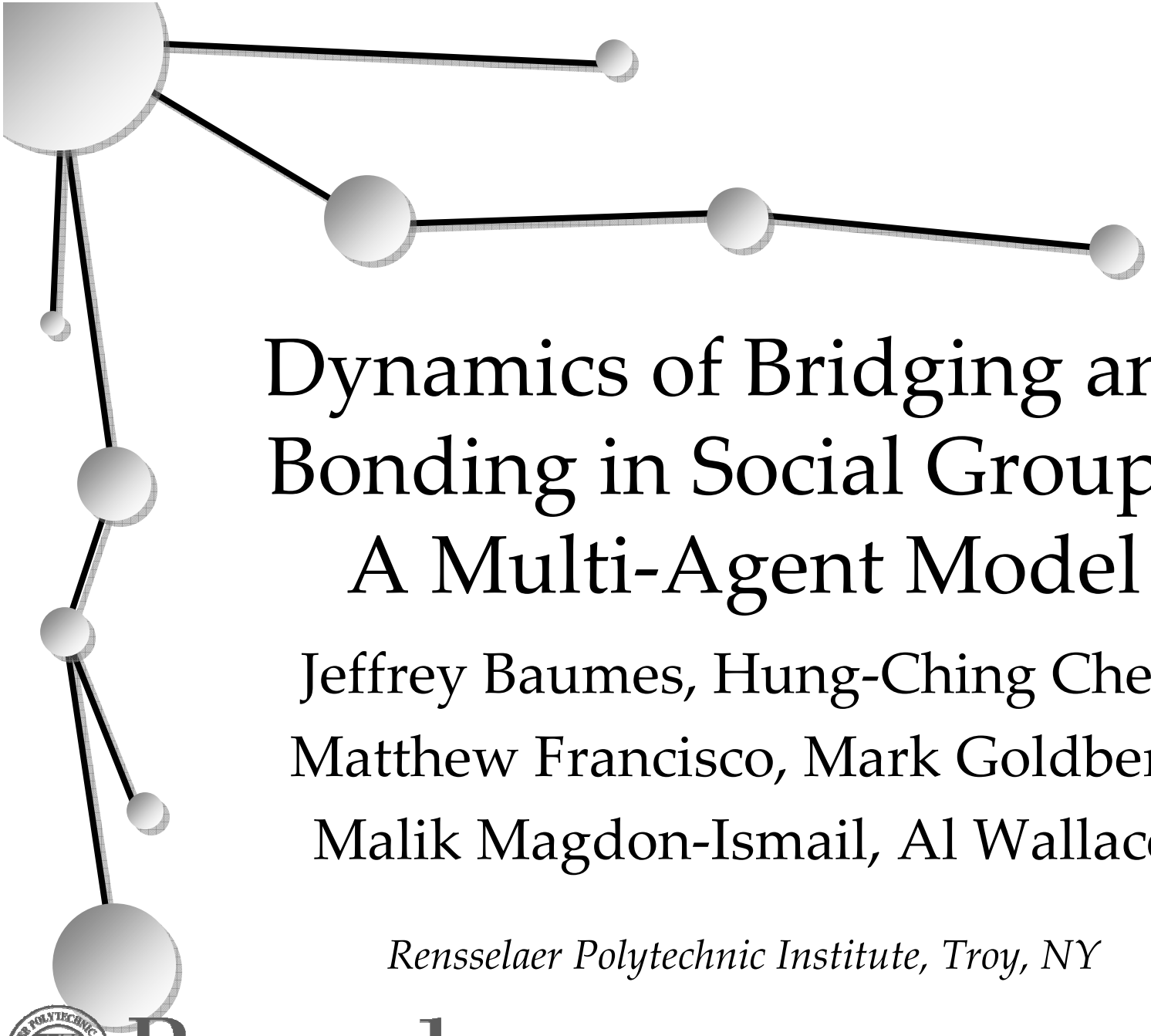

Dynamics of Bridging and Bonding in Social Groups: A Multi-Agent Model

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Model overview

- Dynamic group membership simulation
- Agents may belong to more than one social group at a given time
- Decisions are modeled by guided but random processes
- Incorporates ideas of energy and social capital
- Agents have a rank in each group based on their time in the group

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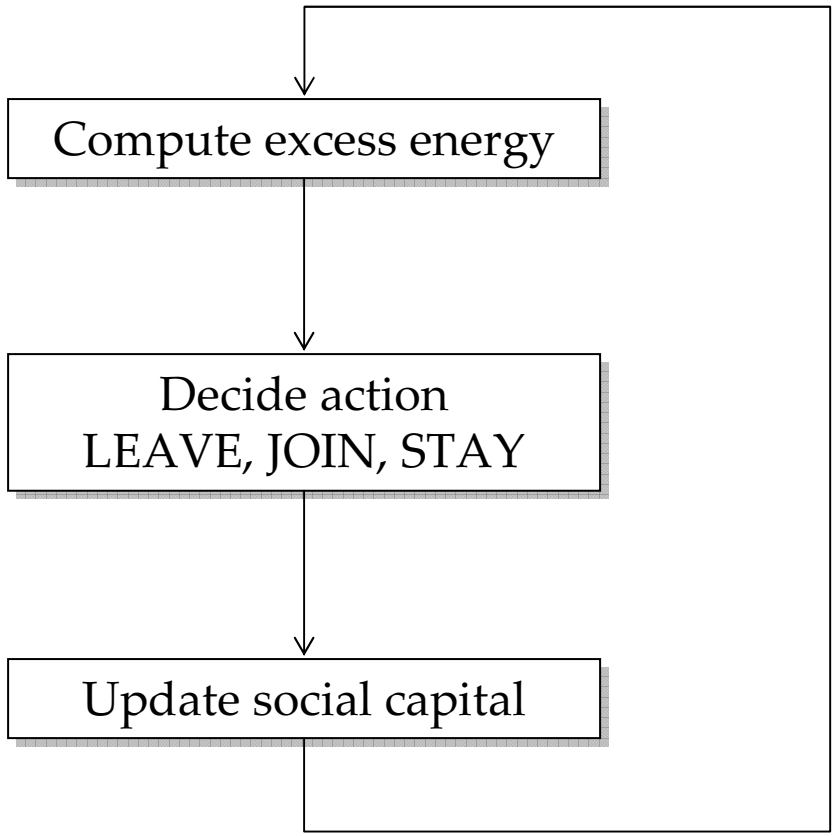
Agent main loop



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Compute excess energy

Number of groups participating in

Total rank in those groups

$$E_i^{ex} = E_i - \underbrace{\phi_i * \overbrace{|\{k : i \in G_k\}|}}_{} - \underbrace{\psi_i * \overbrace{\sum r_i^k}}_{}$$

Total energy

Bridging (breadth) cost

Bonding (depth) cost

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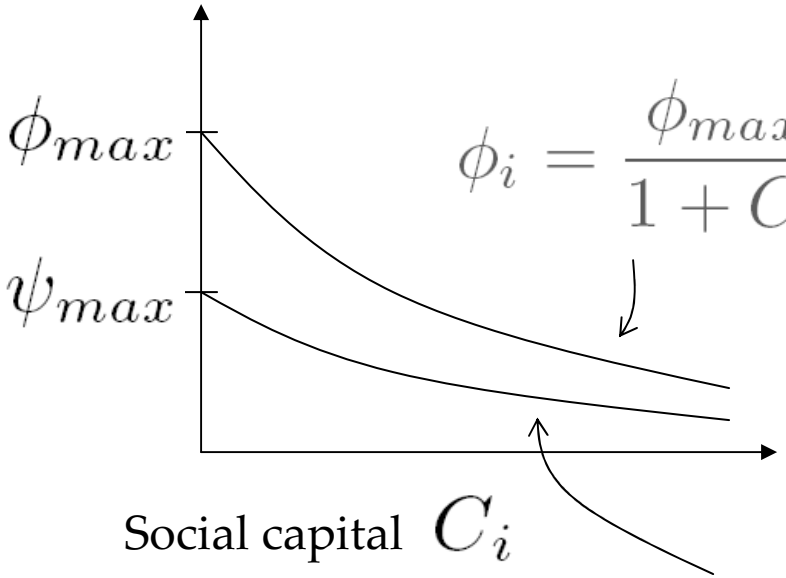
Compute excess energy



$$\phi_i = \frac{\phi_{max}}{1 + C_i}$$

$$\psi_i = \frac{\psi_{max}}{1 + C_i}$$

Increasing social capital decreases the energy cost per group and the energy cost per quantity of rank

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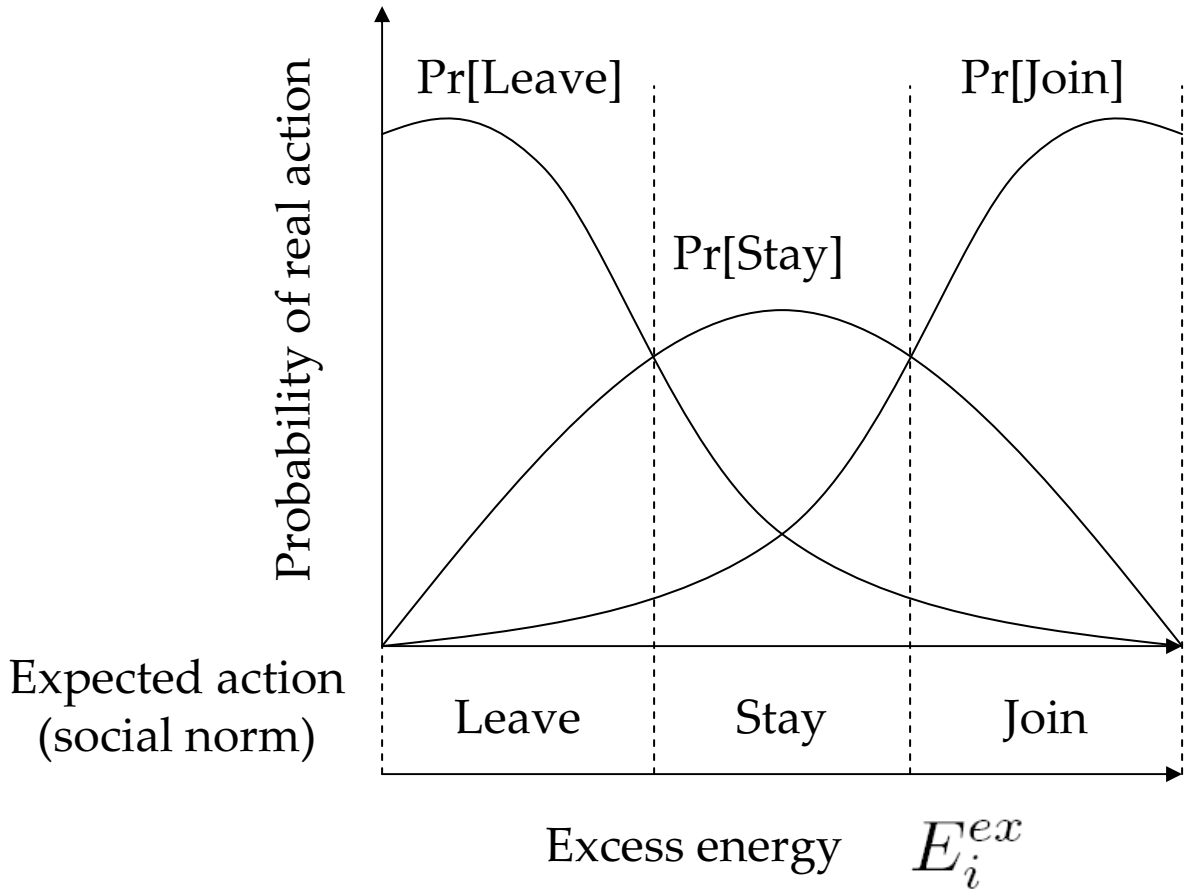
Decide action



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Update based on social interaction

$$C_i' = C_i + f(A_i^{real}, A_i^{expected})$$

- If social capital is only contingent on the amount of social interaction

Expected action

Real action / f_s	Join	Stay	Leave
Join	+	+	+
Stay	0	0	0
Leave	–	–	–

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Update based on social norms

- If social capital is only contingent upon following social norms

Expected action

Real action / f_n	Join	Stay	Leave
Join	+	0	–
Stay	0	+	0
Leave	–	0	+

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Combined update

$$C_i' = C_i + f = C_i + (f_s + f_r)$$

Expected action

Real action: f_s	J	S	L
J	+	+	+
S	0	0	0
L	–	–	–

Expected action

Real action: f_n	J	S	L
J	+	0	–
S	0	+	0
L	–	0	+

Expected action

Real action: f	Join	Stay	Leave
Join	++	+	0
Stay	0	+	0
Leave	– –	–	0

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“Ideal” configuration

$$C_i' = C_i + f = C_i + (f_s + f_r)$$

Expected action

f_s	J	S	L
J	+	+	+
S	0	0	0
L	–	–	–

Real action

Expected action

f_n	J	S	L
J	0	0	+
S	–	0	+
L	–	0	0

Real action

Expected action

f	Join	Stay	Leave
Join	+	+	++
Stay	–	0	+
Leave	– –	–	–

Real action

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“Real” configuration

$$C_i' = C_i + f = C_i + (f_s + f_r)$$

Expected action

f_s	J	S	L
J	+	+	+
S	0	0	0
L	–	–	–

Real action

Expected action

f_n	J	S	L
J	+	0	–
S	+	0	–
L	+	0	0

Real action

Expected action

f	Join	Stay	Leave
Join	++	+	0
Stay	+	0	–
Leave	0	–	–

Real action

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Experiment

- 500 agents
- 500 time step simulation
  - Sampled from range 140-240
- Both “ideal” and “real” configurations
- 3 classes of agents
  - 10% prefer to join small groups
  - 30% prefer to join medium groups
  - 50% prefer to join large groups

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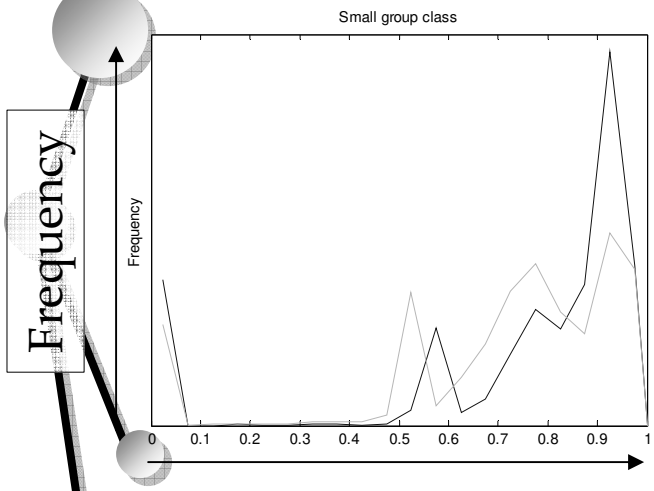
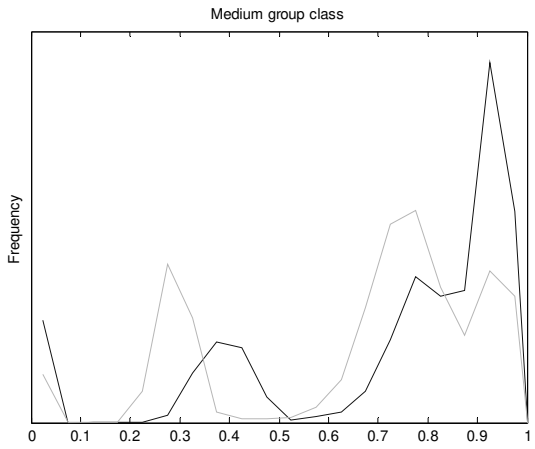
Bonding energy ⏲ total energy

Prefer small groups



Uses more bonding

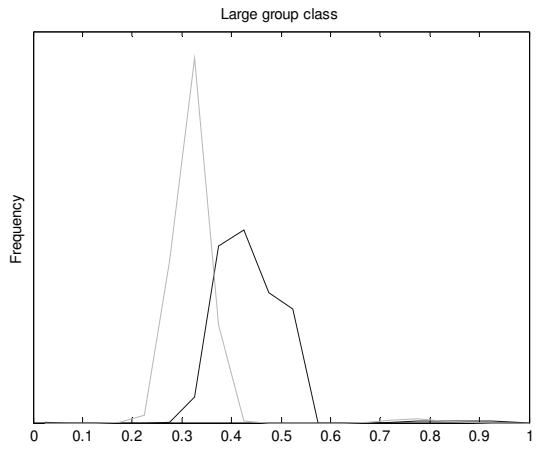
Prefer medium groups



"ideal" configuration

"real" configuration

Prefer large groups



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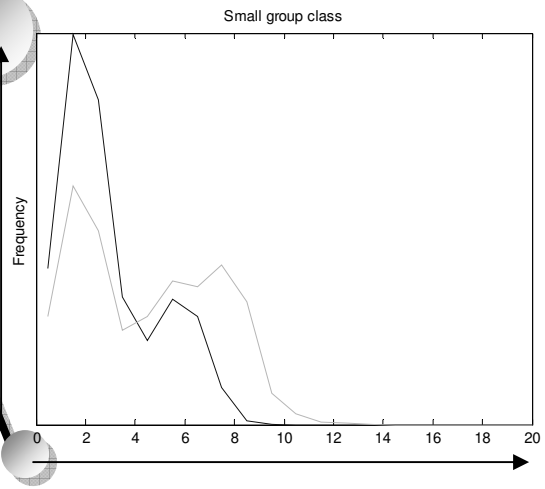
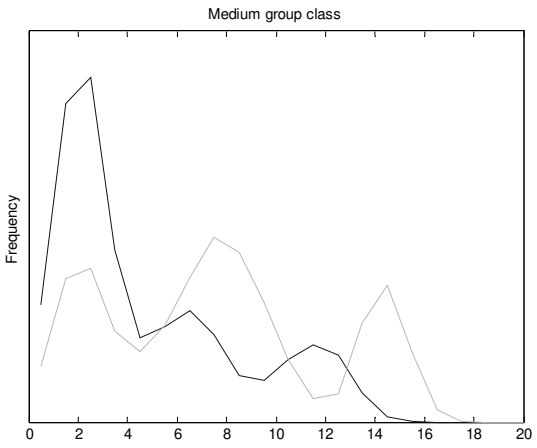
Number of groups in which the agent participates

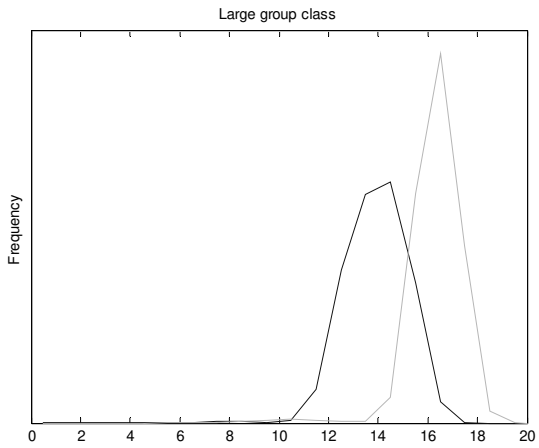
Prefer small groups



Prefer medium groups



Prefer large groups



Frequency

In more groups

"ideal" configuration

"real" configuration

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Conclusions

- A method of simulation of multiple groups per agent
- Model simulation demonstrates bridging and bonding behavior
- Can use different update matrices based on characteristics of population of interest

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Future

- Compare social capital in model with network definitions for social capital
- Look into using Repast
  - Michael North
- Membership layout
  - Malcolm Alexander

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