

Diffusion Among Cognitively Complex Agents

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LABORATORY DIRECTED RESEARCH & DEVELOPMENT

Early Career R&D Program

Problem

How do we anticipate changes in society?

How do we predict attitude change?

What factors influence attitude change?

Factors to consider:

- Sociological issues
 - Social Roles
 - Influence of friends/family
- Psychological issues.
 - Cognitive biases and constraints.



Attitudes:

- “General, relatively enduring evaluations of an object” (Visser, 2003)
- Object: person, group, concept
- Attitudes known to influence behavior.

Approach

Computational Modeling

Mathematical abstractions of humans; capturing social and psychological factors.

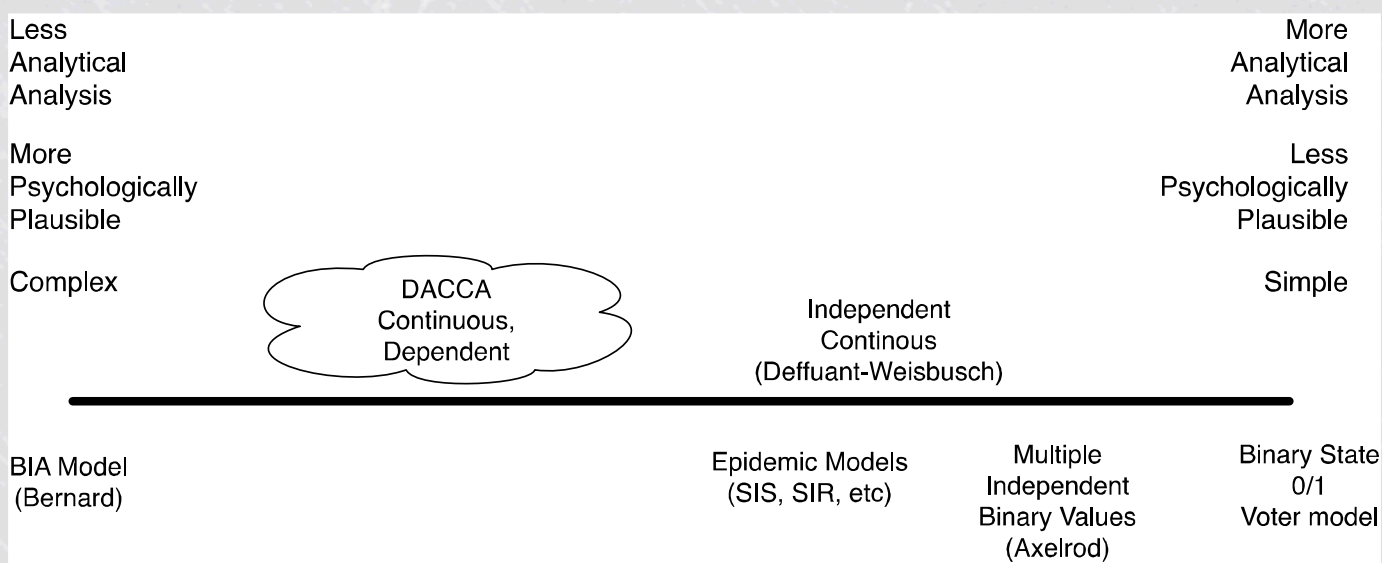
Benefits:

- Repeatable
- Parameterized
- Provide a “What-if” tool for analysts

Restrictions:

- Limited complexity
- Validation

State of the art and where DACCA fits:



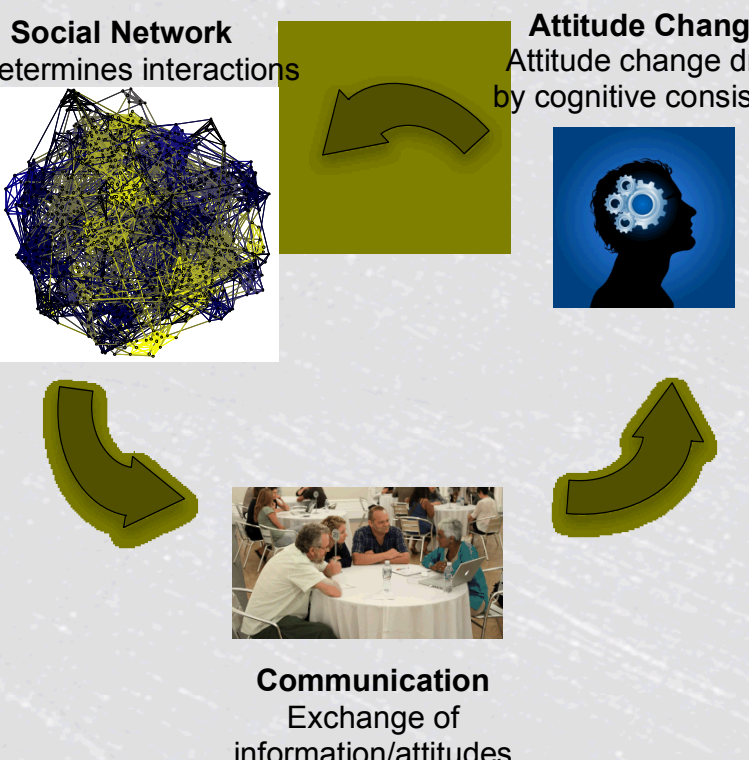
Specific goal: Develop a model that captures both:

- Captures social interaction
- Cognitive factors

Identification of critical factors in attitude change:

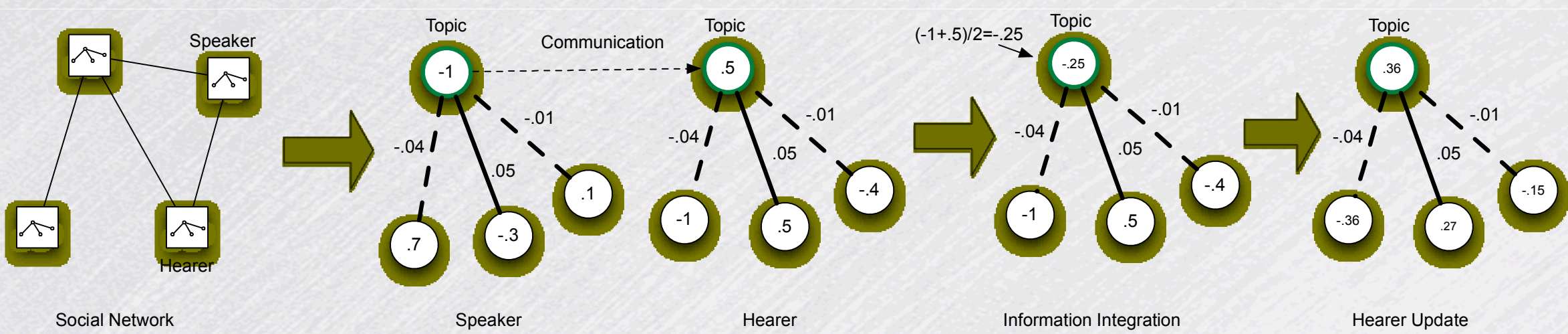
Phenomena	Description and its Effect
The drive for consistency	Maintaining a consistent set of attitudes can drive attitude change as well as information distortion.
Information distortion	One way in which to maintain consistency between attitudes – instead of changing an attitude one can decrease the importance or impact of incoming information.
Persuasion route	Peripheral and systematic routes determine which aspects play a role in attitude structure; systematic routes focus on logical arguments whereas peripheral routes utilize heuristics. The persuasion route also influences the durability of attitude change.
Implicit/explicit attitudes	These two types of attitudes influence different behavior. Implicit attitudes affect spontaneous behaviors while explicit attitudes affect deliberate behaviors. Their change profile is also different, with explicit attitudes tending to be more malleable than implicit attitudes.

Factor	Effect
Cognitive load	Impacts persuasion route.
Attitude relationships	Related attitudes influence each other through the drive for consistency.
Social network	The structure of relationships between individuals influences the rate of information diffusion; in addition the distribution of attitudes of an individuals acquaintances can impact the strength of an attitude.



Results

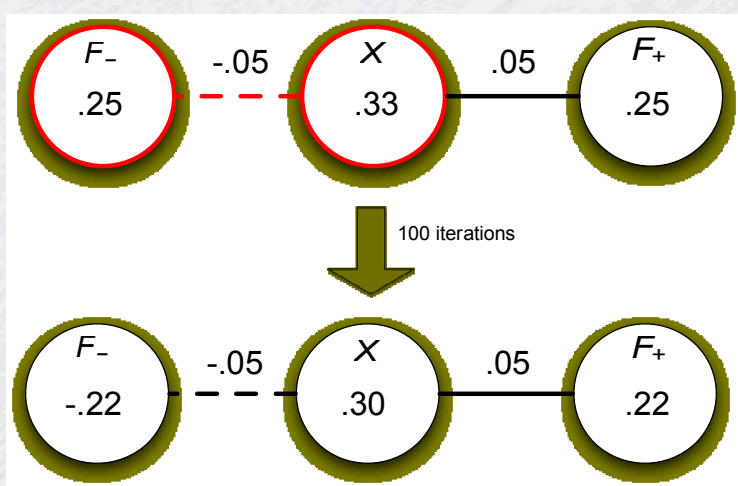
Development of a new socio-cognitive model:



Update equation:

$$u_i(t+1) = \sum_j \pi_{ij} u_j(t) \quad (3)$$
$$\sigma^i(t+1) = \sigma^i(t)(1 - \eta) + \begin{cases} \Delta \sigma^i(t) (\sigma^i(t) - \eta) & \text{if } \Delta \sigma^i(t) \leq 0 \\ \Delta \sigma^i(t) (\eta - \sigma^i(t)) & \text{if } \Delta \sigma^i(t) > 0 \end{cases} \quad (1)$$

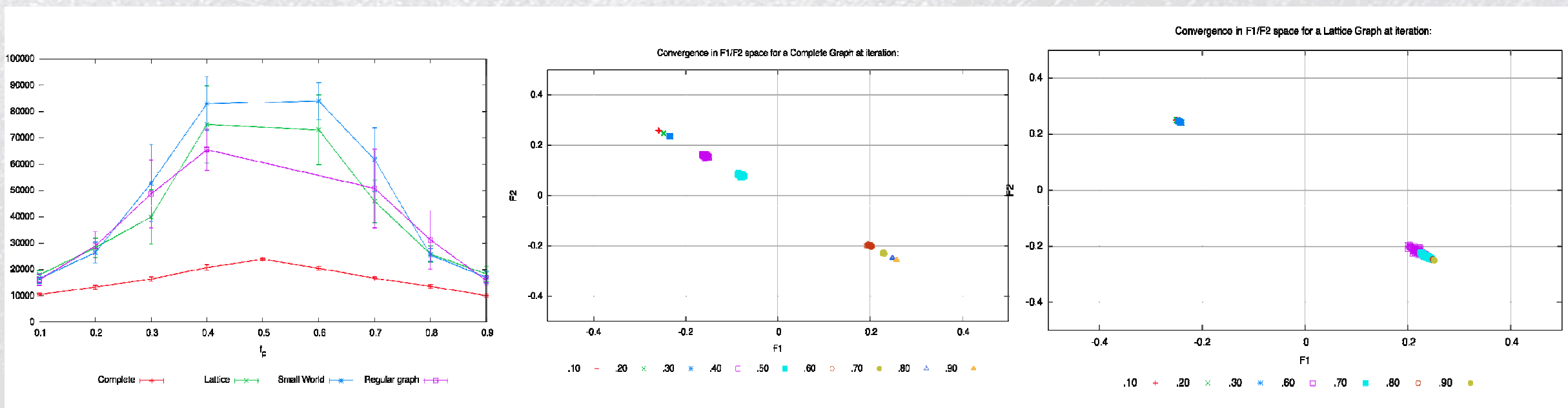
Example dynamics:



From: (Kunda & Thagard, 1996)

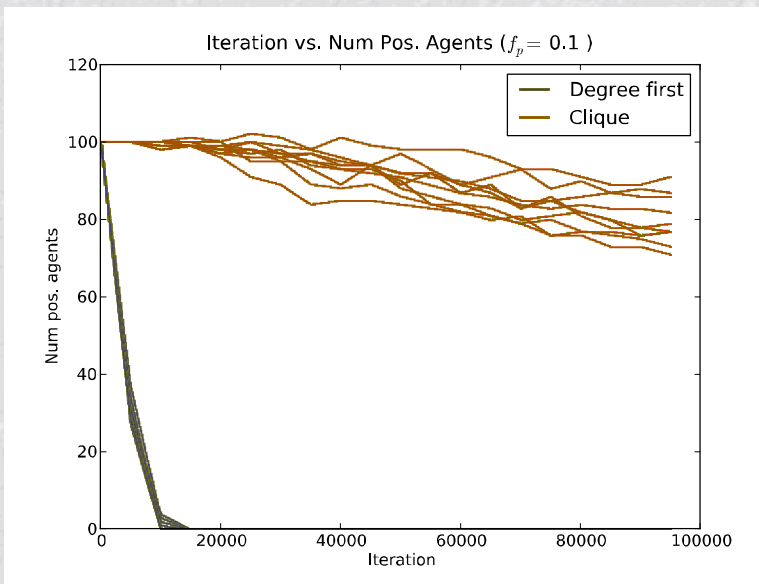
Experiment 1:

- Two states, positive and negative.
- Assign f_p agents to positive state
- How long till convergence and what state to converge upon?



Experiment 2:

- Can we decrease convergence time by assigning positive agents to cliques?



Significance

- New computational model of attitude change in populations.
 - Incorporation of both social and cognitive factors.
- Capture complex social structures and complex cognitive structures.
- Can be used as a tool to evaluate “what-if” scenarios.
- Programmatic impact:
 - Diffusion of Tactics, Techniques and procedures.
 - Climate change attitudes.

