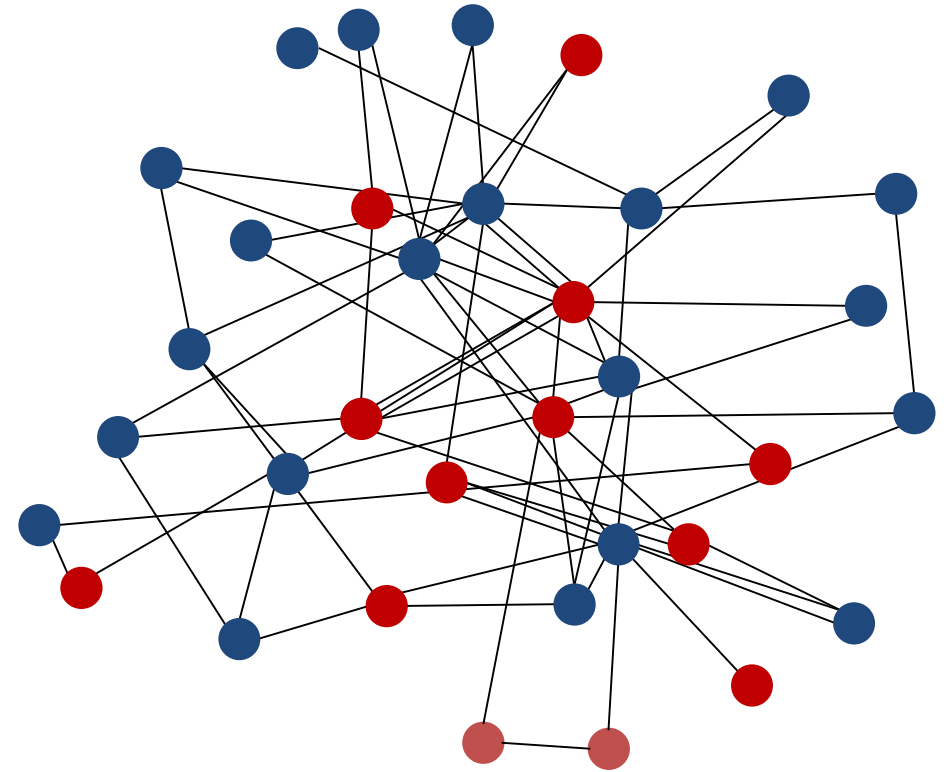
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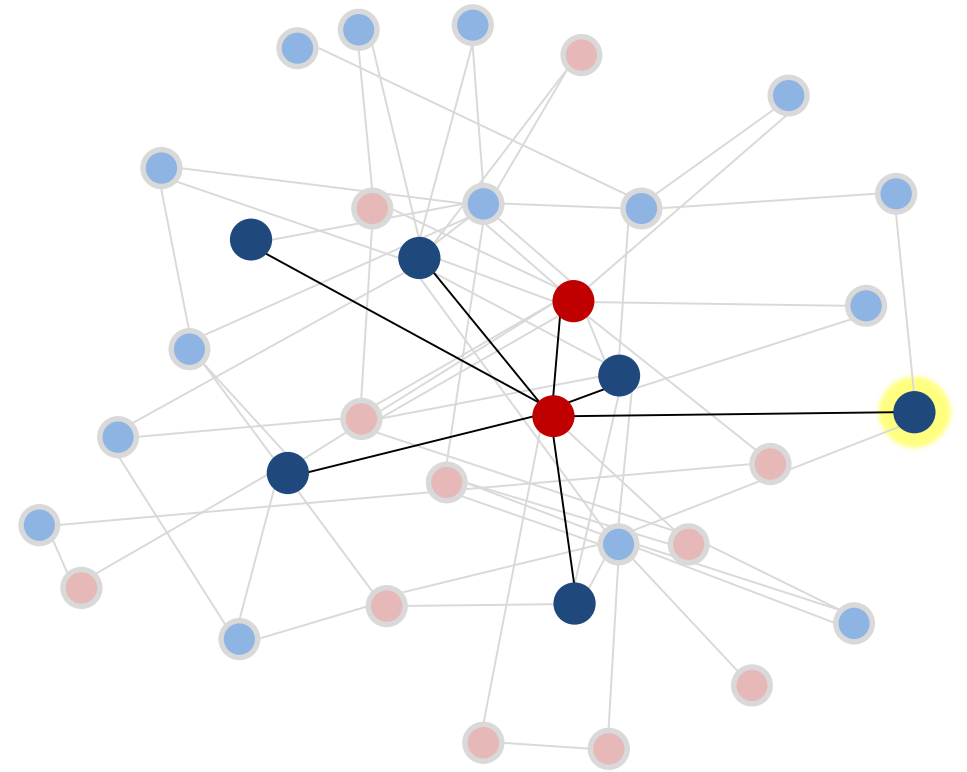
Selection

- Influence
 - agents changing their opinions to match their neighbors
- Selection
 - agents re-wiring to connect to new agents when the existing neighbor has a different opinion



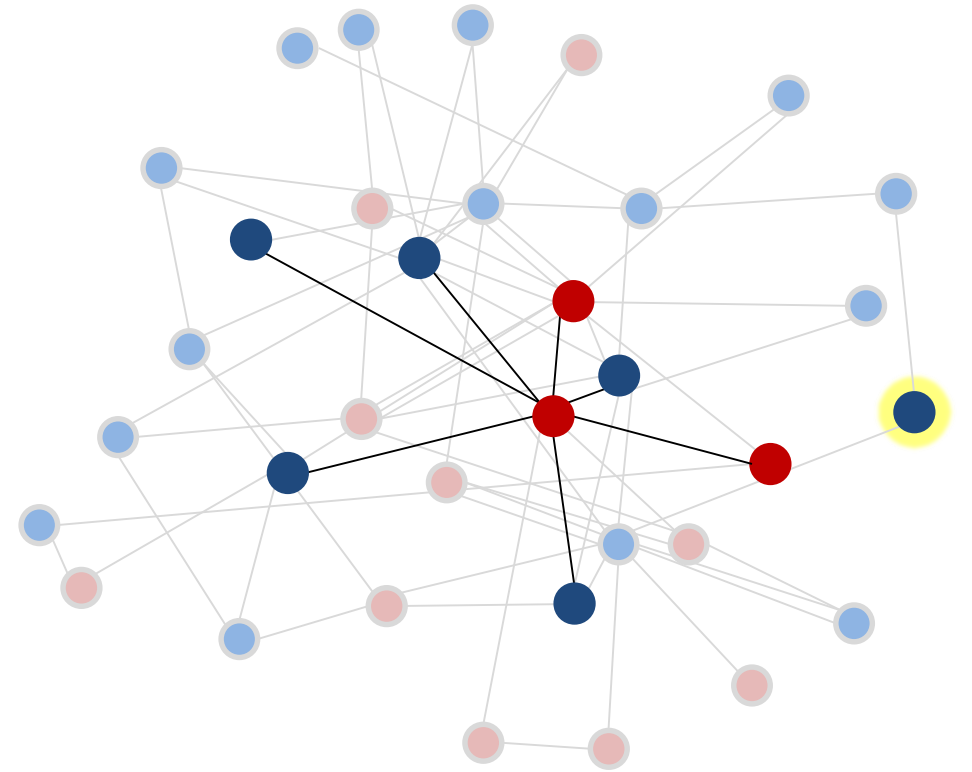
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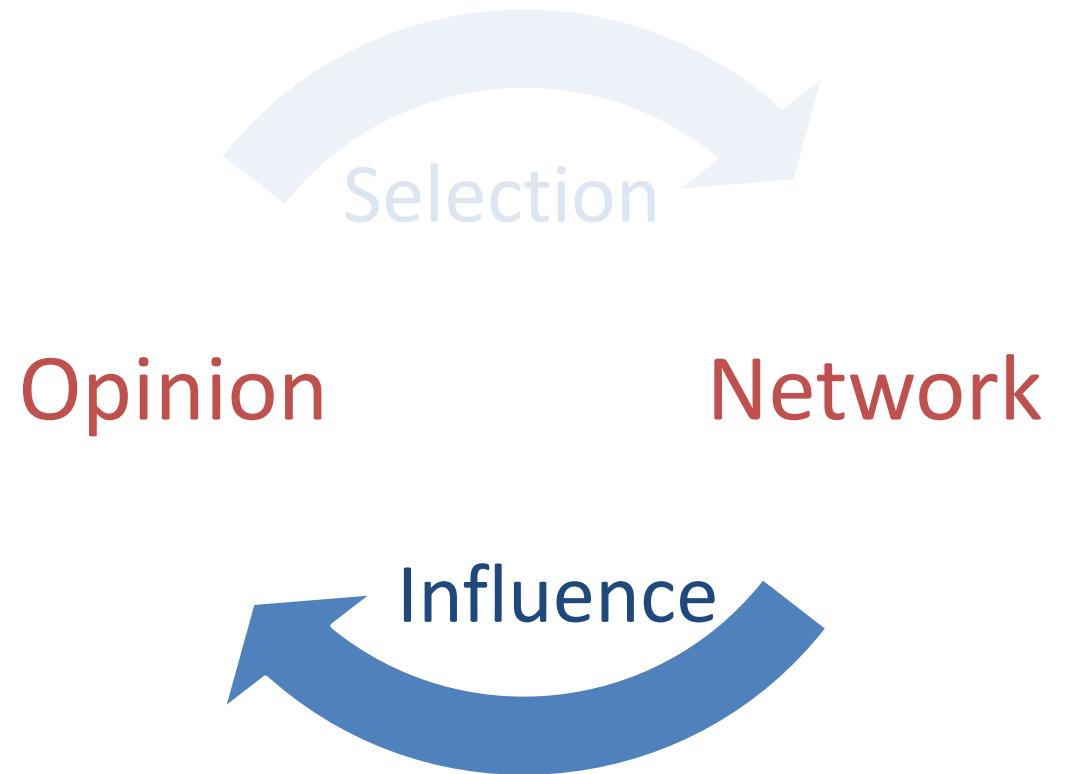
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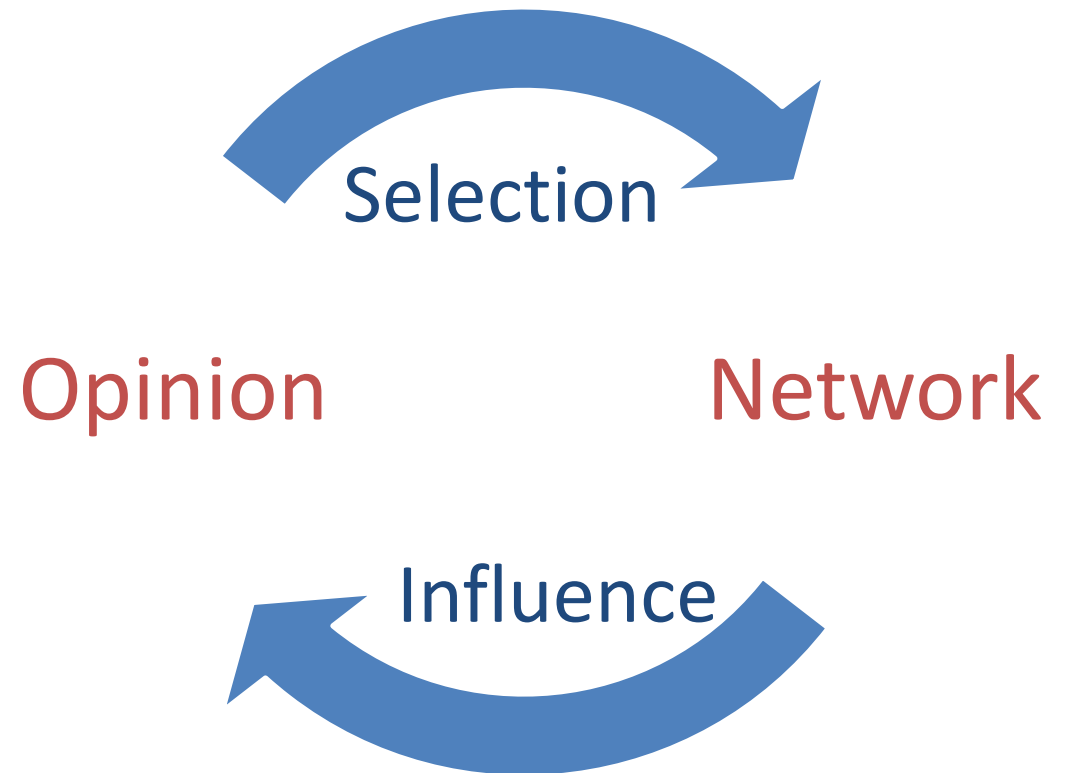
Co-evolution of Selection and Influence

- Influence
 - agents changing their opinions to match their neighbors
 - bring new information through weak ties



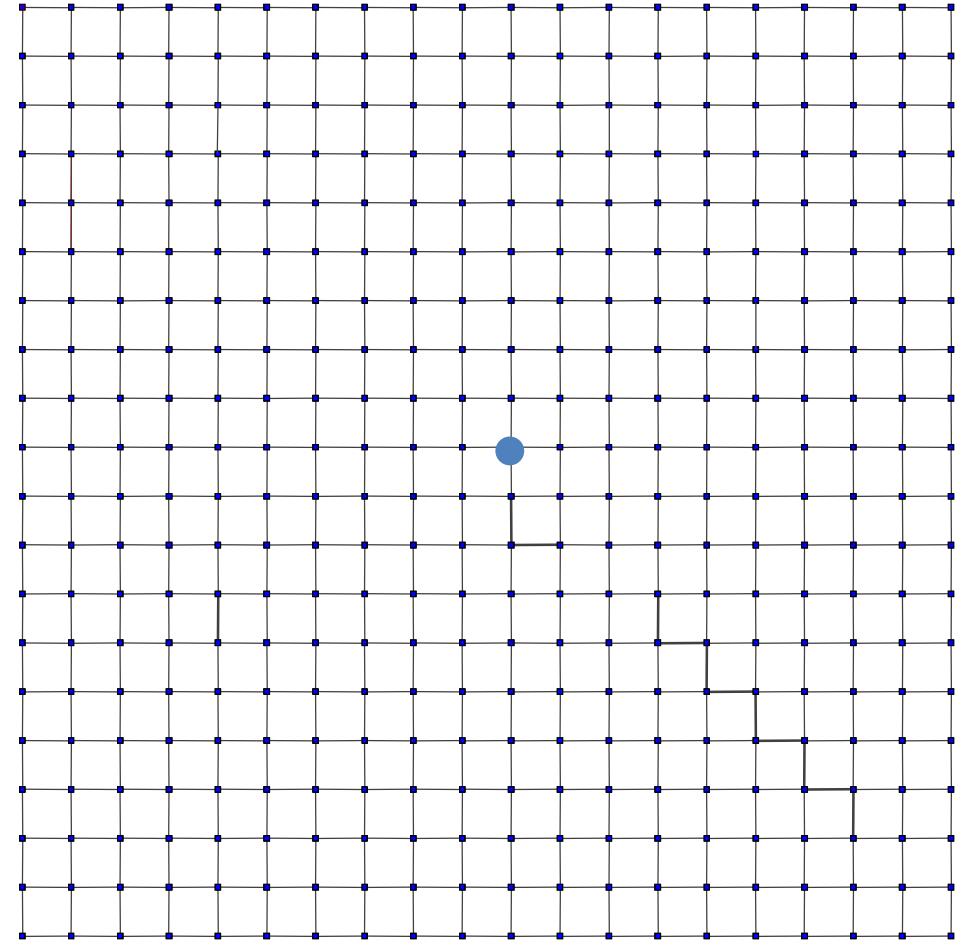
Co-evolution of Selection and Influence

- Influence
 - agents changing their opinions to match their neighbors
 - bring new information through weak ties
- Selection, p_{sel}
 - agents re-wiring to connect to new agents when the existing neighbor has a different opinion
 - unfriend weak ties



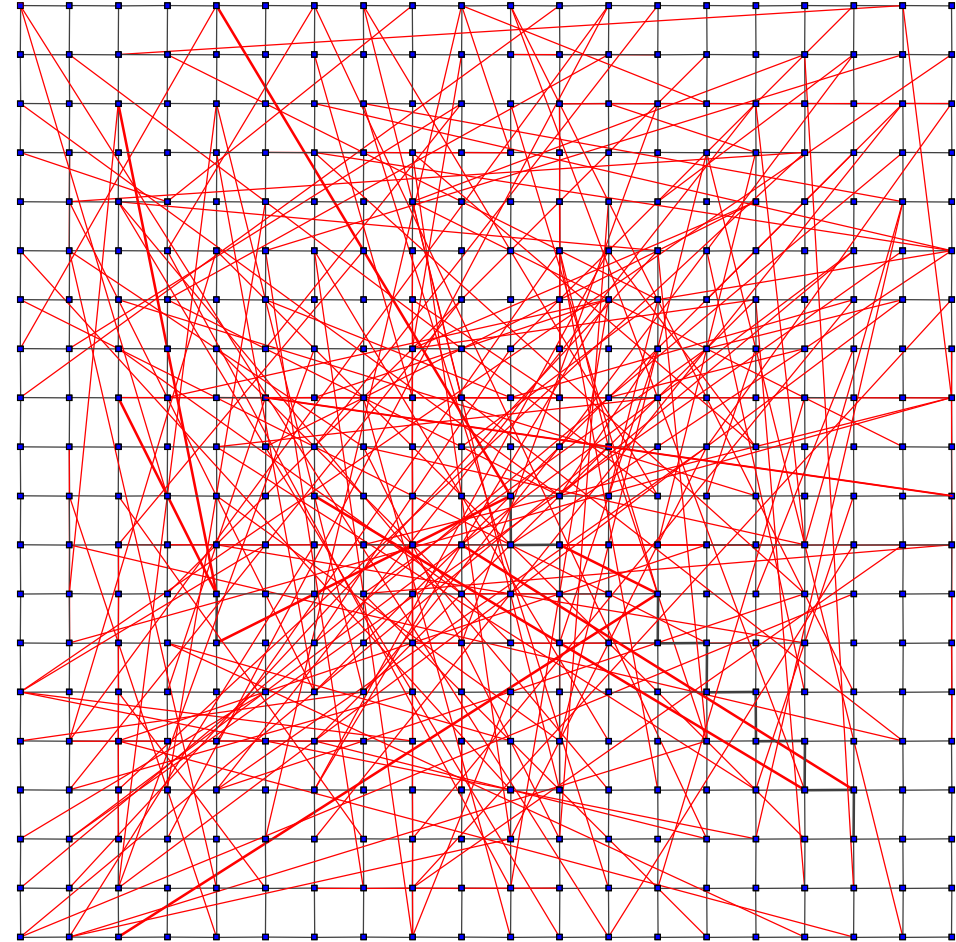
Model of Network $G^0 = (V, E_S, E_W)$

- Strong ties E_S
 - grid edge
 - Not affected by selection



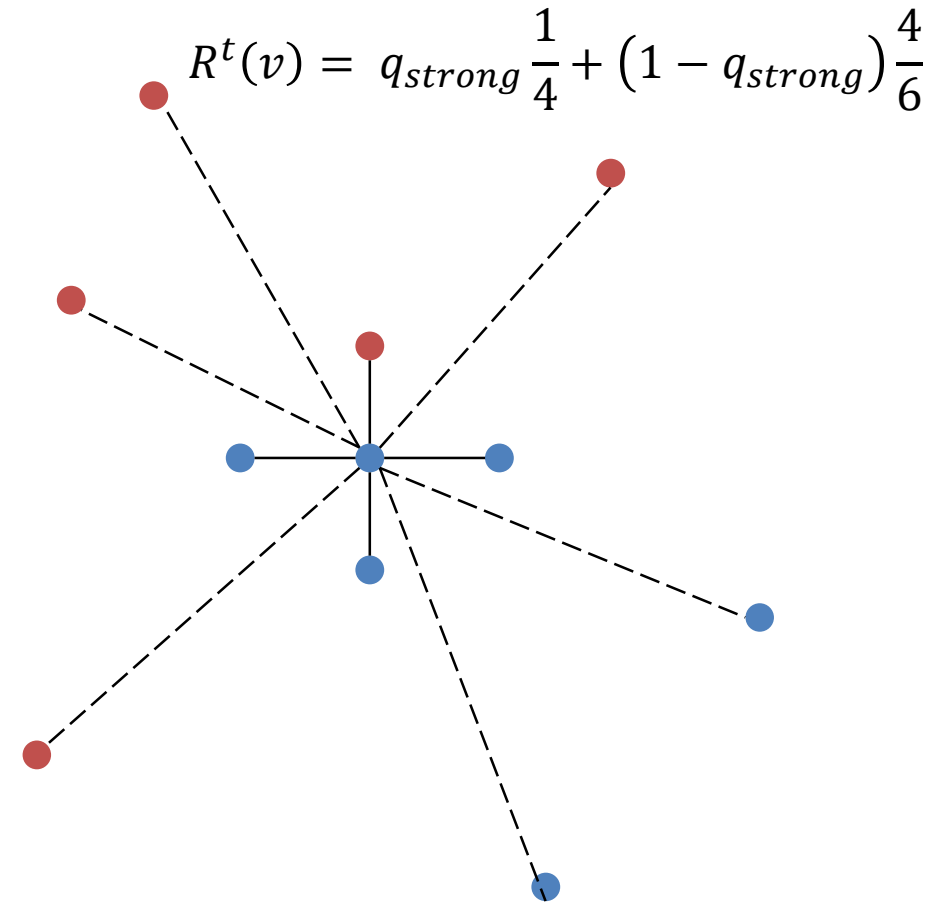
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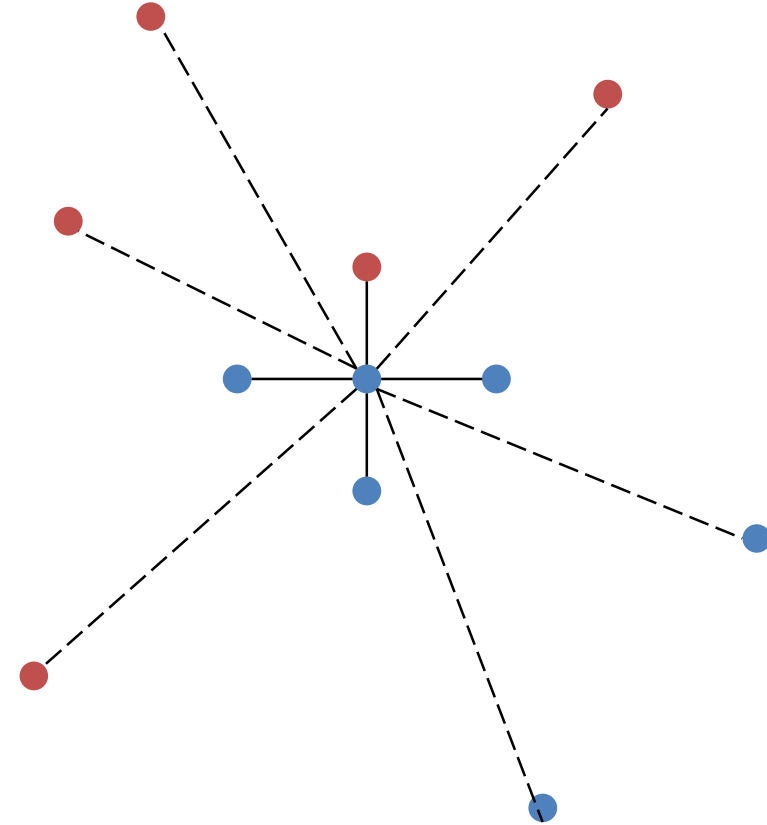
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- Weak ties E_W
 - random edge
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- Strength of strong ties, q_{strong}
 - Relative frequency of communication through strong ties



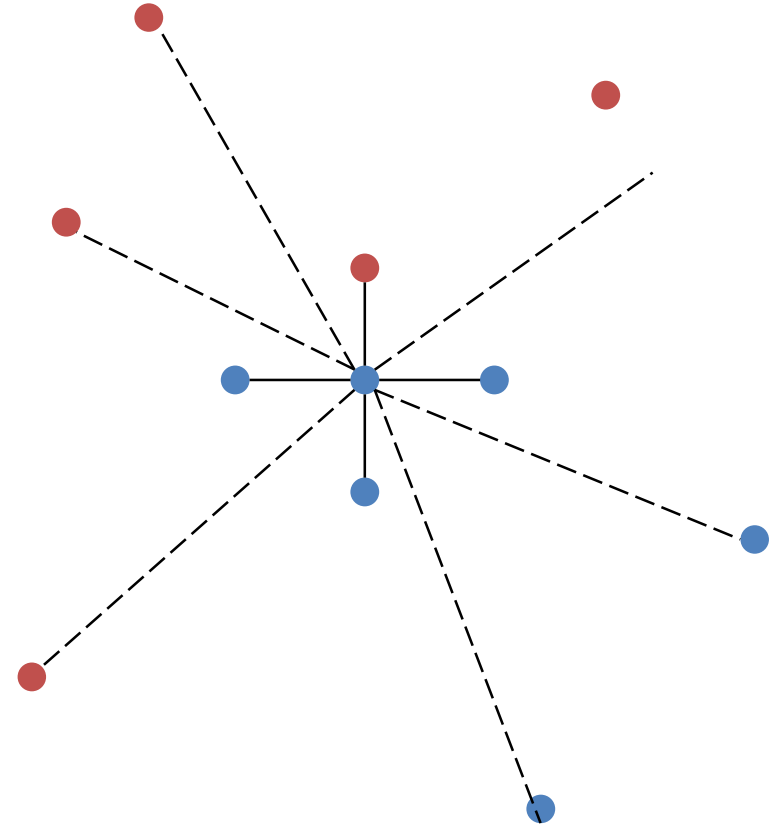
Sel-Inf ($G^0, f_{inf}, p_{select}, q_{strong}$)

- Dynamic over binary opinion (χ^t)
 - Agent v has a random opinion $\chi^t(v) \sim \{0,1\}$
 - At round $t + 1$, a random node v is picked
- Selection w.p. p_{select}
 - Pick an incident weak tie (v, u) and rewire if $\chi^t(v) \neq \chi^t(u)$
- Influence w.p. $1 - p_{select}$
 - $R_S^t(v)/R_W^t(v)$ fraction of opinion 1 in strong/weak neighborhood of v
 - Update to 1 w.p. $f_{inf}(R^t(v))$



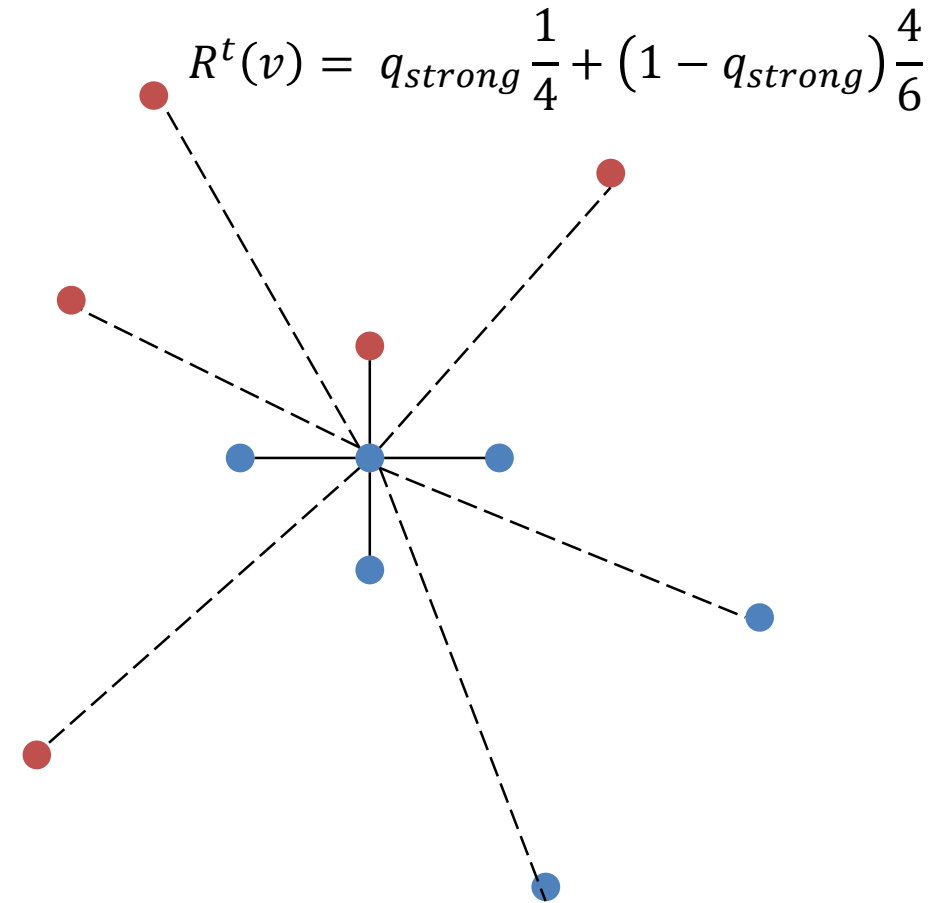
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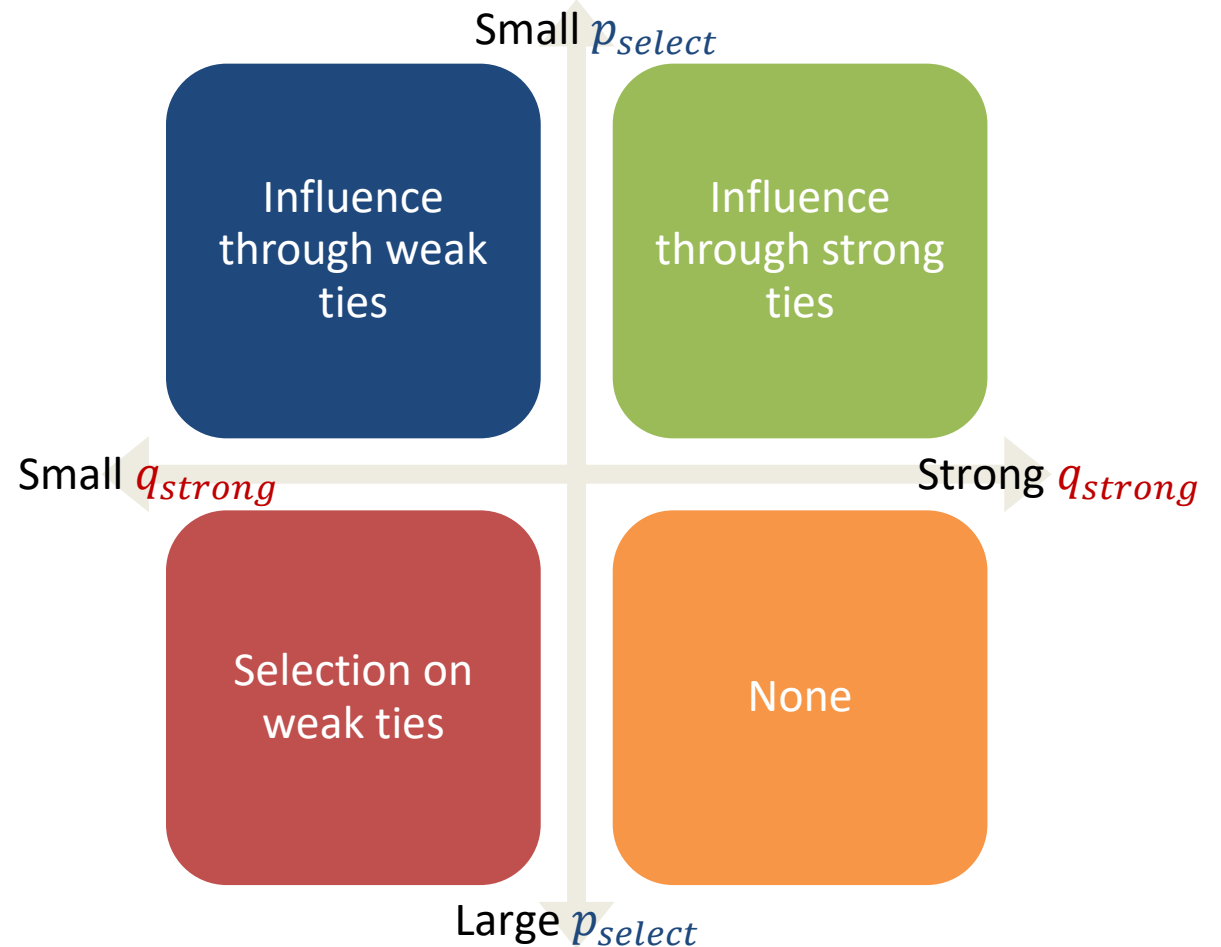
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Sel-Inf ($G^0, f_{inf}, p_{select}, q_{strong}$)

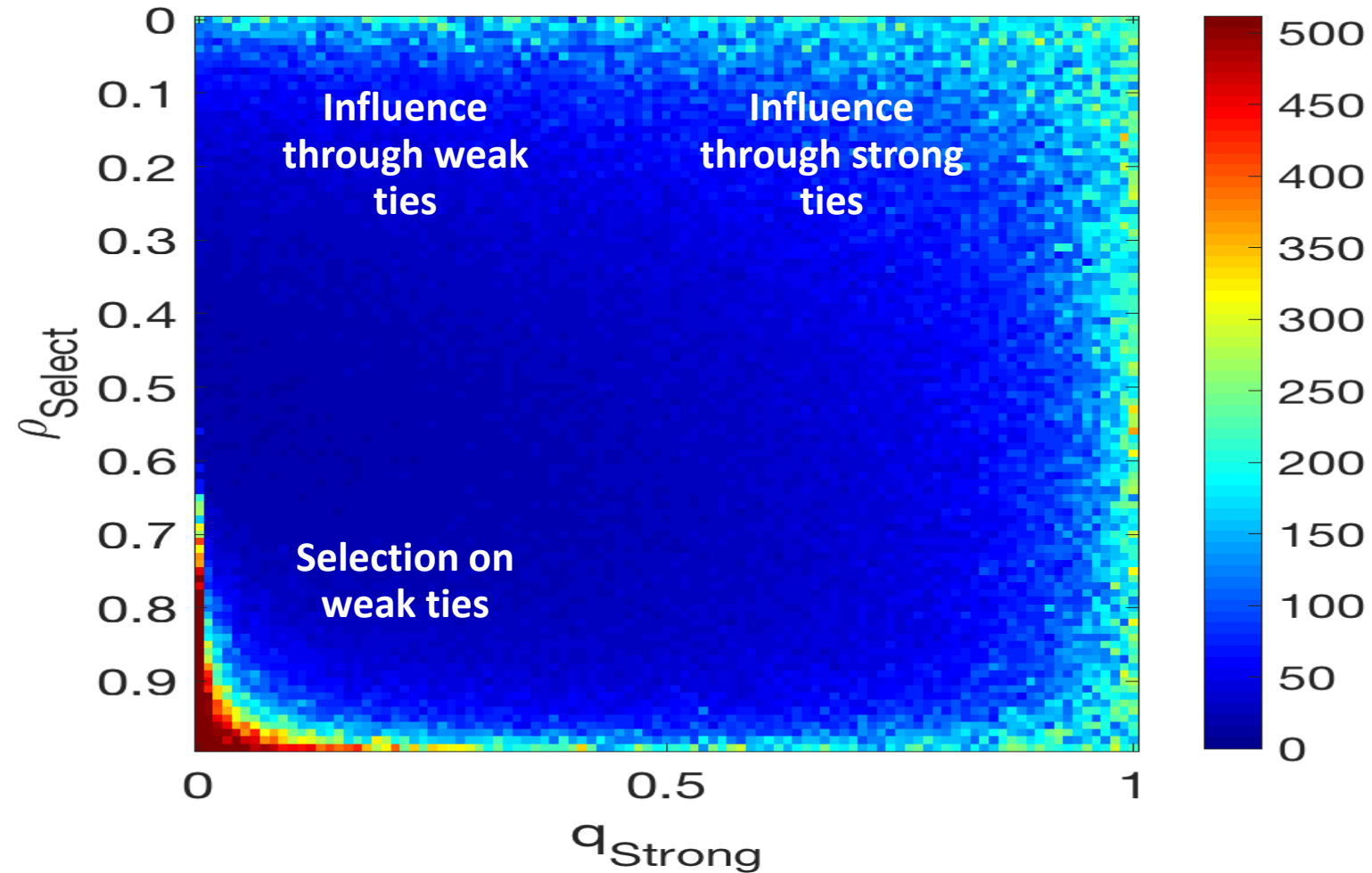
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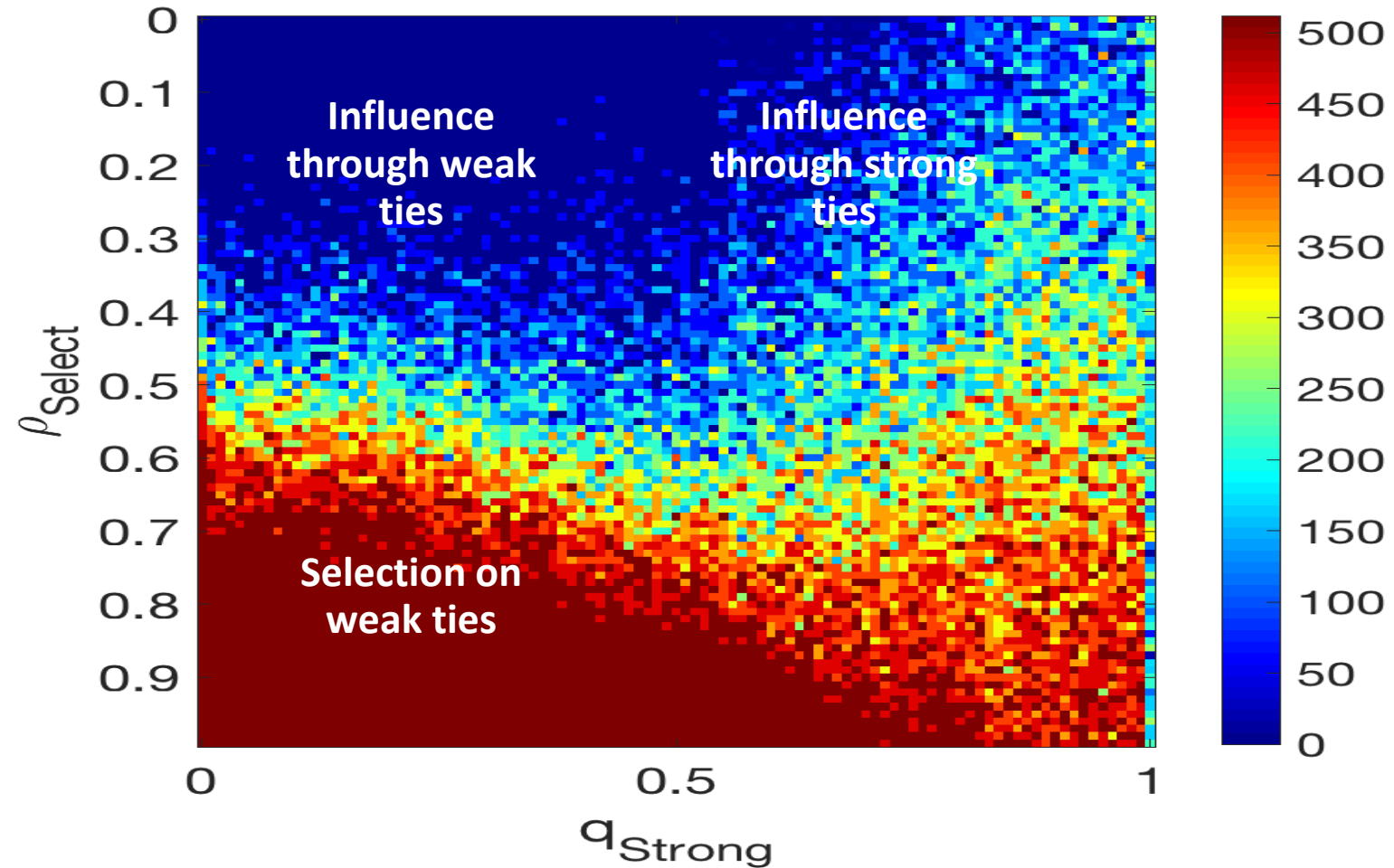
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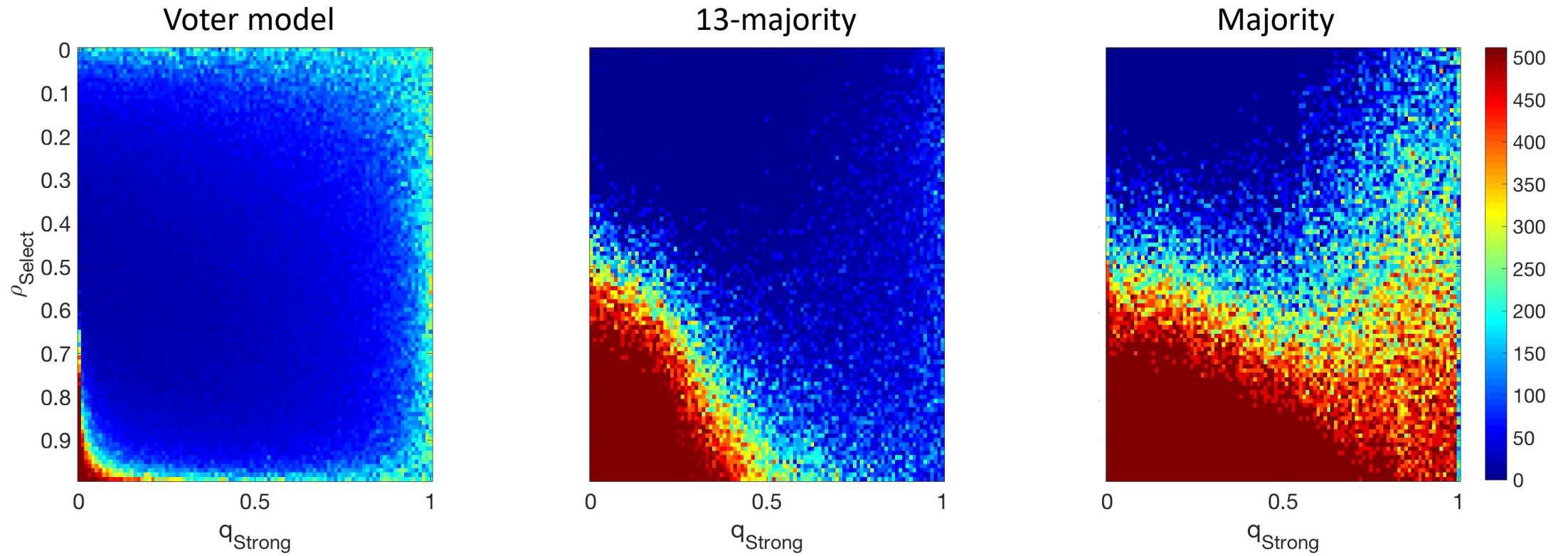
Consensus Time of Voter Model



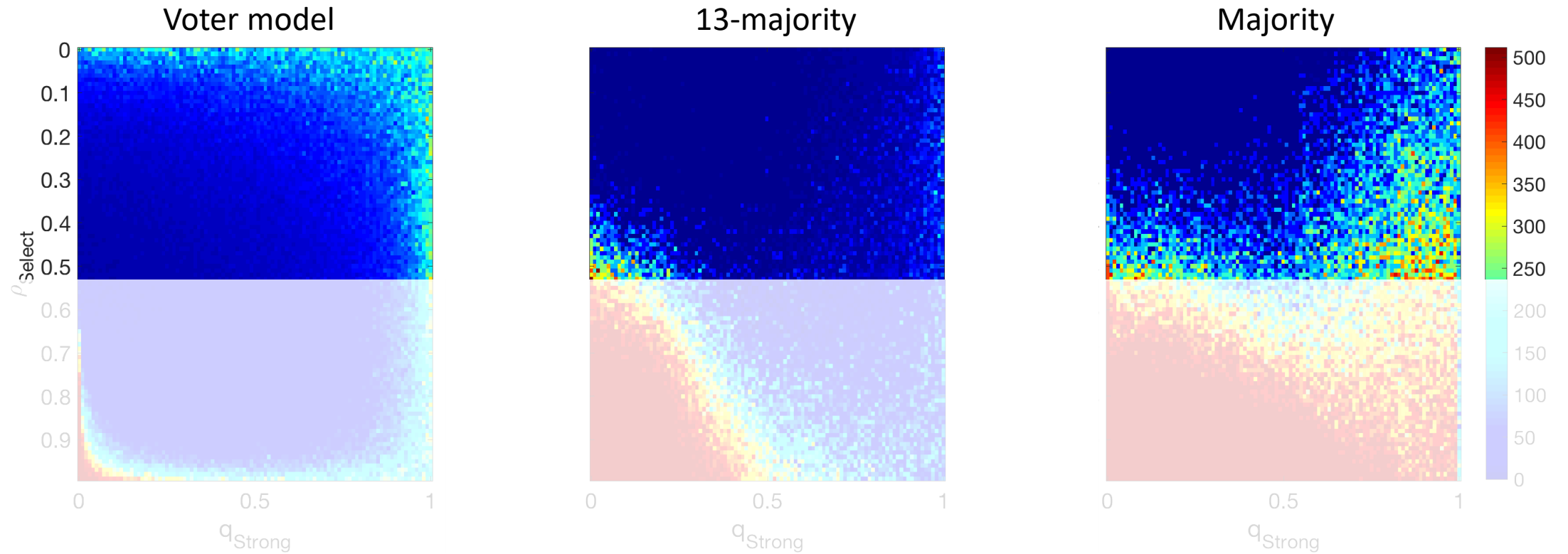
Consensus Time of Iterative Majority



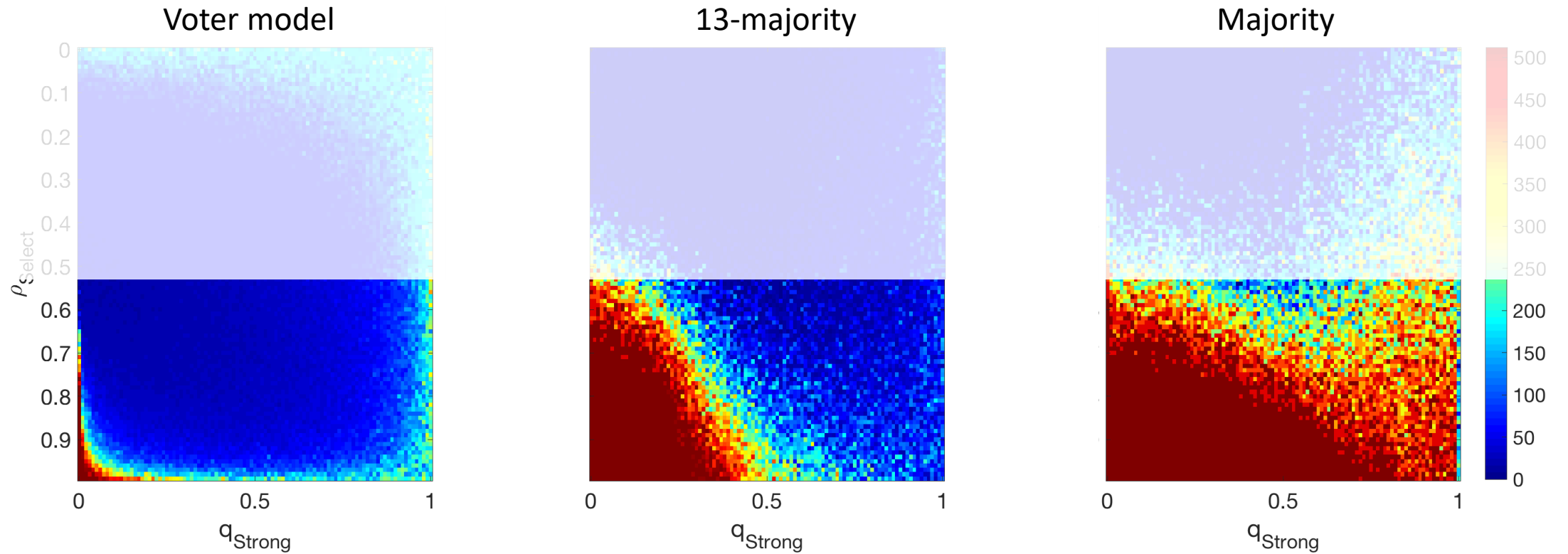
Consensus Time



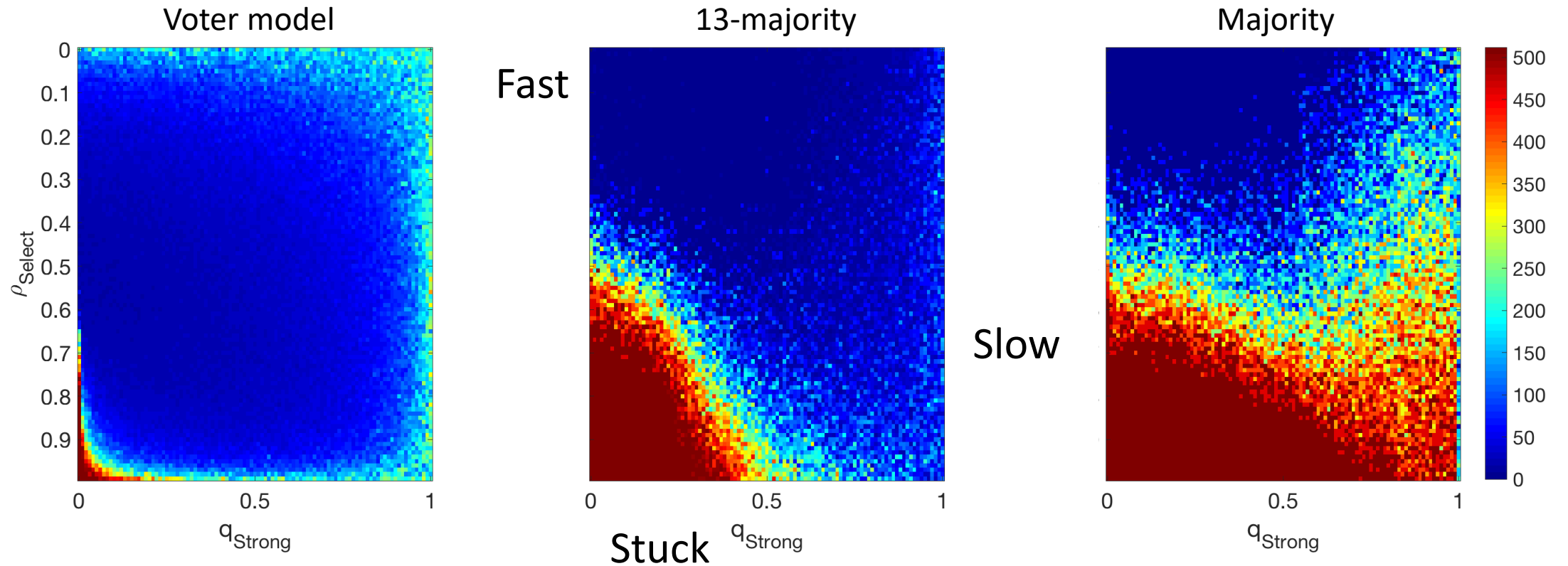
Low selection->Spread



High Selection->Bubble Filter

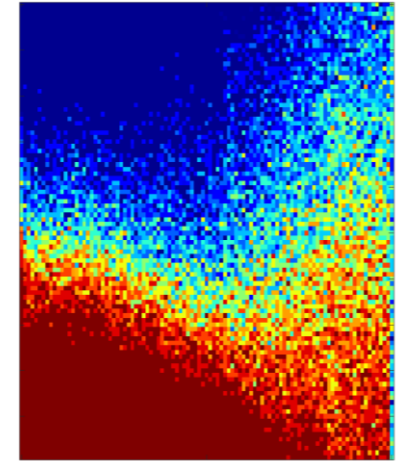
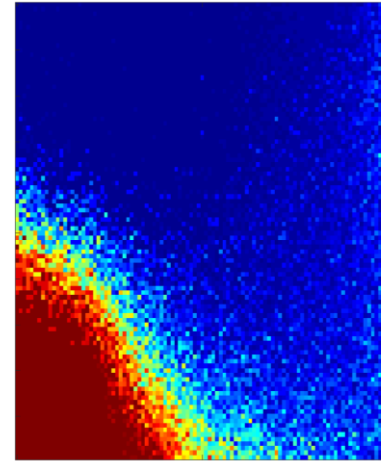
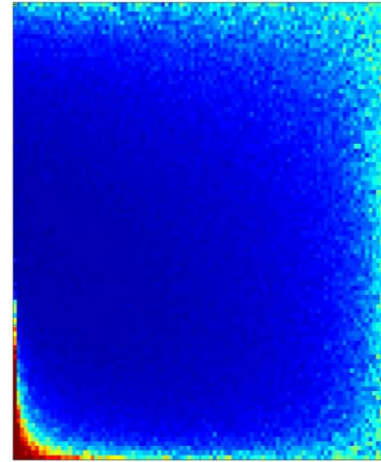


Strong Ties

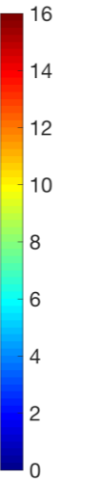
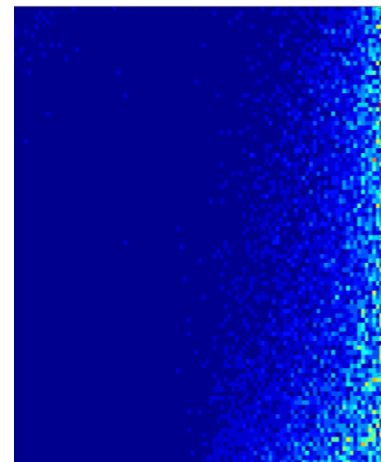
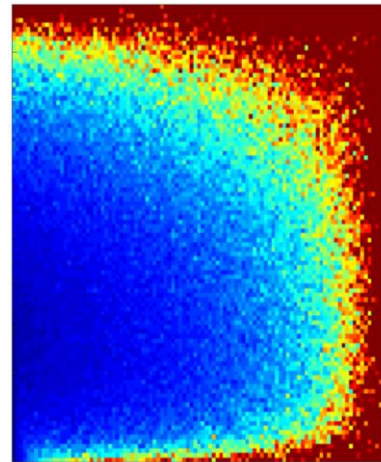


Fast, Slow, and Stuck

Consensus Time



Number of Switches



Take-home Message

- In influence dynamics, the strength of weak ties is to get new information and fresh ideas into the comfort zone created by strong ties.
- In selection dynamics, the role of strong ties and weak ties, in terms of spreading fresh ideas, are swapped.

