Political Polarization and Fractionalisation from Rational Values-Based Inference in an Agent-Based Graph Network

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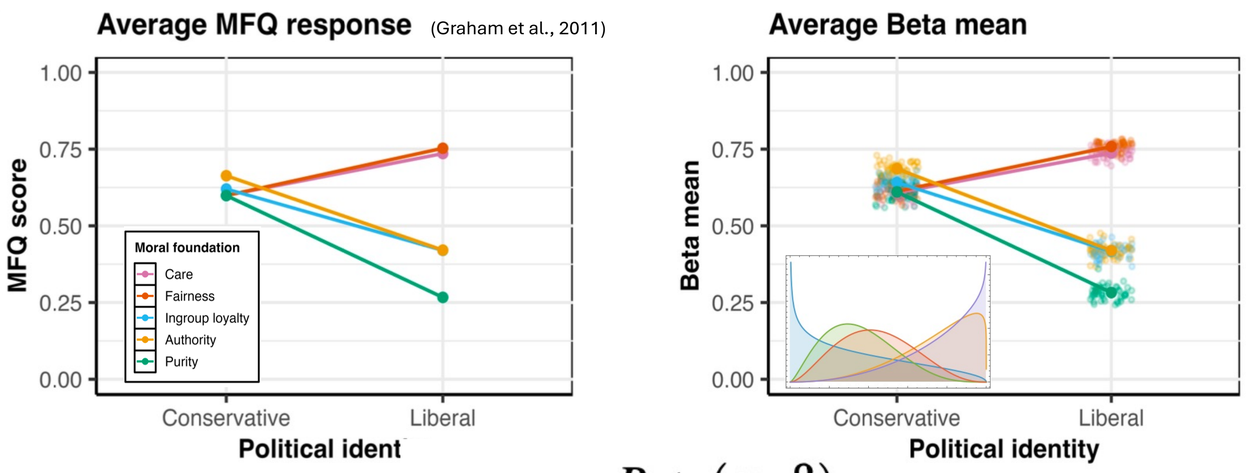
Background

- Political polarization is identity-based[1-3]
- Political identities can be communicated through signals [4,5] → **signal mechanism** (e.g., moral values) required to
  - mediate **signal generation** and **inference**
  - update as a function of **self** and **social influence**
- **Moral values** as a signal mechanism: they are (a) distinct for liberals and conservatives[6-13] (b) malleable[14-15], (c) sensitive to ingroup alignment[16], and (d) facilitate political communication[17-2

Methods



$$v_{i,\,m,\,t} \sim Beta(\alpha,\,\beta)$$

$$v_{i\,\rightarrow\,a,\,m,\,t} \sim Beta(\alpha,\,\beta)$$

Moral Value inference *:*

Individual:

$$\alpha_{i,\,m,\,t+1} = \alpha_{i,\,m,\,t} + \sum_{a} \begin{cases} \frac{1}{N-1} e^{-w_{i\rightarrow a,\,m,\,t}}, & \text{if} S_{a,\,t-1} = m \\ \delta_{S_{a,\,t-1}=m}, & \text{if } a = i \end{cases}$$

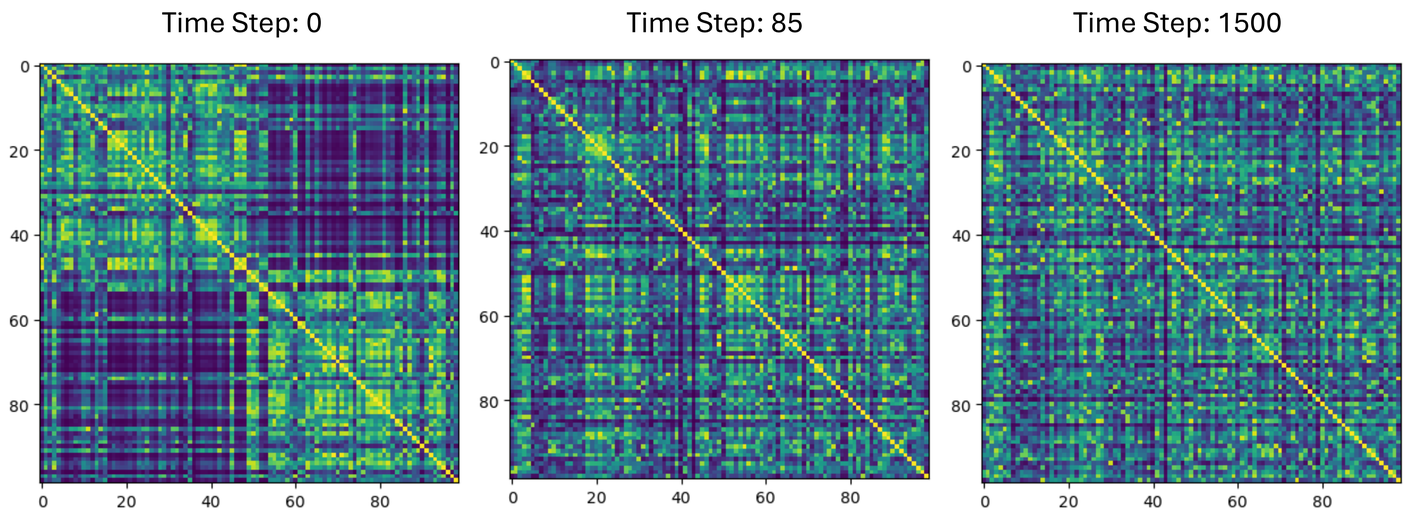
$$\beta_{i,\,m,\,t+1} = \beta_{i,\,m,\,t} + \sum_{a} \begin{cases} \frac{1}{4(N-1)} e^{-w_{i\rightarrow a,\,m,\,t}}, & \text{if} S_{a,\,t-1} \neq m \\ \frac{1}{4}\delta_{S_{a,\,t-1}\neq m}, & \text{if } a = i \end{cases}$$

Other agents:

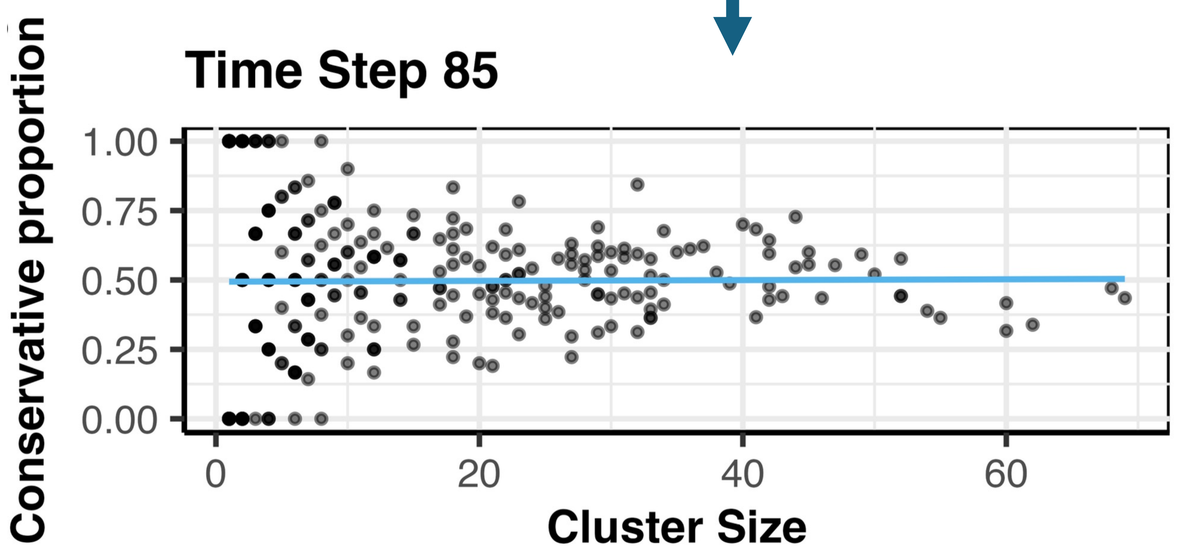
$$\alpha_{i\rightarrow a,\,m,\,t+1} = \begin{cases} \alpha_{i\rightarrow a,\,m,\,t} + 1, & \text{if } S_{a,\,t} = m \\ \alpha_{i\rightarrow a,\,m,\,t}, & \text{otherwise} \end{cases}$$

$$\beta_{i\rightarrow a,\,m,\,t+1} = \begin{cases} \beta_{i\rightarrow a,\,m,\,t} + \frac{1}{4}, & \text{if } S_{a,\,t} \neq m \\ \beta_{i\rightarrow a,\,m,\,t}, & \text{otherwise} \end{cases}$$

Results

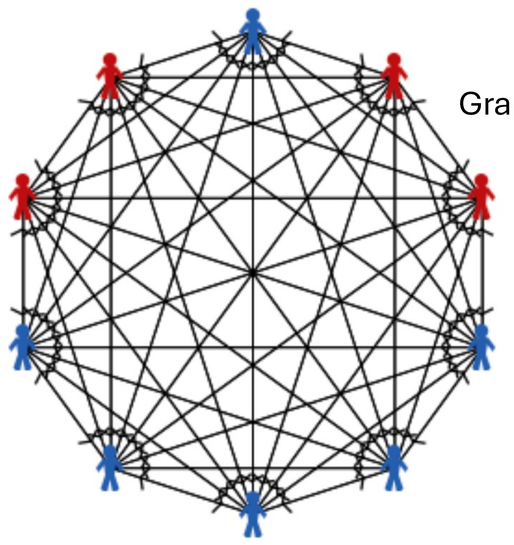


Spectral Clustering



Research questions

1. Can we use an agent-based graph network to measure group homogeneity through moral values-based inference?
2. How do group-level moral values change over time between political identities in this formulation?
3. How do initial latent moral identities influence ability to find groups of similar moral values?



Graphs defined by **KL-divergence** of **moral values**

$$w_{i,a,\,t} = \sum_{m} D_{KL}(v_{i,a,\,m,\,t} || v_{i,\,m,\,t})$$

$$w_{i\rightarrow a,\,t} = \sum_{m} D_{KL}(v_{i\rightarrow a,\,m,\,t} || v_{i,\,m,\,t})$$

Simulation Details

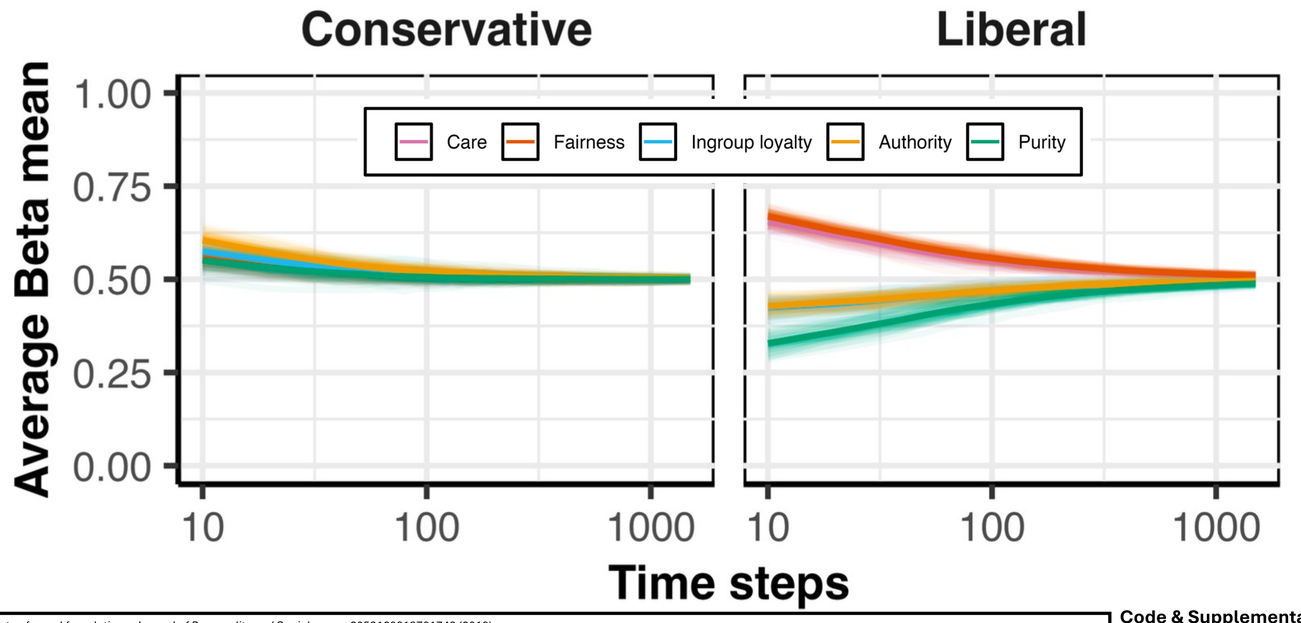
- 50 simulations:
  Number of agents: N ~ Normal(100,15); 1500 time steps
- Initial **moral values** randomly assigned from MFQ responses evenly split between conservative and liberal responses –other agents were assigned random priors
- **Signals** were generated by selecting largest **moral values** sample between two competing moral values (dilemma)
- Each agent observes all other agent and **infers** both **individual** and **other agents'** moral values
- Individual agents are **influenced** by their own generated **signals**

Discussion

- Total group homogeneity is possible contrary to previous results using rational inference tools and previous moral value[22-23]
- Graph clustering may be a viable path for measuring dynamically changing groups

Future Directions

1. Evaluate effect of self-influence
2. Incorporate explicit ingroup inference
3. Update signaling process to include more complex decision patterns (e.g., maximize ingroup homogeneity)



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Code & Supplementary