Ideology-ology

Data-driven modeling of US information-ideological dynamics

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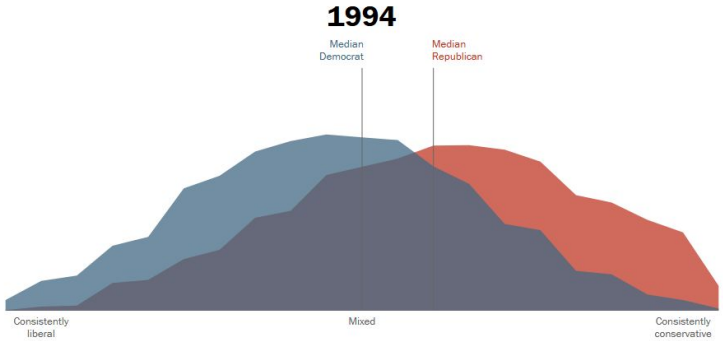
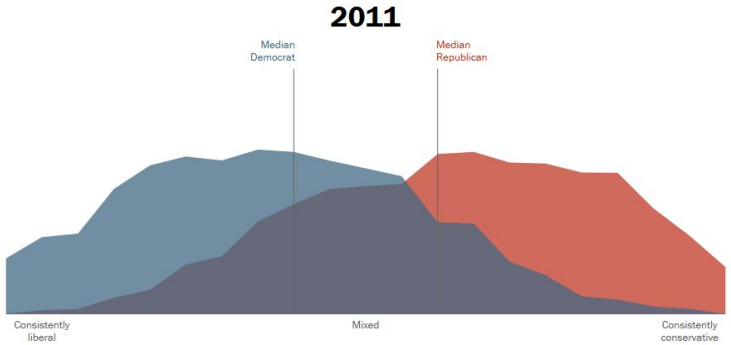
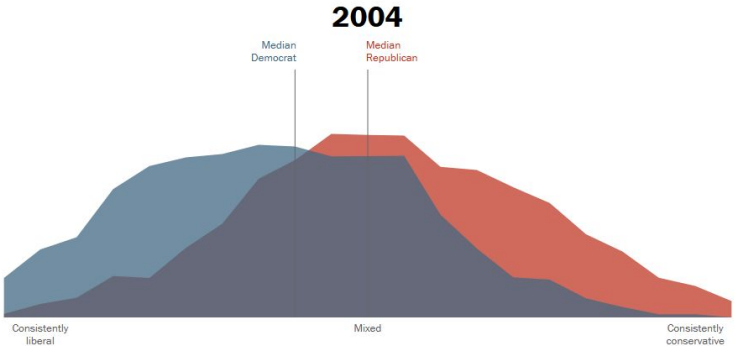
SMB 2025 Minisymposium: Modeling Social and Political Ecosystems

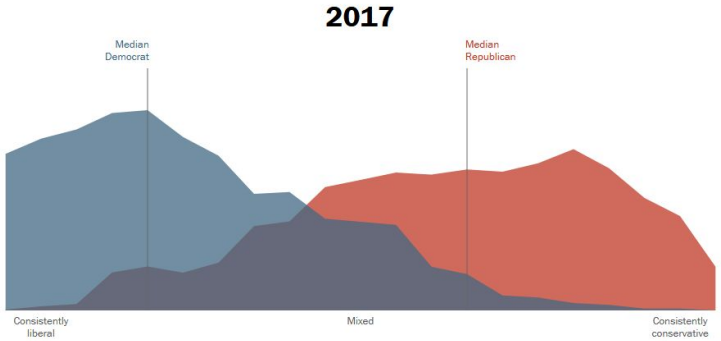
July 16, 2025

Motivation









Source: Pew Research (2017)

Motivation: A Dynamical Connection?

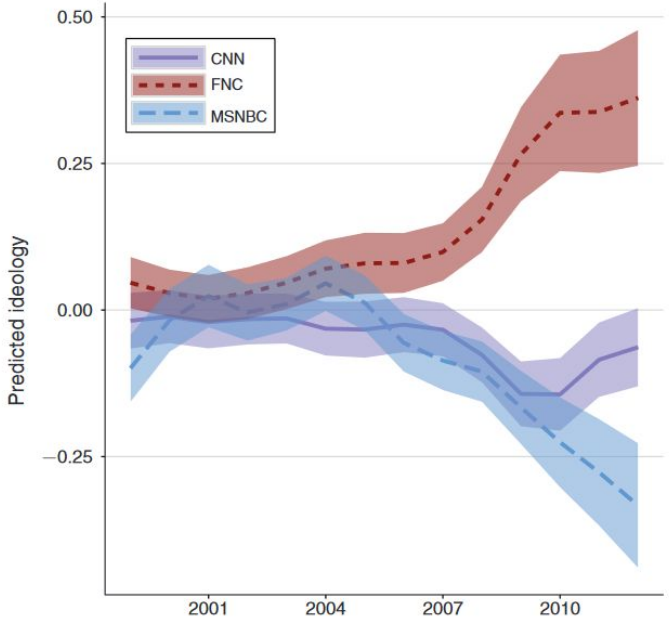
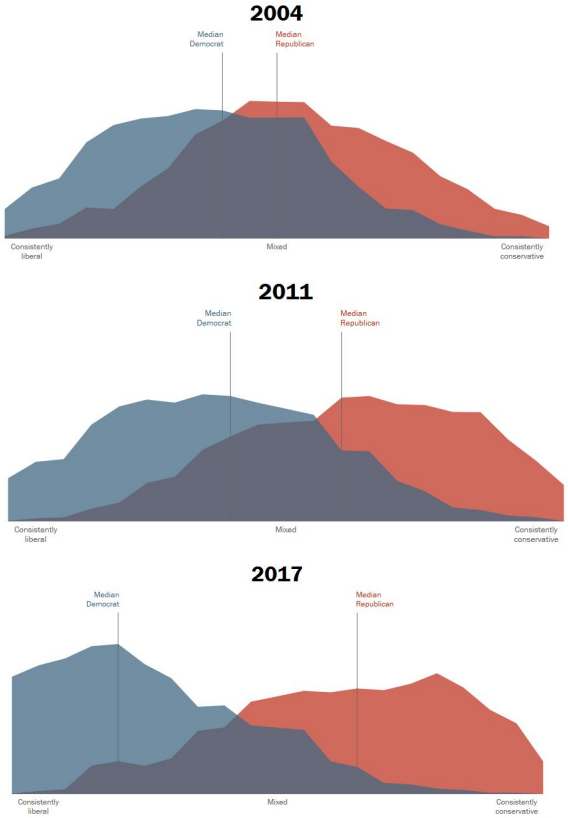


FIGURE 3. ESTIMATED IDEOLOGY BY CHANNEL YEAR

Martin/Yurukoglu (2017)



Modeling Philosophy

The dynamics of ideological drift in populations (and leaders) are immensely important.

Simplifying Observation/Hypothesis: Political influence mostly engages with a one-dimensional "left-right" axis (powerful "us-them" psychology, game theory, etc)

We should seek to model this dynamical system as accurately as we can, and improve those models over time by informing them with data

- Urgency for realism/prediction like epidemiology
    - Toy models for intuition are great but often unverifiable in practice
- "Reality-seeking" modeling mindset

Modeling Philosophy

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- Sidestep (huge, open-ended, many-modal) influence networks by coupling individuals to a (systematically biased, probabilistic) *environment*, not each other
    - Reflects shared algorithmically-mediated information ecosystem

Model Framework

Continuous, finite ideology domain [-1,1]

- Current ideology score, g_i (subjectively rated)
- Percepts, p_j (subjectively rated)
- *Dissonance* of a percept: $d_{ij} = p_j - g_i$

Hypothesis 2: percepts are primary driver of change in beliefs

Measurable quantity: Agreement, a_{ij}

- Likely core trend: more agreement with ideas near self
- Noise: persuasiveness/framing/situational nuance

Simplest proposed ideological movement:

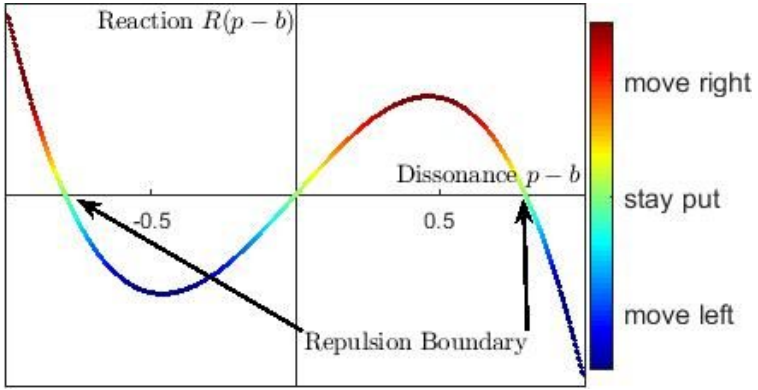
- $\Delta g_i = (1-g_i^2) \int (d_{ij} * a_{ij}) \, dp_j$

Model Framework (Conceptually)

1) Individuals ideologically drift as they react to political things they experience (*percepts*)

Plausible example theory:

A(D) = Downward quadratic → repulsion distance d



$$R(p-b;d) = (p-b)\left[1 - \frac{(p-b)^2}{d^2}\right]$$

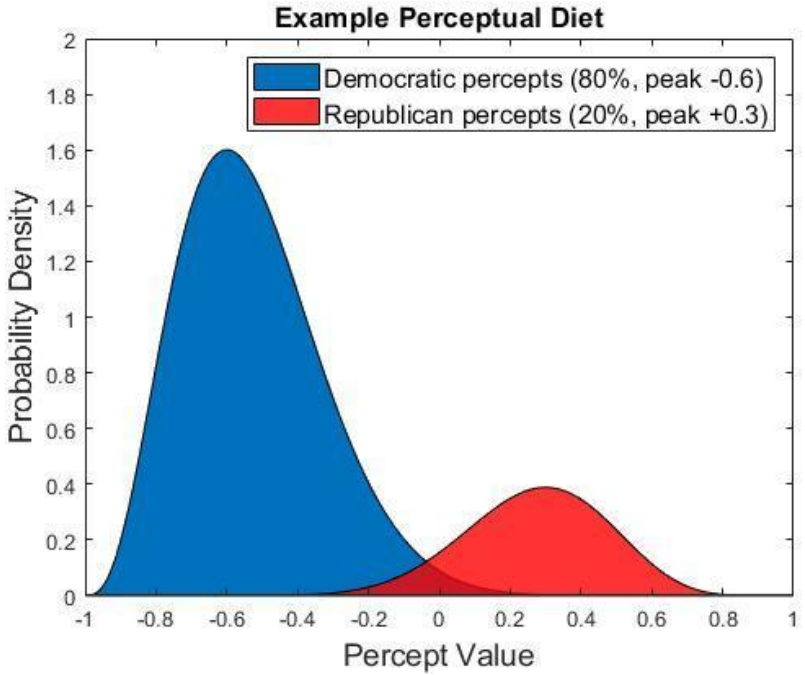
"Dissonance" "Agreement"

Model Framework (Conceptually)

1) Individuals ideologically drift as they react to political things they experience (*percepts*)

2) What individuals experience is systematically biased by their current ideology (and possibly party affiliation)

- Probability distribution of content —> no assumption on influence type or structure



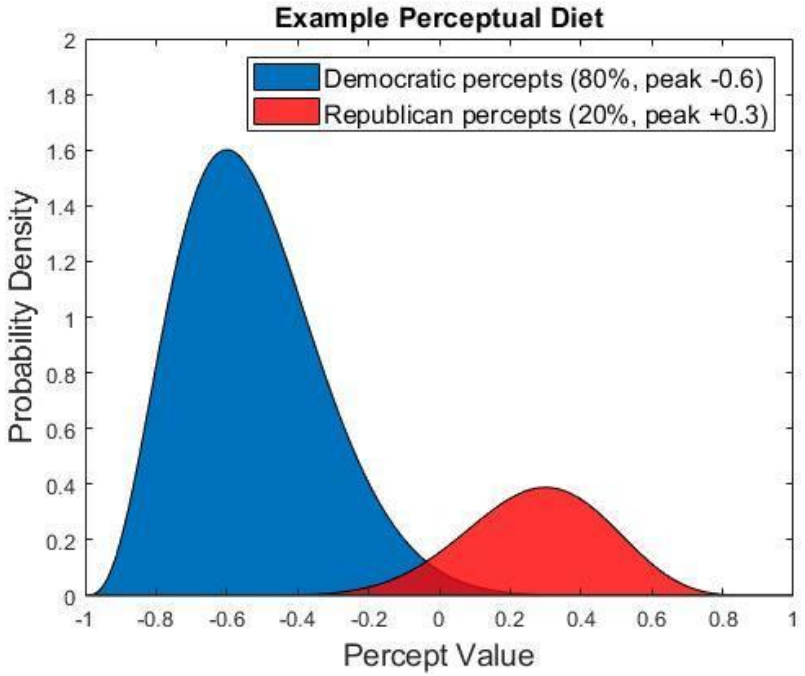
Model Framework (Conceptually)

1) Individuals ideologically drift as they react to political things they experience (*percepts*)

2) What individuals experience is systematically biased by their current ideology (and possibly party affiliation)

3) Political content source's partisan affiliation may act as a significant cognitive primer for the impact of political content

- Ex: Same proposal from your side sounds better (benefit-of-the-doubt)



Model Proof-Of-Concept (2020)

Conjectured Dynamics:

- cubic function of dissonance (=d*a | a quadratic)

Conjectured Information Ecosystem:

- Beta-distributed diets from each party
- Peak of distribution = sigmoid function of ideology

Wiggle room: 8 parameters (two sigmoids)

Can match real-world data:

- Dem and Rep equilibrium distributions
- Intervention dynamics (Bail 2018)

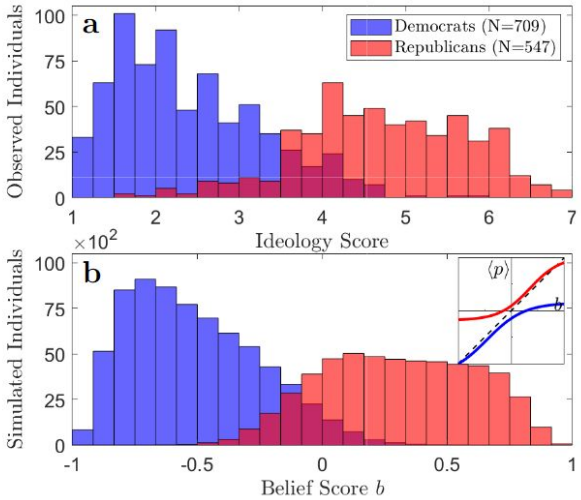


FIG. 1. **(a) Empirical ideological distributions by U.S. political party.** Average ideological position score from 1 (strongly liberal) to 7 (strongly conservative) on social, economic, and military issues for 1256 U.S. Twitter users. Data from [38]. **(b) Model predictions.** Steady state for our simulated population of 70,900 Democrats and 54,700 Republicans, with party perception curves shown in the inset. See Results section for details.

Survey Structure

Opinion Statements (pool of 68)

- Judge its ideological position
  - Slider, -50 (extremely liberal) to +50 (extremely conservative)
- Indicate agreement level
  - Slider, -50 (vehemently disagree) to +50 (emphatically agree)

Information Environment

- How much of your political influences (online, print, radio, in-person) come from each type of source?
  - 3 party allegiances (D, I/U, R)
  - 5 ideological positions (FL, ML, C, MR, FR)

Data: 804 respondents:

- August 2023: 166 US Mechanical Turk "Masters"
- Sept 2023: 130 Volunteers (incl. 90 UM students)
- May 2024: 508 Prolific participants
  - nationally representative sample
  - (confirmed all the patterns from our previous samples!)
- Each sees 30 statements (or some volunteers: 68)
  - 24,576 observer-statement events

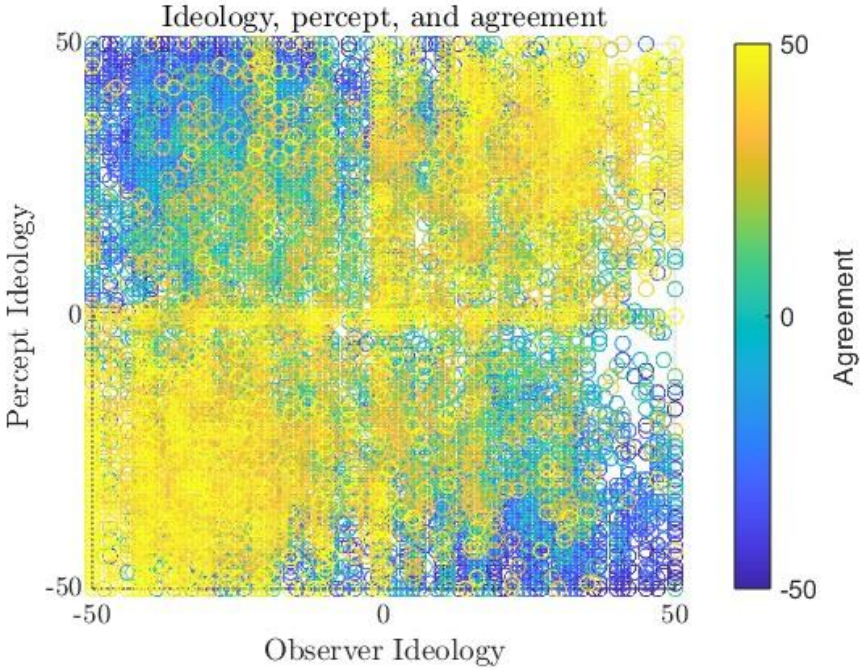
Political Opinion Agreement Data

For each observer/statement pair, get an agreement value

Plot: **Observer Ideology (X)** vs **Estimated Percept Ideology (Y)** vs **Agreement (Z/color)**

Diagonal symmetry signature!

- Suggests use of just *dissonance* (distance from Y=X diagonal) instead of depending on observer and percept ideology separately



Political Opinions: Dissonance vs Agreement

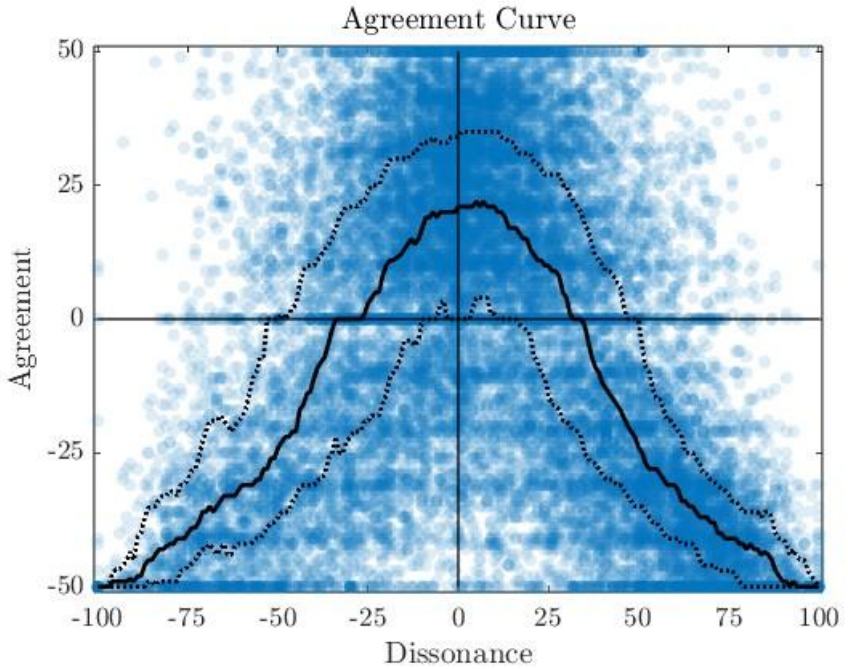
A clear arch shape appears!

Middle 50% of responses fall in relatively narrow band

- Median crosses at about ±30
- Useful for political messaging strategy already: if you want most of a given ideological audience to agree with you, keep messaging within 30% the width of the ideological domain

Very noisy: the noise is important!

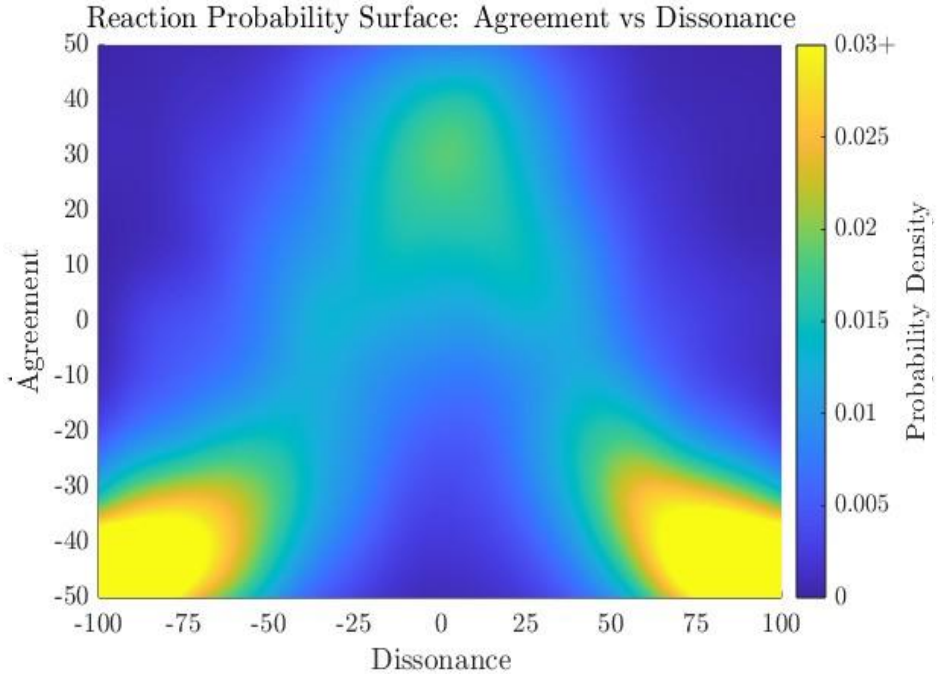
- still a lot of dependence on issue and quality for small dissonances
- noise is non-Gaussian and dissonance-dependent



Political Opinions: Dissonance vs Agreement

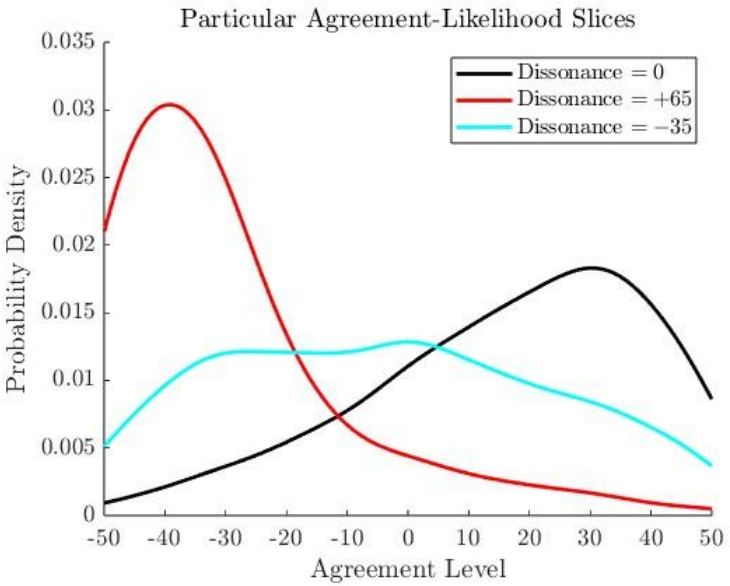
Seek a probability distribution for each dissonance level:

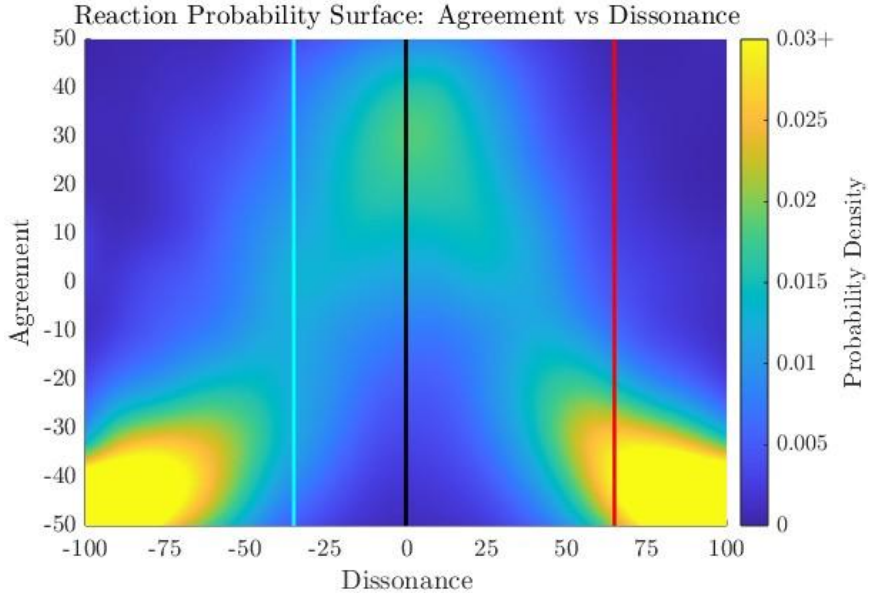
- “Fuzz” each point into a 2d gaussian to reflect inherent uncertainty of the scale
- Normalize each vertical slice



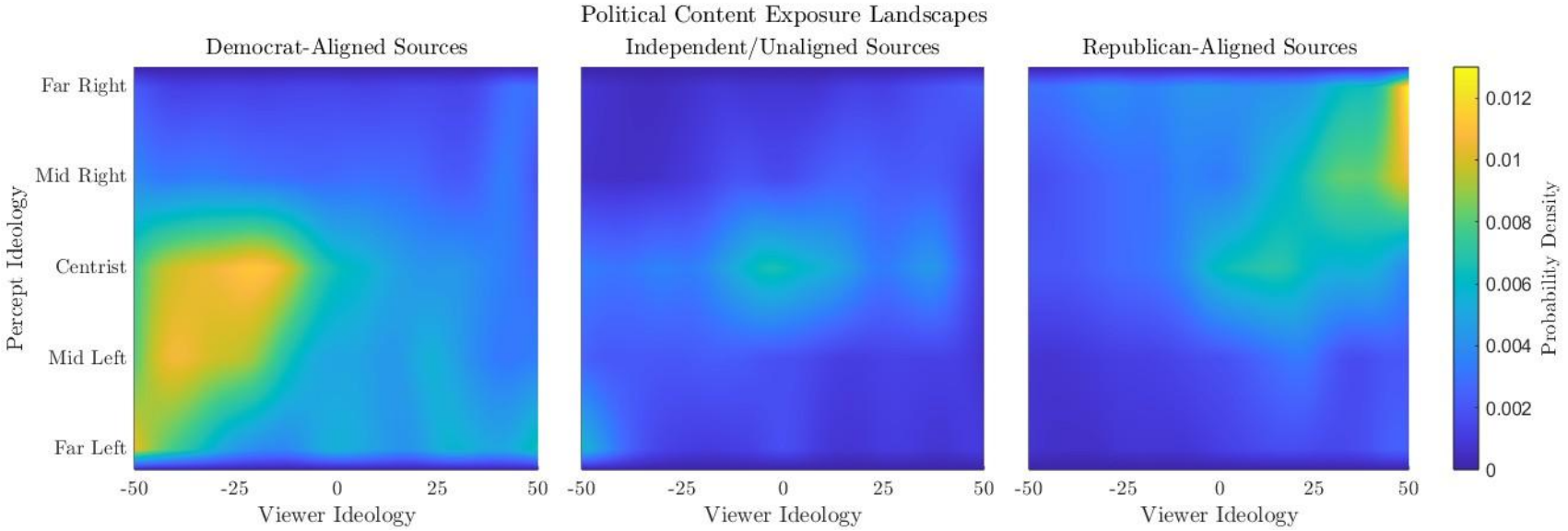
Political Opinion Agreement Surface

With this agreement surface, given a particular level of dissonance we obtain a probability distribution of likely agreement outcomes:





Self-Reported Political Information Ecosystem



Very rough initial estimate, but pretty clear patterns!

(Saves many parameters relative to hypothesizing three surfaces)

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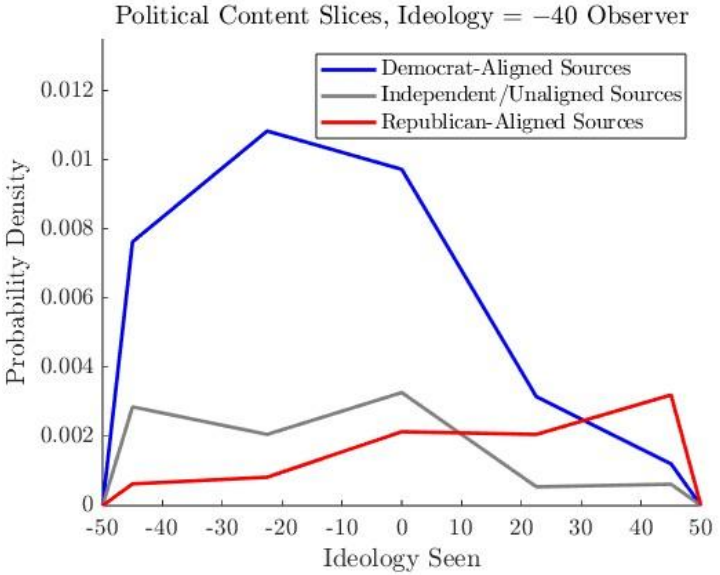
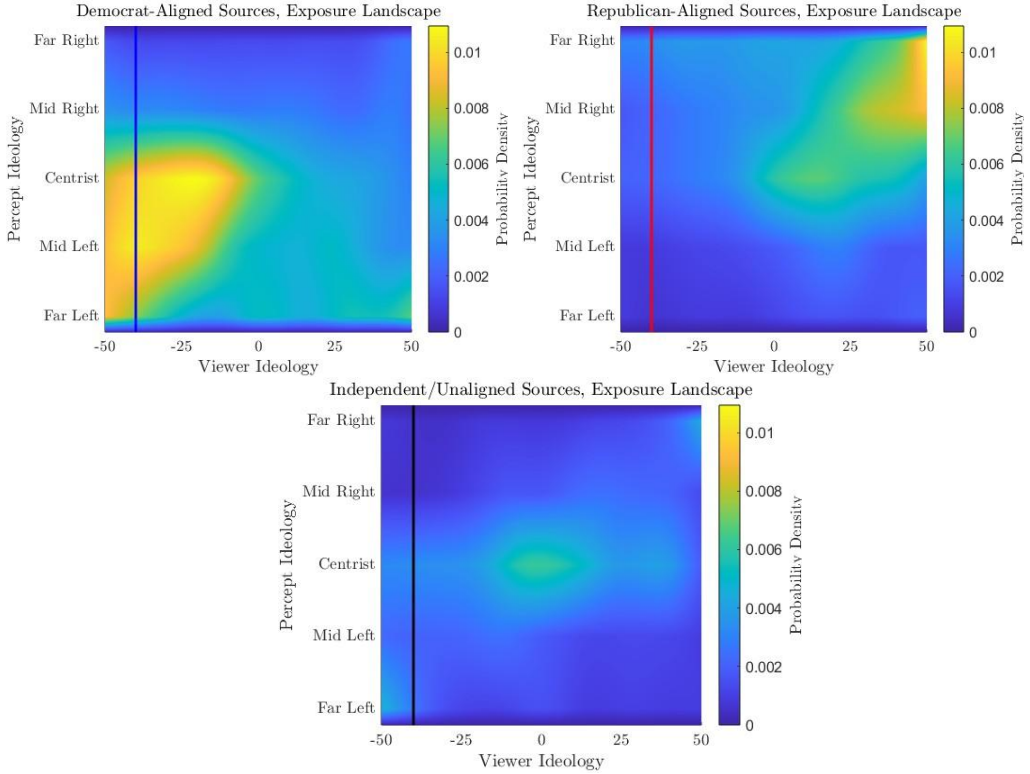
Information Ecosystem: Implications



b = -40 (aka -0.8 on [-1,1] scale)



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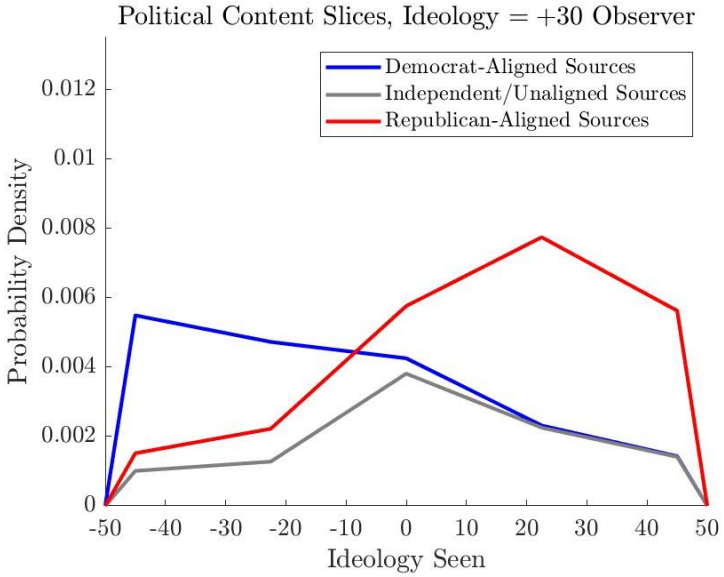
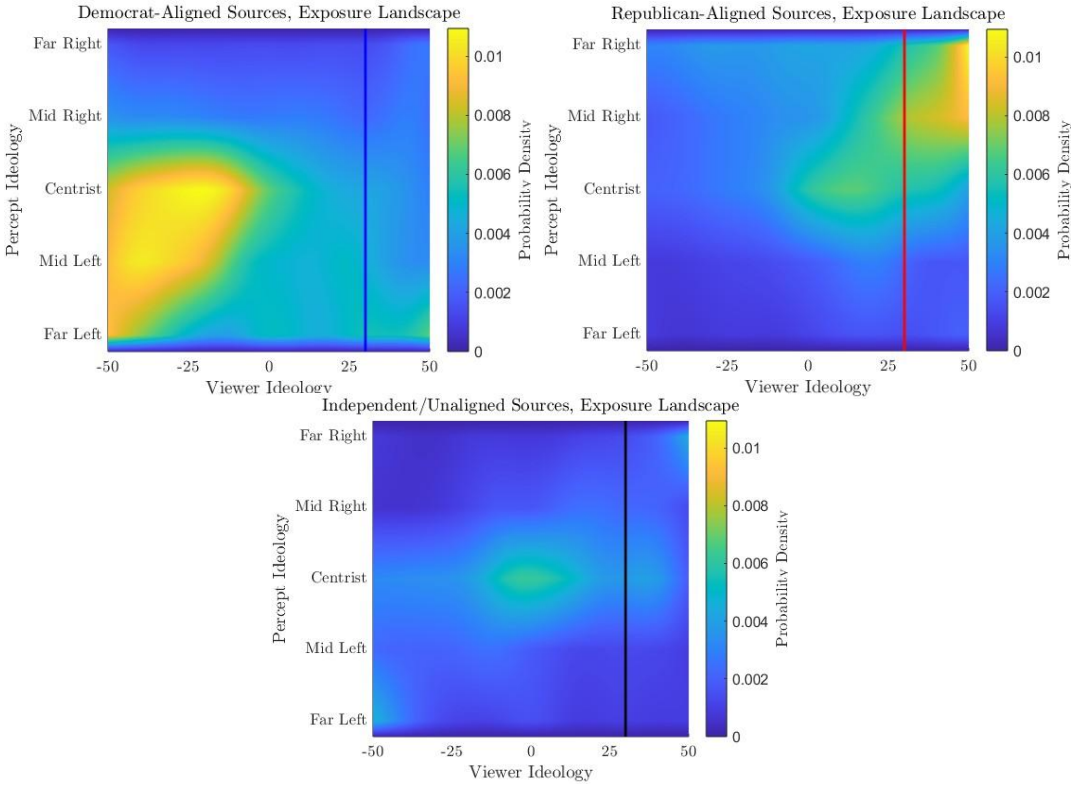
Information Ecosystem: Implications



b = +30 (aka +0.6 on [-1,1] scale)



Model Results Driven by Data

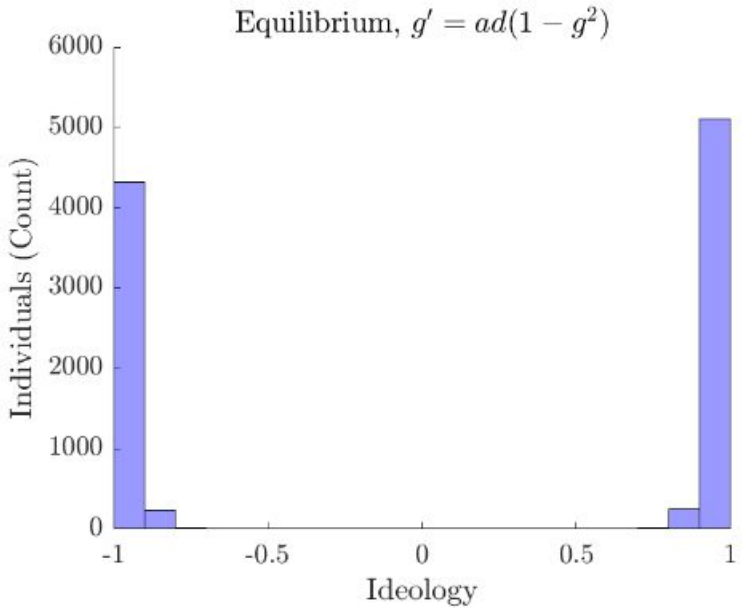
- Given a person's ideology, they see biased distributions of content of each **ideology value**
- Each bit of content implies a **dissonance**
- Each dissonance level implies a distribution of potential **agreement** levels to that content
    - Current Ideology → Joint (2D) distribution of each dissonance and agreement: P(d, a)

→ Finally, put together into (simple) dynamical theory:

- Ideology Drift = d * a * edge-damping

P(d, a)→**mean** drift and **stdev** of drift distribution at each ideo → SDE

So, what do the data say happens?



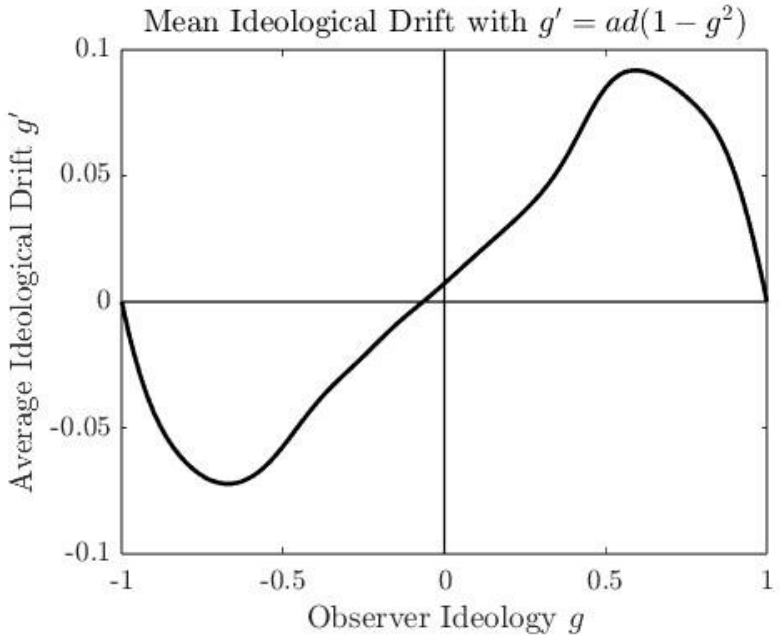
Model Results Driven by Data

This does NOT produce real-looking outcome distributions…

(everyone polarizes to ± 1)

Possible takeaways:

1. This is accurate, and people are actually polarizing like this, but *slowly*



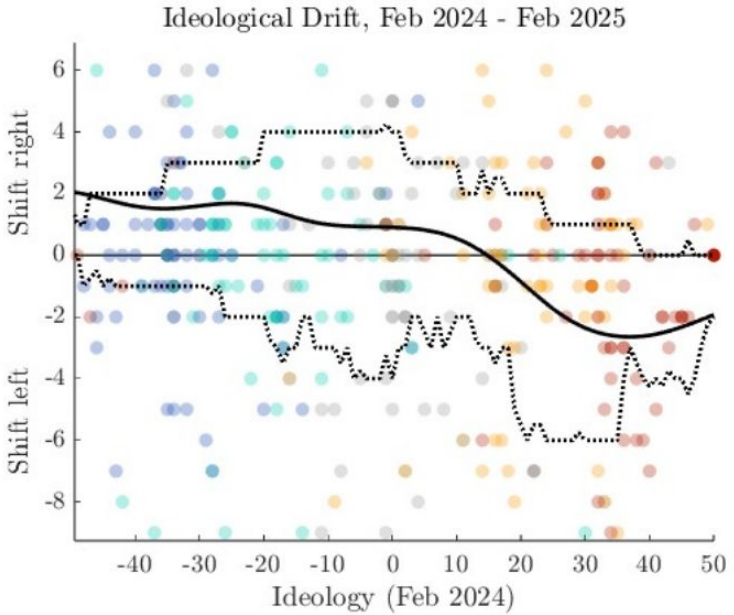
Model Results Driven by Data (May 2025)

This does NOT produce real-looking outcome distributions…

(everyone polarizes to ± 1)

Possible takeaways:

1. ~~This is accurate, and people are actually polarizing like this, but *slowly*~~
   - Unlikely: new data comparing 2025 to (self-recalled) 2024 and 2020 seem to suggest people have been *depolarizing*



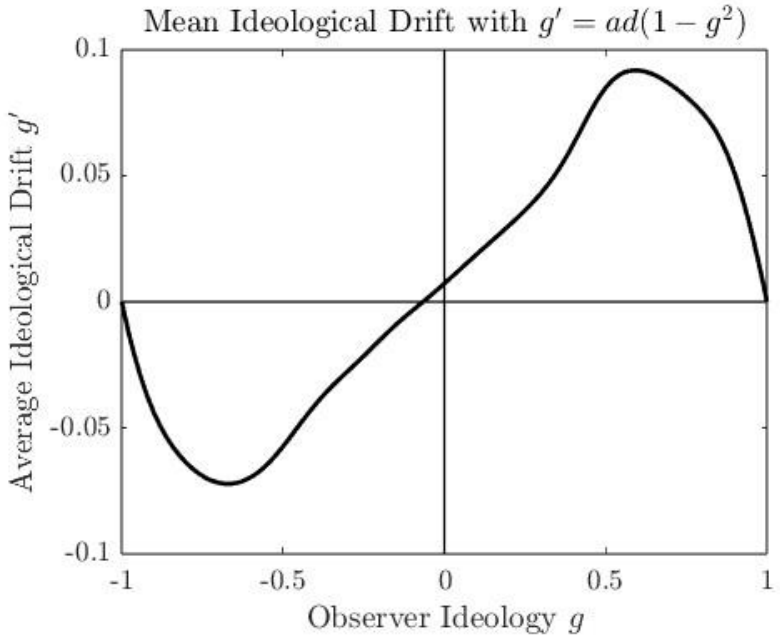
Model Results Driven by Data

This does NOT produce real-looking outcome distributions…

(everyone polarizes to ± 1)

Possible takeaways:

1. ~~This is accurate, and people are actually polarizing like this, but *slowly*~~
2. We need to add more effects to our dynamical hypothesis of ideological forcing
3. We need more/better data, particularly for the content ecosystem



Our theory (as explanation for *current* distributions) was **falsifiable**! If we want to do better, we're forced to augment theory to reconcile with observations

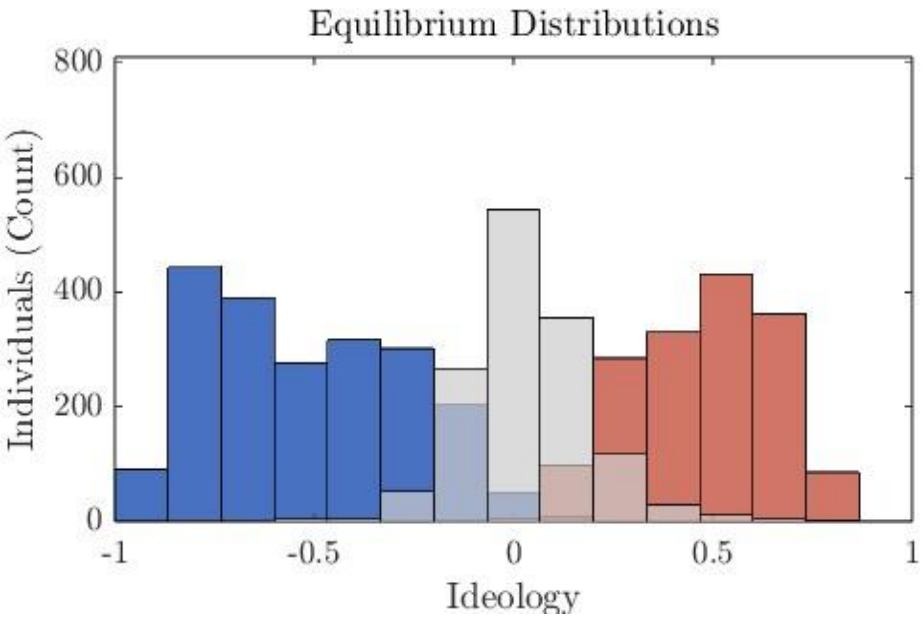
Augmenting Dynamical Hypotheses

General observation: with basic theory, repulsion dominates. Within reasonable values, need:

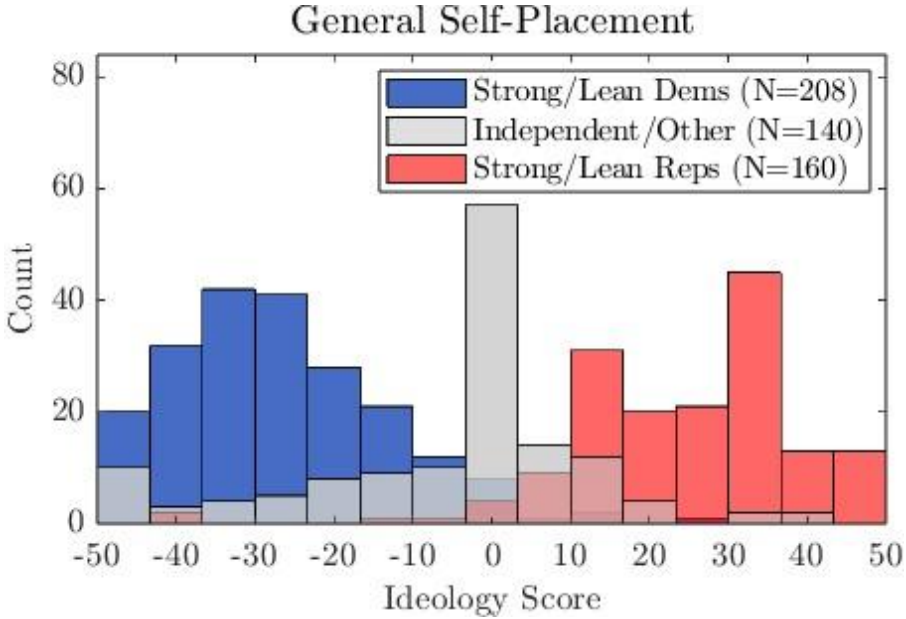
- Additional Effect 1: **Centralizing Drift** (1 param)
- Additional effect 2: **Saturating Dissonance** (1 param)
- Additional effect 3: **Positive tribalism** (1 param)
  - “benefit-of-the-doubt” upshift in effect for each step of homophily
- Additional effect 4: **Cohesion bias** (1 param)
  - Drift towards party mean
- Additional effect 5: **Asymmetric out-group impact-estimation bias** (2 params)
  - Dems say they aren’t influenced by Rep content, Reps say they’re massively influenced by Dem content (semantic interpretation difference)

Augmenting Dynamical Hypotheses

Putting it all together (6 parameters, only 2 of them asymmetric):



(Simulated sample: 10x empirical sample)

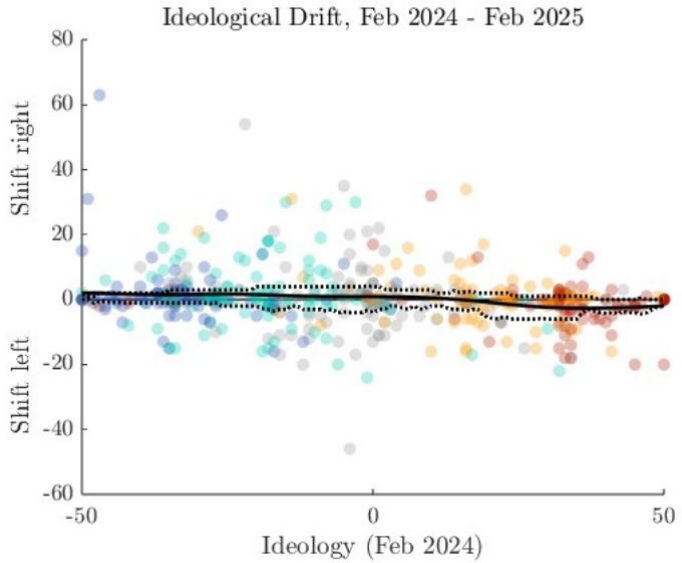


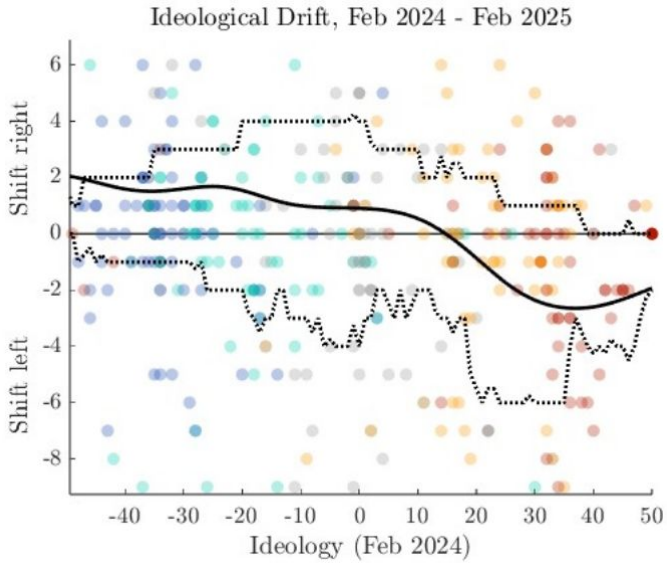
Representative sample (Prolific platform)

Non-Uniform Dynamical Hypotheses

The new drift data: Most are stationary, some move a lot

Suggests a less uniform model, with inherent “types” of people or “influenceability” state





Summary

Previously:

- assumed core functional forms (reaction, exposure), 5+ static parameters
- 8 fit parameters
- Idea for this experiment

Now:

- all core functions and distributions replaced by real data
- 6 new fit parameters, possible basic moderating functions
- Ideas for where to look next
  - Refine exposure surface
  - Examine speaker-identity bias
  - See how close this gets us!
  - We are in the “rolling a ball down a hill” stage of discovering these dynamics
- Get lots of independently cool data to analyze along the way!

Big Picture

The hope for accurately modeling this system is severalfold:

- Predict undesirable outcomes
  - Hyperpolarization
  - Fractured/unrepresentative parties
- Inform interventions
  - Effective (consensus-building) political messaging
  - Responsible algorithm design, media norms/regulations

➢ Understanding confers resistance to manipulation tactics
  - Acknowledging personal biases = first step to seeing more clearly
  - “Sunlight is the best disinfectant”

website (work in progress): david-sm.com

Thank You!

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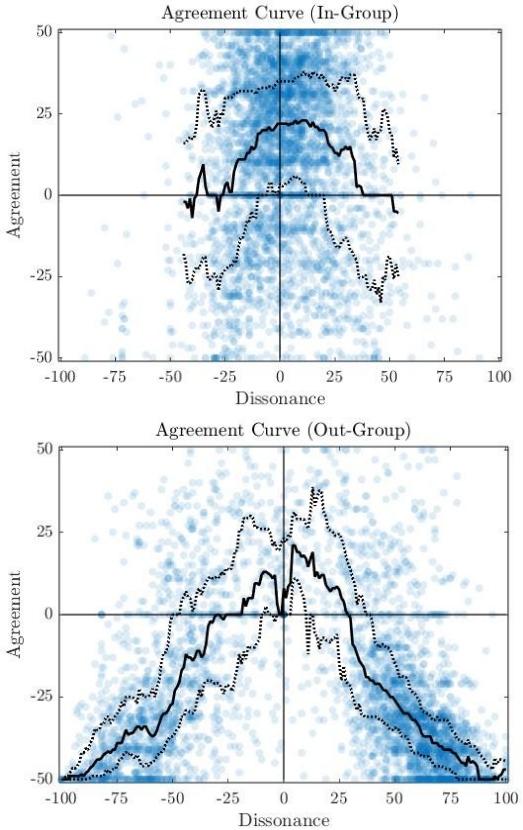
Alternate Dynamical Hypotheses

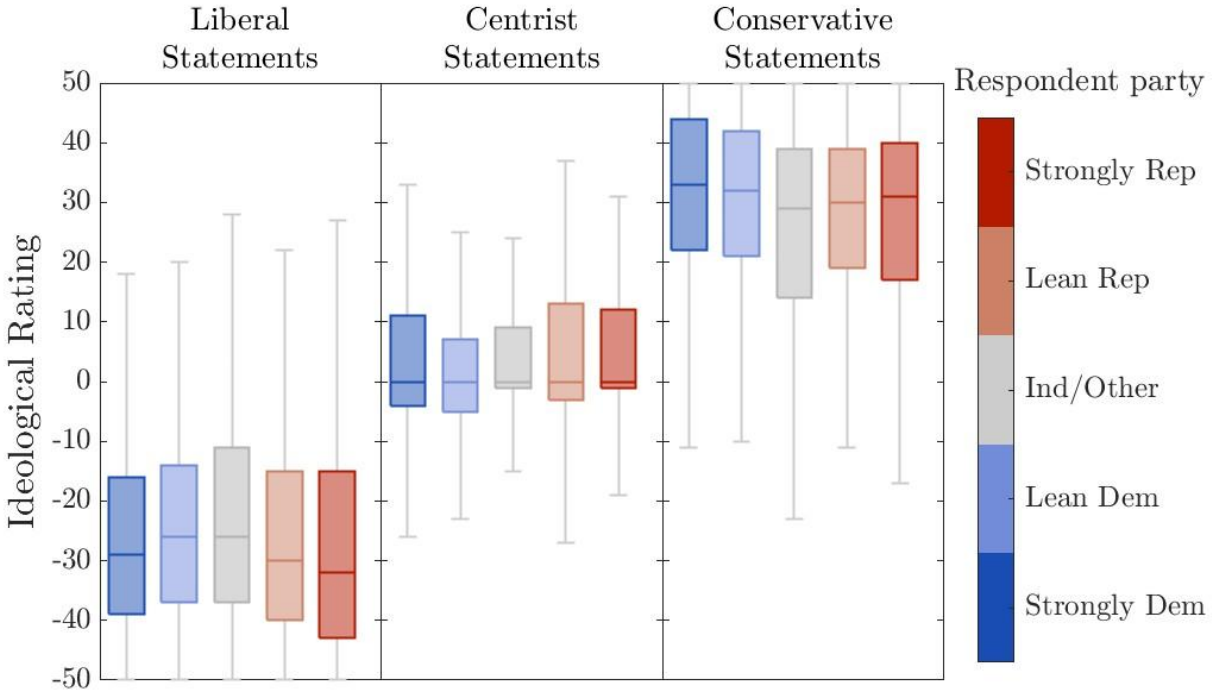
Can we come up with a new plausible theory which reproduces real-world ideology distributions as its equilibrium using only the data we have?

Challenge 1: In order to have different distributions for different parties, we need to have observer party matter for reactions

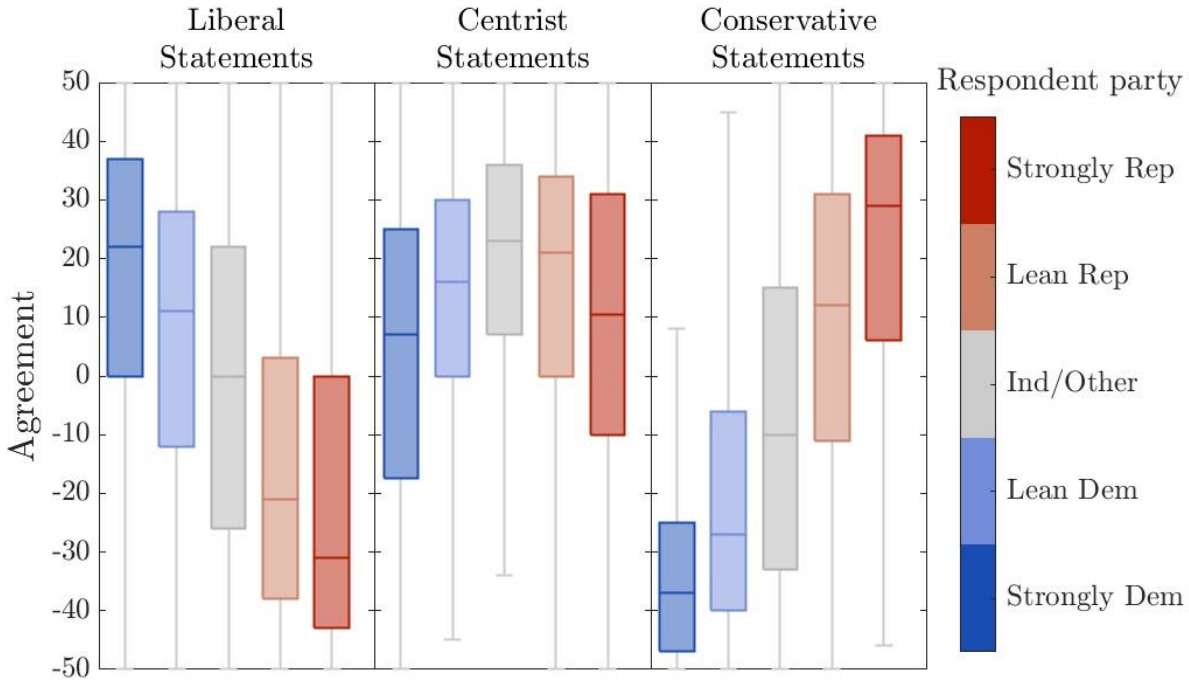
- But, hard to parse that from our data due to partisan segregation
  - Reaction and content surfaces are basically non-intersecting
  - So, must reintroduce free parameters to fit



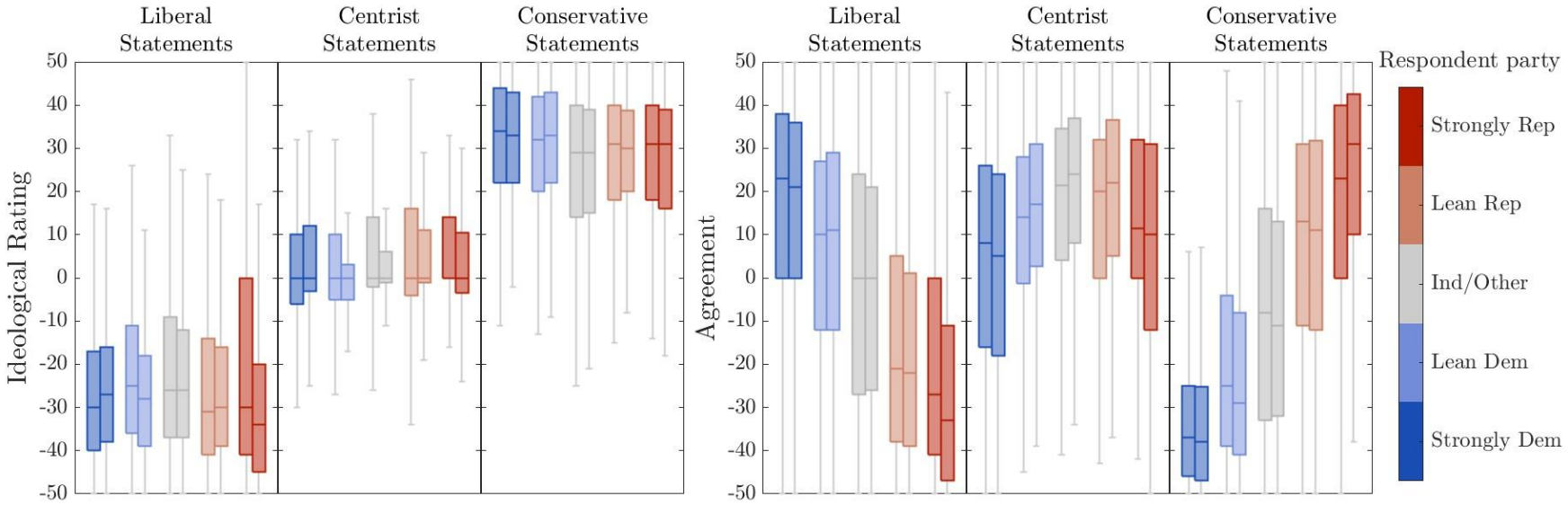
The Political "Spectrum": Shared Meaning



Not Shared Acceptance!



(Non-)Effect of Speaker's Party Declaration



Not Declared (control, left bars) vs Declared (e.g., "A Democrat says, '...'", right bars)

Ideology robustness

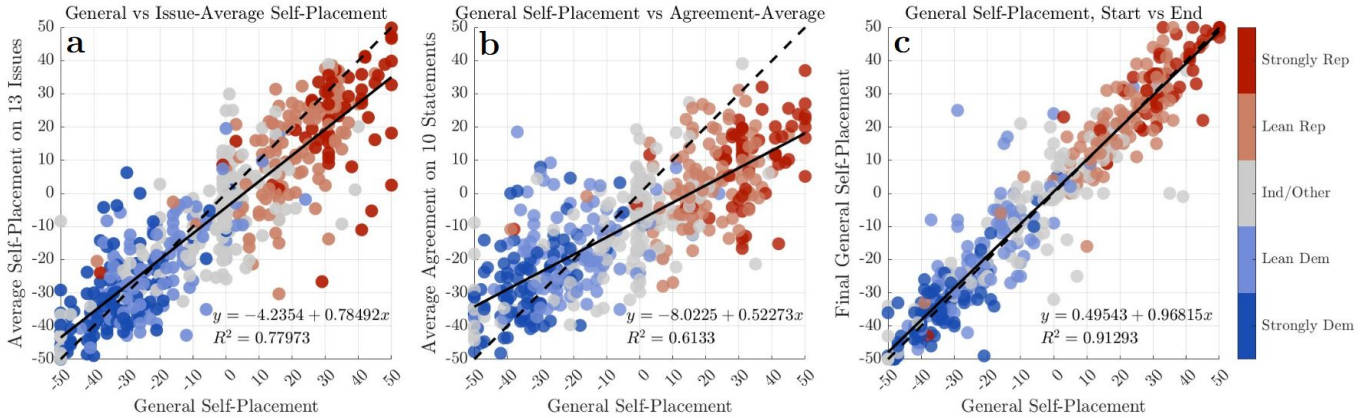


FIG. 1: **Comparing Ideology Measures**. General ideological self-placement (at survey start) on the political ideology spectrum (x axis) plotted against three other measures to assess consistency and relative bias. **a)** Comparison to average of self-placement on 13 prominent political issues. **b)** Comparison to average policy-stance agreement ideology. We see a systematic centralizing and liberalizing effect of the agreement-based metric (best-fit slope of 0.52, intercept -8.0), along with a weaker, but still substantial fit ($R^2 = 0.6133$) based on respondents' general ideology. **c)** For "null" comparison, general ideology is seen to be very consistent with itself across the length of the survey, despite potential re-contextualization of the political environment from the intervening stimuli—the average absolute deviation between measures of general self-placement was 5.25 on the 100-point scale, serving as an upper bound on individuals' inherent response deviation.

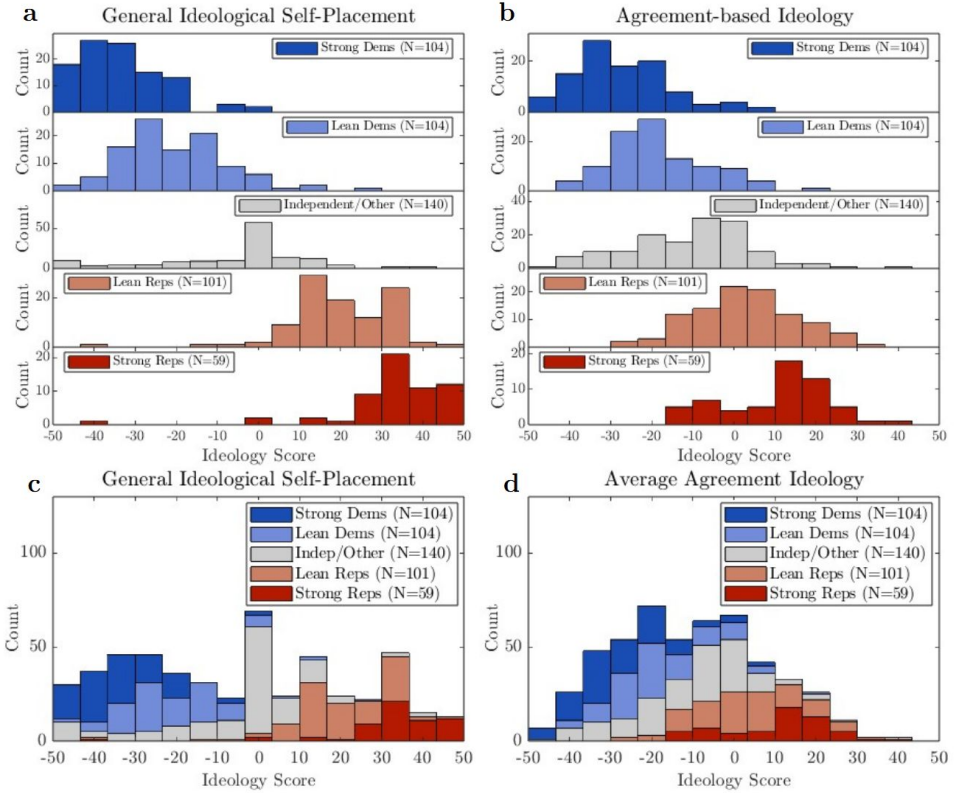
Ideology distributions

Clear “partisan-ideological sorting”

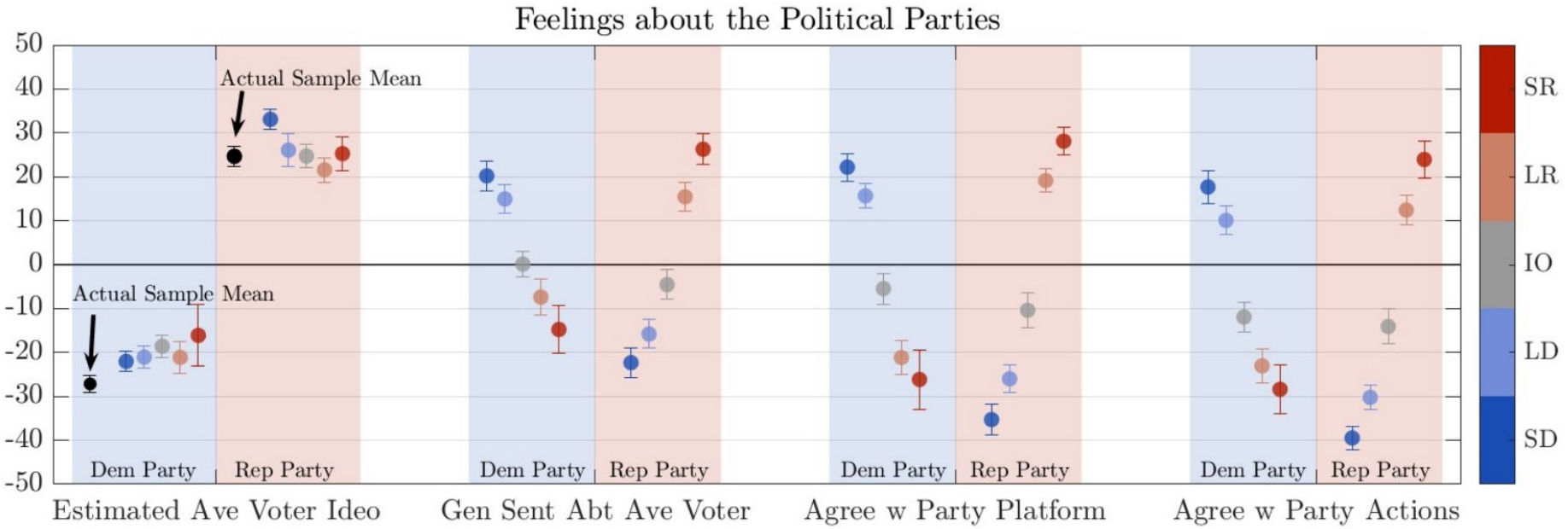
Single subjective measure: people fill whole space relatively evenly

Researcher-constructed agreement-average across major issues: unimodal left of center

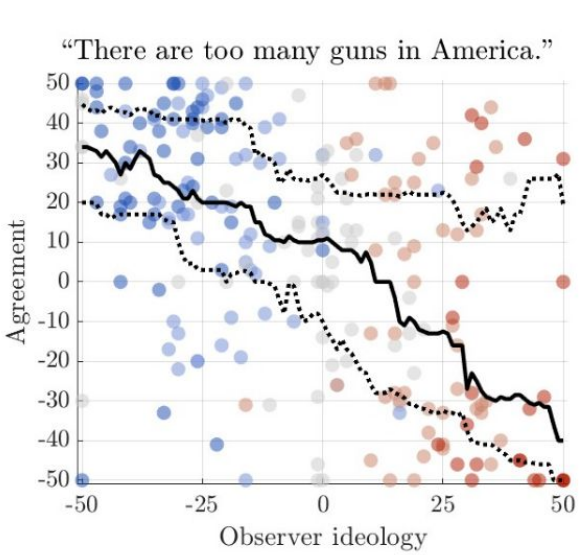
Suggests that internal sense of ideology is NOT an equally-weighted average of issue stances, especially for conservatives

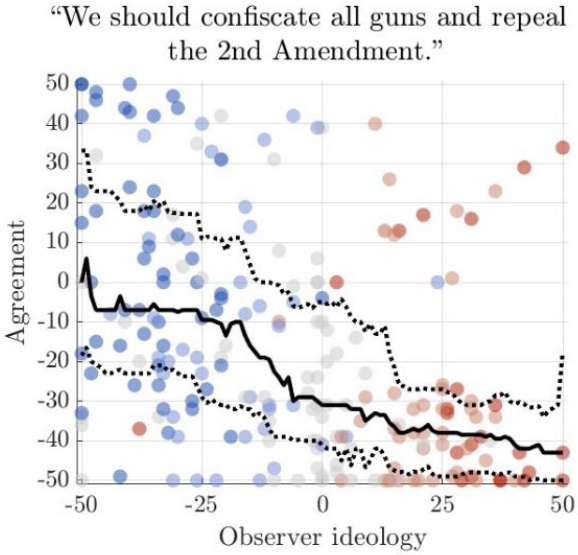


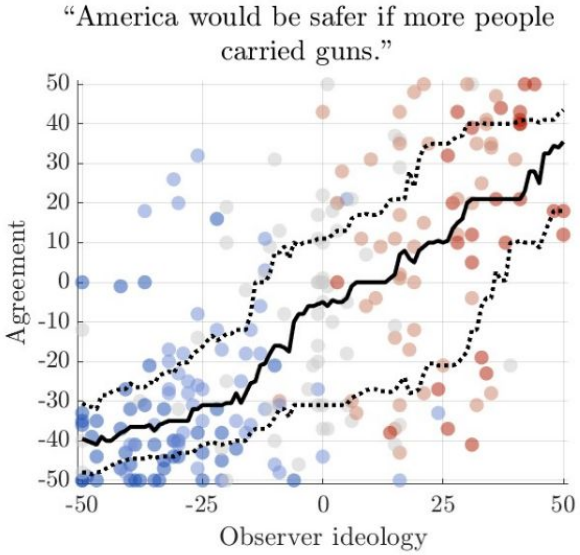
Political Parties



Guns


"There are too many guns in America."
Agreement
Observer ideology
50
40
30
20
10
0
-10
-20
-30
-40
-50
-50
-25
0
25
50


"We should confiscate all guns and repeal the 2nd Amendment."
Agreement
Observer ideology
50
40
30
20
10
0
-10
-20
-30
-40
-50
-50
-25
0
25
50


"America would be safer if more people carried guns."
Agreement
Observer ideology
50
40
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-50
-25
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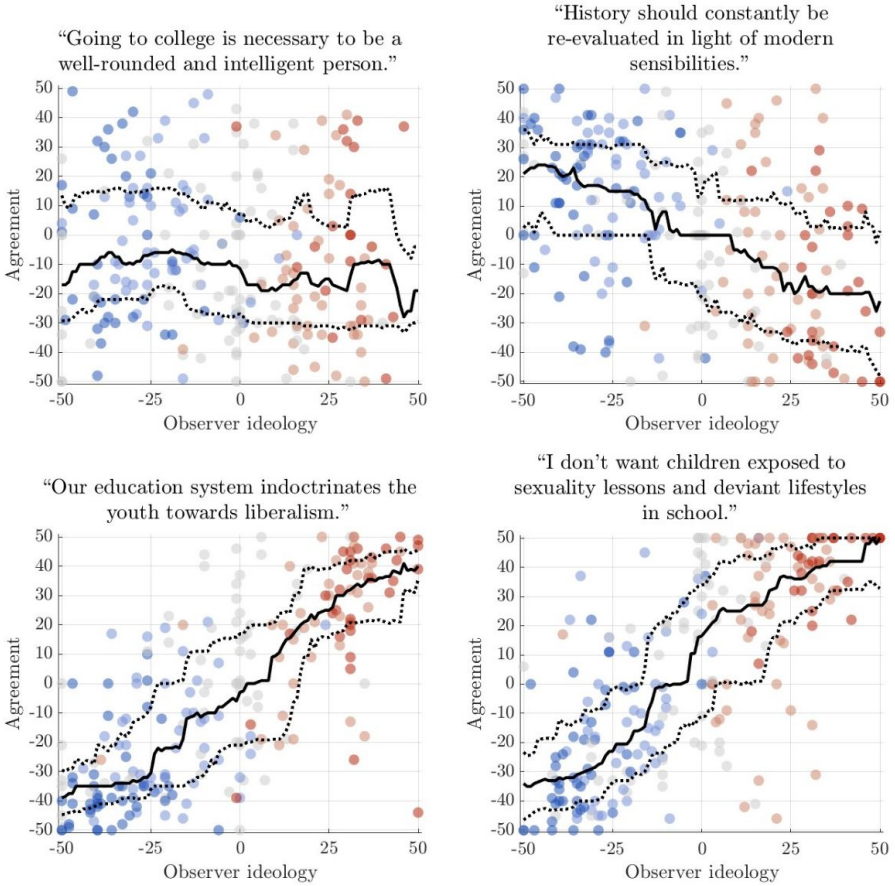
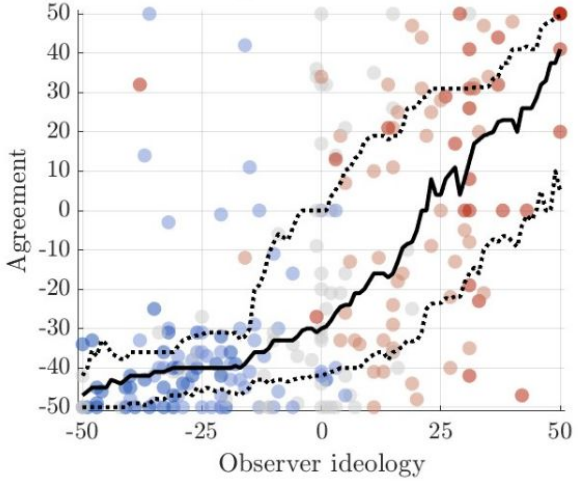
25
50

Education

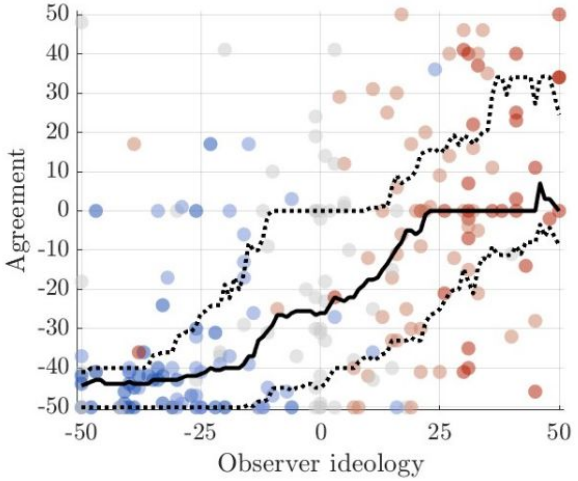

"Going to college is necessary to be a well-rounded and intelligent person."
"History should constantly be re-evaluated in light of modern sensibilities."
"Our education system indoctrinates the youth towards liberalism."
"I don't want children exposed to sexuality lessons and deviant lifestyles in school."
Agreement
Observer ideology
50
40
30
20
10
0
-10
-20
-30
-40
-50
-25
25

Conspiracism

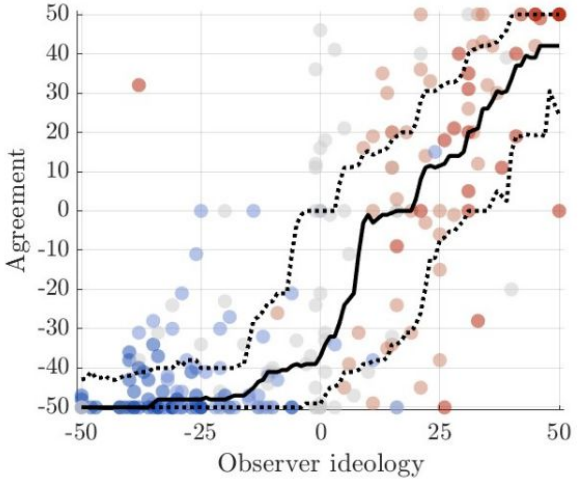
"Climate change is a hoax perpetuated by globalists."



"Q and Donald Trump are secretly fighting to expose the liberal cabal of deep-state child-abusers and save our country."

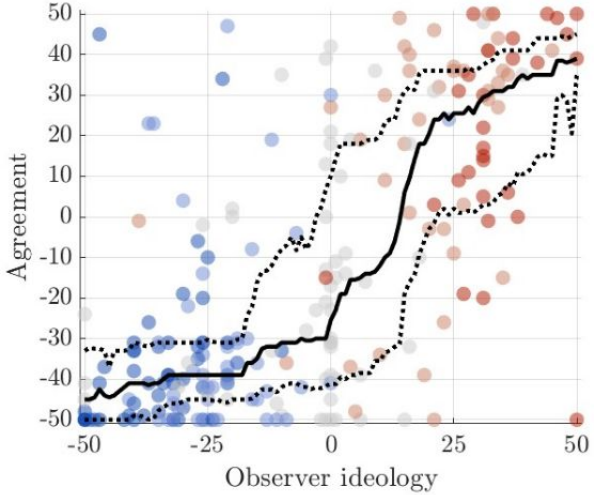


"Donald Trump really won the 2020 election, there was massive fraud to make Biden president."

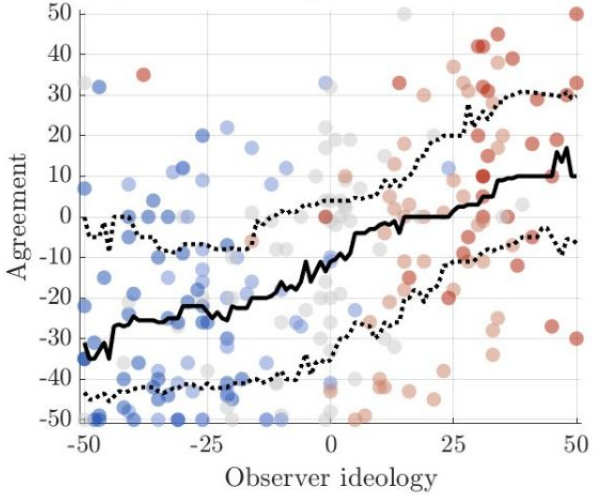


Religion

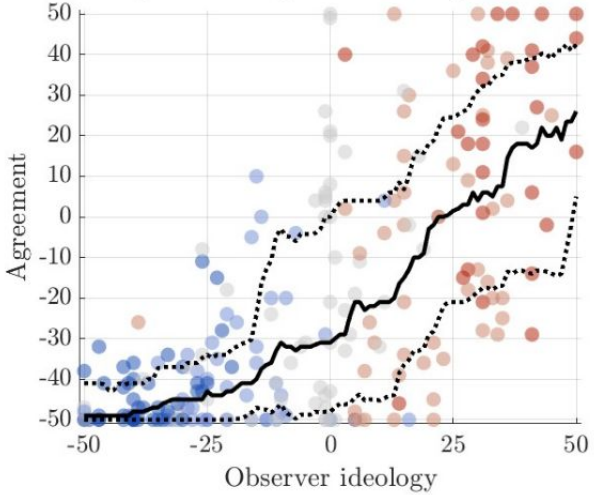
"America is a Christian nation and our laws should reflect Christian values."



"Religious beliefs should be a valid exemption when they conflict with laws."



"All abortion is murder and should be prosecuted just as harshly."



Political Dissatisfaction