Beliefs, Opinion Dynamics and Extremism

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Opinion Dynamics Models

- Different models are used for different problems.
  - Discrete Opinions: few options, can represent decisions well.
  - Continuous Opinions: more useful to represent choices of numerical values.
- And decisions that have a strength of opinion attached?

Continuous Opinions and Discrete Actions

- Definition: Opinion means the subjective probability that a certain statement is right.
- Opinions are not observable, but discrete actions or choices are.
- The observable actions are a function of the internal opinion.
- Agents update their opinions based on the observation of other agents choices by using Bayesian rules.

CODA model

- Local consensus emerges, but not global!
- Opinions get stronger and islands of similar behavior appear.
- Barriers to changing choices become increasingly stronger and freeze islands eventually.
- Extremists appear everywhere.

Structure of the Presentation:

A Theoretical Framework for Update Rules.

- Define an opinion as the subjective probability on the debated issue.
- Bayes Theorem can provide rules for changing the opinion.

Details

- Assign a variable x to the issue (continuous or discrete? what range? one issue or a cultural problem, with several dimensions?).
- Each agent makes inferences about x.
- Each agent i needs to have a subjective opinion about x, represented by a probability distribution $f_i(x)$.
- The function indicates agent i belief on how likely each possible value of x is.
- $f_i(x)$ can be continuous or discrete, depending on the characteristics of x.

Details
Communicating

- Communication depends on the agent opinion $f_i(x)$: a functional $A[f_i]$.
- Important: Communication does not need to be intentional, it could be a an observed behavior of j.
- The agents must have in their minds a relationship between the true value of x, x^*, and the stated value A_j, given by a likelihood distribution $p(A_j|x^*)$.
- That is, given that a possible value x^* were the correct value, how likely it would be that the neighbor j would comunicate A_j.

Details
Updating

- The probability distribution $p(A_j|x)$ plays the role of a likelihood of the observation A_j and thus defines a Bayesian update rule.
- Agent i already had a prior opinion $f_i(x)$, obtaining its posterior opinion $f_i(x|A_j)$ is a simple task of applying Bayes Theorem.

Structure of the Presentation:

Bounded Confidence or CODA

- Bounded Confidence: continuous opinion over range 0 to 1. Tendency to moderate opinions.
- CODA: Internal probability (0 to 1), observed choice (A or B). Tendency to extremism.

What drives extremism?

- One obvious difference: communication - discrete versus continuous
- One subtle difference: world model - choosing sides versus mixing choices

What drives extremism?

	Certainty wishers	**Mixers**
Discrete observation	CODA	New model 2
Continuous observation	New model 1	Bounded Confidence (BC)

Wishers with Continuous observations (New model 1)

- Estimate p - probability that A is best choice.
- Agent observes opinion p_j of agent j.
- Likelihood: $Be(p_j|\alpha,\beta,A) = \frac{1}{B(\alpha,\beta)} p_j^{\alpha-1}(1-p_j)^{\beta-1}$.

Huge increase in extremism

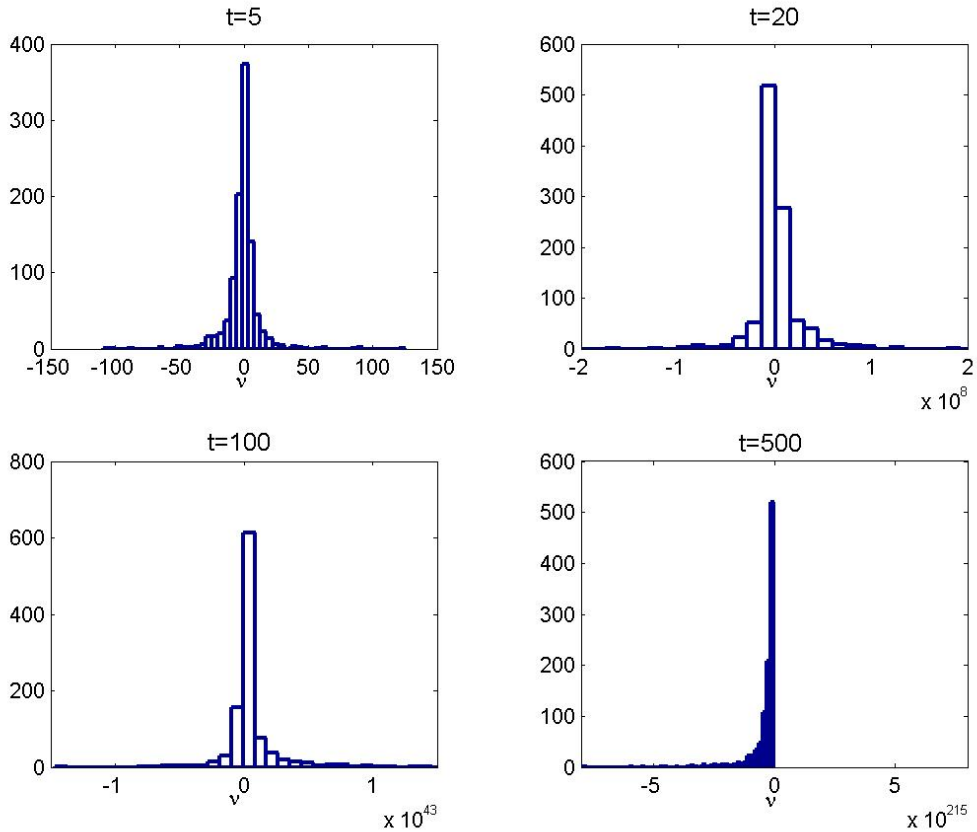

Figura : Log-odd opinions ν_i after t interactions per agent.

Mixers with Discrete Observations (New Model 2)

- Estimate f - optimal proportion for A.
- Requires a continuous probability distribution over $0 \leq f \leq 1$.
- Agent observes only if j thinks there should be more A or more B.
- Likelihood: Binomial distribution.

Comparing

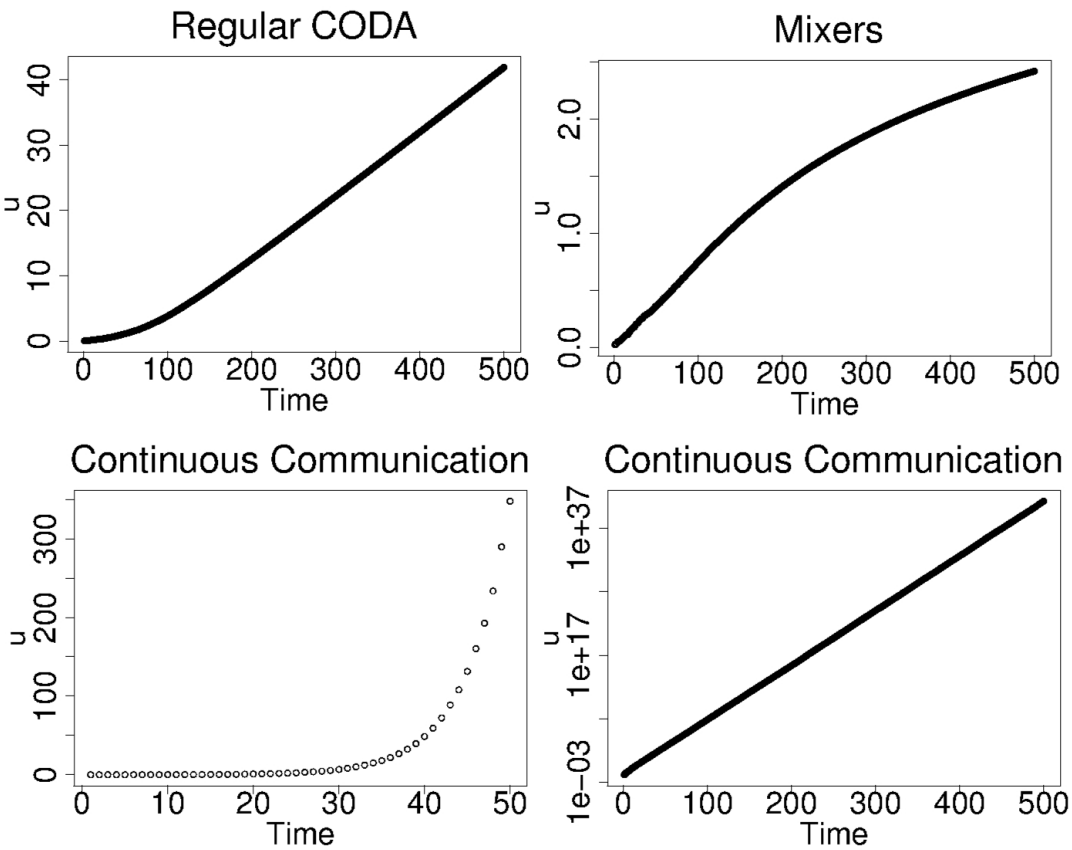

Figura : Strength of the opinion ($\nu = \ln\left(\frac{p}{1-p}\right)$) as a function of time.

Thank you!