Co-evolution of social influence and social selection

A social simulation approach to explain polarization and extremism

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Emergence of different social forms

- Homo-economicus (micro) vs Durkheimean (macro)
- Meso (Moscovici): cognitive mechanisms and social structure co-evolve in a way to shape each other
- Aim of this presentation: a dynamic social network analysis perspective explaining:
  - public opinion formation and the role of social selection and social influence during this process
  - the mechanisms of polarization and alignment of singular attitudes as coherent belief systems.

Public opinion formation

- Is distinguished from collective decision making (e.g. Moscovici and Doise 1992): Aggregation effects must be analysed separately from group effects.
- Is constituted neither as majority rule nor as consensus but is fragmented into social representations, sometimes leading to polarization and/or extremism.
- Aggregation effects must be analysed separately from group effects.
- Galam & Moscovici (1991) investigated the mechanisms of different forms of public opinion formation from a statistical physics perspective.
- We are offering a dynamic social network perspective investigating the role of co-evolution of social influence and social selection mechanisms during the bi-polarization process

Public opinion formation

- **Social selection:** A person's friend selection depends on both the attributes and social positions of the person initiating the friendship (ego) and the friendship target (alter).
- **Social influence:** A person's emotions, opinions, or behaviours are affected by the others in the group
  - **Informational influence** (or social proof) is an influence to accept information from alter as an endorsement about the truth of a belief.
  - It comes into play when people are uncertain, either because stimuli are intrinsically ambiguous or because there is social disagreement.

Method: social simulation

- Models for the co-evolution of networks and behaviour allow the joint representation of social selection and social influence (Steglich, Snijders, and Pearson, 2010).
- Computer simulations can help us to understand complex phenomena especially when it is hard to perform experiments or collect empirical data.
- They help us to formulate some hypotheses on the rules of interactions modifying (artificial) agent opinions for the purposes of exploring their consequences on the collective behaviour

Model: assumptions (Staerkle)

- People are no fools: What appears as "contradictory attitudes is often better viewed as outcomes of different sense-making strategies based on shared representations of social order;
- People think through opposites because it helps them to define their own and other people's place in society;
- People do not make up and express their opinions in a vacuum, but refer to what others think in doing so.

Factors affecting opinion formation

- **Individual attributes** (Values, emotions, personality, needs etc. . .)
- **Environmental influences**
  - **Micro**: interactions between neighbours at a local level.
  - **Macro**: technology, economy, institutions and culture
- **Information flow**: topological properties of a social network i.e. the organization of social exchanges and patterns of information flow.

Experimental condition

- Two distinct macro-social environments:
  - Control group: Random society where attitudes of agents are uniformly distributed over 4 attitude scales.
  - Experiment group: Society with ideological elites where attitudes of two most central agents are aligned into extreme poles (e.g. 0.2 and 0.8) and the rest of agents are random as in the previous case.

Endogenous variable: Bi-polarization

- Polarization is not a single phenomenon but a class of phenomena:
- group polarization : tendency for a group to make decisions that are more extreme than the initial inclination of its members (Isenberg 1986)
- **bi-polarization (EV1)**: a group is divided into two opposing parties having contrasting positions (DiMaggio et al. 1996).
- **Operationalization**: network is segmented into at least 2 clusters with each including at least n/4 elements
  - The clusters are obtained by following Newman & Girman algorithm

Endogenous variable 2: Extremism

- A descriptive, non-condemning, operational definition:
  - "advocacy of extreme measures or views"
  - coherently aligning the positions in isolated issues to the opposite poles of a singular dimension
- Operationalization
  - Cronbach's alpha calculated over four attitudes should be greater than 0.70
  - The alignment of attitudes should not be around the mean but around the opposite poles of a singular dimension.

Exogenous Vaiables: Micro-environmental factors

- **Tolerance threshold** (ϵ): Ego's consideration for severing a tie according to its value distance with the alter

$$\nu_\epsilon \leq 1 - e^{1-d(i,j)/\epsilon} \text{ for } \nu_\epsilon \sim U(0, c_j/c_i),$$

- **Openness** (q): The probability of forming a new relationship

$$\nu_p < p \text{ for } \nu_p \sim U(0,1)$$

- **Conformity** (δ): The tendency for converging attitudes to the neighbourhood average (local norms).

Exogenous variables: Information flow network

- Information flows fast in compact networks
- The concepts of density and centralization refer to differing aspects of the overall 'compactness' of a network.
- **Density**: general level of cohesion in a network
- **Centralization**: the extent to which this cohesion is organized around particular focal agents.

Simulation Design

- We consider 20 agents each having 4 attitudes, $n = 20, n_{att} = 4$.
- Initial networks are generated with Barabasi-Albert (1999) algorithm with 4 cases of degree of preferential attachment, $power = (0.2,0.5,1,2)$ and 3 cases of outgoing ties $n_{tie} = (2, 3, 5)$.
- Two types of ideological distribution is considered; either randomly distributed, or manipulated.
  - For society with elites, agents with high centrality are set to 0.2 and 0.8, the rest are picked from uniformly distributed numbers between 0 to 1,
  - For random distribution, all attitudes are picked from uniform distribution.
- $\epsilon \in (0.20, 0.21, \ldots, 0.30)$ $q \in (0.05, 0.06, \ldots, 0.10)$, $\delta \in (0.25, 0.50, 0.75)$ and ξ is set to 0.000001.
- Each type of network and distribution is generated 10 times.

Results: Factors leading polarization

Control

	Estimate	Std. Error	z	Pr(>|z|)	
(Intercept)	5.8835	1.3831	4.254	2.10E-05	***
epsilon	-39.0533	5.9624	-6.55	5.76E-11	***
q	-20.0345	3.934	-5.093	3.53E-07	***
delta	-4.5869	2.2088	-2.077	0.03783	*
denst	-0.4695	1.0663	-0.44	0.65973	
Central	1.5377	0.7122	2.159	0.03084	*
epsilon:delta	26.3968	9.7078	2.719	0.00655	**

Experiment

	Estimate	Std. Error	z	Pr(>|z|)	
(Intercept)	-0.1322	0.5262	-0.251	0.8016	
epsilon	-14.9093	1.9768	-7.542	4.63E-14	***
q	-3.9014	1.8785	-2.077	0.0378	*
delta	-9.5598	0.9507	-10.056	<2E-16	***
denst	12.4651	0.6816	18.289	<2E-16	***
Central	4.4691	0.3899	11.461	<2E-16	***
epsilon:delta	43.1336	3.7923	11.374	<2E-16	***

Results: Factors leading extremism

Control

	Estimate	Std. Error	z	Pr(>|z|)	
(Intercept)	-5.7397	0.6925	-8.288	<2E-16	***
epsilon	14.3735	2.5648	5.604	2.09E-08	***
q	5.0993	2.221	2.296	0.0217	*
delta	2.8359	1.1911	2.381	0.0173	*
denst	0.3126	0.6256	0.5	0.6174	
Central	0.8723	0.4211	2.072	0.0383	*
epsilon:delta	-8.5903	4.5941	-1.87	0.0615	.

Experiment

	Estimate	Std. Error	z	Pr(>|z|)	
(Intercept)	-0.5871	0.5695	-1.031	0.303	
epsilon	-10.1698	2.1276	-4.78	1.75E-06	***
q	-8.6172	2.1317	-4.042	5.29E-05	***
delta	-6.4353	1.049	-6.134	8.55E-10	***
denst	15.4701	0.76	20.355	<2E-16	***
Central	3.7988	0.4105	9.255	<2E-16	***
epsilon:delta	31.7429	4.2217	7.519	5.52E-14	***

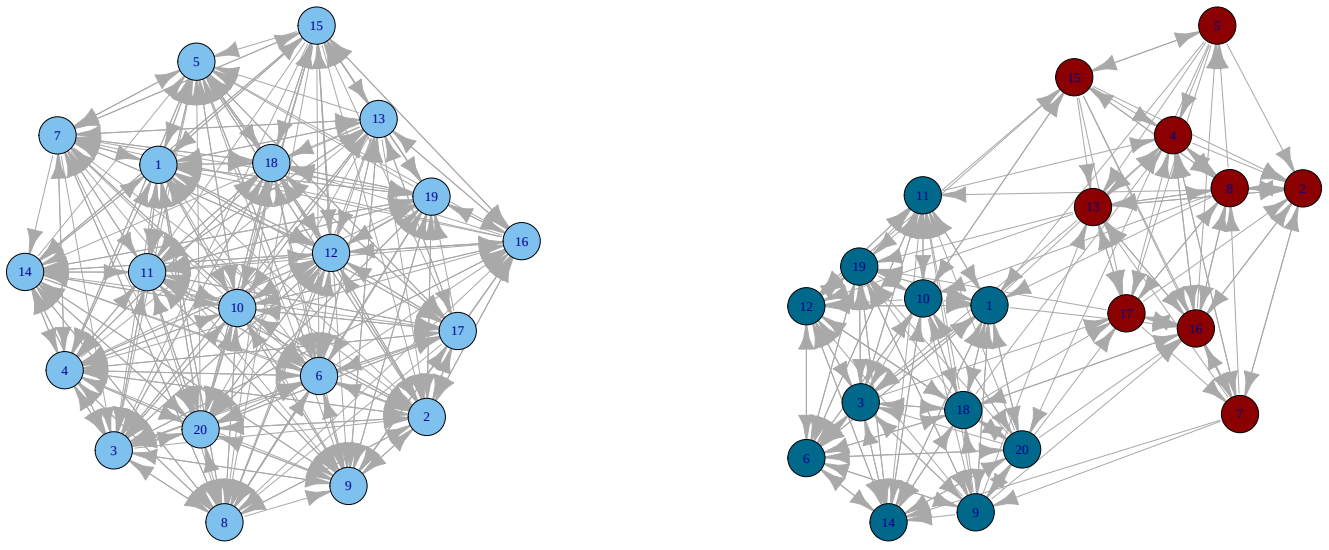
Results: Polarization

- Micro-environmental local effects:
  - There is an interaction effect for tolerance and conformity in both control and experiment groups
  - In control group, as tolerance increases polarization decreases for all levels of conformity
  - In experiment group, as tolerance increases polarization decreases only for lower level of conformity but it increases for higher levels of conformity
  - In control group, as openness increases polarization decreases, in experiment group the effect is very weak
- Information flow: global network effects
  - Density has a positive effect on polarization for experiment group only,
  - Centralization has a positive effect on polarization for the experiment group

Results: Extremism

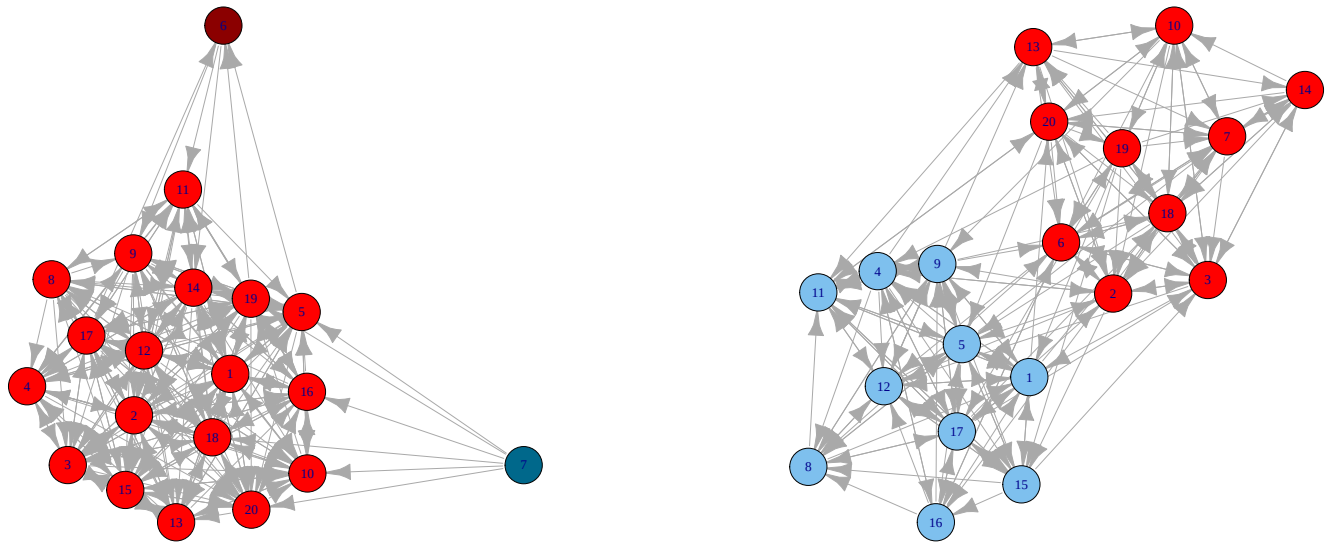
- Micro-environmental local effects:
  - There is an interaction effect for tolerance and conformity in experiment group but not in control group
  - In control group as tolerance increases, extremism also increases
  - In experiment group as tolerance increases extremism decreases only for lower level of conformity but it increases for higher levels of conformity
  - In experiment group, as openness increases extremism decreases, it is vice versa for the control group
- Information flow: global network effects
  - Density has a positive effect on extremism for experiment group only,
  - Centralization has a positive effect on extremism for the experiment group

Controlled Group vs Experiment Group: Low Openness



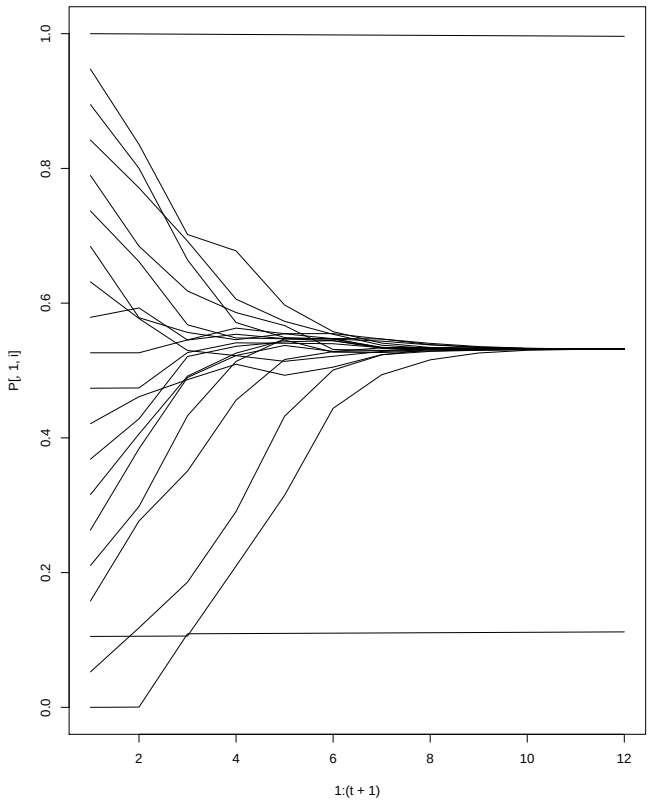
For $\epsilon = 0.3, q = 0.05, \delta = 0.5$

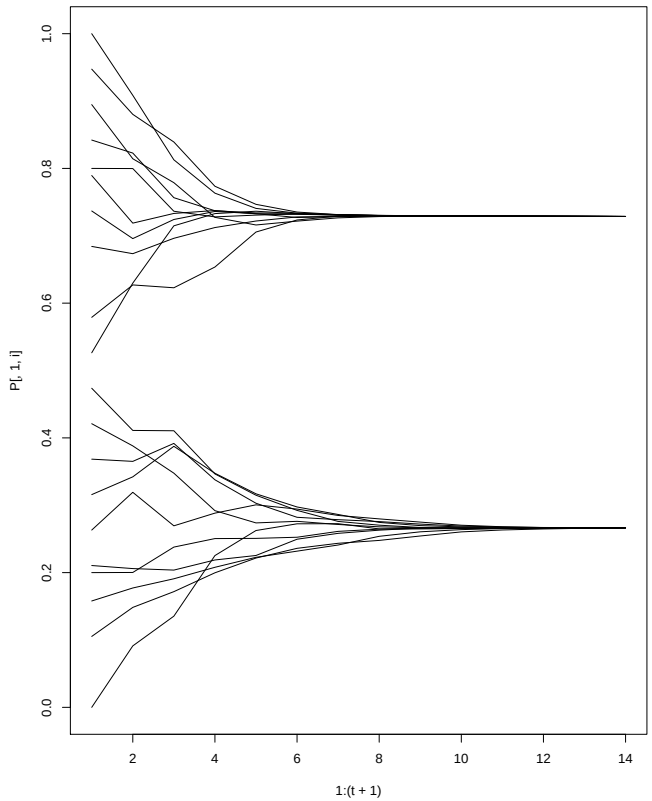
Controlled Group vs Experiment Group: High Openness



For $\epsilon = 0.3, q = 0.1, \delta = 0.715$

Controlled Group vs Experiment Group: Attitude formation





Discussion

- The results indicate that emergence of polarization and extremism is dependent on a variety of factors,
- However, the effects of these factors change according to the nature of the macro-environmental settings,
- In societies with elites possessing coherently organized belief systems, individuals are more open to ideological learning and polarize around coherently organized opinions,
- This can have both positive or negative implications: Destructive conflict, or an opportunity for critical thinking challenging the status-quo.