

# Attraction by ingroup coherence drives the emergence of ideological sorting

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## Abstract

The increasing political polarization is driving hatred and segregation, and these pose a threat to democracy. While disagreement on policy issues is increasing and receiving great attention, people are also becoming more aligned across diverse and seemingly unrelated topics, leading to issue polarization and ideological sorting. Observational studies have described the rising ideological alignment and experimental work has addressed the relevant mechanisms involved in political interactions. However, how these two relevant phenomena relate to each other is still unclear. To address this question, we propose a multidimensional agent-based model that incorporates two main mechanisms: homophily, in which people who share similar opinions are more likely to interact, and ingroup-coherence favoritism, in which partisans are more attracted to coherent ingroups rather than incoherent or outgroup members. We developed and solved the model's master equations that perfectly describe the simulated model's dynamics. We found that the ideological alignment reported in political opinions in several experiments can only be explained by the presence of ingroup-coherence favoritism in pairwise interactions. By comparing the model's outcomes with more than 20,000 opinions from people living in different countries, the model can infer the weight of ingroup-coherence needed to match each other. We found a strong correspondence between the presence of this mechanism and the political content of the answers. This work helps us understand the role of ingroup-coherence favoritism in political opinion formation and sheds light on the importance of combining efforts from experimental approaches, theoretical modeling, and large-scale empirical studies.

## INTRODUCTION

The increasing political polarization<sup>1-3</sup> has become a worrying concern in many different countries<sup>4</sup> and a serious threat to society and democracy itself<sup>5</sup>. From the multiple negative consequences of polarization, one recent event stands out. We now know that an effective response to the COVID-19 pandemic required a developed healthcare system, a fast adoption of new social norms, and large-scale cooperation<sup>6-8</sup>. Unfortunately, some solutions were hindered by political polarization as this social phenomenon exacerbates misinformation<sup>9,10</sup> and conditions partisans' compliance to cooperation<sup>11-14</sup>. This is only one particular example of the huge impact polarization is having in both political and nonpolitical aspects of society<sup>3,5,15</sup>. In response to this scenario, interdisciplinary efforts combining empirical and theoretical approaches, have sought to better understand the involved mechanisms and the conditions under which societies are expected to polarize<sup>16-23</sup>.

One promising way to address this question is by studying the behavior of agent-based models (ABMs) under different conditions of social influence and interactions. From a modeling point of view, several mechanisms have been explored in order to explain issue polarization. For instance, bounded confidence<sup>24-27</sup>, negative influence or repulsion<sup>28-30</sup>, or homophily in conjunction with other mechanisms such as social influence in cultural vectors<sup>31</sup>, persuasive arguments theory<sup>32,33</sup>, or biased assimilation<sup>16</sup>. Based on a few simplistic assumptions, most studies have focused on under which conditions individuals may polarize and become more extreme across one single topic, even though this simplification lacks the possibility of modeling phenomena that arise due to the interplay of multiple issues.

While disagreement on policy issues is increasing and is receiving great attention, opinions are also becoming more extreme and more aligned across diverse and seemingly unrelated topics. People are becoming ideologically sorted in terms of partisanship leading to an issue alignment<sup>2,34,35</sup>. For example, an individual who supports the women's right to voluntarily terminate pregnancy will be more likely to support stricter legislation on gun control, even though these topics are, a priori, unrelated to each other. Particularly in the US, voters of the Democratic party are becoming consistently more liberal and Republican voters more conservative. In a more general case, we can consider two possible ideological dimensions: the left- and the right-wing in which opinions are becoming more aligned.

In a recent paper, large scale social experiments have shown that people not only hold politically coherent opinions across very different issues but also that this property, i.e., political coherence, increases interpersonal attraction among co-partisans<sup>36</sup>. In other words, individuals who hold coherent opinions are more attractive than those individuals having some degree of ambivalence in their attitudes (e.g., a person who is anti-abortion but supports gun control). This idea is in line with previous findings that showed that people favor pro-norm deviants<sup>37,38</sup>. However, whether and how this driver of interpersonal attraction relates to macro-level patterns of political polarization and partisan-ideological sorting remains largely unknown.

This endeavor necessarily requires the formulation of multidimensional dynamic models where polarization could arise in independent individual topics (with no correlation between them) or as in proportion, there are far fewer models that study opinion in multidimensional spaces, which could give rise to these phenomena <sup>39-44</sup>. While modeling ideological sorting has been addressed by considering continuous opinions and non-orthogonal and overlapping topics <sup>45</sup> or directional voting, i.e. people prefer others whose opinions are on the same side as them <sup>46</sup>, previous models incorporate their key mechanisms based on theoretical works. In this paper, we developed an agent-based model where homophily and ingroup-coherence favoritism are the primary mechanisms involved in the pairwise interactions between agents. Here we show that, by incorporating this latter novel experimental finding from political psychology at the microscopic level, issue alignment emerges starting from a random distribution of opinions. We formulated the model, ran multiple simulations, and solved its master equations obtaining the same results. We compared different final states with actual data from multiple datasets that include more than 20,000 opinions on different controversial issues. The analyses indicate that homophily alone is insufficient to account for the ideologically sorted states, highlighting the significance and impact of ingroup-coherence favoritism in political interactions.

## BACKGROUND

In the paper “Political coherence and certainty as drivers of interpersonal liking over and above similarity”<sup>36</sup>, the authors performed three different studies in different countries and found that people are more attracted to politically coherent ingroups rather than to those who hold ambiguous or ambivalent opinions. In this study, someone was considered as coherent if her/his opinions were aligned with her/his political ideology. For example, a coherent Democrat would be pro-choice regarding abortion and also favor stricter gun control.

The authors performed two live experiments in which participants were arranged in dyads, discussed five controversial topics, and completed an interpersonal attraction questionnaire. They observed and replicated that interpersonal liking increases as a function of similarity but also of ingroup coherence. With this latter finding, liking was found to be nonreciprocal: people with ambivalent and uncertain political views were more attracted to coherent ingroups than vice versa. These results were validated by performing an online pre registered experiment in which political coherence was experimentally manipulated. Overall, their results indicate that liking in the political domain may not be solely driven by homophily but by more complex notions of group affiliation such as ingroup coherence.

## THE MODEL

### Agents, opinions, and communities

We considered a system of  $N$  agents. Each agent holds a multidimensional vector opinion, where each dimension stands for the agent’s opinion on a particular issue (For the sake of simplicity, we considered only two issues). For each issue, the agent could be against, undecided, or in favor. Two considerations about how opinions are modeled are to be made: Firstly, the inclusion of a neutral or undecided state is grounded on modeling approaches<sup>47–50</sup>, behavioral experiments<sup>48,51</sup> and surveys (e.g., ANES). Secondly, in order to define a metric for quantifying ingroup coherence, we assume that every political issue expressing a right-wing opinion will be labeled as +1, left-wing opinions as -1, and undecided as 0.

Therefore, in terms of coherence, we can define four different communities:

- Coherent agents (C): Agents that hold assertive and matching opinions on both issues. Left-wing coherent agents ( $C_L$ ) hold both left-wing opinions ( $O=(-1,-1)$ ) and right-wing coherent agents ( $C_R$ ) hold right-wing opinions ( $O=(1,1)$ ).
- Incoherent agents (I): Agents that hold assertive but opposite opinions on the two different issues. Incoherent agents hold one left-wing opinion and one right-wing opinion ( $O=(-1,1)$  or  $O=(1,-1)$ ).
- Weak agents (W): Agents that hold an assertive opinion in one issue and are undecided regarding the other one. Agent’s ideology is determined by the political leaning of its assertive opinion ( $O=(-1,0)$  or  $O=(0,-1)$  are considered left-wing weak agents and  $O=(1,0)$  or  $O=(0,1)$  right-wing weak agents).
- Apathetic agents (A): Agents that are undecided on both issues ( $O=(0,0)$ ).

Following these definitions, every possible agent's opinions can be mapped into a 3x3 board as shown in Fig. 1A.

In this work, we focused on the populations' dynamics of each community. Agents' opinions were initially independent and uniformly distributed. Because the number of possible combinations of opinions is not the same for each community, the initial proportion of agents for each community varies. For example, the initial proportion of coherent and incoherent agents is 2/9, while the proportion of weak agents is 4/9.

### Agents' metrics

In what follows, we show how we define similarity and ingroup coherence and how to implement them in the mechanism of interaction between agents.

First, we defined similarity between the agents  $i$  and  $j$  ( $S_{ij}$ ) as a function of the Manhattan distance between the agents' opinions (i.e. the absolute value of the sum of the distance in both coordinates). If two agents hold the same two opinions similarity is 1, and it is 0 if they have opposite stances on both issues. This is computed as:  $S_{ij} = 1 - \frac{|(O_i - O_j)|_1}{4}$

For example, as depicted in Fig. 1B, for agents  $i$  and  $j$  with opinions  $O_i=(0,1)$  and  $O_j=(1,1)$ , the similarity between them is  $S_{ij}=S_{ji}=3/4$  while for an agent  $m$  with opinion  $O_k=(-1,0)$  the similarity with  $i$  is  $S_{ik}=S_{ki}=2/4$ .

Second, in order to implement attraction from ingroup coherence, we define two metrics:

Agents' ideology computed as:  $I_i = \frac{O_i^{(x)} + O_i^{(y)}}{2}$ , which ranges from -1 to 1.  $I_i=-1$  corresponds to left-wing coherent agents which hold two left-wing opinions and  $I_i=+1$  corresponds to right-wing ones. Weak agents have an absolute value of  $I_i=0.5$  and incoherent agents  $I_i=0$ . The ideology's sign value corresponds to the agent's leaning: a positive value describes right-wing agents and a negative one describes left-wing agents. Agents whose ideology is 0 are neutral as they do not belong to any of the two groups.

Ingroup coherence, computed as  $C_{ij} = |I_i| \delta_{ij}$  (where  $\delta$  is 1 if  $i$  and  $j$  have the same ideology's sign and 0 otherwise), depends on both agents' ideology and the partner agent's coherence. It takes positive values for dyads who share the same leaning and it is 0 otherwise. Its maximum possible value corresponds to coherent ingroup agents and it is 0 for outgroup agents. This measure is not commutative and this is in line with experimental results that showed that social influence is not always reciprocal<sup>52</sup>.

In Fig. 1C, we show an example for the three agents  $i$ ,  $j$ , and  $m$ . The ingroup coherence that  $j$  perceives from  $i$  is  $C_{ij}=0.5$ , while the coherence that  $i$  perceives from  $j$  is  $C_{ji}=1$ . Meanwhile, the ingroup coherence between  $i$  and  $m$  is 0 as they have ideologies with opposite signs. Interestingly, ingroup coherence for neutral agents is 0 with all communities.

## Interactions dynamics

In this model, agents interact with each other and these interactions influence agents' opinions. At each time step, two agents are randomly selected and their interaction would lead one of the agents to influence the other with probability "P". We incorporated two different mechanisms that impact agents' influence: homophily<sup>53,54</sup> and ingroup coherence<sup>36,55</sup>, as were defined previously. This probability of influence is implemented as a linear combination of both mechanism:

$P_{ij} = (1 - k)S_{ij} + kC_{ij}$ . The parameter  $k$  modulates the strength of each of the two terms and ranges from 0 to 1. When  $k$  is 0, interactions are only driven by homophily and, when it is 1, only by ingroup coherence. Any intermediate value takes into consideration both dynamics as proposed by previous experimental work.

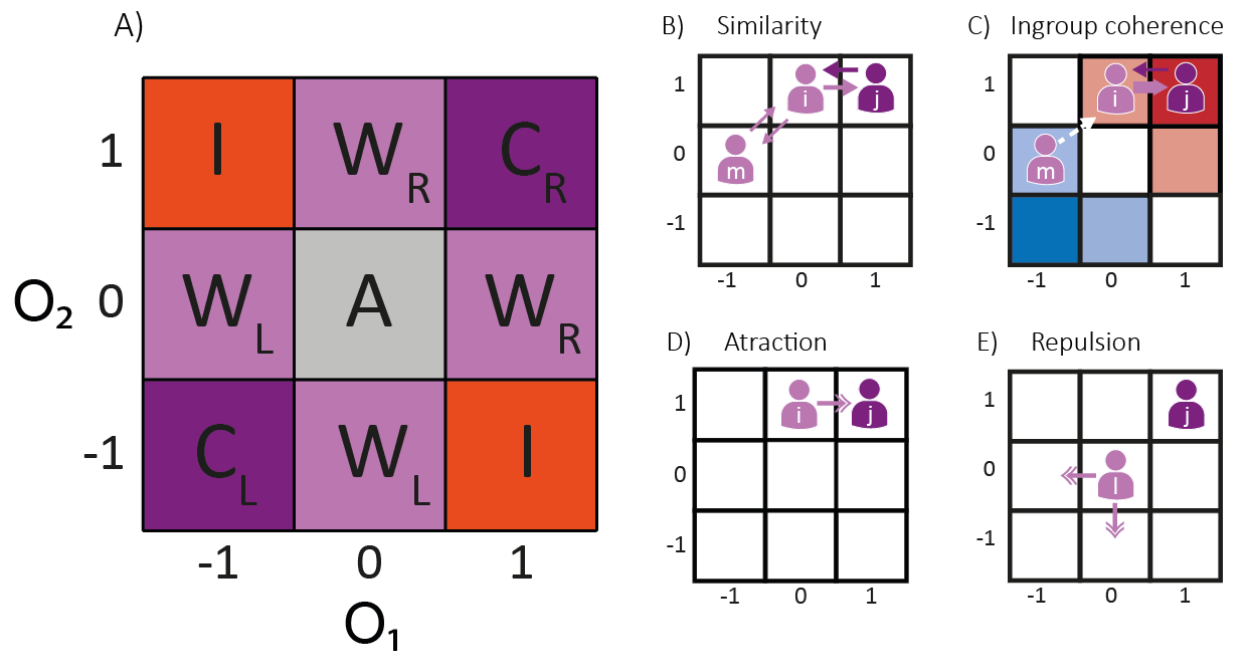
Pairwise interactions lead to opinion changes that could occur only in one of the two issues in discussion. Following field-experiment results that showed that partisans who are taken out of their Twitter's echo-chamber became more extreme<sup>56</sup>, this model's interactions can be attractive, repulsive, or have no effect depending on agents' similarity. When agents are similar enough, influence will be attractive and agent  $i$  will move closer to  $j$  by changing one of its own opinions as depicted in Fig. 1D. Conversely, for dissimilar agents they can repel or ignore each other. In this last case (non-repulsive model), it can be thought of as an extension to 2D of a bounded confidence mechanism<sup>24,27,57</sup>. In the repulsion case, agent  $i$  changes one of its opinions (selected at random) moving further from agent  $j$  and reducing their similarity as shown in Fig. 1E. It can happen that the agent can not move any further in the selected direction and, in this particular case, no change will be made and the interaction would have no effect at all. For example, in the case of an agent holding  $O = (-1, -1)$  that could not move further to negative values in any dimension.

We set the attraction-similarity boundary at similarity 3/4. This means that for greater or equal similarity values of 3/4, interactions are attractive and they are repulsive or have no effect otherwise.

### Summary of interaction rules

In summary, let  $N$  agents hold two different opinions initially randomly distributed. For each time step:

- Two agents  $i$  and  $j$  are randomly chosen.
- We compute  $S_{ij}$ ,  $I_{ij}$  according to their opinions.
- Agent  $i$  influence  $j$  with probability  $P_{ij}$
- The influence can be attractive, repulsive, or have no effect depending on the agents' similarity.
- The agent  $i$  can modify its opinion on one of the two issues.



**Figure 1: The model.** **A)** Each agent holds an independent opinion on two different topics and according to their opinions they are classified in four different communities: coherent (C), incoherent (I), weak (W), or apathetic (A). Additionally, agents' opinions define their ideology. Agents can be considered left- or right-wing (L or R) depending on whether most of their opinions are left- or right-wing oriented. **B)** Similarity measures how similar are the opinions between two agents. It is a commutative measure. Similarity between agents  $i$  and  $j$  ( $S_{ij}=S_{ji}=0.75$ ) is higher than similarity between  $i$  and  $m$  ( $S_{ik}=0.5$ ) as the manhattan distance is lower. **C)** Ingroup coherence measures the target agent's political coherence. This is a non-commutative measure.  $C_{ji}$  is 1 because agent  $j$  is coherent, but  $C_{ij}$  is 0.5 because  $i$  is a weak agent.  $C_{ki}$  is 0 because agents do not share the same ideology. While  $i$  is a right-wing oriented agent,  $m$  is left-wing oriented. **D)** Interactions between similar agents are attractive. After an interaction between  $i$  and  $j$ ,  $i$  changes its opinion and moves closer to  $j$ . **E)** Interactions between dissimilar agents are repulsive. After an interaction between  $I$  and  $j$ ,  $I$  changes its opinion and moves further from  $j$ . This movement could be to the left or down with probability 0.5.

## SIMULATIONS

We present the results of the model's simulations. All simulations were done for systems with  $N=1000$  agents and we ran 100 simulations per set of parameters. The parameter  $k$  was varied from 0 to 1 by steps of 0.05. Simulations stopped when the system reached the stationary state, and no agent could move from one community to another.

We observed the proportion of agents in each community over time and focused on the system's final state. For every  $k < 1$ , weak and apathetic communities disappear. Fig. 2A shows the final distribution of coherent and incoherent communities for different  $k$  values. When  $k=0$  the proportion of coherent and incoherent agents are the same ( $C(t_f)=I(t_f)=0.5$ ) and there is no correlation between opinions (Fig. 2A top-left inset). As  $k$  increases, so does the proportion of coherent agents (Fig. 2A top-right inset).

In the specific case where interactions are solely driven by ingroup coherence ( $k=1$ ), apathetic

and incoherent agents do not interact with any other population, so these groups do not change over time.

## MASTER EQUATIONS

We developed a set of master equations that describe the dynamics of the agents' communities. As at each interaction, two agents are randomly selected, the probability of choosing an agent from a particular community depends on the community's proportion. We computed the likelihood of changing opinions after pairwise interactions and obtained the flux's expected values between populations.

For example, we calculated the probability of a weak agent becoming coherent or vice versa by considering the four possible scenarios in which this could occur:

- A weak agent interacts with a coherent neighbor with probability  $WC/2$  (where  $W$  and  $C$  are the proportion of Weak and Coherent agents, respectively). With influence probability given by  $P = (1 - k)\frac{3}{4} + k$ , the weak agent would move to the coherent population.
- A weak agent interacts with another weak agent with an opposite ideology with probability  $W^2/4$ . With probability  $P = (1 - k)\frac{1}{2}$  it would become coherent, and due to a repulsive interaction it would become coherent.
- A weak agent interacts with an opposite ideology coherent agent with probability  $WC/2$ . With probability  $P = (1 - k)\frac{1}{4}$  and it would move to the coherent population due to a repulsive interaction it would move to the coherent population.
- A coherent agent interacts with an adjacent weak agent with probability  $WC/2$ . With probability  $P = (1 - k)\frac{3}{4} + k/2$  the coherent agent would move to the weak population.

By repeating this analysis with the other communities, we obtained the following equations:

$$\frac{dC}{dt} = WC\left(\frac{1-k}{16} + \frac{k}{4}\right) + W^2\frac{1-k}{16}$$

$$\frac{dI}{dt} = WI\frac{1-k}{16} + W^2\frac{1-k}{16}$$

$$\frac{dA}{dt} = -AC\frac{1-k}{2} - AI\frac{1-k}{2}$$

$$\frac{dW}{dt} = -WC\left(\frac{1-k}{16} + \frac{k}{4}\right) - WI\frac{1-k}{16} - W^2\frac{1-k}{8} + AC\frac{1-k}{2} + AI\frac{1-k}{2}$$

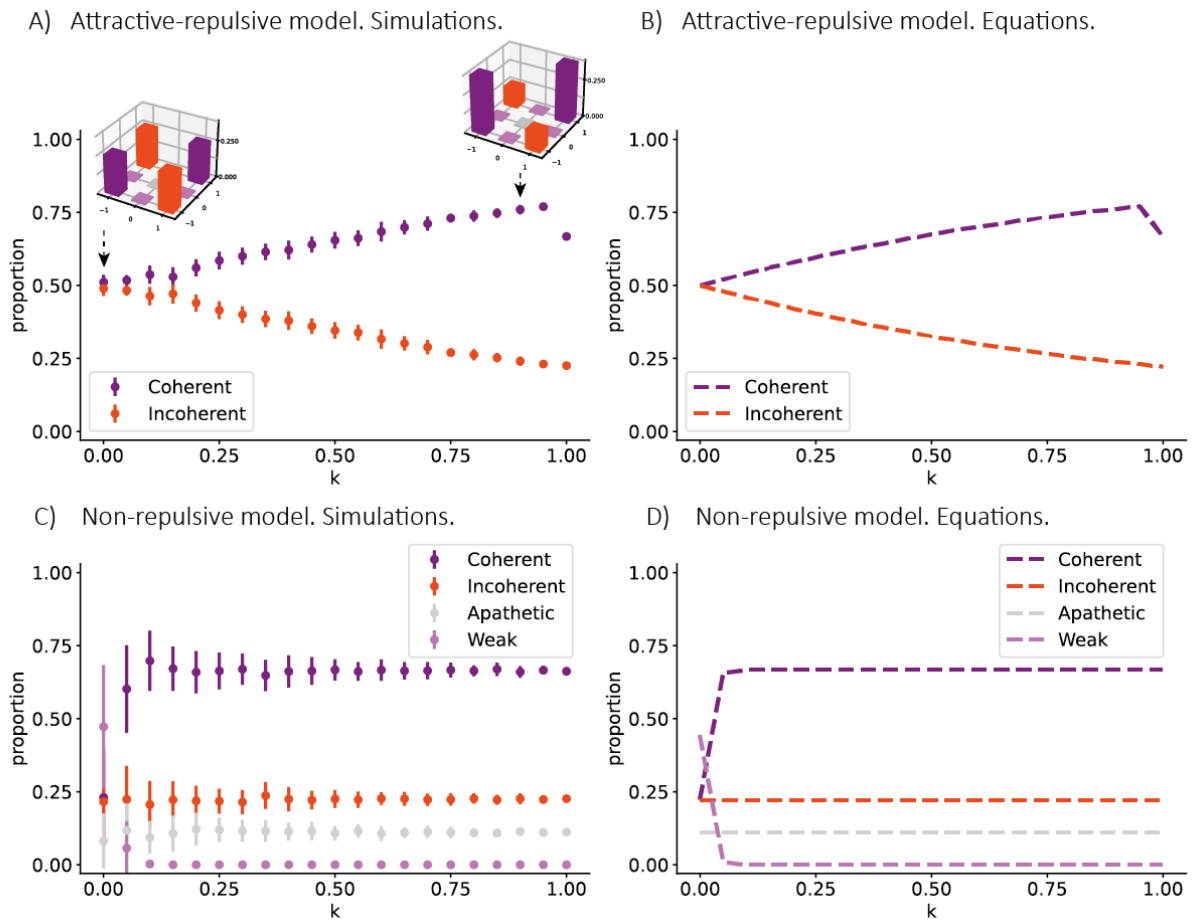
We solved them numerically with agents' initial opinions randomly distributed. It corresponds to  $C(0)=I(0)=2/9$ ,  $A(0)=1/9$ , and  $W(0)=4/9$ . Then we observed the final distribution of each community, as can be observed in Fig. 2B for coherent and incoherent communities for different values of  $k$ . We obtained the same results from the analytical solutions (Fig. 2B) and the simulations' final states (Fig. 2A). Particularly, when  $k=0$ , interactions are only driven by homophily. Coherent and incoherent populations exhibit the same behavior ( $dC/dt=dI/dt$ ). Consequently, the final agents' proportions are the same for both communities. When  $k=1$ , interactions are only driven by ingroup coherence, and, on average, apathetic and incoherent populations do not change over time ( $dA/dt=dI/dt=0$ ). In the same way as in the simulations, we observe that as  $k$  increases so does the number of coherent agents.



We also developed and solved the equations for the non-repulsive variant of the model . The terms involving repulsive interaction are not present and the dynamic equations are as follows:

$$\begin{aligned}\frac{dC}{dt} &= WC\frac{k}{4} \\ \frac{dI}{dt} &= 0 \\ \frac{dA}{dt} &= 0 \\ \frac{dW}{dt} &= -WC\frac{k}{4}\end{aligned}$$

In this variant, incoherent and apathetic communities, on average, do not change over time. When  $k > 0$ , all weak agents become coherent, and, as a consequence, their communities' final proportions of agents do not depend on  $k$ . Fig. 2C shows the simulations' final state and Fig. 2D the numerical solutions for the non-repulsive model.



**Figure 2: Final states.** The model's final states are shown for different values of  $k$ . **Attractive-repulsive model:** **A)** The figure depicts the mean (dots) and the standard deviation (error bar) values of the final populations' proportions. The coherent community is shown in purple and the incoherent one in orange. For  $k < 1$ , as  $k$  increases, so does the final proportion of coherent agents. The top-left inset shows the agents' opinions' mean final distribution for  $k=0$  and the top-right inset for  $k=0.9$ . **B)** The figure depicts the

analytical solution of the model. It shows the final proportion of coherent agents in purple and the final proportion of incoherent agents in orange. **Non-repulsive model: C)** The figure shows the final populations' proportions. The coherent community is shown in purple, the incoherent one in orange, the apathetic community in gray, and the weak one in pink. For  $k > 0$ , their final proportions of coherent agents do not vary significantly with  $k$ . **D)** The figure depicts the analytical solution of the non-repulsive model.

## COMPARISON WITH EMPIRICAL DATA

Here, we focus on one of the multiple phenomena of political polarization: ideological sorting, in which opinions on seemingly unrelated topics display a strong correlation with each other. In the context of the proposed model, higher ideological sorting corresponds to an increase in the proportion of coherent agents. Next, we analyze to what extent actual opinions on a wide variety of controversial issues are sorted and can be analyzed in the context of the developed model to study the role of homophily and ingroup-coherence in opinion dynamics. We work with multiple data sources with more than 20,000 responses on 80 different polarizing topics. All responses indicate whether participants agree or not to each different issue (Table 1).

### Datasets

**Zimmerman et al. 2022.** They conducted multiple behavioral experiments in order to understand how people perceive politically coherent individuals. First, they performed an online survey asking 180 participants from Argentina for their opinion on 28 different topics to select relevant and controversial political issues. This survey allowed them to select the five political issues and the five non-political topics they used in an experiment with 5,038 participants.

**ANES 2020 and 2016.** The American National Election Studies (ANES) are national representative surveys of eligible American voters. Surveys have been conducted before and after every presidential election since 1948. All of the questions are related to US politics. We only made use of the survey's questions which express participants' approval or disapproval of controversial issues, and we worked with data from the last two surveys. The survey performed before the 2020 presidential election was completed by 8,280 citizens, while the one before the 2016 election by 4,270.

**Freira et al. 2021.** They performed an online behavioral experiment in 2020 in four different countries to understand how partisan differences influenced the COVID-19 pandemic perception. 1,995 participants from Argentina, Brazil, Uruguay, and the USA expressed their opinion on eight different pandemic preventive political policies.

**Pew Research 2020 and 2014 surveys.** The Pew Research Center is an American think tank that provides information on social issues and public opinion trends. Their different representative surveys cover a wide variety of topics, such as U.S. politics, climate, religion, and driverless vehicles. For our purposes, we selected two surveys: one oriented to understand the public's opinion on American federal agencies and the other to study how religion influences the daily lives of Americans. The first one was performed in 2020 and 1,013 participants completed an omnibus survey expressing whether they favor or not different American federal organizations. On the 2014 trends panel survey, 3,278 Americans completed a self-administered web survey covering a wide range of topics including religion and personal opinions. Within this survey, we focused on personal opinions on topics such as lying or meditation.

Although every popular opinion is of interest to political science, we observed that some of the selected datasets cover topics that are part of specific partisan agendas, e.g., abortion or gun control. We considered this set of opinions as political. Besides, some issues are not relevant to any political platform, e.g., pets or food preferences. This latter group of topics was labeled as non-political (Table 1).

Source and year	Number of selected issues	Number of participants	Country	Topic
Zimmerman et al. 2022	20	5,218	Argentina	Political & non-political
ANES 2020	14	8,280	USA	Political
ANES 2016	28	4,270	USA	Political
Freira et al. 2021	8	1,642	Argentina, Brazil, Uruguay & USA	Political
Pew Research 2020	5	1,013	USA	Political
Pew Research 2014	5	3,278	USA	Non-Political

**Table 1:** A brief summary of the most relevant characteristics of the six data sources considered in this work: the source, the year in which the survey was conducted, the number of selected issues, the number of participants who completed each survey, the country, and whether topics are related to politics or not. More than 20,000 responses on 80 different topics were used to fit the model’s parameters.

For each dataset, we selected the questions that express participants’ opinions on a particular topic. Moreover, we only consider controversial issues in which there is not a majoritarian opinion. The selected issues’ responses exhibit high variance following our selection criteria ( $\sigma^2 > 0.5$ ). Following the proposed model, all responses were mapped into three possible answers: -1, 0, or 1 where 0 expresses an undecided or neutral posture. For some questions this procedure was trivial, but for others, we merged different degrees of acceptance into one unique alternative. For example, all the following answers were considered as an agreement to our model: ‘agree strongly’, ‘agree somewhat’, ‘very favorable’, and ‘mostly favorable’. Furthermore, in order to observe ideological alignment, we needed to code responses as in the model: right-wing opinions as 1 and left-wing opinions as -1 regardless of how the question was presented. To do so, we followed the procedure proposed by Zimmerman et. al 2022 where they projected the agree/disagree opinions to the data’s first principal component, which (in the political domain) is equivalent to coding them as left/right-wing answers and align the responses into their corresponding ideology.

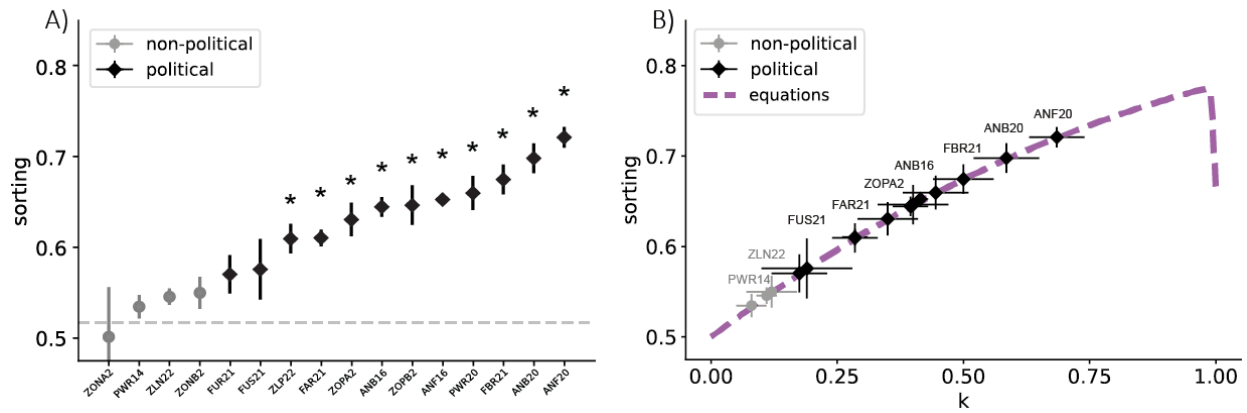
## Sorting

In order to contrast the data's partisan-ideological sorting to the proposed two-dimensional model, we focused only on the relationship between the proportion of coherent (C) and incoherent (I) opinions. We computed sorting (S) as the proportion of coherent agents in relationship with the coherent and incoherent communities for all the possible pairs of opinions within each dataset:  $S = \frac{C}{(C+I)}$ . Fig. 3A shows the mean sorting value for each dataset ranked from lowest to highest. Non-political datasets are shown in light gray dots and black diamonds are used for political datasets. Noteworthy, the political datasets exhibit the highest sorting values.

Furthermore, we followed the same procedure to compute the mean sorting value of 100 simulations where  $k=0$ , this is, homophilic-only simulations. First, for each simulation's final state, we projected the opinions to their first principal component, and then we computed the corresponding sorting value. The mean sorting value of the simulations ( $y=0.52$ ) is depicted in a dashed horizontal gray line (Fig. 3A). We observed that not any non-political sorting value is significantly different from homophilic-only simulations (one sample t-test;  $t_s < 3.1$ ,  $p_s > 0.013$ ) and 10 out of 12 political sorting values are ( $t_s > 5.7$ ,  $p_s < 0.0004$ ).

Additionally, having the model's analytical solution allows us to map every sorting value into its corresponding model's  $k$  parameter as shown in Fig 3B. Consequently, the political datasets correspond to the highest  $k$  values.

Taken altogether, by combining the model with actual data we found that non-political controversial opinions exhibit the lowest observed levels of sorting which can be explained by homophily and attractive-repulsive interactions. But, in the political domain, homophily alone can not explain the emergence of the observed levels of ideological sorting. These results are in accordance with recent experimental work that showed that both homophily and ingroup coherence favoritism are relevant in pair-wise political interactions. What is more, our model allowed us to study how these mechanisms impact the macroscopic opinions' landscape. Particularly, how they relate to issue-polarization and ideological alignment.



**Figure 3: Fitting the model's parameters to actual opinions on different topics. A)** The figure shows the mean sorting value for each dataset ranked from lowest to highest. Non-political datasets are shown in light gray dots and black diamonds are used for political datasets. Acronyms refer to different sets of questions as described in Table S1. The asterisks indicate whether the sorting value is significantly higher than the one observed in homophilic-only simulations ( $*p < 0.01$ ). **B)** Every dataset's mean sorting value was mapped to its corresponding model's  $k$  value. Non-political datasets are shown in light gray and political ones in black.

## DISCUSSION

In this work, we propose an agent-based model to study how novel findings from experimental psychology could explain the observed opinion dynamics at the macro level. This model considers two well known and studied phenomena: Agents who share similar opinions are more likely to interact and, also, these pairwise interactions can be attractive or repulsive depending on their similarity. Moreover, we included a third and novel experimental finding in which people and therefore agents are more attracted to coherent ingroups rather than incoherent or outgroup members. Interestingly, by incorporating this last assumption, opinions become more aligned and we were able to reproduce different correlation patterns similar to those widely observed among political opinions, i.e., ideological sorting.

We developed a two-dimensional model as our main interest was to study the effect of ingroup-coherence favoritism in political interaction and its impact on ideological sorting. The commonly used one-dimensional models of opinion formation lack the possibility to model these mechanisms as well as other relevant phenomena involving the relation between topics. The implementation of opinion models necessarily requires making assumptions to decide which dynamics should be implemented and how. Here, the criterion was to consider only mechanisms that are experimental findings from social psychology and not merely hypothetical assumptions. Additionally, we compared the model's outcomes with more than 20,000 opinions on controversial issues. These opinions belong to multiple surveys which studied a wide diversity of topics in different countries. As we formulated and solved the model's master equations, we were able to fit the model's parameter  $k$ . This allowed us to replicate the opinions' distribution for every dataset, observe that there are different mechanisms involved in political and non-political discussions, and study which underlying psychological mechanisms could be driving the observed increase in ideological sorting. For instance, for the non-political datasets,  $k$  was not found to be significantly different from 0, implying that ingroup-coherence does not influence these debates. These results are consistent with previous studies that showed that ingroup-coherence is characteristic of the political domain.

Moreover, our analysis helped us understand the relationship between the different data sources and the traditional political parties' agendas. For example, the ANES' results, which cover the most relevant and discussed topics within American politics, exhibit a higher proportion of coherent respondents. On the other end, the least aligned political topics are related to the COVID-19 pandemic perception<sup>58</sup>. On the one hand, opinions regarding the pandemic are recent and they are not expected, a priori, to be aligned to a particular political platform. On the other hand, the required response to control the virus' spread is not merely political, as it involves both political and personal aspects of every citizen. Also, we know that the perception and compliance to the recommended behavior widely varied in different countries and contexts<sup>59-62</sup>.

The simplicity of the proposed model comes with its limitations. Firstly, we focused our study on controversial issues that exhibit a low proportion of undecided opinions. Whether and how the proposed model could explain other opinions' distributions remains unexplored. Secondly,

although it allows us to capture the temporal dynamics of opinions, it is hard to define an adequate time frame in order to match the model time evolution with actual observed opinion changes. Finally, we observed that it is not possible to replicate the correlation patterns of political opinions by only taking into account attractive and repulsive homophilic interactions. But this observation does not necessarily imply that ingroup favoritism is the one and only mechanism driving ideological alignment. More behavioral experiments are needed to understand the importance of each of the multiple factors associated with the increase of ideological sorting.

It has become urgent to find and implement solutions to the worryingly rising political polarization. As issue polarization, outgroup hate and distrust, political segregation, and ideological alignment increase, democracy gets weaker. One key element of this herculean mission is to fully understand the underlying social, political, and psychological mechanisms driving polarization. To do so, more combined efforts from experimental approaches, theoretical modeling, and large-scale empirical studies are needed.

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## APPENDIX

Source and year	Set of questions	Acronym	N. of issues	N. of part.	Country	Topic
Zimmerman et al. 2022	Live experiment. Political issues.	ZLP22	5	2,632	Argentina	Political
Zimmerman et al. 2022	Online survey. Political issues A.	ZOPA2	6	88	Argentina	Political
Zimmerman et al. 2022	Online survey. Political issues B.	ZOPB2	6	92	Argentina	Political
Zimmerman et al. 2022	Live experiment. Non-political issues.	ZLN22	5	2,406	Argentina	Non-Political
Zimmerman et al. 2022	Online survey. Non-political issues A.	ZONA2	4	88	Argentina	Non-Political
Zimmerman et al. 2022	Online survey. Non-political issues B.	ZONB2	5	92	Argentina	Non-Political
ANES 2020	All opinion questions	ANF20	14	8,280	USA	Political
ANES 2020	Binary choice questions	ANB20	5	8,280	USA	Political
ANES 2016	All opinion questions	ANF16	28	4,270	USA	Political
ANES 2016	Binary choice questions	ANB16	11	4,270	USA	Political
Freira et al. 2021	Argentinian survey	FAR21	8	639	Argentina	Political
Freira et al. 2021	Brazilian survey	FBR21	8	352	Brazil	Political
Freira et al. 2021	Uruguayan survey	FUR21	8	371	Uruguay	Political
Freira et al. 2021	American survey	FUS21	7	614	USA	Political
Pew Research 2020	All opinion questions	PWR20	5	1,013	USA	Political
Pew Research 2014	Non-political issues	PWR14	5	3,278	USA	Non-Political

**Table S1:** The most relevant characteristics of all the datasets used in work: the source, the set of questions, the year in which the survey was conducted, the number of selected issues, the number of participants who completed each survey, the country, and whether topics are related to politics or not.

### **Overview of all the analyzed questions:**

#### **Zimmerman et al. 2022 - Live experiment. Political issues**

1. High school students should be allowed to go on strike.
2. The government should mandate a transgender hiring quota for public servants.
3. The government should subsidize the broadcasting of Argentine football matches.
4. National universities should start charging a fee to those who can afford it.
5. Argentina should sign bilateral trade agreements with the United States.

#### **Zimmerman et al. 2022- Online survey. Political issues A**

1. In order to progress, Argentina should imitate developed countries.
2. The government should mandate a transgender hiring quota for public servants.
3. No union claim should interfere with the free movement of persons.
4. The government should subsidize the broadcasting of Argentine football matches.
5. The minimum age of criminal responsibility in Argentina (now 16 years) should be reduced.
6. The sentence for rapists should be the death penalty.

Not considered because they were not found to be controversial:

- The state should not subsidize any religious institution.
- The consumption or use of recreational drugs should not be a crime.

#### **Zimmerman et al. 2022 - Online survey. Political issues B**

1. If someone does graffiti on a public building, they should be detained.
2. Argentina should sign bilateral trade agreements with the United States.
3. National universities should start charging a fee to those who can afford it.
4. High school students should be allowed to go on strike.
5. People with criminal records should not receive any state subsidy.
6. Foreigners should pay for medical care in an Argentine public hospital.

Not considered because they were not found to be controversial:

- Heterosexual couples should have higher priority than gay couples to adopt.
- Abortion should not be a crime.

#### **Zimmerman et al. 2022 - Live experiment. Non-political issues**

1. One should choose to adopt a dog over a cat.
2. Everyone should use a bidet if they have the possibility.
3. All good barbecues must have blood sausages.
4. Baked schnitzels taste better than fried schnitzels.
5. It is better to go on holidays to the mountains rather than to the seaside.

### **Zimmerman et al. 2022 - Online survey. Non-political issues A**

1. Everyone should use a bidet if they have the possibility.
2. When ordering a dozen 'medialunas' more than half should be of animal grease instead of butter.
3. In order to improve the taste, 'empanadas' should carry raisins.
4. One should choose to adopt a dog over a cat.

Not considered because they were not found to be controversial:

- Argentinian Rock radio stations should play more Redondos' songs than Soda Stereo's.
- Whenever possible one should choose the aisle seat over the window seat.

### **Zimmerman et al. 2022 - Online survey. Non-political issues B**

1. All good barbecues must have blood sausages.
2. Baked schnitzels taste better than fried schnitzels.
3. It is better to go on holidays to the mountains rather than to the seaside.
4. Maradona should receive the award as 'best history Argentinian soccer player' and Messi should not.
5. 'Queso y dulce' dessert should have sweet potato and not quince.

Not considered because they were not found to be controversial:

- 'Mate' should be taken with sugar and not bitter.

### **ANES 2020 - All opinion questions**

#### **1. V201252 MEDICAL INSURANCE**

Where would you place yourself on this scale, or haven't you thought much about this? From Government insurance plan to Private insurance plan

#### **2. V201258 GOV ASSISTANCE TO BLACKS**

Where would you place yourself on this scale, or haven't you thought much about this? From Government should help blacks to Blacks should help themselves

#### **3. V201306 FEDERAL BUDGET SPENDING: TIGHTENING BORDER SECURITY**

What about tightening border security to prevent illegal immigration? Should federal spending on tightening border security to prevent illegal immigration be increased, decreased, or kept the same?

#### **4. V201309 FEDERAL BUDGET SPENDING: DEALING WITH CRIME**

What about dealing with crime? Should federal spending on dealing with crime be increased, decreased, or kept the same

#### **5. V201318 FEDERAL BUDGET SPENDING: AID TO THE POOR**

What about aid to the poor? Should federal spending on aid to the poor be increased, decreased, or kept the same?

#### **6. V201336 STD ABORTION**

There has been some discussion about abortion during recent years. Which one of the opinions on this page best agrees with your view?

- a) By law, abortion should never be permitted



- b) The law should permit abortion only in case of rape, incest, or when the woman's life is in danger
- c) The law should permit abortion other than for rape/incest/danger to woman but only after need clearly established
- d) By law, a woman should always be able to obtain an abortion as a matter of personal choice

#### 7. V201406 SERVICES TO SAME SEX COUPLES

Do you think business owners who provide wedding-related services should be allowed to refuse services to same-sex couples if same-sex marriage violates their religious beliefs, or do you think business owners should be required to provide services regardless of a couple's sexual orientation?

#### 8. V201409 TRANSGENDER POLICY

Should transgender people - that is, people who identify themselves as the sex or gender different from the one they were born as - have to use the bathrooms of the gender they were born as, or should they be allowed to use the bathrooms of their identified gender?

#### 9. V201415 GAY AND LESBIAN COUPLES BE ALLOWED TO ADOPT

Do you think gay or lesbian couples should be legally permitted to adopt children?

#### 10. V201416 POSITION ON GAY MARRIAGE

Which comes closest to your view?

- a) Gay and lesbian couples should be allowed to legally marry
- b) Gay and lesbian couples should be allowed to form civil unions but not legally marry
- c) There should be no legal recognition of gay or lesbian couples' relationship

#### 11. V201417 US GOVERNMENT POLICY TOWARD UNAUTHORIZED IMMIGRANTS

Which comes closest to your view about what government policy should be toward unauthorized immigrants now living in the United States?

- a) Make all unauthorized immigrants felons and send them back to their home country
- b) Have a guest worker program that allows unauthorized immigrants to remain in US to work but only for limited time
- c) Allow unauthorized immigrants to remain in US & eventually qualify for citizenship but only if they meet requirements
- d) Allow unauthorized immigrants to remain in US & eventually qualify for citizenship without penalties

#### 12. V201418 FAVOR OR OPPOSE ENDING BIRTHRIGHT CITIZENSHIP

Some people have proposed that the U.S. Constitution should be changed so that the children of unauthorized immigrants do not automatically get citizenship if they are born in this country. Do you favor, oppose, or neither favor nor oppose this proposal?

#### 13. V201424 FAVOR OR OPPOSE BUILDING A WALL ON BORDER WITH MEXICO

Do you favor, oppose, or neither favor nor oppose building a wall on the U.S. border with Mexico?

#### 14. V201429 BEST WAY TO DEAL WITH URBAN UNREST

What is the best way to deal with the problem of urban unrest and rioting? Some say it is more important to use all available force to maintain law and order, no matter what results. Others say it is more important to correct the problems of racism and police violence that give rise to the disturbances. And, of course, other people have opinions in between. From Solve problems of racism and police violence to Use all available force to maintain law and order

Not considered because they were not found to be controversial:

- V201300 FEDERAL BUDGET SPENDING: SOCIAL SECURITY

What about Social Security? Should federal spending on Social Security be increased, decreased, or kept the same?

- V201401 GOVERNMENT ACTION ABOUT RISING TEMPERATURES

Do you think the federal government should be doing more about rising temperatures, should be doing less, or is it currently doing the right amount?

- V201412 LAWS PROTECT GAYS/LESBIANS AGAINST JOB DISCRIMINATION

Do you favor or oppose laws to protect gays and lesbians against job discrimination?

**ANES 2020 - Binary choice questions**

1. V201406 SERVICES TO SAME SEX COUPLES

Do you think business owners who provide wedding-related services should be allowed to refuse services to same-sex couples if same-sex marriage violates their religious beliefs, or do you think business owners should be required to provide services regardless of a couple's sexual orientation?

2. V201409 TRANSGENDER POLICY

Should transgender people - that is, people who identify themselves as the sex or gender different from the one they were born as - have to use the bathrooms of the gender they were born as, or should they be allowed to use the bathrooms of their identified gender?

3. V201424 FAVOR OR OPPOSE BUILDING A WALL ON BORDER WITH MEXICO

Do you favor, oppose, or neither favor nor oppose building a wall on the U.S. border with Mexico?

4. V201418 FAVOR OR OPPOSE ENDING BIRTHRIGHT CITIZENSHIP

Some people have proposed that the U.S. Constitution should be changed so that the children of unauthorized immigrants do not automatically get citizenship if they are born in this country. Do you favor, oppose, or neither favor nor oppose this proposal?

5. V201415 GAY AND LESBIAN COUPLES BE ALLOWED TO ADOPT

Do you think gay or lesbian couples should be legally permitted to adopt children?

**ANES 2016 - All opinion questions**

1. V161113 Healthcare

Do you favor, oppose, or neither favor nor oppose the health care reform law passed in 2010? This law requires all Americans to buy health insurance and requires health insurance companies to accept everyone.

2. V161184 Insurance

Where would you place yourself on this scale, or haven't you thought much about this? From Government insurance plan to Private insurance plan.

3. V161196 Wall

Do you favor, oppose, or neither favor nor oppose building a wall on the U.S. border with Mexico?

4. V161198 Black

Where would you place yourself on this scale, or haven't you thought much about this? From Government should help Blacks to Blacks should help themselves.

5. V161201 Environment

Where would you place yourself on this scale, or haven't you thought much about this? From Regulate business to protect the environment and create jobs to No regulation because it will not work and will cost jobs.

6. V161214 Syrian

Do you favor, oppose, or neither favor nor oppose allowing Syrian refugees to come to the United States?

7. V161228 TransBathroom

Should transgender people – that is, people who identify themselves as the sex or gender different from the one they were born as – have to use the bathrooms of the gender they were born as, or should they be allowed to use the bathrooms of their identified gender?

8. V161227 Same Sex Service

Do you think business owners who provide wedding-related services should be allowed to refuse services to same-sex couples if same-sex marriage violates their religious beliefs, or do you think business owners should be required to provide services regardless of a couple's sexual orientation?

9. V161193 Birthright

Some people have proposed that the U.S. Constitution should be changed so that the children of unauthorized immigrants do not automatically get citizenship if they are born in this country. Do you favor, oppose, or neither favor nor oppose this proposal?

10. V161204 Affirmative Action

Do you favor, oppose, or neither favor nor oppose allowing universities to increase the number of black students studying at their schools by considering race along with other factors when choosing students?

11. V161213 ISIS

Do you favor, oppose, or neither favor nor oppose the U.S. sending ground troops to fight Islamic militants, such as ISIS, in Iraq and Syria?

12. V161229 Gay protection

Do you favor or oppose laws to protect gays and lesbians against job discrimination?

13. V161232 Abortion

There has been some discussion about abortion during recent years. Which one of the opinions on this page best agrees with your view?

a) By law, abortion should never be permitted.

b) By law, only in case of rape, incest, or woman's life in danger.

c) By law, for reasons other than rape, incest, or woman's life in danger if need established.

d) By law, abortion as a matter of personal choice.

14. V161233 death penalty

Do you favor or oppose the death penalty for persons convicted of murder?

15. V161343 protesters

When protestors get 'roughed up' for disrupting political events, how much do they generally deserve what happens to them?

16. V161346 feminism

How well does the term feminist' describe you?

17. V162123 Countries like America

'The world would be a better place if people from other countries were more like Americans.' Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat, or agree strongly] with this statement?

18. V162169 forefathers

'Our country would be great if we honor the ways of our forefathers, do what the authorities tell us to do, and get rid of the 'rotten apples' who are ruining everything.' (Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat, or agree strongly] with this statement?)

19. V162170 strong leader

What our country really needs is a strong, determined leader who will crush evil and take us back to our true path.' (Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat, or agree strongly] with this statement?)

20. V162210 traditional family

'This country would have many fewer problems if there were more emphasis on traditional family ties.' (Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat, or agree strongly] with this statement?)

21. V162211 help blacks

'Irish, Italians, Jewish and many other minorities overcame prejudice and worked their way up. Blacks should do the same without any special favors.' Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat, or agree strongly] with this statement?

22. V162221 hispanics

How important is it that more Hispanics be elected to political office?

23. V162244 equality

'This country would be better off if we worried less about how equal people are.' (Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat, or agree strongly] with this statement?)

24. V162266 traditions

Now thinking about minorities in the United States. Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat or agree strongly] with the following statement? 'Minorities should adapt to the customs and traditions of the United States'

25. V162268 immigrants economy

And now thinking specifically about immigrants. (Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat or agree strongly] with the following statement?) 'Immigrants are generally good for America's economy.'

26. V162270 immigrants crime

(Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat or agree strongly] with the following statement?) 'Immigrants increase crime rates in the United States.'

27. V162276 differences

Please say to what extent you agree or disagree with the following statement: 'The government should take measures to reduce differences in income levels'. (Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat or agree strongly]?)

28. V162295 torture

Do you favor, oppose, or neither favor nor oppose the U.S. government torturing people who are suspected of being terrorists, to try to get information?

Not considered because they were not found to be controversial:

- V161154 Military

How willing should the United States be to use military force to solve international problems?

- V161226 Parental leave

Do you favor/oppose, or neither favor nor oppose requiring employers to offer paid leave to parents of new children?

- V162125x Flag

How good/bad does R feel to see American flag?

- V162150x equal pay

Favor/oppose equal pay for men and women

- V162168 free thinkers

'Our country needs free thinkers who will have the courage to defy traditional ways, even if this upsets many people.' Do you [agree strongly, agree somewhat, neither agree nor disagree, disagree somewhat, or disagree strongly / disagree strongly, disagree somewhat, neither agree nor disagree, agree somewhat, or agree strongly] with this statement?

- #V162186 business regulation

How much government regulation of business is good for society?

### **ANES 2016 - Binary choice questions**

1. V161113 Healthcare

Do you favor, oppose, or neither favor nor oppose the health care reform law passed in 2010? This law requires all Americans to buy health insurance and requires health insurance companies to accept everyone.

2. V161196 Wall

Do you favor, oppose, or neither favor nor oppose building a wall on the U.S. border with Mexico?

3. V161214 Syrian

Do you favor, oppose, or neither favor nor oppose allowing Syrian refugees to come to the United States?

4. V161228 TransBathroom

Should transgender people – that is, people who identify themselves as the sex or gender different from the one they were born as – have to use the bathrooms of the gender they were born as, or should they be allowed to use the bathrooms of their identified gender?

5. V161227 Same Sex Service

Do you think business owners who provide wedding-related services should be allowed to refuse services to same-sex couples if same-sex marriage violates their religious beliefs, or do you think business owners should be required to provide services regardless of a couple's sexual orientation?

6. V161193 Birthright

Some people have proposed that the U.S. Constitution should be changed so that the children of unauthorized immigrants do not automatically get citizenship if they are born in this country. Do you favor, oppose, or neither favor nor oppose this proposal?

7. V161204 Affirmative Action

Do you favor, oppose, or neither favor nor oppose allowing universities to increase the number of black students studying at their schools by considering race along with other factors when choosing students?

8. V161213 ISIS

Do you favor, oppose, or neither favor nor oppose the U.S. sending ground troops to fight Islamic militants, such as ISIS, in Iraq and Syria?

9. V161229 Gay protection

Do you favor or oppose laws to protect gays and lesbians against job discrimination?

10. V161233 death penalty

Do you favor or oppose the death penalty for persons convicted of murder?

11. V162295 torture

Do you favor, oppose, or neither favor nor oppose the U.S. government torturing people who are suspected of being terrorists, to try to get information?

Not considered because they were not found to be controversial:

- V161226 Parental leave

Do you favor/oppose, or neither favor nor oppose requiring employers to offer paid leave to parents of new children?

#### **Freira et al. 2021 - Argentinian survey**

1. Schools should reopen before the end of the academic year.
2. Non-essential public meetings should be banned until the development of a vaccine.
3. People should be allowed to leave their homes and exercise at least once a day.
4. People over 70 years old should not be allowed to leave their homes until a vaccine is found.
5. People who are found in a public space without a valid reason should have a criminal record.
6. People should be allowed to freely travel within the country without requesting permission from the government.
7. The government should track the movements of all patients who tested positive for COVID-19 using their cell-phone data.
8. The government should fine those individuals who upload false information to the official virus-tracking app.

Not considered because they were not found to be controversial:

- The government should force the citizens to share their geolocation through an official virus-tracking app.

#### **Freira et al. 2021 - Brazilian survey**

1. Schools should reopen and resume face-to-face teaching by the end of the year.
2. Non-essential public meetings should be banned until the development of a vaccine.
3. Gatherings of more than 10 people should not be allowed until a vaccine is developed.
4. People over 70 years old should not be allowed to leave their homes until a vaccine is found.
5. People who are found in a public space without a valid reason should have a criminal record.
6. The government should track the movements of all patients who tested positive for COVID-19 using their cell-phone data.
7. The government should fine those individuals who upload false information to the official virustracking app.
8. The government should force the citizens to share their geolocation through an official virus-tracking app.

Not considered because they were not found to be controversial:

- All businesses and stores should reopen without requiring them to obtain an official authorization.

#### **Freira et al. 2021 - Uruguayan survey**

1. Universities should reopen and resume face-to-face teaching by the end of the year.
2. Gatherings of more than 10 people should not be allowed until a vaccine is developed.
3. The government should fine people who do not respect social distance in the street.
4. People diagnosed with COVID19 should have a criminal record if they are found in a public space during the period when transmission risk is high.
5. People should be allowed to freely travel within the country without requesting permission from the

government.

6. The government should track the movements of all patients who tested positive for COVID-19 using their cell-phone data.
7. The government should fine those individuals who upload false information to the official virustracking app.
8. The government should force the citizens to share their geolocation through an official virus-tracking app.

Not considered because they were not found to be controversial:

- People over 70 years old should not be allowed to leave their homes until a vaccine is found.

### **Freira et al. 2021 - American survey**

1. All schools in the United States should reopen before the end of 2020.
2. All non-essential public events should be banned until a vaccine is found.
3. The Federal Government should track the location of people infected with COVID-19 using a mobile phone app.
4. Wearing a mask in public spaces should be optional.
5. People over 70 years old should not be allowed to leave their homes until a vaccine is found.
6. People should request permission to the Federal Government to travel from one state to another.
7. Until a vaccine is found, the Federal Government should not allow mass protests in the United States.

### **Pew Research 2020 - All opinion questions**

Is your overall opinion of [INSERT ITEM] very favorable, mostly favorable, mostly unfavorable, or very unfavorable?

1. The Department of Homeland Security
2. The Internal Revenue Service, the IRS
3. The Justice Department
4. The Department of Veterans Affairs, the VA
5. The Immigration and Customs Enforcement, known as ICE [PRONOUNCED: 'ice']

Not considered because they were not found to be controversial:

- The Centers for Disease Control and Prevention, the CDC
- The Department of Health and Human Services, the HHS
- The Census Bureau
- The Postal Service
- The Federal Reserve

### **Pew Research 2014 - Non-political issues**

1. In the past week, did you donate money, time or goods to help the poor and needy?
2. In the past week, did you tell a white lie?
3. In the past week, did you lose your temper?
4. In the past week, did you ever eat too much?
5. In the past week, did you meditate to cope with stress?