

# AN AGENT-BASED MODEL OF POLITICAL POLARIZATION WITHOUT PARTY INFLUENCE OR CENTRALIZED MESSAGING

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## Abstract

This work describes results from an agent-based opinion dynamics model that simulates the phenomenon of political polarization. Agents each hold continuous-valued opinions on a set of unrelated issues, which abstractly represent viewpoints on various political matters. The agents interact pairwise on an arbitrary social network, similar to many models in the opinion dynamics literature. However, instead of mutually influencing each other on a single issue, the model features a “cross-issue influence” dynamic whereby similar views on one (randomly-chosen) issue will cause agents to adjust their opinions closer on a different (randomly-chosen) issue.

We find that the model is sufficient to produce complete polarization of the virtual society. This is true despite the absence of any centrally-controlling mechanism, and even though the abstract issues in the model are completely decoupled from each other. This result suggests that rigid polarization may be an inevitable consequence of a free society, even when no invested actors are actively encouraging it.

## Political polarization

Political polarization – reflected in echo chambers, entrenched views, and the vilification of those with differing opinions – can be harmful to a democratic society, even as experts differ on its definition and on the extent to which it exists in Western nations[2, 4, 9, 11, 13]. Polarization can inhibit the reaching of consensus and compromise upon which a democracy is built. It affects not only political actors, but also the interpersonal relationships among the rank and file citizens of a country which bolster and strengthen society[5, 9].

## “Issue Entanglement”

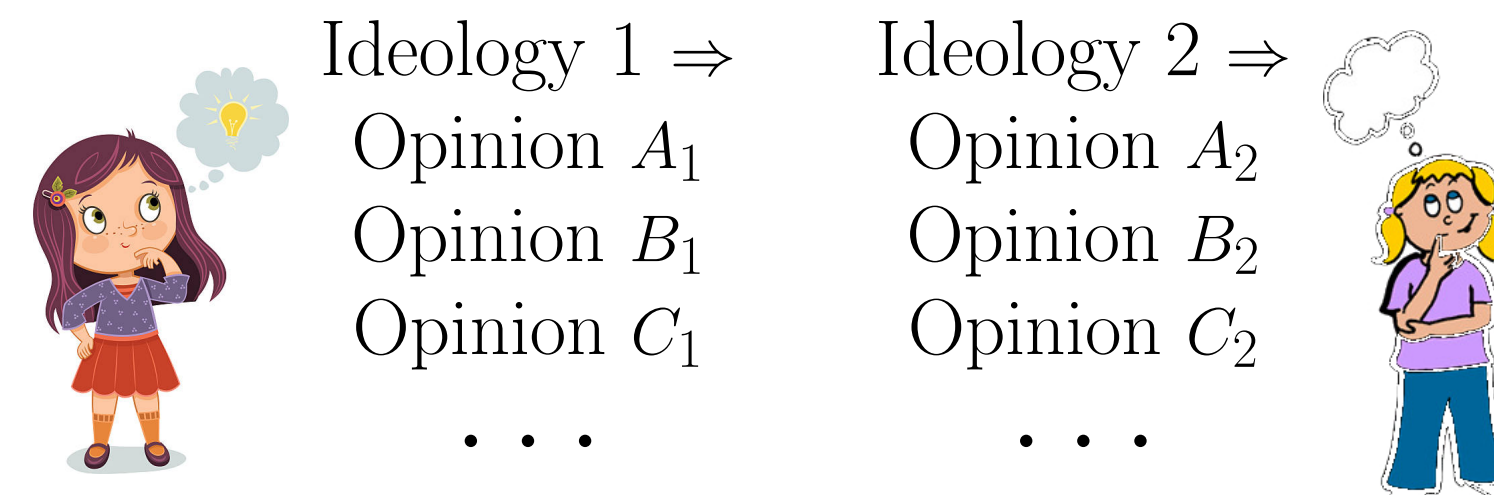
One intriguing aspect of this phenomenon is agents forming “opinion clusters”: sets of opinions on seemingly unrelated issues that nevertheless correlate strongly. In the U.S., for example, consider how likely someone who identifies as “pro-choice” is to also be in favor of raising the national minimum wage, or restricting gun ownership. These links between opinions are correlatively strong, despite the fact that the issues have little in common.[1, 8]

We coin the term “**issue entanglement**” to refer to the tendency of individuals who agree on one issue to also agree on other, unrelated issues. Two commonly-cited explanations for the presence of issue entanglement are **ideological coherence** – namely, the theory that these seemingly unrelated issue positions do in fact stem from some consistent worldview – and **media influence**: a small number of outlets broadcast sets of opinions, and information consumers who are influenced primarily by one outlet will naturally adopt most of them.

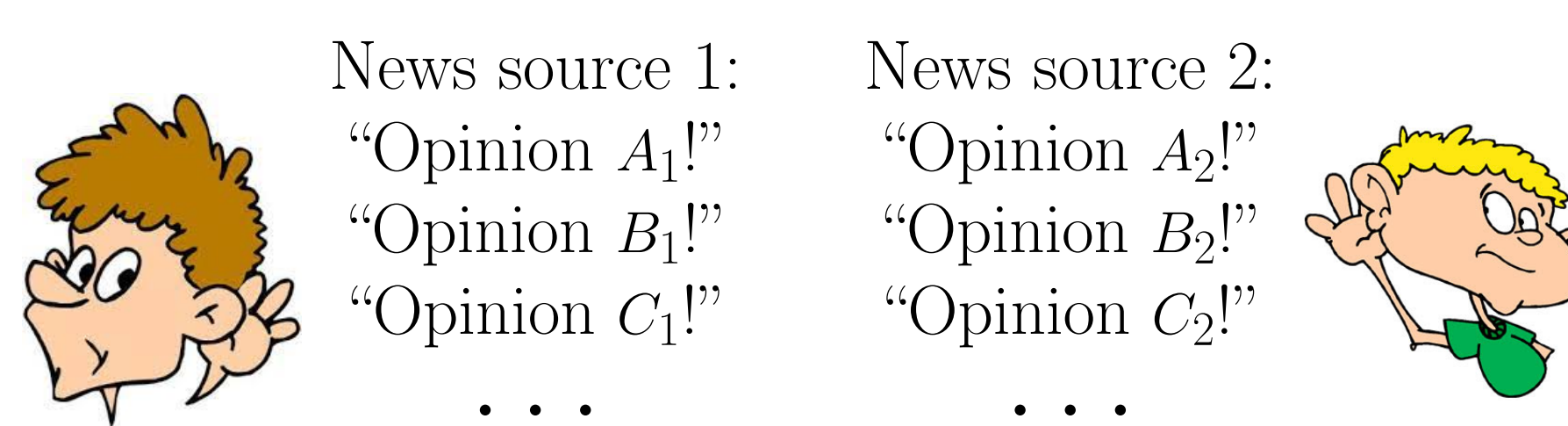
## Issues: related, or merely correlated?

$A_1$ : raise the minimum wage	$A_2$ : lower the minimum wage
$B_1$ : pro-choice	$B_2$ : pro-life
$C_1$ : higher taxes & services	$C_2$ : lower taxes & services
$D_1$ : anti-guns	$D_2$ : pro-guns
$E_1$ : pro-immigration	$E_2$ : anti-immigration
$F_1$ : pro-vaccine-mandate	$F_2$ : anti-vaccine-mandate
$G_1$ : pro-renewable-energy	$G_2$ : pro-fossil-fuels
...	...

## Ideological coherence?



## Media influence?



## “Cross-issue influence” (CI2)

In this work, however, we conclusively demonstrate that neither of these two proposed causes are necessary to produce widespread issue entanglement throughout a society.

We do this by presenting an agent-based model, inspired by the opinion dynamics literature[3, 6]. The only necessary conditions to produce issue entanglement are:

1. a body of agents, each of whom holds continuous-valued opinions on several unrelated issues, and who interact pairwise on an arbitrary social network, and
2. a straightforward extension of the well-known homophily effect from social psychology[10].

The key dynamic of the model is termed **cross-issue influence** (or “**CI2**”). It somewhat resembles the mechanism of “bounded confidence” models such as [7] and [12] in which agents whose opinions on an issue are already close to one another will update those opinions to be even more like-minded. The CI2 mechanic, however, operates *across* issues. If agent A encounters agent B, and discovers that B is similar to A on one issue, A will adjust its opinion on a *different* issue to be more like B. This is homophily, but of a different sort: if I discover that you and I think alike on the issue of immigration, I’m more likely to view you as generally trustworthy, and thus be convinced by your view on vaccines.

## Results

We find that despite random initial conditions, the model nearly always produces complete polarization of the virtual society, in that all agents are eventually absorbed into one of two homogeneous “opinion clusters” (all agents in a cluster agree on every issue).

The plot at the bottom of the poster shows a typical simulation outcome. It depicts a *census of agent pairs who agree on a given number of issues* (out of ten total), as the simulation proceeds. The dashed line depicts the number of “clusters”; i.e., the number of distinct opinion profiles among the model’s agents. At the simulation’s start, no two agents are alike (all ten opinions are on a continuous interval, and a ten-fold collision is unlikely) so every agent is in its own cluster. By the time the CI2 process has swept through society, there are only two clusters left. All ten issues have become completely entangled, and the society has become completely polarized.

To further illustrate the phenomenon, the figure also shows the number of “clones” (pairs of agents who agree on all issues) and “anti-clones” (pairs of agents who *disagree* on all issues.)

Our results suggest that given modest assumptions, issue entanglement is inevitable in a free society, regardless of whether anything exogenous forces them to be entangled. This in turn suggests that attempts to mitigate polarization (for instance, by reducing the effects of monolithic media sources) may be doomed.

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