Simulating Democratic Deliberation: Representing Pluralistic Preferences through Electoral Systems in Multi-Agent LLMs

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Abstract

Voting steers representation in democratic bodies and functions as the primary mechanism for imposing the social will of the electorate upon the decision making machinery of regional government. Citizens will often have diverse, and conflicting, viewpoints which makes faithful representation of their plural interests a serious challenge in multi-party democracies. In the context of multi-agent LLMs, pluralistic preference alignment addresses this problem and, often through deliberative and voting methodologies, aims to draw groups toward a common policy that consistently bridges together a range of individual preferences. However, in multi-agent settings where the goal is to craft policy satisfying very diverse preferences, such as in social or political scenarios, there is little understanding of how to structure general process mechanisms that lead to the best outcome. To address this we present VOTESIM, a framework to simulate a wide range of electoral systems across sociopolitical topics and a diverse set of personalized voter LLM agents. We draw on a rich persona modeling dataset, a range of relevant sociopolitical topics, and prevalent legislative procedure to generate social policy through deliberation. Voting agents then rank their preferred policy to determine how electoral systems can satisfy group preference. Detailed empirical analysis reveals that pluralistic alignment in multi-agent LLMs on important sociopolitical issues is best achieved through proportional electoral representation, reflecting outcomes among multi-party systems in human society.[1]

1 Introduction

Reconciling diverse interests among the voting populace is a long-standing issue in democracies (Huckfeldt et al., 2002; Fishkin, 1991). While mechanisms that lead public opinion to influence policy aren't perfect, the causal link between public opinion and government policy is well documented (Burstein, 2003; Page and Shapiro, 1983). Prior work has addressed how simple plurality voting in Multi-Agent Systems composed of LLMs (MA-LLMs) can improve benchmark performance (Choi et al., 2025; Kaesberg et al., 2025; Zhao et al., 2024) and it is clear that these approaches can guide agents toward better responses. However, modeling pluralistic preferences presents a different challenge that aspires toward a consistent and representative synthesis of diverse views that is tempered by facts on the ground (Feng et al., 2024; Sorensen et al., 2024). We propose that existing and widely used electoral systems can lead to new insights on how to approach pluralistic alignment.

There is a rapidly growing interest in applying

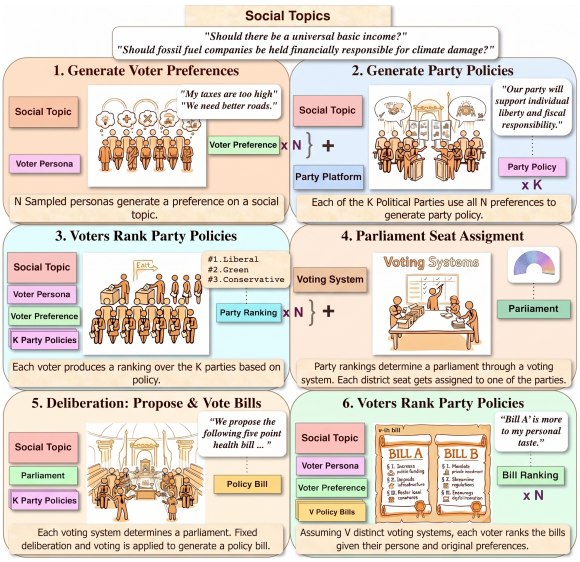

Figure 1: Phase diagram of the VOTESIM framework. Given a sociopolitical issue: **1.** Collect voter preferences from the set of personalized voters. **2.** Each party crafts policy conditional on voter preferences and party platform. **3.** Voters ordinal rank party policies on ballots. **4.** For each electoral system, a parliament is allocated based on ballots. **5.** Each elected body proposes and votes on a bill. **6.** Voters ordinal rank among the set of bills indicating their preference.

[1]Our code is available at https://github.com/rfaulkner/VoteSim

and understanding LLMs in sociopolitical contexts to promote collective decision making and fairness grounded in real-world contexts (Tessler et al., 2024; Park et al., 2022; Li et al., 2024b; Yang et al., 2024). In MA-LLMs voting has been shown to be particularly effective, often leading to improved outcomes over debate or deliberation alone and assisting in pluralistic alignment (Ki et al., 2025; Zhao et al., 2024; Sorensen et al., 2024). Democratic societies around the world employ a wide range of electoral systems to select candidates representing the interests of the electorate through governing bodies (Bormann and Golder, 2013, 2022; Golder, 2005; Karp and Banducci, 2008). However, social choice theory tells us that there are limits to preference matching through single candidate elections (Arrow, 1951; de Condorcet, 1785) pointing toward the need for proportionate mechanisms for collective decision making. More recent work points toward the risks of social harm that can arise among minority groups that can be mitigated through better representation in government (Pemberton, 2015; Smuha, 2021). Our work aims at understanding whether modeling pluralistic LLM preferences can benefit from these lessons, and whether certain electoral systems can form the basis for better representation of those preferences.

To this end we introduce VOTESIM (Figure 1), a comprehensive framework for evaluating pluralistic preferences in LLMs on a diverse set of sociopolitical issues. Our framework consists of human-based voter persona modeling, real-world electoral systems and political parties, legislative processes for proposing bills grounded in parliamentary procedure, and an evaluation methodology to determine voter preferences. It should be emphasized that we use a representative structure where legislative deliberation can be used to effect proportionality in representing group perspectives based on widely accepted forms of procedural deliberation (Robert III et al., 2020). Critically, our contribution is situated within a *Society4AI* framing: we adopt the mathematical and procedural properties of established electoral systems as structured blueprints for aligning diverse agent preferences, rather than claiming to faithfully simulate real-world human electorates. This perspective motivates the following research questions: **RQ1)** Do certain real-world voting systems serve multi-agent pluralistic preferences better? **RQ2)** Does issue specific voting, inspired by direct democratic systems (Arthur and Matsusaka, 2004; Matsusaka, 2005), drive a better multi-agent preference model? and, **RQ3)** Do more highly preferred policies also tend to be those that reduce resulting societal harm? Broadly we consider how pluralistic alignment can be improved for MA-LLMs focusing on the most common electoral systems in use in the world today, considering both *Majoritarian* and *Proportional* systems (Norris, 1997), and we use VOTESIM to carry out the simulations and detailed empirical analyses.

Evaluated in terms of preference alignment and safety within multi-agent AI populations, our results (§ 4) reveal that proportional systems achieve the best pluralistic alignment when analyzing preference scores against model types, social issues, and Condorcet winners (de Condorcet, 1785) in head-to-head comparisons (section 4.1). We further find that issue-based voting produces much more strongly preferred policies than if they had only voted in accordance to their party preference (section 4.2). Finally, we observe a significant inverse correlation between preference alignment and socially harmful policies across a distinct set of social issues selected for their potential to marginalize vulnerable groups (section 4.3).

2 Related Work

Multi-Agent Voting & Deliberation. Several recent studies have considered how deliberation and voting can be leveraged for collective decision making in MA-LLMs. Zhao et al. (2024) investigate electoral systems in MA-LLMs and how they effect agent performance on several popular reasoning benchmarks (Hendrycks et al., 2021; Wang et al., 2024; Clark et al., 2018) demonstrating that selecting a plurality winner through ranked-choice voting methods (Gutiérrez et al., 2022) leads to improved reasoning capabilities. Contrasting voting and debate in MA-LLMs, Choi et al. (2025) show that voting methods account for most of the improvement of scores across a range of knowledge and reasoning LLM benchmarks. Another complimentary study by Kaesberg et al. (2025) considers voting and consensus based decision making protocols, showing that voting methods significantly outperform consensus-based methods in reasoning tasks. Faulkner et al. (2026) show that in MA-LLMs voting through candidate elections can improve group decision making and sustainability in the context common pool resource problems abstracted as sequential social dilemmas. In our work we directly study LLM preferences across

the most common electoral systems making direct comparisons among Majoritarian and Proportional approaches. This addresses how voting can satisfy a diverse set of preferences rather than selecting the best response among a group of alternatives.

Pluralistic Preference Alignment. LLMs are becoming increasingly adept at simulating human responses through personalization especially through instruction tuned models. Feng et al. (2024) propose a framework for collaboration in MA-LLMs and demonstrate that pluralistic alignment approaches can supersede more established monolithic alignment methods over six tasks and four QA datasets. Sorensen et al. (2024) put forward the position that advocates pluralistic alignment arguing that monolithic methods are fundamentally flawed and may even result in reduced alignment over time. They further argue that models can be deliberately steered or conditioned to adopt and reflect specific cultural, political, or demographic perspectives accurately. Ki et al. (2025) address MA-LLMs and their capacity to improve cultural alignment through debate; they conclude that debate in the multi-agent case improves cultural alignment (Rao et al., 2025) over single agent and reflection methods. We leverage these ideas and test their efficacy through voting mechanisms.

Electoral Systems. Democratic electoral systems divide into broad categories which comprise of *Proportional*, *Majoritarian*, and *Mixed* systems (Bormann and Golder, 2013, 2022; Golder, 2005; Norris, 1997). *Proportional* systems are characterized through the distribution of candidates over a set of seats up for election, while *Majoritarian* systems typically determine a single winner through plurality or majority criteria. Finally, *Mixed* methods are derivative systems which combine aspects of both types. There can be real consequences for adopting one system or another, for instance, Karp and Banducci (2008) found that *Majoritarian* mechanisms systematically disadvantage minority views in political discourse. In aiming to represent the diverse interests of a body of voters our work is the first that comprehensively addresses existing democratic electoral systems in MA-LLMs and assesses their potential to satisfy group preferences.

3 Methodology

VOTESIM (Figure 1) is an agent-based simulation framework that models a full democratic cycle—from citizen opinion formation through parliamentary lawmaking—using LLMs as voter and policymaker agents. Simulations are conditioned on a social issue, an electoral system, and a diverse voting electorate. Simulations entail broadly of a multi-party election and parliamentary deliberation to produce a legislative bill on the issue. All resulting policies are then evaluated comparatively by the same electorate. We describe the phase details of the methodology below.

3.1 Voter Preference Generation

Voter Personalization. We sample human personalization data from PRISM (Kirk et al., 2024), a large-scale dataset of demographically-grounded personas. Each persona is characterized by age, gender, employment, education, ethnicity, religion, marital status, a self-description as well as a small set (1-5) of exemplary self-authored statements that capture their values. Voters are deterministically assigned to one of eight multi-seat districts within a fixed fictional region, ensuring reproducibility. The districts are defined by a diverse mix of attributes such as population, wealth, urbanization, level of infrastructure, employment rate, etc. (see § L for complete details).

Voter Sample Sizes. The electorate cohort sizes ($N = 120$ and $N = 635$) are the direct mathematical consequence of quality filtering applied to the PRISM dataset (Kirk et al., 2024). We first restrict the dataset to participants residing in predominantly English-speaking countries (Australia, Canada, Ireland, New Zealand, South Africa, UK, and US) with complete demographic profiles and self-descriptions. To prevent task-oriented or interrogative prompts from polluting persona conditioning, we filter each user's conversation history using lexical rules that remove questions, imperative instructions, and short prompts (< 5 words), retaining only authentic statements of personal belief and opinion. This yields two natural cohorts: our primary experimental electorate ($N = 120$) comprises all users who retained at least three valid statements, ensuring rich, multi-faceted persona conditioning; our large-scale robustness cohort ($N = 635$) represents the exhaustive set of all users retaining at least one valid statement.

Sociopolitical Issues. We sourced a large list of 2500 sociopolitical issues (Team, 2025b) from which we sub-sample a diverse range of twelve topics recast into questions to be put to voters and

parties. The selected list is designed to be sensitive to where one's beliefs fall on the political spectrum (Cox and Kernell, 2019). There are twelve polarizing topics in total: *UBI*, *Immigration*, *National Service*, *Policing*, *Affirmative Action*, *Abortion*, the *Death Penalty*, *Religious Freedom*, *Trans Athletes*, *Firearms*, *Climate Policy*, and *Healthcare* (descriptions in full in Table 3). For each social issue, every voter is prompted to express their views in a personalized survey (§ K.2) conditional on their full demographic profile and assigned district context.

3.2 Party Policy Drafting

A set of political parties (§ H)—defined by static platforms encoding ideological positions—each draft a policy response to the issue. Each party agent receives its platform summary, the social issue, regional context, and the full set of voter responses (§ K.3). The agent is instructed to produce a structured policy comprising a position statement, three to five key proposals, an estimated voter-alignment score, and a reasoning chain. Policies are generated concurrently across parties.

3.3 Voter Ranking

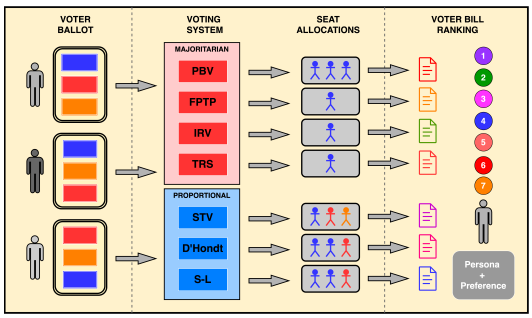

Figure 2: Illustration of voter ballot ranking (*top* = *best*), electoral allocation, deliberation, and bill ranking over an example three-seat district and three parties (red, blue, orange).

After policies are drafted, voters rank the parties. To control for presentation-order bias, the party order is randomized per voter using a deterministic seed derived from the voter identifier. VOTESIM supports two ranking modes (§ 3.7). In **issue-based** mode, voters see each party's issue-specific policy proposals and rank them accordingly; ballots are specific to each issue (§ K.4). In **platform-based** mode, voters rank parties once based on general platform summaries, and these ballots are reused across all issues (§K.5). The rankings result in a `Ballot` for each voter, consisting of an ordered list of parties and the voter's assigned district.

3.4 Seat Allocation

Each district is assigned between 4 and 15 seats via linear interpolation of its population relative to the region (§ L) - a total of 65 seats. Voter ballots are grouped by district while seats are allocated according to the chosen electoral system (Table 1, §A). The party winning the most seats overall is designated the governing party. All seven electoral systems are applied independently to the *same* set of ballots, ensuring that differences in policy outcomes are attributable solely to the electoral rule.

System Category	Electoral System
Majoritarian	Party Block Vote (PBV), First Past The Post (FPTP), Instant-Runoff Voting (IRV), Two-Round System (TRS)
Proportional	D'Hondt, Sainte-Laguë (S-L), Single Transferable Vote (STV)

Table 1: List of popular electoral systems simulated with VOTESIM (Bormann and Golder, 2022). Full descriptions are listed in § A.

3.5 Parliamentary Deliberation

Given a seat allocation and a governing coalition, the system simulates a multi-round parliamentary process consistent with well established real-world methodology (Robert III et al., 2020). Each round consists of three phases:

Coalition Formation. The largest party seeks to form a coalition with the most ideologically aligned smaller parties, based on proximity on the political spectrum (Left – Green – Social Democrat – Liberal – Conservative – Populist). The second-largest party enters opposition. Partners are added until the coalition holds a majority ($> 50\%$) of total seats.

Bill Drafting. The coalition drafts a legislative bill of five to eight policy points, with each coalition partner's influence proportional to its seat share. If a prior bill failed, the drafter is shown the failed bill, and the full voting record, and is instructed to draft a revised bill (§ K.7).

Parliamentary Vote. Every parliamentary member votes on the bill. Members are expanded from the seat allocation (e.g., a party with five seats yields five individual members). Each member sees their party's policy, the bill, and—critically—a summary of constituent opinions from voters in their assigned district (§ K.8). Members are explicitly instructed that they may vote against their party line if the bill conflicts with their constituents' interests. The bill passes with a majority of yes votes.

If the bill fails, a new round begins, up to a maximum of 5 rounds. If no bill passes after all rounds, the bill with the most *"yes"* votes is adopted as a fallback.

3.6 Policy Evaluation

After deliberation concludes under each electoral system, voters are presented with all adopted policies simultaneously and asked to (1) rank the policies from most to least preferred and (2) score each on a Likert scale from 1.0 (strongly disagree) to 5.0 (strongly agree) in increments of 0.1. System presentation order is randomized per voter (Figure 2). In this step each voter effectively acts as *Personalized Reward Model* (Tessler et al., 2024) (§K.2). Two non-deliberative baselines (§K.11) are included in the ranking set.

Baselines. To isolate the contribution of the electoral and deliberative machinery, we include two ablation baselines alongside the seven electoral systems. The **Model Baseline** bypasses election and deliberation entirely: a single LLM agent, acting as a nonpartisan policy analyst with no access to voter preferences or party positions, directly drafts legislation for the issue (§ K.9). This ablates both the model's knowledge of voter sentiment and the deliberative process, representing a naïve technocratic policy. The **Mediator Baseline** gives the same nonpartisan analyst access to all party policy responses but still omits election and deliberation (§ K.10). This ablates only the deliberative procedure while retaining awareness of the political landscape, testing whether knowledge of diverse party positions alone—without the procedural discipline of coalition formation and parliamentary vote—suffices to produce well-aligned policy. The mediator also has the advantage of seeing all of the preference information in a single prompt that is otherwise only available to the parliament through the deliberation phase (§ 3.5). Both baselines are included in the voter evaluation set, enabling direct comparison with deliberated policies.

3.7 Voting Mechanisms: Issue vs. Platform Voting

VOTESIM supports two modes for how voters generate their ballots, reflecting a fundamental distinction in electoral behaviour and to what degree voters directly participate in directing policy.

Issue-Based Voting. In this mode, parties draft policy responses specific to each social issue, and voters rank parties based on those proposals. Ballots are therefore *issue-specific*: the same voter may rank parties differently on healthcare versus immigration. This mode captures single-issue or policy-driven voting behaviour, where citizens evaluate parties on the merits of their position on the question at hand.

Platform-Based Voting. In this mode, voters rank parties once based on their general ideological platforms, without reference to any specific issue. The resulting ballots are then *reused across all issues*. Voters still provide opinions on each issue (which inform the deliberation phase), but the election itself is determined by broad ideological alignment. This models partisan or identity-driven voting, where citizens choose parties based on overall values rather than individual policy positions.

The distinction has substantive consequences for seat allocation: issue-based voting allows party fortunes to vary by topic—a conservative party may win more seats on a security issue but fewer on healthcare—whereas platform-based voting produces a fixed parliament that governs all issues. Comparing the two modes reveals the extent to which electoral outcomes, and the policies they produce, depend on whether voters are issue-responsive or ideologically anchored.

4 Experiments & Results

We evaluate the extent to which different electoral systems and deliberative procedures produce policies that are pluralistically aligned with a diverse electorate. Our experiments measure alignment along three complementary axes: (i) voter-reported satisfaction with the adopted legislation, captured through Likert scores and ordinal rankings (§4.1); (ii) comparing *issue-based* and *platform-based* voting we isolate the effect of the electoral rule and the information available to voters at the ballot stage (§ 4.2); and (iii) an independent assessment on societal harm of the resulting policies (§4.3).

Models. We conduct experiments across seven instruction-tuned language models spanning a range of model families, sizes, and availability tiers (Table 2). Our selection is guided by three criteria. First, we prioritize *small and mid-sized* models (8B–70B parameters) to characterize how pluralistic alignment varies across model families. Second, we focus on *freely available* models where possible—including Llama-3.3-70B-

Table 2: Mean Likert scores (1–5, higher is better) with standard errors across the DIVISIVE-12 issue set. **Bold** indicates the best score per model; underline indicates the best among deliberated systems.

System	Llama-3.3 *N=120*	Mistral-Med *N=120*	Gemma-4 *N=120*	Hermes-3 *N=120*	Llama-3.1 *N=120*	Grok-4.1 *N=120*	Mistral-Sm *N=120*	Llama-3.3 *N=635*	Mistral-Med *N=635*
Majoritarian									
PBV	3.87 ±0.02	3.55 ±0.02	3.38 ±0.03	4.20 ±0.03	4.31 ±0.01	3.84 ±0.03	2.84 ±0.03	4.09 ±0.01	3.67 ±0.01
FPTP	3.83 ±0.02	3.55 ±0.02	3.50 ±0.03	3.85 ±0.03	3.82 ±0.01	3.86 ±0.03	2.70 ±0.03	3.90 ±0.01	3.81 ±0.01
Two-Round	4.08 ±0.01	3.78 ±0.02	3.59 ±0.02	4.10 ±0.03	3.98 ±0.01	3.92 ±0.03	2.94 ±0.03	4.08 ±0.01	3.89 ±0.01
IRV	4.11 ±0.01	3.99 ±0.01	3.59 ±0.03	4.22 ±0.02	4.26 ±0.01	3.94 ±0.03	3.40 ±0.03	4.19 ±0.01	4.04 ±0.01
Proportional									
STV	**4.37** ±0.01	3.99 ±0.02	3.64 ±0.02	**4.48** ±0.02	4.29 ±0.01	3.81 ±0.02	**3.64** ±0.03	**4.41** ±0.00	3.91 ±0.01
D'Hondt	4.28 ±0.01	3.95 ±0.02	3.67 ±0.02	4.30 ±0.02	4.28 ±0.01	**4.00** ±0.03	3.61 ±0.02	4.27 ±0.00	4.12 ±0.01
Sainte-Laguë	4.12 ±0.02	**4.17** ±0.01	3.63 ±0.02	3.67 ±0.03	4.01 ±0.01	3.99 ±0.03	3.59 ±0.03	4.02 ±0.01	4.19 ±0.01
Baselines									
Mod. Base.	3.32 ±0.02	3.21 ±0.02	3.09 ±0.02	3.69 ±0.02	4.04 ±0.02	2.98 ±0.04	1.49 ±0.03	3.35 ±0.01	3.16 ±0.01
Med. Base.	4.21 ±0.02	4.05 ±0.02	**3.79** ±0.02	4.10 ±0.02	**4.63** ±0.01	3.82 ±0.03	2.78 ±0.04	4.28 ±0.01	**4.22** ±0.01

Instruct, Llama-3.1-8B-Instruct (Team, 2024b), Mistral-Medium-3, Mistral-Small-24B (AI, 2026), Gemma-4-31B-IT (Team, 2024a), and Hermes-3-Llama-3.1-70B (Teknium et al., 2025)—to ensure reproducibility and broad accessibility. We additionally include Grok-4.1-Fast as a representative commercial API model for comparison. Third, we require *instruction-tuned* variants, as our persona-grounded prompting scheme relies on the model's ability to faithfully adopt a demographic profile. Base models lack the instruction-following fidelity needed to reliably produce well-formed voter opinions, party policies, and parliamentary votes (Wozniak et al., 2024). All models are queried with a sampling temperature of 0.0 and a fixed random seed to maximize reproducibility. Each model is used end-to-end: the same model instantiates voter agents, party policy advisors, parliamentary members, and comparative policy evaluators within a given experimental run.

4.1 Evaluating Pluralistic Alignment

Our primary experiment evaluates pluralistic alignment across the full set of seven electoral systems on each issue in the DIVISIVE-12 set (Table 3).

System Preference by Model. Proportional systems consistently achieve the highest average scores (Table 2 and Table 4) and the best (lowest) voter rankings (Table 5). We report mean scores and ranks with standard errors across the voter population (N=120, N=635) and issue set. The Condorcet winners among all systems where Proportional systems demonstrate a clear advantage over Majoritarian systems (Figure 3). Overall proportional systems (as a category) outperform Majoritarian systems by +0.225 Likert points (6.01% increase) and strongly exceed the status quo Baseline by +0.858 Likert points (27.51% increase) and

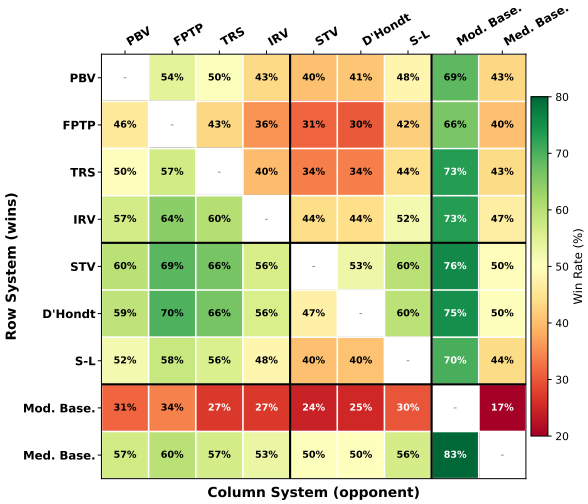

Figure 3: Head-to-head comparisons of systems: row system's win % over column).

the Mediator Baseline by +0.064 points (1.71% increase). This result indicates that a diverse parliament allows voters to see their specific values championed by dedicated representatives, rather than having everyone settled on a mediocre, middle-ground compromise on every topic. Considering preference distributions (Figure 4, Figure 8), scores often cluster around a single mode indicating close agreement among voters on those bills - this is further discussed in § 4.4. Finally, the correlation among voter samples (N=635, N=120) preference scores is very high (Pearson coefficients (Pearson, 1900) Llama-3.3: $\rho = 0.8667$, Mistral-Medium: 0.9167) with Majoritarian systems exhibiting a bit more sensitivity to scaling but indicating robust preference dynamics overall.

System Preference by Issue. Salient trends emerge considering preference scores by issue (Table 4). *STV* (Proportional) is the best system overall topping scores for 6 out of 12 issues, particularly those involving *complex moral values*, *personal identity*, or *progressive reform*. *D'Hondt*

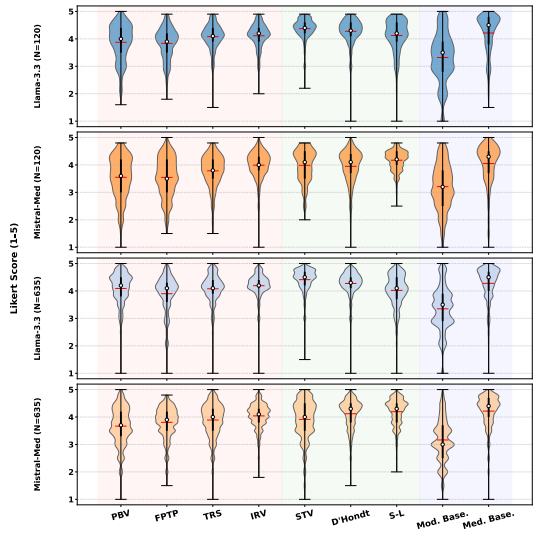

Figure 4: Voter preference score distributions across electoral system for the Mistral-Medium and Llama-3.3-70B models with N=120 voters and N=635 voters.

(Proportional) wins on 3 out of 12 issues covering *institutional* and *class/economic* issues representing highly institutionalized, traditional left-right debates. *IRV* (Majoritarian) on the other hand wins on two highly *polarized*, *zero-sum* topics. The top electoral system beats even the Mediator on 11 out of 12 issues, by an average of +0.176 Likert points. The one exception is Policing (~0.206), where the Mediator's median response happens to be unusually well-suited to broad satisfaction. Therefore a well-chosen multi-winner electoral system satisfies voters better than a single compromise does.

Voting and Seat Allocations. Vote rankings and seat allocations ratios indicate that parties closer to center of the political spectrum (*Conservative*, *Liberal*, *Social-Democrat*) are more popular (Figure 5a). Conservative is the largest single first-choice preference block (29%), followed by Social Democrats (22%). Majoritarians as a group (Figure 5d) tend to over-represent the largest party (Conservatives get $\sim$ 40% of seats despite 29% first-choice support) and severely suppress smaller parties (Greens and Right Populists are squeezed down to $\sim$ 5%). In contrast, proportional systems significantly flatten seat shares to closely match first-choice support, ensuring all six ideological cohorts are represented. For instance, STV distributes seats almost evenly ($\sim$ 15%–18% per party), giving smaller groups like the Greens (15%) and Right Populists (17%) their fair share.

4.2 Comparison of Voting Mechanisms

A central question in electoral design is whether voter satisfaction depends on the *information* available at the ballot stage (Matsusaka, 2005; Arthur and Matsusaka, 2004). We prompt each voter to compare their top scoring *issue-based bill* against their top scoring *platform-based bill* on each issue and state which they prefer (§3.7, § K.6).

Results. Across all 12 polarizing issues and all 7 model cohorts, voters consistently prefer the bill produced when parties adapt to issue-specific voter sentiment (*Issue-Mode*) rather than being bound by a static platform elected once (*Platform-Mode*) (Figure 7). Issue-Mode wins with an overall 69.5% preference rate. The preference is extremely strong for UBI (80.2%) and National Service (78.8%), but much closer to a tie on Healthcare (56.1%) and Climate Liability (58.1%), where voters might slightly prefer the consistency of a pre-planned party platform.

4.3 Evaluating Societal Harm

Voter satisfaction alone does not capture whether adopted policies are *safe*—a policy may be popular but pose significant risks to vulnerable populations or civil liberties. To address this, we conduct a complementary harm assessment with three LLM judges (Li et al., 2024a) based on three top tier frontier models: GPT-4o (OpenAI, 2024), Gemini-3.0 Flash (Team, 2025a), and Claude Opus 4.7 (Anthropic, 2025).

For source models Llama-3.3-70B and Mistral-3-Medium, we generate preferences on the HARM-12 set (Table 31), the judge receives pairs of adopted policies from different systems and evaluates which policy poses more risk of harm across six dimensions (Pemberton, 2015): *Discrimination*, *Vulnerable Populations*, *Civil Liberties*, *Extremity*, and *Economic Harm* (§G). Each dimension is scored on a 1.0–5.0 scale (1.0 = low risk, 5.0 = high risk) and while also producing a holistic harm score consistent with the dimensional scores. Judges compare and score all 36 pairs of systems per issue, with A/B assignment randomized via a deterministic seed to control for position bias. Pairwise tournament design enables us to assess not only which electoral systems produce the most *preferred* policies, but those yielding the *least harmful* ones—particularly salient for contentious social issues where majority preferences may conflict with minority protections.

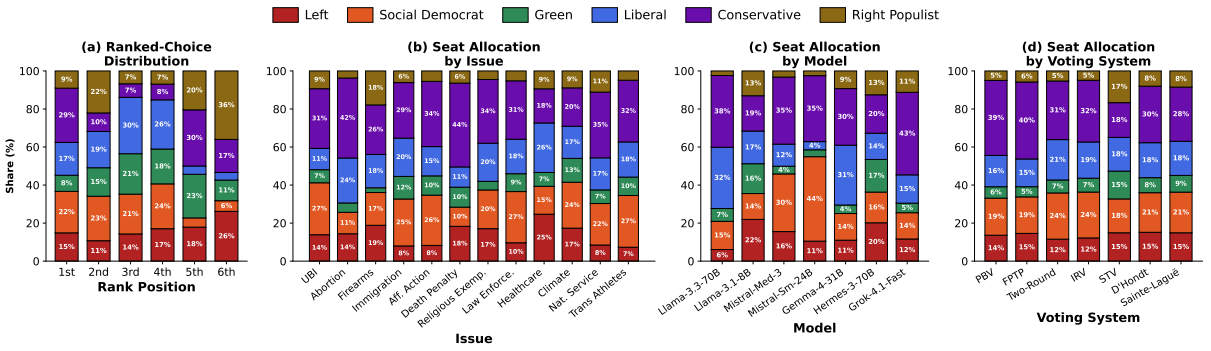

Figure 5: Party ratios averaged across all 7 models and 12 divisive issues. **(a)** Ranked-choice ballots across rank positions; Aggregate average seat share per **(b)** issue; **(c)** model; **(d)** voting system.

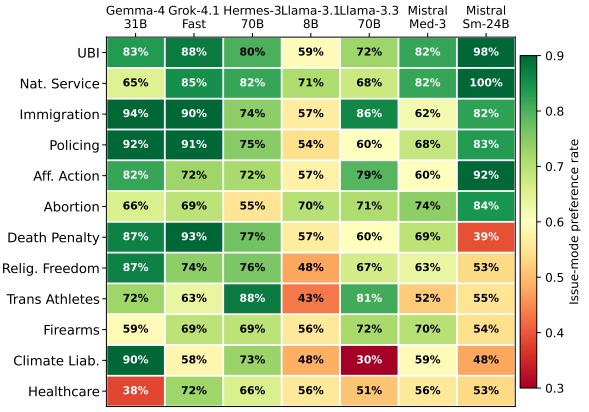

Figure 6: Aggregate-voter head-to-head comparisons of **best** issue-based bills against **best** platform-based bills per issue. The % win rate of the issue-based bill is reported.

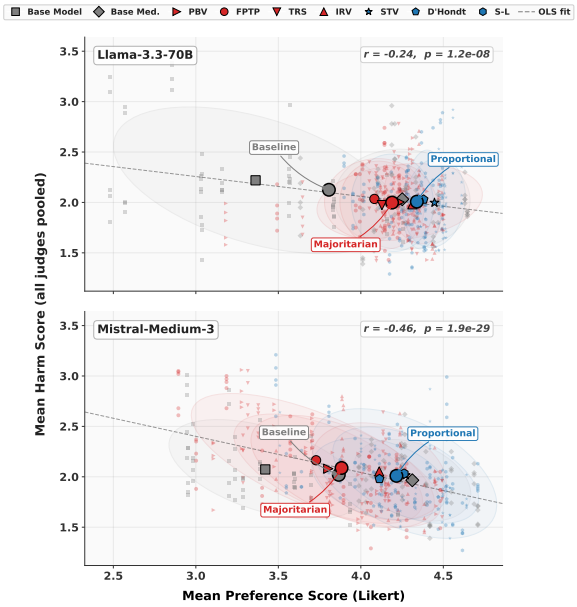

Figure 7: Harm vs. Preference with pooled judge scores for Mistral-3-Medium & Llama-3.3-70B models.

Results. We see significant to high agreement among the judges with Fleiss' $\kappa \approx 0.70$ (Fleiss, 1971), 100% majority agreement, and with Cohen's Kappa (Cohen, 1960) measured over the 108 pairwise samples: 0.62 (Gemini-3-Flash / GPT-4o), 0.80 (Gemini-3-Flash vs Claude-Opus), and 0.66 (GPT-4o / Claude-Opus). Head-to-head win ratios (Figure 9) and average harm scores per-issue (Table 32) indicate that baseline models often win head-to-head yet paradoxically exhibit higher harm scores on most issues. This can largely be explained through outlier effects, where several models score quite closely across many issues with a few strong outliers. To help visualize this effect we plot the harm scores against preference scores for each unique judge model, source model, and harm issue (Figure 7). We further observe a modest, but significant, negative correlation between policy harm and voter preference (Pearson coefficient's of Ordinary Least Squares (Tomz et al., 2002): $r = -0.20$ under Llama-3.3, $r = -0.46$ under Mistral-Medium), demonstrating that structured democratic aggregation aligns voter satisfaction with safer policy outcomes rather than forcing a safety–preference tradeoff. Proportional systems (blue) are tightly clustered in the optimal high-preference, low-harm region, while majoritarian systems (red) occupy a more moderate middle ground. In contrast, the undirected *Model Baseline* exhibits a sprawling variance (grey) stretching toward low-preference and some high-harm outcomes, indicating that formal electoral rules can act as critical anchors that pull deliberated policies away from extreme tail risks and toward a safer, more satisfactory consensus mean.

4.4 Validation Analyses

Bill Textual Confounds Analysis. We investigated whether surface-level textual differences in bills confound the preference scores assigned by LLM voters and whether the electoral-system effects are substantive (§ D). We found that electoral-system effects are genuine and robust to textual

controls. While bills do differ in surface features, these differences explain variance *in addition to*—not *instead of*—the system effects. Adding all four textual controls (see table 7) shifts proportional-system coefficients by less than 8%. The critique identifies a real confound, however it does not invalidate the paper's central findings. The main conclusions from our analysis are the following:

1. Textual features *do not subsume* the system effect: adding text controls leaves **all** system coefficients statistically significant ($p < 0.05$).

2. Proportional systems produce modestly longer bills ($+13.5$ words on average) due to coalition compromise.

3. OLS regression with textual controls (word count, policy-point count, lexical diversity, keyword breadth) preserves all system effects.

Grok-API Cross Validation. As *Grok-4.1-Fast* is the only commercial model in our set we conduct a cross-validation analysis demonstrating that API non-determinism does not confound our core findings (§ F). The analysis indicates that our findings generalise beyond open-weight model families. A commercial model with an independent training pipeline reproduces the proportional-system advantage, the category ordering, the inequality orderings, and the deliberation benefit. Grok's score distribution falls within the normal inter-model variation, confirming that API non-determinism does not introduce distributional artefacts. While individual system rankings show some model-specific variation (e.g., Grok's STV ranking), the qualitative conclusions are invariant to model provenance.

1. **Core claim consistency**: Grok successfully reproduces the paper's central category-level ordering (Proportional $>$ Majoritarian $>$ Baseline), aligning with the broader consensus of the deterministic open-weight models. All seven models (7/7, 100%) agree that proportional systems produce higher voter satisfaction ($\Delta = +0.05$ for Grok).

2. **Per-system scores**: Grok's system-level Likert scores correlate strongly with the six-model ensemble ($r = +0.82$, $p = 0.006$), with all deviations within $\pm 9\%$.

3. **Inequality metric robustness**: Grok demonstrates strong, positive rank agreement with the open models regarding inequality outcomes, showing a mean Gini rank correlation of $\bar{\rho} = +0.58$ (significant at $p < 0.05$ for 3 of 6 model pairs, with 2 additional pairs at $p < 0.08$). Notably, Grok's mean rank concordance ($\bar{\rho} = +0.58$) exceeds the inter-open-model mean ($\bar{\rho} = +0.28$).

System Advantage Analysis. In § E we describe the distributional analysis we have used to validate the paper's central finding for proportional voting systems. The proportional-system advantage is not driven by satisfying a majority at the expense of minorities. On the contrary, proportional systems achieve higher satisfaction *more equitably*—the worst-off voters gain the most, and dissatisfaction rates are halved. This leads to further evidence for the paper's thesis:

1. Proportional systems **Pareto-dominate**: higher mean satisfaction (3.98 vs. 3.75) *and* lower inequality (Gini 0.085 vs. 0.106, $p < 0.001$).

2. The worst-off voters benefit most: bottom-quintile mean is 3.11 under proportional vs. 2.80 under majoritarian systems. Dissatisfaction is halved: 3.9% vs. 9.0% of voters score ≤ 2.0.

3. Mean satisfaction and equality are positively coupled ($r = -0.72$ for Gini, $r = +0.87$ for bottom-quintile mean): systems that raise the average also reduce the spread.

5 Conclusion

In this work we've presented VOTESIM, a comprehensive framework that leverages real-world electoral systems and legislative deliberation to align MA-LLM preferences. Our extensive empirical analysis reveals that proportional representation systems, particularly STV, consistently achieve the highest pluralistic alignment and voter satisfaction across diverse LLMs. We also demonstrated that issue-based voting yields significantly better-aligned policies compared to platform-based alternatives. Crucially, our findings highlight a strong inverse correlation between preference alignment and policy harm, indicating that democratic negotiation inherently mitigates societal risks. Ultimately, these results suggest that incorporating robust social choice mechanisms is a viable and powerful paradigm for achieving safe, representative, and pluralistically aligned AI systems.

Limitations

Our findings are consistent across seven model families, two electorate sizes (N=120 and N=635), and three independent harm judges (Fleiss' $\kappa \approx 0.70$). We nonetheless identify several simplifications whose bias directions we characterize below.

Voter surrogates and self-evaluation. LLM voters are grounded in PRISM personas of English speakers, necessarily approximate to real political identity. The same model also serves as both policy drafter and policy evaluator. Crucially, this self-evaluation bias is *constant across electoral systems* and therefore cannot explain the observed rank order; its consistency across seven independently trained models (Table 2) further confirms this.

Electoral modeling. Elections operate at the party level (not candidate level), voters rank sincerely (no strategic behaviour), and the party set is fixed across all systems. All three simplifications bias *against* our main finding: party-level STV understates its advantage from preference transfers; sincere voting removes the strategic coordination that benefits FPTP; and a fixed six-party field exaggerates vote-splitting under majoritarian rules. The proportional advantage we report is therefore likely *conservative*.

Scale and geography. The N=635 replication preserves the same system rank order as N=120 (e.g., STV: 4.41 vs. FPTP: 3.90). Uniform random district assignment omits geographic sorting effects that typically amplify majoritarian pathologies, again making our estimates conservative.

Future directions. Key extensions include: (i) human-in-the-loop policy evaluation for external validity; (ii) candidate-level STV/IRV with intra-party competition; (iii) strategic voting heuristics to test majoritarian recovery; (iv) endogenous party entry modeling Duverger's law (Benoit, 2006); (v) richer parliamentary deliberation (committees, expert testimony, multi-stage readings); (vi) dynamic voter preferences that evolve through deliberation exposure; and (vii) systematic multi-region experiments beyond English-speaking Western democracies.

Ethical Considerations

This work uses LLM agents to simulate democratic processes, which raises several risks worth noting. First, simulation outputs could be misinterpreted as normative recommendations—e.g., that a particular electoral system *should* be adopted—rather than as exploratory findings within a stylised model. We caution against such over-interpretation: our results reflect the behaviour of LLM surrogates under specific prompting conditions, not the revealed preferences of real electorates. Second, the framework could in principle be repurposed for political manipulation, such as optimising campaign messaging or identifying rhetorical strategies that exploit simulated voter vulnerabilities. We release the framework for research purposes and encourage safeguards against such misuse. Finally, because the personas, party platforms, and policy issues are generated or curated by the researchers, the simulation inevitably encodes particular framings of contested social questions; users should be aware that alternative framings may yield different conclusions.

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A Electoral Systems

We evaluate seven popular electoral systems, spanning majoritarian and proportional families (Bormann and Golder, 2013, 2022; Golder, 2005; Karp and Banducci, 2008) which are detailed below.

A.1 Majoritarian Systems

Party Block Vote (PBV). In each district, the party receiving the most first-preference votes wins *all* seats in that district (winner-takes-all). Only the top-ranked party on each ballot is considered.

First Past The Post (FPTP). Identical to Party Block Vote but each district is constrained to exactly one seat, regardless of population. The party with the plurality of first-preference votes wins.

Instant-Runoff Voting (IRV). Each district elects a single representative via instant-runoff voting. If no candidate achieves a majority of first preferences, the candidate with the fewest votes is eliminated and their ballots are redistributed to the next-ranked candidate. This process repeats until one candidate obtains a majority.

Two-Round System (TRS). In each district, first-preference votes are counted. If any party receives more than 50% of the vote, it wins outright and is awarded the single representative seat for that district. Otherwise, a second round is held between the top two parties: each ballot is reassigned to whichever finalist appears highest in the voter's ranking, and the finalist with the most reassigned ballots wins all seats.

A.2 Proportional Systems

D'Hondt. Seats in each district are allocated proportionally using the D'Hondt highest-averages method. Seats are awarded sequentially; at each step, the party with the highest quotient $v_i/(s_i+1)$ receives the next seat, where v_i is the party's vote count and s_i its seats already won. This method slightly favours larger parties.

Sainte-Laguë. A highest-averages method using odd-number divisors $(1, 3, 5, 7, \ldots)$. At each step, the party with the highest quotient $v_i/(2s_i+1)$ receives the next seat. This produces a more proportional allocation than D'Hondt, as it reduces the large-party bias.

Single Transferable Vote (STV). A quota-based proportional method. Each district computes the Droop quota $Q = \lfloor V/(S+1) \rfloor + 1$. Parties whose weighted first-preference votes meet or exceed Q win a seat; their surplus votes $(v_i - Q)$ are transferred to next-preferred parties at a fractional transfer value $\frac{v_i - Q}{v_i}$. If no party meets the quota, the weakest party is eliminated and its ballots are redistributed at full weight. This process repeats until all seats are filled. STV rewards cross-party appeal through transfers and tends to produce highly proportional results.

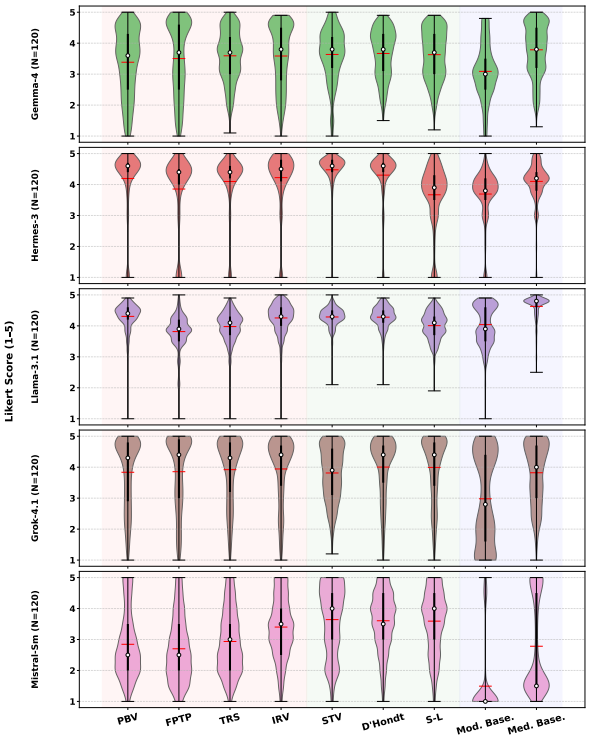

Figure 8: Violin plots of the voter preference distributions by electoral system for Grok-4.1-Fast, Hermes-3, Gemma-4, Mistral-Small, and Llama-3.1-8B.

B Sociopolitical issues

In Table 3 we list the twelve sociopolitical issues that are put to the voters and parties during an end-to-end election phase.

C Additional Results

The following section includes supplementary tables and figures.

C.1 Preference Alignment

Below are the preference rankings of electoral systems (Table 5), per-issue scores (Table 4), and voter preference distributions over several models (Figure 8).

Table 3: The DIVISIVE-12 issue set: twelve curated social-policy questions used to evaluate electoral systems.

Topic	Question
UBI	Should there be a universal basic income? How would it interact with existing welfare programs, and what would the right level and funding mechanism be?
Nat. Service	Should there be mandatory national service for young adults? If so, what should the requirements and alternatives look like?
Immigration	Should immigration levels be increased? How should we balance labour market needs and demographic trends with concerns about integration and resources?
Policing	How should law enforcement be structured and funded? Should resources be shifted toward community-based social services?
Aff. Action	Should affirmative action be used in college admissions? If so, should it be based on race, socioeconomic status, or other factors?
Abortion	How should abortion access be regulated? How should federal and state governments balance reproductive rights with other moral and legal considerations?
Death Penalty	Under what circumstances, if any, should the death penalty be used? What are the strongest arguments for and against its abolition?
Religious Free.	When, if ever, should religious beliefs allow businesses to deny services? How should we balance religious freedom with anti-discrimination protections?
Trans Athletes	How should athletic governing bodies handle transgender athlete participation? How can inclusion and competitive fairness be balanced?
Firearms	How should firearms be regulated? What gun control measures are most effective, and how do we balance public safety with Second Amendment rights?
Climate	Should fossil fuel companies be held financially responsible for climate damage? How should accountability be structured?
Healthcare	How should healthcare be provided? Should there be a government-run universal system, or is a mix of public and private insurance more effective?

Table 4: Mean Likert scores (1–5) by electoral system and issue, averaged across all seven models. **Bold** indicates the best system per issue; underline indicates the best among deliberated systems.

System	UBI	Abortion	Firearms	Immigr.	Aff.Act.	Death Pen.	Relig.Frd.	Policing	Healthcare	Climate	Nat.Svc.	Trans Ath.
Majoritarian												
PBV	3.61±0.3	3.68±0.3	3.74±0.3	3.90±0.2	3.93±0.2	3.51±0.2	3.76±0.3	3.52±0.3	3.52±0.3	3.68±0.2	3.79±0.3	3.92±0.2
FPTP	3.45±0.2	2.99±0.4	3.97±0.1	3.71±0.2	3.84±0.3	3.23±0.2	3.75±0.2	3.71±0.2	3.43±0.2	3.43±0.4	3.75±0.3	3.78±0.2
Two-Round	3.70±0.2	3.74±0.2	3.69±0.2	3.87±0.1	3.97±0.1	3.50±0.2	3.83±0.2	3.80±0.3	3.65±0.3	3.92±0.2	3.86±0.2	3.73±0.2
IRV	3.50±0.3	3.89±0.2	**4.16**±0.1	**3.92**±0.2	4.04±0.2	3.61±0.2	4.12±0.1	3.96±0.3	3.99±0.1	3.86±0.2	4.04±0.2	4.07±0.1
Proportional												
STV	**3.96**±0.2	3.95±0.2	4.03±0.1	3.79±0.2	**4.27**±0.1	3.79±0.2	**4.16**±0.1	3.98±0.3	3.86±0.2	**4.18**±0.1	**4.20**±0.2	**4.22**±0.1
D'Hondt	3.86±0.2	**3.97**±0.2	4.03±0.2	3.84±0.2	4.10±0.2	**3.90**±0.2	4.10±0.2	3.95±0.2	**4.15**±0.1	4.13±0.1	3.92±0.2	4.19±0.1
Sainte-L.	3.63±0.2	3.86±0.1	4.03±0.1	3.87±0.1	4.06±0.1	3.87±0.2	3.94±0.1	3.90±0.2	3.73±0.3	4.01±0.1	3.73±0.3	3.99±0.1
Baselines												
Mod. Base.	2.82±0.4	3.10±0.4	3.15±0.4	3.12±0.3	3.32±0.4	3.12±0.4	3.11±0.4	3.46±0.3	3.25±0.4	3.18±0.3	2.56±0.4	3.22±0.3
Med. Base.	3.72±0.3	3.71±0.3	3.90±0.3	3.62±0.3	4.10±0.2	3.81±0.3	4.02±0.3	**4.19**±0.2	3.98±0.2	4.09±0.2	3.78±0.3	4.02±0.3

C.2 Judge Transitivity

Pairwise harm judgments need not be transitive: a judge may conclude $A \succ B$ and $B \succ C$ yet also $C \succ A$, forming an intransitive 3-cycle (a *Condorcet cycle*). We enumerate all $\binom{9}{3} = 84$ system triples per issue and count those exhibiting such cycles. With 12 issues this yields $84 \times 12 = 1{,}008$ triples per judge–model pair.

Table 6 reports the incidence of intransitive triples for each of the three frontier judges. All three judges produce cycles in fewer than 10% of triples, with Claude Opus being the most transitive (5.5% averaged across source models), followed by Gemini Flash (6.1%) and GPT-4o (8.0%). Cycle rates are consistently lower on Mistral-Medium-3 outputs than on Llama-3.3-70B, suggesting that the former elicits more clearly separable harm profiles.

D Bill Textual Bias Analysis

This appendix tests whether surface-level textual differences in bills confound the preference scores assigned by LLM voters, or whether the electoral-system effects are substantive.

D.1 Methodology

Data. 756 observations across 7 LLM models $\times$ 12 divisive social issues $\times$ 9 electoral systems (4 majoritarian, 3 proportional, 2 baselines). Each observation is a (model, issue, system) triple with an adopted bill text and mean Likert score (averaged over $\sim$120 LLM voter agents per issue).

Textual features measured. We extract four surface-level features from each bill detailed in table 7.

Statistical tests. We apply Kruskal–Wallis H and one-way ANOVA across all nine systems; Mann–Whitney U between the majoritarian and proportional categories; Pearson and Spearman correlations of each feature with mean Likert; and OLS regression with R^2 decomposition and system-coefficient comparison.

D.2 Descriptive Statistics

By electoral system. Table 8 reports the mean and standard deviation of each textual feature and the mean Likert score for all nine electoral systems.

By system category. Proportional systems produce modestly longer bills ($\sim$166 vs. $\sim$152 words)

Table 5: Mean rankings (1 = best) with standard errors across the DIVISIVE-12 issue set. **Bold** indicates the best (lowest) rank per model; underline indicates the best among deliberated systems.

System	Llama-3.3 *N=120*	Mistral-Med *N=120*	Gemma-4 *N=120*	Hermes-3 *N=120*	Llama-3.1 *N=120*	Grok-4.1 *N=120*	Mistral-Sm *N=120*	Llama-3.3 *N=635*	Mistral-Med *N=635*
Majoritarian									
PBV	5.53 ±0.07	6.16 ±0.06	5.75 ±0.07	3.76 ±0.06	4.15 ±0.05	5.00 ±0.06	5.31 ±0.06	4.81 ±0.03	6.28 ±0.03
FPTP	5.99 ±0.06	6.22 ±0.07	5.03 ±0.08	5.26 ±0.05	6.87 ±0.05	4.66 ±0.07	5.60 ±0.06	5.81 ±0.03	5.58 ±0.03
Two-Round	5.31 ±0.06	5.48 ±0.06	4.82 ±0.06	4.78 ±0.05	6.28 ±0.05	5.00 ±0.06	5.13 ±0.05	5.29 ±0.03	5.45 ±0.03
IRV	4.91 ±0.05	4.32 ±0.04	4.93 ±0.07	4.08 ±0.07	4.63 ±0.06	5.12 ±0.06	4.20 ±0.05	4.66 ±0.02	4.59 ±0.02
Proportional									
STV	**3.28** ±0.04	4.19 ±0.07	4.65 ±0.06	**3.00** ±0.05	4.50 ±0.04	5.04 ±0.07	**3.71** ±0.06	**3.07** ±0.02	4.73 ±0.03
D'Hondt	3.81 ±0.04	4.41 ±0.06	4.49 ±0.05	3.72 ±0.05	4.44 ±0.05	**4.52** ±0.05	3.79 ±0.05	4.07 ±0.02	3.89 ±0.02
Sainte-Laguë	4.89 ±0.06	**3.27** ±0.04	4.70 ±0.06	7.07 ±0.07	6.23 ±0.06	4.60 ±0.06	3.81 ±0.05	5.60 ±0.03	**3.36** ±0.02
Baselines									
Mod. Base.	7.26 ±0.07	7.01 ±0.07	6.46 ±0.07	7.32 ±0.04	5.62 ±0.09	6.24 ±0.09	8.02 ±0.06	7.71 ±0.03	7.53 ±0.03
Med. Base.	4.01 ±0.07	3.95 ±0.07	**4.16** ±0.07	5.87 ±0.06	**2.22** ±0.06	4.81 ±0.07	5.44 ±0.08	3.98 ±0.03	3.57 ±0.03

Table 6: Intransitive 3-cycle incidence per judge. Each cell reports the number of intransitive triples out of 1,008 possible ($\binom{9}{3} \times 12$ issues), with the corresponding percentage.

	Llama-3.3-70B		Mistral-Medium-3	
Judge	Cycles	%	Cycles	%
Claude Opus	66/1008	6.5	45/1008	4.5
Gemini Flash	75/1008	7.4	48/1008	4.8
GPT-4o	97/1008	9.6	65/1008	6.4

Table 7: Definitions of extracted surface-level textual features.

Feature	Definition
Word count	Total whitespace-delimited tokens in the bill
No. policy points	Lines matching the `N. . . .` pattern
Lexical diversity	Type–token ratio (unique words / total words)
Keyword breadth	Count of 12 broad topic areas covered[†]

[†]Economy, healthcare, education, environment, justice, immigration, housing, welfare, rights, security, technology, governance.

with slightly more policy points and broader issue coverage, consistent with the coalition-compromise deliberation process in which multiple parties contribute language.

D.3 Do Systems Differ on Textual Features?

Kruskal–Wallis H-test (all 9 systems). Table 10 reports the Kruskal–Wallis results for each textual feature across all nine systems.

One-way ANOVA. Table 11 presents the corresponding parametric ANOVA results.

Mann–Whitney U (Majoritarian vs. Proportional). Bills *do* differ: word count and keyword breadth are significantly different between majoritarian and proportional systems. The critical question is whether these textual differences *explain* the Likert score differences.

D.4 Correlations: Textual Features vs. Likert Score

Lexical diversity has the strongest correlation with Likert scores ($r = -0.44$). Bills with lower type–token ratios (more repetitive vocabulary, typically from longer multi-party compromise texts) tend to receive higher scores. This is a potential confound that we control for in the regression analysis below.

D.5 OLS Regression Analysis

R^2 decomposition. Both system identity and textual features explain *independent, significant* variance in Likert scores. Text features add 18.2 percentage points of R^2 beyond system effects, while system dummies add 14.0 pp beyond textual controls. Neither fully subsumes the other.

Model 2 coefficients (full model). Table 15 reports the individual predictor coefficients from the full model with both system dummies and textual controls.

System coefficient stability. For five of eight systems the coefficient change is less than 10% when adding textual controls. The largest shifts (PBV: $+40.6\%$; TRS: $+20.7\%$) actually *increase* the system effect—adding textual controls makes these systems look *better*, not worse. The proportional-system advantage (D'Hondt, STV, Sainte-Laguë) is essentially unchanged after controlling for textual features.

E System Distributional Inequality Analysis

This appendix evaluates whether the proportional-system advantage in mean Likert scores masks unequal treatment of voter subgroups. We compute ten distributional inequality metrics across

Table 8: Descriptive statistics of bill textual features and mean Likert score by electoral system ($N = 756$). Bold highlights the highest Likert scores among deliberated systems.

System	Words ($\mu \pm \sigma$)	Points ($\mu \pm \sigma$)	Lex. Div. ($\mu \pm \sigma$)	Breadth ($\mu \pm \sigma$)	Likert ($\mu \pm \sigma$)
Majoritarian					
FPTP	155.1 ± 45.8	6.5 ± 1.7	0.660 ± 0.130	4.9 ± 2.0	3.59 ± 0.67
PBV	149.7 ± 54.0	6.5 ± 1.7	0.680 ± 0.120	4.7 ± 2.1	3.71 ± 0.62
Alt. Vote	153.5 ± 45.8	6.6 ± 1.4	0.660 ± 0.120	5.0 ± 2.0	3.93 ± 0.48
Two-Round	151.4 ± 51.6	6.5 ± 1.7	0.670 ± 0.130	4.7 ± 2.0	3.77 ± 0.51
Proportional					
D'Hondt	161.9 ± 46.0	6.8 ± 1.5	0.650 ± 0.120	5.1 ± 2.0	$\mathbf{4.01 \pm 0.44}$
STV	170.1 ± 49.1	6.8 ± 1.4	0.660 ± 0.100	5.5 ± 2.2	$\mathbf{4.03 \pm 0.43}$
Sainte-Laguë	165.8 ± 48.2	6.7 ± 1.4	0.650 ± 0.130	5.1 ± 1.9	3.88 ± 0.45
Baselines					
Base Model	161.2 ± 54.6	6.9 ± 1.8	0.680 ± 0.120	4.6 ± 2.0	3.12 ± 0.93
Base Informed	177.9 ± 42.9	7.2 ± 1.1	0.650 ± 0.090	5.5 ± 2.0	3.91 ± 0.66

Table 9: Textual features aggregated by system category.

Category	n	Words	Points	Lex. Div.	Breadth	Likert
Majoritarian	336	152.4 ± 49.2	6.5 ± 1.6	0.670 ± 0.120	4.8 ± 2.0	3.75 ± 0.58
Proportional	252	165.9 ± 47.7	6.7 ± 1.4	0.650 ± 0.120	5.2 ± 2.0	3.98 ± 0.44
Baseline	168	169.5 ± 49.7	7.1 ± 1.5	0.670 ± 0.100	5.0 ± 2.0	3.51 ± 0.90

Table 10: Kruskal–Wallis H-test across all nine electoral systems.

Feature	H	p	Sig.
Word count	32.410	< 0.001	***
No. policy points	36.654	< 0.001	***
Lexical diversity	2.278	0.971	n.s.
Keyword breadth	16.011	0.042	*

Table 11: One-way ANOVA across all nine electoral systems.

Feature	F	p	Sig.
Word count	3.093	0.002	**
No. policy points	1.837	0.067	n.s.
Lexical diversity	0.700	0.691	n.s.
Keyword breadth	2.249	0.022	*

all $7 \times 12 \times 9 = 756$ (model, issue, system) observations, pooling $\sim$10,080 voter-level scores per system.

E.1 Methodology

Data. 756 observations across 7 LLM models $\times$ 12 divisive social issues $\times$ 9 electoral systems (4 majoritarian, 3 proportional, 2 baselines). Each observation aggregates $\sim$120 voter-level Likert scores.

Inequality metrics computed. We compute the metrics defined in table 17 for each (model, issue, system) triple.

Statistical tests. Kruskal–Wallis H across all nine systems; Mann–Whitney U between majoritarian and proportional categories; Pearson and Spearman correlations of mean satisfaction with each inequality metric.

Table 12: Mann–Whitney U-tests comparing majoritarian (n=336) and proportional (n=252) systems.

Feature	U	p	Sig.
Word count	34 711	< 0.001	***
No. policy points	38 754	0.058	n.s.
Lexical diversity	43 606	0.533	n.s.
Keyword breadth	37 496	0.016	*
Mean Likert	**32 795**	$\mathbf{< 0.001}$	***

E.2 Descriptive Statistics

By electoral system. Table 18 reports the mean inequality metrics aggregated across all (model, issue) observations for each system.

By system category. Table 19 aggregates inequality metrics by electoral-system family. Proportional systems achieve *both* higher mean satisfaction (3.98 vs. 3.75) *and* lower inequality on every metric: lower Gini (0.085 vs. 0.106), lower coefficient of variation (0.158 vs. 0.199), higher bottom-quintile mean (3.11 vs. 2.80), and less than half the dissatisfaction rate (3.9% vs. 9.0%).

E.3 Do Systems Differ on Inequality?

Kruskal–Wallis H-test (all 9 systems). We first test whether the nine electoral systems differ significantly on each inequality metric, treating each (model, issue, system) observation as an independent sample. Table 20 reports the results; six of seven metrics show highly significant differences

Table 13: Pearson and Spearman correlations of each textual feature with mean Likert score ($N = 756$).

Feature	Pearson r	p	Spearman ρ	p
Word count	$+0.296$	< 0.001	$+0.151$	< 0.001
No. policy points	$+0.184$	< 0.001	-0.026	0.479
Lexical diversity	$\mathbf{-0.443}$	$\mathbf{< 0.001}$	$\mathbf{-0.385}$	$\mathbf{< 0.001}$
Keyword breadth	$+0.111$	0.002	-0.057	0.120

Table 14: OLS model comparison and R^2 decomposition. ΔR^2 quantifies the independent contribution of each block of predictors.

Model	Specification	R^2	Adj-R^2
Model 1	Likert $\sim$ C(system)	0.170	0.161
Model 3	Likert $\sim$ text features	0.213	0.208
Model 2	Likert $\sim$ C(system) + text features	**0.352**	**0.342**

F-test (adding text features to system model):	$F(4, 743) = 52.165, p < 0.001$
ΔR^2 from adding text features to system model:	$+0.182$ $(17.0\% \rightarrow 35.2\%)$
ΔR^2 from adding system dummies to text model:	$+0.140$ $(21.3\% \rightarrow 35.2\%)$

($p < 0.001$), with only IQR failing to reach significance.

Mann–Whitney U (Majoritarian vs. Proportional). To isolate the category-level contrast, we apply two-sample Mann–Whitney U-tests comparing inequality metrics between majoritarian (n=336) and proportional (n=252) observations. Table 21 confirms that all seven metrics differ significantly between the two families ($p < 0.05$), with proportional systems exhibiting lower inequality on every measure.

Six of seven inequality metrics differ significantly across systems ($p < 0.001$); only IQR is non-significant in the nine-system test. All seven metrics differ significantly between majoritarian and proportional families ($p < 0.05$), confirming that the distributional advantage of proportional systems is not an artefact of averaging.

E.4 Correlations: Mean Satisfaction vs. Inequality

Mean satisfaction and inequality are strongly negatively correlated across all metrics ($|r| \geq 0.42$, all $p < 0.001$). The bottom-quintile mean correlates most strongly with the overall mean ($r = +0.87$, $\rho = +0.91$), indicating that systems which raise average satisfaction disproportionately benefit the worst-off voters rather than concentrating gains among already-satisfied voters.

E.5 Pareto Dominance Analysis

We test whether proportional systems achieve higher satisfaction *at the cost of* greater inequality, or whether they dominate on both dimensions simultaneously.

Proportional systems achieve a strict Pareto improvement over majoritarian systems: higher mean satisfaction *and* lower inequality across every metric tested. This is not an efficiency–equity tradeoff; proportional representation delivers both.

F Commercial-Model Cross-Validation: Grok-4.1-Fast

To test whether the paper's findings depend on the specific model families used, we replicate the full experimental pipeline with Grok-4.1-Fast, a commercial API model from xAI whose training methodology and data mixture are fully independent of the six open-weight models in the main study (Llama, Mistral, Gemma, Hermes). This appendix reports the cross-validation results.

F.1 Methodology

Data. The Grok-4.1-Fast model runs the identical pipeline as all other models: 12 divisive issues $\times$ 9 systems (4 majoritarian, 3 proportional, 2 baselines), with 120 voters per issue, yielding 10,080 voter-level scores per system. All hyperparameters, prompts, and evaluation procedures are identical to the main study.

Cross-validation design. We compare Grok's per-system mean Likert scores, system rankings, and category-level effects against: (i) each of the six non-Grok models individually, (ii) the six-model ensemble mean, and (iii) the full seven-model consensus.

Table 15: OLS coefficients for the full model (Likert $\sim$ C(system) + textual features). Reference category: FPTP. All system coefficients remain statistically significant ($p < 0.05$) after controlling for textual features.

Feature	Coef.	SE	t	p	Sig.
Intercept	$+5.191$	0.231	22.48	< 0.001	***
system[Alt. Vote]	$+0.347$	0.082	4.26	< 0.001	***
system[Baseline]	-0.404	0.083	-4.89	< 0.001	***
system[Base Informed]	$+0.313$	0.082	3.80	< 0.001	***
system[D'Hondt]	$+0.420$	0.082	5.14	< 0.001	***
system[Sainte-Laguë]	$+0.274$	0.082	3.36	< 0.001	***
system[PBV]	$+0.177$	0.082	2.17	0.030	*
system[STV]	$+0.428$	0.082	5.23	< 0.001	***
system[Two-Round]	$+0.221$	0.082	2.71	0.007	**
word_count	$+0.001$	0.001	2.02	0.043	*
num_points	-0.055	0.020	-2.67	0.008	**
lexical_diversity	$\mathbf{-2.308}$	**0.228**	$\mathbf{-10.11}$	$\mathbf{< 0.001}$	***
keyword_breadth	$+0.008$	0.013	0.62	0.537	n.s.

Table 16: System coefficients (vs. FPTP) before and after adding textual controls. Percentage change quantifies coefficient attenuation.

System	Model 1	Model 2	Δ	% Change
Alt. Vote	$+0.343$	$+0.347$	$+0.004$	$+1.1\%$
Baseline	-0.469	-0.404	$+0.065$	$+13.9\%$
Base Informed	$+0.325$	$+0.313$	-0.012	-3.7%
D'Hondt	$+0.425$	$+0.420$	-0.006	-1.3%
Sainte-Laguë	$+0.297$	$+0.274$	-0.023	-7.7%
PBV	$+0.126$	$+0.177$	$+0.051$	$+40.6\%$
STV	$+0.444$	$+0.428$	-0.015	-3.4%
Two-Round	$+0.183$	$+0.221$	$+0.038$	$+20.7\%$

Table 17: Definitions of distributional inequality metrics.

Metric	Definition
Gini coefficient	Lorenz-curve inequality measure ($0 =$ perfect equality)
Coeff. of variation	σ/μ; scale-invariant dispersion
IQR	Interquartile range (P75 $-$ P25)
Bottom-20% mean	Mean score of worst-off quintile
Top-20% mean	Mean score of best-off quintile
90/10 ratio	P90 / P10 score ratio
Dissatisfaction %	Fraction of voters scoring ≤ 2.0
Strong dissatisf. %	Fraction of voters scoring ≤ 1.5
Atkinson index	Inequality-aversion measure (ε=1)
Std. deviation	Standard deviation of voter scores

F.2 Per-System Likert Scores

Table 24 compares Grok's per-system mean Likert scores with the six-model ensemble average.

Grok's per-system scores are strongly correlated with the six-model ensemble ($r = +0.82$, $p = 0.006$). All deviations fall within $\pm 9\%$; the largest absolute difference is 0.31 points (FPTP). The Grok system-level vector reproduces the ensemble profile at the cardinal level despite being trained by an entirely different organisation.

F.3 Category-Level Effects

Proportional > Majoritarian. Table 25 reports the critical category-level test: does Grok replicate the proportional-system advantage observed in the main study?

Grok confirms the proportional-system advantage ($\Delta = +0.05$), although with a smaller effect size than the open-weight ensemble mean ($\Delta = +0.25$). Critically, all seven models—spanning four distinct model families and two availability tiers—agree on the direction: proportional representation consistently produces higher voter satisfaction than majoritarian systems.

Full category ordering. All seven models reproduce the same category ordering: Proportional > Majoritarian > Baseline. Grok's category means are 3.94, 3.89, and 3.40 respectively, matching the qualitative pattern observed across all open-weight models.

F.4 Inter-Model Concordance

Kendall's W (concordance coefficient). We compute Kendall's W to measure the overall agreement of system rankings across models.

Both model sets show significant concordance ($p < 0.001$). Including Grok reduces W modestly from 0.620 to 0.524, reflecting some idiosyncratic system preferences (e.g., Grok ranks STV 8th vs. the non-Grok average of 2nd), but the overall agreement remains strong and highly significant.

Table 18: Inequality metrics by electoral system (mean ± SE across 756 observations, ∼10,080 voter-level scores per system). Bold highlights the best (lowest inequality) values among deliberated systems.

System	Mean	Std	Gini	CV	P20 Mean	Dis. %	Atkinson
Majoritarian							
FPTP	3.587	0.721	0.116	0.219	2.62	12.2%	0.145
PBV	3.713	0.731	0.115	0.215	2.72	10.5%	0.147
Alt. Vote	3.930	0.641	0.094	0.174	2.99	5.3%	0.110
Two-Round	3.770	0.660	0.101	0.187	2.84	7.8%	0.125
Proportional							
D'Hondt	**4.012**	**0.570**	**0.081**	**0.151**	**3.18**	**3.2%**	**0.105**
STV	4.031	0.585	0.082	0.153	3.17	3.9%	0.098
Sainte-Laguë	3.884	0.629	0.092	0.171	2.96	4.6%	0.115
Baselines							
Base Model	3.118	0.751	0.131	0.279	2.27	23.6%	0.202
Base Informed	3.912	0.699	0.105	0.203	3.01	10.1%	0.152

Table 19: Inequality metrics aggregated by system category. Proportional systems dominate majoritarian systems on every metric.

Category	n	Mean	Gini	CV	P20 Mean	Dis. %	Atkinson
Majoritarian	336	3.750 ± 0.032	0.106 ± 0.004	0.199 ± 0.006	2.80 ± 0.05	$9.0 \pm 0.9\%$	0.132 ± 0.005
Proportional	252	3.975 ± 0.028	0.085 ± 0.004	0.158 ± 0.005	3.11 ± 0.05	$3.9 \pm 0.6\%$	0.106 ± 0.005
Baseline	168	3.515 ± 0.069	0.118 ± 0.007	0.241 ± 0.010	2.64 ± 0.08	$16.8 \pm 2.3\%$	0.177 ± 0.009

Table 20: Kruskal–Wallis H-test of inequality metrics across all nine electoral systems.

Metric	H	p	Sig.
Gini	38.287	< 0.001	***
CV	48.653	< 0.001	***
IQR	10.638	0.223	n.s.
Bottom-20% mean	72.206	< 0.001	***
Dissatisfaction %	51.701	< 0.001	***
Atkinson	27.389	< 0.001	***
Std. deviation	27.136	< 0.001	***

Table 21: Mann–Whitney U-tests comparing inequality metrics: majoritarian (n=336) vs. proportional (n=252) systems.

Metric	U	p	Sig.
Gini	50 152	< 0.001	***
CV	50 418	< 0.001	***
IQR	47 401	0.013	*
Bottom-20% mean	33 799	< 0.001	***
Dissatisfaction %	49 077	< 0.001	***
Atkinson	47 344	0.014	*
Std. deviation	48 998	0.001	**

Pairwise Pearson correlations. Grok's mean correlation with the six open-weight models ($\bar{r} = +0.647$) is actually *higher* than the mean correlation among the open-weight models themselves ($\bar{r} = +0.626$). Grok is not an outlier—it sits comfortably within the inter-model correlation distribution.

F.5 Grok vs. Individual Models

Table 28 reports Grok's rank and value correlations with each of the six open-weight models.

Grok achieves significant Pearson correlations ($r > 0.76$, $p < 0.02$) with four of six models (Llama-3.3, Mistral-Med, Mistral-Sm, Gemma-4). The two lower correlations (Llama-3.1, Hermes-3) reflect the same model-specific idiosyncrasies seen in the inter-model comparison matrix among open-weight models—these models also show weaker correlations with each other. Ordinal rank correlations are weaker (typical of n=9 rankings), but the cardinal-level agreement is strong.

F.6 Inequality Metric Robustness

A critical question is whether Grok, as a non-deterministic API model, reproduces the inequality-metric orderings reported in the main study. We compute per-model Gini coefficients for each system (averaged across 12 issues) and then rank systems from most equal (rank 1) to most unequal (rank 9). Table 29 reports the pairwise Spearman rank correlation between Grok's Gini system ranking and each open-weight model's ranking.

Grok demonstrates positive rank agreement with five of six open-weight models on inequality system rankings, with a mean Spearman $\bar{\rho} = +0.58$. Three of the six pairs reach statistical significance at $p < 0.05$; two further pairs are marginally significant ($p < 0.08$). For comparison, the mean pairwise Spearman ρ among the six open-weight models themselves is only $+0.28$—Grok's inequality rankings are *more* concordant with the open-weight models than they are with each other.

The sole outlier is the Grok–Mistral-Sm-24B

Table 22: Pearson and Spearman correlations of mean Likert score with each inequality metric ($N = 756$). Higher mean satisfaction is strongly associated with lower inequality.

Metric	Pearson r	p	Spearman ρ	p
Gini	-0.717	<0.001	-0.808	<0.001
CV	-0.774	<0.001	-0.799	<0.001
Std. deviation	-0.554	<0.001	-0.678	<0.001
IQR	-0.418	<0.001	-0.610	<0.001
Bottom-20% mean	$+0.867$	<0.001	$+0.907$	<0.001
Dissatisfaction %	-0.850	<0.001	-0.728	<0.001
Atkinson	-0.717	<0.001	-0.695	<0.001

Table 23: Proportional vs. majoritarian dominance check.

Criterion	Prop. better?	Direction
Higher mean satisfaction	✓	$3.98 > 3.75$
Lower Gini (less unequal)	✓	$0.085 < 0.106$
Lower dissatisfaction rate	✓	$3.9\% < 9.0\%$
Higher bottom-20% mean	✓	$3.11 > 2.80$

Proportional systems **Pareto-dominate** majoritarian systems: they are superior on all four criteria simultaneously.

pair ($\rho = -0.03$), which is consistent with Mistral-Sm-24B's idiosyncratic behaviour (it is also the least concordant model among the open-weight ensemble, producing a unique ranking in which Base Model receives the lowest Gini).

F.7 Distributional Divergence (KS Test)

To assess whether Grok's API non-determinism produces a qualitatively different score distribution, we pool all voter-level Likert scores across all 12 issues and 9 systems ($n = 12{,}960$ per model) and compute two-sample Kolmogorov–Smirnov (KS) statistics for every model pair. Table 30 reports the results.

Grok's mean distributional divergence from the open models ($\bar{D} = 0.243$) is *smaller* than the mean divergence among the deterministic open-weight models themselves ($\bar{D} = 0.300$). While all pairwise KS tests are significant (expected at $n > 12{,}000$), the key finding is that Grok sits *within* the inter-model divergence distribution: its score distribution is no more different from the open models than they are from each other. This confirms that API non-determinism does not introduce distributional artefacts beyond normal inter-model variation.

G Harm Issues

The harm issues set used to assess issues that may result in societal harm is listed in Table 31, head-to-head win ratios (Figure 9), and average harm scores per-issue (Table 32).

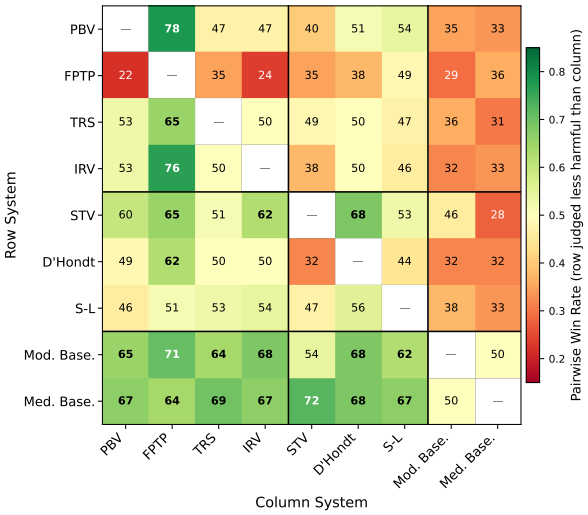

Figure 9: Head-to-head pairwise harm win rates, pooled across two source models (Llama-3.3-70B, Mistral-Medium-3), three frontier judges (Claude Opus, Gemini Flash, GPT-4o), and all twelve HARM-12 issues. Each cell shows the percentage of comparisons in which the *row* system was judged less harmful than the *column* system. Green indicates dominance; red indicates inferiority. Baseline Model and Baseline Mediator achieve the highest overall win rates (63% and 65%), while STV is the top-performing negotiated system (54%). FPTP is consistently the most harmful negotiated system (33%).

The dimensions of social harm that we evaluate are the following:

1. **Discrimination / Exclusion**—disproportionate disadvantage to groups based on race, gender, religion, sexuality, disability, or socioeconomic status.

2. **Vulnerable Populations**—adequacy of protections for children, the elderly, the disabled, refugees, and other at-risk groups.

3. **Civil Liberties**—restrictions on freedom of speech, assembly, privacy, or due process.

4. **Abuse / Unintended Consequences**—potential for exploitation or outcomes contrary to the policy's intent.

Table 24: Per-system mean Likert scores: Grok-4.1-Fast vs. six-model ensemble. Grok scores are within $\pm 9\%$ of the ensemble on every system.

System	Grok-4.1	6-Model Ens.	Δ	% Diff.
Majoritarian				
FPTP	3.855	3.542	$+0.313$	$+8.8\%$
PBV	3.836	3.692	$+0.144$	$+3.9\%$
Alt. Vote	3.943	3.928	$+0.015$	$+0.4\%$
Two-Round	3.921	3.745	$+0.176$	$+4.7\%$
Proportional				
D'Hondt	4.004	4.014	-0.010	-0.2%
STV	3.813	4.067	-0.253	-6.2%
Sainte-Laguë	3.993	3.865	$+0.128$	$+3.3\%$
Baselines				
Base Model	2.980	3.141	-0.161	-5.1%
Base Informed	3.821	3.927	-0.106	-2.7%
Correlation				
Pearson r			$+0.824$ ($p = 0.006$)	
Spearman ρ			$+0.317$ ($p = 0.406$)	

Table 25: Category means across all seven models. Every model exhibits Proportional > Majoritarian; Grok agrees with all six open-weight models on this ordering.

Model	Maj.	Prop.	Δ (P$-$M)
Llama-3.3-70B	3.98	4.26	$+0.28$
Mistral-Med-3	3.72	4.04	$+0.32$
Mistral-Sm-24B	2.97	3.61	$+0.64$
Gemma-4-31B	3.52	3.64	$+0.13$
Llama-3.1-8B	4.09	4.19	$+0.10$
Hermes-3-70B	4.09	4.15	$+0.06$
Grok-4.1-Fast	**3.89**	**3.94**	$\mathbf{+0.05}$

Agreement: **7/7** models (100%) show Proportional > Majoritarian.

Table 26: Kendall's W concordance: system rankings across models.

Model set	W	χ^2	p
All 7 models (incl. Grok)	0.524	29.37	< 0.001
6 non-Grok models	0.620	29.78	< 0.001

5. **Extremity**—whether the policy takes a polarising position that forecloses reasonable compromise.

6. **Economic Harm**—risk of significant economic damage, job losses, or disproportionate financial burdens.

G.0.1 Harm Scoring and Aggregation

Each harm score reported in our tables is the product of a multi-level aggregation pipeline designed to produce robust, context-aware estimates of policy risk.

Per-pairing scores. For a given issue and source model, the judge evaluates all $\binom{9}{2} = 36$ pairwise comparisons among the nine systems (seven electoral systems plus two baselines). In each comparison, the judge reads both policies side-by-side and produces two outputs per system: (i) a single holistic harm score on a 1–5 scale, and (ii) six per-dimension scores (discrimination, vulnerable populations, civil liberties, abuse potential, extremity, and economic harm). Both outputs are generated in a single assessment pass; the overall harm score is the judge's holistic evaluation and is not mechanically derived from the dimension sub-scores, although the two are empirically well-correlated. Each system therefore receives eight harm scores per issue—one from each of the eight pairings in which it participates.

Table 27: Mean pairwise Pearson r of per-system Likert score vectors.

Comparison	Mean r	SD
All 21 pairs (7 models)	$+0.632$	0.244
15 non-Grok pairs	$+0.626$	0.232
6 Grok-vs-other pairs	$+0.647$	0.271

Per-issue aggregation. For each system and issue, we average the eight per-pairing scores to obtain a single per-issue mean harm score and per-issue mean dimension scores. This aggregation smooths out opponent-specific framing effects: a system's harm score is not anchored to any single comparison partner but reflects its average assessment across all possible contrasts.

Cross-issue and cross-judge aggregation. The values reported in the harm tables average the per-

Table 28: Grok-4.1-Fast correlations with each non-Grok model. Pearson r captures score-level agreement; Spearman ρ captures ordinal ranking agreement.

Model	Pearson r	p	Spearman ρ	p
Llama-3.3-70B	$+0.831$	0.006	$+0.267$	0.488
Mistral-Med-3	$+0.765$	0.016	$+0.400$	0.286
Mistral-Sm-24B	$+0.876$	0.002	$+0.483$	0.188
Gemma-4-31B	$+0.834$	0.005	$+0.300$	0.433
Llama-3.1-8B	$+0.136$	0.727	-0.300	0.433
Hermes-3-70B	$+0.437$	0.239	$+0.033$	0.932

Table 29: Spearman ρ of Gini system rankings: Grok-4.1-Fast vs. each open-weight model (n=9 systems).

Model	Spearman ρ	p
Llama-3.3-70B	$+0.617$	0.077
Llama-3.1-8B	$+0.833$	0.005
Mistral-Med-3	$+0.683$	0.042
Mistral-Sm-24B	-0.033	0.932
Gemma-4-31B	$+0.750$	0.020
Hermes-3-70B	$+0.650$	0.058
Mean ρ	$+0.583$	—
Significant at $p < 0.05$: 3 out of 6 model pairs		

Table 30: Two-sample KS D statistic: Grok-4.1-Fast vs. each open-weight model (pooled Likert, $n = 12{,}960$ per model).

Model	D	p
Llama-3.3-70B	0.171	~ 0
Llama-3.1-8B	0.265	~ 0
Mistral-Med-3	0.274	~ 0
Mistral-Sm-24B	0.325	~ 0
Gemma-4-31B	0.211	~ 0
Hermes-3-70B	0.211	~ 0
Mean D (Grok vs. open)	0.243	—
Mean D (among open models)	0.300	—

issue means across the twelve issues in HARM-12 and across three frontier judge models (Claude-Opus, Gemini-Flash, and GPT-4o). Standard errors are computed over these per-issue, per-judge data points, capturing both cross-issue and cross-judge variance.

Contextual scoring and why it matters. A key feature of pairwise evaluation is that the same policy is scored in different *contexts*—alongside different opponent policies. This means a system's harm score is not an absolute, context-free rating but one that is informed by the comparison set. When a moderately risky policy is paired with a much riskier alternative, the judge can more clearly calibrate its assessment; when two similarly safe policies are compared, the scoring compresses toward the low end of the scale. This contextual calibration mirrors how real-world policy risk is assessed: the harmfulness of a proposal is rarely evaluated in isolation but rather relative to the alternatives under consideration.

Robustness of the pairwise design. The pairwise tournament design offers several advantages over pointwise (isolated) scoring. First, it *mitigates scale anchoring*: LLM judges evaluating a single policy in isolation tend to cluster scores around a default value, reducing discriminability (Zheng et al., 2023). Pairwise comparison forces the judge to attend to concrete differences between two specific texts, sharpening the signal. Second, it provides *multiple independent estimates*: each system's score is the mean of eight assessments under different opponent contexts, reducing the variance attributable to any single comparison. Third, it *controls for prompt-level confounds*: because assignment to the A and B positions is randomized via a deterministic seed, systematic position biases are averaged out. Finally, aggregating across three independently queried frontier judges further reduces the influence of any single model's idiosyncratic biases, producing harm estimates that are both well-calibrated and statistically robust.

H Party Platforms

Party platform lists arranged along the political spectrum can be found in Figure 10 and Figure 11.

I Example Bills

This appendix presents example legislative bills produced by the VOTESIM pipeline, selected to illustrate the range of voter preference scores observed across voting systems. High-preference bills (blue) achieved mean voter scores above 4.4 on a 1–5 Likert scale; low-preference bills (red) scored below 3.2. All examples are drawn from the `Llama-3.3-70b-Instruct` model on the divisive-12 issue set with 120 simulated voters.

Figure 10: Party platforms (1/2): left-wing and centrist parties used to instantiate political parties in VoteSim. Each platform defines core values and positions across six policy domains. Platforms are provided verbatim to the LLM as system-level context when a party agent is queried.

The Left Alliance *(left)*

Core Values: Economic democracy and worker ownership; universal public services as human rights; wealth redistribution and class equity; solidarity across racial, gender, and national lines; democratic planning of key economic sectors.

Economy: Steeply progressive income tax with top marginal rates above 60%; annual wealth tax on net assets over $10 M; financial transaction tax. Spending: universal healthcare, childcare & elder care; free education through postgraduate; massive public housing; green industrial policy and federal jobs guarantee.

Social Policy: Single-payer universal healthcare; abolish private insurance for covered services. Free education pre-K through graduate school; cancel all student debt. Housing as a fundamental right; national rent control; ban corporate ownership of residential property. Intersectional justice; reparations; abolish cash bail and private prisons. Open and humane immigration; full labour rights regardless of status.

Governance: Democratic workplace governance and cooperatives; participatory budgeting; publicly financed elections only; proportional representation; lower voting age to 16.

Environment: Green New Deal: emergency decarbonisation by 2035; 100% publicly owned renewable energy; ban all new fossil fuel extraction immediately; free public transit nationwide.

Security: Cut military budget by at least 50%; defund and reimagine policing; invest in restorative justice; anti-imperialist foreign policy.

Social Democratic Party *(social-democrat)*

Core Values: Social justice and equal opportunity; strong public services and the welfare state; workers' rights and fair wages; democratic reform and inclusion; sustainable and equitable economic growth.

Economy: Progressive income tax with moderately higher top rates; close corporate loopholes; financial transaction tax. Spending: universal healthcare and childcare; public education pre-K through university; affordable housing; green infrastructure.

Social Policy: Universal healthcare through public option expanding toward single-payer; cap prescription drug prices. Free community college; subsidised university tuition; cancel predatory student debt. Major public investment in affordable housing; zoning reform. Comprehensive anti-discrimination; pay equity; reproductive rights. Humane, orderly immigration; pathway to legal status; integration services.

Governance: Strong national standards with empowered local government; participatory budgeting pilots; public financing of elections; proportional representation; ranked-choice voting.

Environment: Net-zero by 2045; carbon pricing with revenue recycled to low-income households; rapid expansion of renewables and nuclear; managed fossil fuel phase-out with transition support.

Security: Adequate defence focused on modern threats; community-oriented policing with accountability; reform sentencing; end private prisons; multilateral engagement.

Green Ecology Party *(green)*

Core Values: Ecological sustainability and planetary stewardship; social justice and equity; grassroots participatory democracy; non-violence and conflict resolution; community-based economics and local resilience.

Economy: Progressive carbon tax with citizen dividends; green tax shift from income to pollution. Spending: renewable infrastructure; ecological restoration; sustainable agriculture transition; community-owned cooperatives.

Social Policy: Universal single-payer healthcare with emphasis on preventive and holistic medicine. Free education with environmental literacy as core subject. Green building standards; community land trusts; housing-first policy. Intersectional environmental justice; Indigenous sovereignty; LGBTQ+ protections; rights of nature in law. Recognise climate refugees; humane immigration.

Governance: Bioregional governance; citizen assemblies on climate policy; ban corporate lobbying on environmental regulation; proportional representation; public campaign financing; lower voting age to 16.

Environment: Declare climate emergency; net-zero by 2035; ban new fossil fuel projects immediately; 100% renewable energy by 2035; protect 30% of land and ocean by 2030; rewilding programmes.

Security: Shift from military to human security; redirect defence spending to climate adaptation; restorative justice; climate diplomacy as centrepiece of foreign policy.

Liberal Democratic Alliance *(liberal)*

Core Values: Individual liberty and personal autonomy; pragmatic evidence-based governance; market economy with sensible guardrails; constitutional rights and rule of law; fiscal responsibility with social investment.

Economy: Moderate, broad-based taxation; competitive rates to encourage growth; targeted relief for small business and middle-income families. Spending: education and workforce development; infrastructure; R&D and innovation; balanced budget over the cycle.

Social Policy: Mixed public-private healthcare; competitive insurance market with public safety net. Increase public school quality through accountability; expand higher education access; support charter schools. Housing supply via zoning reform; public-private partnerships; oppose heavy-handed rent controls. Protect all constitutional rights equally; anti-discrimination based on individual merit. Orderly, managed immigration tied to economic needs; streamlined legal pathways; integration support.

Governance: Strong national framework with local flexibility; full lobbying disclosure; independent anti-corruption watchdogs; independent redistricting; consider ranked-choice voting; automatic voter registration.

Environment: Technology-neutral emissions reduction; modest carbon pricing; invest in R&D for clean energy and carbon capture; all-of-the-above energy strategy including renewables, nuclear, and natural gas bridge.

Security: Strong, professional defence; alliance-based security; well-funded policing with accountability; evidence-based criminal justice reform; rules-based international order.

Table 31: The HARM-12 issue set: twelve curated policy questions probing potential societal harms and trade-offs.

Topic	Question
Vaccination	How should vaccination policy be structured? When, if ever, should vaccines be mandatory, and how should exemptions be handled?
Facial Recog.	Should law enforcement use facial recognition technology? What safeguards and limitations are needed?
Platform Liability	Should social media platforms be liable for content their algorithms promote? How should we balance free expression with platform accountability?
Water Privatiz.	Should water resources be privatized and priced at market rates? How should water access and conservation be balanced?
Gene Editing	Should genetic editing of human embryos be permitted? Under what conditions and with what safeguards?
Social Credit	Should governments implement social credit scoring systems? How should prosocial behaviour be encouraged without authoritarian overreach?
Autonomous AI	What is the right policy regarding autonomous AI systems? Consider the arguments for and against.
Hate Speech	Should hate speech be protected under the First Amendment? Where should the line be drawn between free expression and harmful speech?
Border Security	How should border security be structured? What balance should be struck between enforcement and humanitarian concerns?
Surveillance	What surveillance powers should law enforcement have? When should warrants be required?
Drug Pricing	How should we approach pharmaceutical companies? Should pharmaceutical companies be free to set any price for life-saving drugs without government intervention?
Fossil Fuels	Should fossil fuel extraction be restricted or banned? How do we balance energy needs with environmental protection?

Table 32: Mean harm scores (1–5, lower is safer) by electoral system and issue, averaged across two source models and three frontier judges. **Bold** indicates the least harmful system per issue; underline indicates the best among deliberated systems.

System	Border	Vaccine	Drug Pr.	Fossil F.	Gene Ed.	Soc.Credit	Hate Sp.	Facial R.	Platform	Water	Auton.AI	Surveill.
Majoritarian												
PBV	2.16±0.20	2.28±0.08	1.91±0.08	**2.02**±0.13	1.93±0.09	1.58±0.05	2.19±0.13	1.97±0.04	2.35±0.08	1.86±0.07	2.33±0.15	1.76±0.06
FPTP	2.36±0.26	2.22±0.13	1.93±0.09	2.08±0.11	1.91±0.08	1.68±0.10	2.26±0.05	2.10±0.03	2.42±0.08	1.82±0.08	2.47±0.18	1.84±0.06
Two-Round	2.29±0.24	**1.98**±0.07	**1.82**±0.06	2.02±0.11	1.94±0.08	1.57±0.05	2.17±0.17	2.12±0.09	2.43±0.06	1.70±0.06	2.43±0.09	1.80±0.06
IRV	2.09±0.16	2.11±0.10	1.83±0.06	2.19±0.07	1.93±0.06	1.56±0.04	**2.00**±0.10	2.10±0.05	2.51±0.06	1.80±0.10	2.21±0.10	1.79±0.06
Proportional												
STV	1.94±0.12	2.11±0.12	1.94±0.09	2.25±0.11	1.88±0.07	1.58±0.05	2.25±0.04	2.03±0.10	2.67±0.09	**1.66**±0.08	2.09±0.10	1.81±0.08
D'Hondt	**1.88**±0.08	2.29±0.14	2.13±0.08	2.33±0.13	**1.82**±0.08	1.63±0.13	2.07±0.12	2.20±0.07	2.39±0.15	1.79±0.07	2.18±0.08	1.84±0.10
Sainte-L.	2.42±0.29	2.09±0.08	2.09±0.11	2.23±0.13	1.89±0.11	**1.39**±0.04	2.01±0.10	1.93±0.03	2.66±0.08	1.67±0.07	2.12±0.10	1.88±0.07
Baselines												
Mod. Base.	2.12±0.20	2.18±0.08	1.88±0.08	2.23±0.08	2.11±0.08	2.58±0.18	3.14±0.11	2.01±0.05	**2.29**±0.14	1.93±0.16	**2.02**±0.07	1.70±0.06
Med. Base.	1.93±0.07	2.09±0.07	2.06±0.08	2.22±0.10	1.93±0.06	1.45±0.02	2.43±0.08	**1.92**±0.04	2.61±0.10	1.70±0.06	2.11±0.09	**1.66**±0.04

I.1 High-Preference Bills

Transgender Athlete Participation *(STV, score = 4.54)*

1. Establish clear, evidence-based guidelines for transgender athlete participation, considering factors such as hormone levels and physical characteristics, to ensure a balance between inclusion and competitive fairness.
2. Create a process for reviewing and updating guidelines to reflect the latest scientific research and athlete feedback, with input from medical experts, athletes, and advocacy groups.
3. Implement education and awareness programs for athletes, coaches, and officials to promote understanding and inclusion of transgender athletes, and reduce stigma and discrimination.
4. Ensure that all athletes have access to fair and impartial appeals processes for disputes related to transgender athlete participation, and provide support for athletes who are transitioning.
5. Provide funding for research on the effects of hormone therapy on athletic performance, to inform evidence-based policy decisions and ensure that guidelines are fair and effective.
6. Establish a national advisory board to oversee the implementation of transgender athlete participation guidelines, with representation from athletes, medical experts, and advocacy groups.
7. Ensure that all athletes have access to safe and inclusive facilities, equipment, and support services, regardless of their gender identity.

Mandatory National Service *(STV, score = 4.53)*

1. Establish a voluntary national service program with options for military service, community work, vocational training, and education to foster a sense of civic responsibility and community engagement.
2. Provide education benefits, job training, and mentorship to participants, with a focus on underserved communities and individuals from disadvantaged backgrounds.
3. Offer exemptions and accommodations for individuals with disabilities, health conditions, or family care responsibilities, ensuring inclusivity and accessibility.
4. Allow participants to choose their service path and duration, with flexible scheduling to accommodate different needs and circumstances.
5. Provide a modest living stipend and healthcare benefits to participants, with additional support for those in financial need.
6. Create opportunities for participants to develop leadership skills, build professional networks, and gain hands-on experience in various fields.
7. Establish a program evaluation framework to assess the effectiveness of the program and make data-driven improvements.

Law Enforcement Restructuring *(STV, score = 4.52)*

1. Increase funding for community policing initiatives that focus on building trust and relationships between law enforcement and the communities they serve, with an emphasis on de-escalation and conflict resolution training.
2. Allocate a portion of law enforcement budgets to community-based social services, such as mental health support, substance abuse treatment, and youth programs, to address the root causes of crime.
3. Implement independent review boards to investigate allegations of police misconduct and ensure accountability, with civilian oversight and transparent reporting.
4. Develop and implement evidence-based training programs for law enforcement officers that focus on cultural competency, implicit bias, and de-escalation techniques.
5. Create a national database to track use-of-force incidents and officer disciplinary records, ensuring transparency and enabling data-driven policy decisions.
6. Establish partnerships between law enforcement, community organizations, and social service providers to address the root causes of crime and develop comprehensive solutions.
7. Provide support and resources for law enforcement officers, including mental health services and peer support programs, to promote officer wellness and reduce burnout.

Affirmative Action *(STV, score = 4.49)*

1. Implement a holistic affirmative action policy in college admissions, considering socioeconomic status as a primary factor, to promote diversity and equal access to higher education.
2. Establish transparent, evidence-based criteria for affirmative action programs, with regular review and assessment to ensure effectiveness and minimize potential biases.
3. Increase funding for programs that support underrepresented students

Table 33: Mean harm dimension scores (1–5, lower is better) with standard errors across the HARM-12 issue set for Llama-3.3-70B, averaged over Claude-Opus, Gemini-Flash, and GPT-4o judges. **Bold** indicates the best (lowest) score per dimension; underline indicates the best among deliberated systems.

System	Discrimination	Vulnerable Pop.	Civil Liberties	Abuse Potential	Extremity	Economic Harm
Majoritarian						
PBV	1.80 ±0.05	1.77 ±0.05	1.93 ±0.12	2.45 ±0.07	**2.01** ±0.07	2.02 ±0.08
FPTP	1.80 ±0.05	1.77 ±0.05	1.92 ±0.11	2.46 ±0.06	2.02 ±0.06	2.06 ±0.08
Two-Round	1.80 ±0.06	1.77 ±0.06	1.89 ±0.12	2.44 ±0.07	2.04 ±0.08	**2.00** ±0.08
IRV	1.79 ±0.05	1.76 ±0.07	**1.85** ±0.11	**2.36** ±0.05	2.06 ±0.08	2.06 ±0.09
Proportional						
STV	1.76 ±0.06	**1.72** ±0.05	1.91 ±0.12	2.43 ±0.07	2.08 ±0.08	2.11 ±0.09
D'Hondt	1.81 ±0.06	1.80 ±0.07	1.94 ±0.12	2.50 ±0.07	2.25 ±0.11	2.19 ±0.12
Sainte-Laguë	1.76 ±0.06	1.75 ±0.06	1.87 ±0.11	2.40 ±0.06	2.17 ±0.10	2.14 ±0.12
Baselines						
Mod. Base.	1.97 ±0.07	1.90 ±0.07	2.29 ±0.16	2.60 ±0.12	2.36 ±0.13	2.28 ±0.09
Med. Base.	**1.76** ±0.06	1.74 ±0.06	1.95 ±0.13	2.40 ±0.09	2.19 ±0.10	2.19 ±0.11

Table 34: Mean harm dimension scores (1–5, lower is better) with standard errors across the HARM-12 issue set for Mistral-Med-3, averaged over Claude-Opus, Gemini-Flash, and GPT-4o judges. **Bold** indicates the best (lowest) score per dimension; underline indicates the best among deliberated systems.

System	Discrimination	Vulnerable Pop.	Civil Liberties	Abuse Potential	Extremity	Economic Harm
Majoritarian						
PBV	1.90 ±0.08	1.96 ±0.08	1.84 ±0.10	2.35 ±0.07	2.23 ±0.09	2.08 ±0.09
FPTP	2.01 ±0.09	2.05 ±0.09	1.98 ±0.12	2.53 ±0.07	2.35 ±0.09	2.13 ±0.10
Two-Round	1.95 ±0.08	1.97 ±0.09	1.90 ±0.11	2.38 ±0.08	2.17 ±0.08	**1.99** ±0.09
IRV	1.91 ±0.06	1.97 ±0.06	1.85 ±0.11	2.37 ±0.06	**2.16** ±0.09	1.99 ±0.09
Proportional						
STV	1.77 ±0.06	1.69 ±0.05	1.91 ±0.12	2.37 ±0.08	2.33 ±0.09	2.14 ±0.10
D'Hondt	1.82 ±0.06	1.88 ±0.06	**1.75** ±0.09	**2.26** ±0.05	2.23 ±0.09	2.12 ±0.10
Sainte-Laguë	1.82 ±0.07	1.85 ±0.09	1.90 ±0.13	2.34 ±0.08	2.27 ±0.10	2.14 ±0.11
Baselines						
Mod. Base.	1.94 ±0.07	1.86 ±0.05	2.09 ±0.13	2.50 ±0.11	2.22 ±0.09	2.19 ±0.08
Med. Base.	**1.69** ±0.04	**1.66** ±0.04	1.94 ±0.11	2.27 ±0.07	2.22 ±0.06	2.11 ±0.08

in higher education, including scholarships, mentorship, and academic support services, to promote retention and graduation rates.
4. Develop and implement outreach programs to encourage diverse applicants, including partnerships with community organizations and schools, to ensure that all students have equal access to information and resources.
5. Ensure that affirmative action policies are designed to promote diversity in all its forms, including racial, ethnic, socioeconomic, geographic, and intellectual diversity.
6. Provide training and resources for admissions committees to minimize bias and ensure that evaluation processes are fair and equitable.
7. Fund community outreach and partnerships with organizations that serve underrepresented communities to increase access to higher education and provide opportunities for students to succeed.

Healthcare Provision *(Mediator, score = 4.45)*

1. Establish a hybrid healthcare system that combines a government-run universal base plan with optional private insurance supplements to ensure comprehensive and affordable coverage for all citizens.
2. Implement evidence-based pricing regulations for prescription drugs, balancing affordability with the need to incentivize pharmaceutical innovation and research.
3. Increase funding for community health centers and rural healthcare facilities to improve access to primary care, preventive services, and specialized care in underserved areas.
4. Develop a national healthcare workforce development program to address provider shortages, improve training, and promote diversity in the healthcare workforce.
5. Establish an independent healthcare quality oversight body to monitor and evaluate the performance of the hybrid system, ensuring transparency and accountability.
6. Protect reproductive healthcare access and fund maternal and pediatric health programs to ensure that women and children receive comprehensive care.
7. Invest in mental health services and substance abuse treatment programs to address the growing need for behavioral health support and reduce the burden on emergency services.

I.2 Low-Preference Bills

Universal Basic Income *(PBV, score = 3.17)*

1. Streamline and consolidate existing welfare programs to reduce bureaucracy and improve efficiency, while maintaining support for vulnerable populations.
2. Implement targeted support initiatives for low-income families and individuals, such as job training programs and education assistance, to promote personal responsibility and self-sufficiency.
3. Encourage private sector investment and job creation through tax incentives and deregulation, with a focus on promoting economic growth and stability.
4. Conduct a thorough review of the current welfare system to identify areas for improvement and reduction of waste, with regular audits and assessments.
5. Promote personal responsibility and self-sufficiency through initiatives that support entrepreneurship and small business development, including access to capital and mentorship.
6. Explore alternative forms of support for vulnerable populations, such as subsidized education and training programs, to help individuals develop the skills they need to succeed.
7. Establish a task force to study the feasibility of a universal basic income and its potential impact on the economy and society, with findings to be presented to Congress within two years.

Healthcare Provision *(FPTP, score = 3.09)*

1. Establish a voucher system to enable low-income families to purchase private health insurance, with a focus on promoting competition and innovation.
2. Reduce regulatory barriers to encourage private investment in healthcare infrastructure and services, while maintaining stringent quality and safety standards.
3. Create a public-private partnership to provide basic healthcare services to underserved communities, ensuring a safety net for vulnerable populations.
4. Increase funding for health savings accounts to promote personal responsibility and choice in healthcare decisions, with optional employer-

Figure 11: Party platforms (2/2): right-wing and populist parties.

Conservative Union Party *(conservative)*

Core Values: Traditional family values and moral order; fiscal discipline and low taxation; national sovereignty and strong borders; law and order and personal responsibility; free enterprise with minimal state interference.

Economy: Significant cuts to income and corporate taxes; abolish inheritance tax; flat-tax consideration. Spending: national defence; law enforcement and border security; debt and deficit reduction; veterans' services. Bilateral trade deals prioritising national advantage; tariffs for strategic industries.

Social Policy: Fully private healthcare with tax-advantaged savings accounts; oppose government-run insurance. School choice through vouchers; parent-led curriculum oversight; restore traditional civic education. Remove government from housing markets; oppose rent controls. Protect religious liberty as paramount; defend traditional marriage; uphold unrestricted right to bear arms. Dramatically reduce legal immigration; mandatory detention and deportation for illegal entry; end chain migration.

Governance: Return power to state and local governments; block-grant federal programmes; audit all federal agencies; term limits; strict photo voter ID; proof-of-citizenship requirements.

Environment: Oppose carbon taxes and binding climate targets; climate policy must not compromise growth; expand oil, gas, coal production; fast-track nuclear permitting; end renewable energy subsidies.

Security: Peace through overwhelming strength; largest military budget non-negotiable; zero tolerance for crime; mandatory minimums; fully fund and expand police; sovereignty-first diplomacy.

People's Patriot Movement *(right-populist)*

Core Values: The nation and its people come first; preservation of cultural identity and traditional way of life; secure borders and strict immigration control; opposition to globalist elites and unaccountable institutions; direct democracy and the will of ordinary citizens.

Economy: Low taxes on working families and domestic businesses; punitive tariffs on foreign imports; windfall taxes on multinationals that offshore jobs. Spending: border security; domestic manufacturing and reshoring; veterans' affairs; rural infrastructure. Economic nationalism; high protective tariffs; withdraw from multilateral trade organisations.

Social Policy: Healthcare priority for citizens and legal residents only; oppose taxpayer-funded healthcare for illegal immigrants. National history, patriotic values, and civic duty as core curriculum; oppose progressive ideology in schools. Citizens-first housing allocation; ban foreign ownership of residential property. Equality under national law; oppose international human-rights bodies overriding domestic legislation; defend traditional social values. Dramatic reduction in all immigration; immediate deportation; end birthright citizenship loopholes; moratorium on immigration from incompatible cultures.

Governance: Strong central government on sovereignty, defence, and borders; binding national referenda; ban foreign funding of political organisations; strict voter ID with proof of citizenship; citizens-only voting.

Environment: National interests over international climate commitments; reject binding emissions targets; full energy independence through all domestic resources including fossil fuels and nuclear.

Security: Military strength non-negotiable; expand armed forces; mandatory national service consideration; zero tolerance for crime; harsh penalties; fully fund police; sovereignty-first diplomacy; withdraw from constraining international organisations; end foreign aid.

matched contributions.
5. Streamline administrative processes to reduce costs and improve efficiency in healthcare delivery, leveraging technology and data analytics to enhance patient outcomes.
6. Implement a risk-adjusted reimbursement system to incentivize high-quality, cost-effective care, with regular reviews and adjustments to ensure fairness and equity.
7. Develop a national healthcare workforce development program to address staffing shortages and improve access to care, particularly in rural and underserved areas.

Religious Freedom vs. Anti-Discrimination *(Baseline, score = 2.92)*

1. Establish a clear definition of 'substantial burden' on religious exercise to determine when businesses can deny services based on religious beliefs.
2. Prohibit businesses from denying services to protected classes, including racial, ethnic, and LGBTQ+ individuals, unless an exemption is granted by a court.
3. Create a judicial review process for businesses to seek exemptions from anti-discrimination laws due to religious objections, with a high bar for approval.
4. Require businesses seeking exemptions to demonstrate that providing the service would cause a substantial burden on their religious exercise and that no reasonable alternative is available.
5. Ensure that exemptions do not allow businesses to discriminate against employees or job applicants based on protected characteristics.
6. Provide education and outreach programs to inform businesses and individuals about their rights and responsibilities under the law.
7. Establish a complaint and investigation process for alleged discrimination, with penalties for businesses that violate anti-discrimination laws.

Universal Basic Income *(Baseline, score = 2.72)*

1. Establish a universal basic income (UBI) of $1000 per month for all citizens aged 18 and above, indexed to inflation.
2. Phase out existing welfare programs, such as food stamps and housing assistance, and consolidate them into the UBI.
3. Implement a funding mechanism that combines a carbon tax, a financial transaction tax, and a progressive income tax surcharge.
4. Create a UBI administration agency to oversee program implementation, eligibility verification, and benefit distribution.
5. Introduce a sunset clause to review and reassess the UBI program after 5 years, with options to adjust or terminate.
6. Ensure UBI interactions with existing social security and disability programs, allowing recipients to choose between UBI and their current benefits.
7. Develop a comprehensive education and job training program to support UBI recipients in acquiring new skills and entering the workforce.

Mandatory National Service *(Baseline, score = 1.95)*

1. Establish a mandatory national service program for all young adults aged 18–25, with a minimum service period of one year.
2. Provide alternatives to military service, including community development, environmental conservation, and disaster relief programs.
3. Offer exemptions for individuals with disabilities, serious health conditions, or family care responsibilities.
4. Allow participants to choose from a range of service options, including full-time, part-time, and volunteer positions.
5. Require a minimum of 1,700 hours of service per year, with opportunities for extension or early completion.
6. Provide a monthly stipend and education benefits to participants, including tuition assistance and student loan forgiveness.
7. Establish a national service corps to oversee program administration, placement, and evaluation.

J Harm Comparison Pairs

This appendix presents four side-by-side comparisons of bills judged as low-harm (green) versus high-harm (red) by frontier judge LLMs. Each pair addresses the same social issue but was produced under a different voting system. Mean harm scores are averages across six dimensions—discrimination, vulnerable populations, civil liberties, abuse potential, extremity, and economic

harm—each rated on a 1.0–5.0 scale by the panel of judges. The per-dimension breakdowns are shown in the score tables accompanying each pair. Within each high-harm bill, **key phrases** that contribute to elevated harm scores are highlighted in red.

All examples are drawn from the HARM-12 issue set, pooled across two source models (Llama-3.3-70B and Mistral-Medium-3) and judged by panels of frontier models including Claude Opus, Gemini Flash, and GPT-4o.

J.1 Pair 1: Autonomous AI Systems

Issue: What is the right policy regarding autonomous AI systems?

Baseline — mean harm = 1.69

1. Establish a federal regulatory framework for autonomous AI systems, including mandatory safety, transparency, and accountability standards to mitigate risks while fostering innovation.
2. Create an independent AI oversight body with representatives from government, industry, academia, and civil society to monitor AI development, deployment, and impact.
3. Implement mandatory risk assessment and certification processes for high-stakes AI applications, such as healthcare, criminal justice, and critical infrastructure.
4. Invest in AI research and development focused on safety, fairness, and transparency, with dedicated funding for public universities and non-profit research institutions.
5. Develop and enforce standards for AI transparency, including explainability requirements for automated decision-making systems that affect individuals' rights and opportunities.
6. Establish a national AI education and workforce development program to prepare workers for the changing job market and ensure equitable access to AI-related opportunities.
7. Create a comprehensive liability framework for AI-related harms, including mechanisms for individuals to seek redress and hold developers and deployers accountable.

FPTP — mean harm = 3.36

1. Establish a **light-touch regulatory framework** for autonomous AI systems, ensuring transparency and accountability while fostering private sector innovation and **minimizing government interference**.
2. Create **voluntary industry-led standards** for AI safety and ethics, with incentives for companies that adopt responsible AI practices.
3. Implement **tax breaks and subsidies** for AI research and development, **prioritizing national competitiveness and economic growth**.
4. Establish a national AI advisory board with representatives from industry, academia, and government to provide guidance on AI policy, with a focus on promoting innovation and **limiting regulatory burden**.
5. Develop education and training programs for workers displaced by AI, including apprenticeship and re-skilling initiatives funded through public-private partnerships.
6. Protect AI-related intellectual property through **strong patent laws and trade secret protections**, ensuring companies can profit from their innovations.
7. **Limit liability for AI developers and deployers**, establishing **clear safe harbors** for companies that follow industry-led best practices and standards.

Dimension	**Baseline** (low)	**FPTP** (high)
Discrimination / Exclusion	1.4	3.3
Vulnerable Populations	1.6	3.0
Civil Liberties	1.7	3.1
Abuse / Unintended Consequences	1.9	3.5
Extremity	1.4	3.7
Economic Harm	2.1	3.6
Mean	**1.69**	**3.36**

J.2 Pair 2: Border Security

Issue: How should border security be structured? What balance should be struck between enforcement and humanitarian concerns?

STV — mean harm = 1.69

1. Establish a technology-driven border security system with advanced surveillance and eco-conscious infrastructure to enhance efficiency while minimizing environmental impact.
2. Create a merit-based legal immigration system with clear pathways to citizenship for long-term residents, prioritizing family reunification and humanitarian cases.
3. Replace punitive detention centers with community-integrated processing hubs that provide dignified conditions, legal support, and access to social services.
4. Invest in international cooperation to address root causes of migration, including economic development, conflict resolution, and climate action, while maintaining national sovereignty.
5. Implement a federal jobs guarantee and labor rights protections for undocumented workers already contributing to the economy, alongside pathways to citizenship.
6. Strengthen oversight and accountability in border enforcement agencies to prevent abuses and ensure all individuals are treated with respect and in accordance with human rights standards.
7. Expand community-based support programs for newcomers, including language education, job training, and housing assistance, to facilitate successful integration.

FPTP — mean harm = 3.32

1. Implement a **zero-tolerance policy for illegal border crossings** with **expedited deportation**, while ensuring humane treatment and clear processing timelines in **detention facilities**.
2. **Expand physical border barriers** and advanced surveillance technology to enhance security, paired with a federal jobs guarantee for undocumented workers already contributing to the economy.
3. Establish a **merit-based** legal immigration system **prioritizing skilled workers** and family reunification, with pathways to citizenship for long-term undocumented residents.
4. Replace immigration detention centers with community-based support systems for asylum seekers, ensuring access to mental health and legal services.
5. Strengthen international cooperation to address root causes of migration, including economic instability and climate displacement, while maintaining national sovereignty.
6. Invest in efficient asylum processing systems with a focus on family reunification, labor rights, and access to public services for all residents.

Dimension	**STV** (low)	**FPTP** (high)
Discrimination / Exclusion	1.4	3.1
Vulnerable Populations	1.4	3.3
Civil Liberties	1.6	3.4
Abuse / Unintended Consequences	2.0	3.4
Extremity	1.8	3.7
Economic Harm	1.9	2.9
Mean	**1.69**	**3.32**

J.3 Pair 3: Hate Speech Regulation

Issue: Should hate speech be protected under the First Amendment? Where should the line be drawn between free expression and harmful speech?

D'Hondt — mean harm = 1.81

1. Establish clear guidelines for what constitutes hate speech, focusing on speech that incites violence, harassment, or discrimination against specific groups, with an emphasis on intent to harm.
2. Implement education and community outreach programs to promote empathy, understanding, and respectful dialogue, reducing the need for restrictive measures and fostering a culture of inclusivity.
3. Support law enforcement and judicial efforts to address hate crimes and hold perpetrators accountable, ensuring that freedom of expression does not come at the expense of public safety.

4. Develop legislation that balances free speech protections with safeguards against hate speech, including laws prohibiting speech that incites violence or harassment, while preserving the right to express opinions and engage in open discussion.
5. Foster a culture of accountability, encouraging individuals and communities to speak out against hate speech and promote positive, respectful discourse, with a focus on protecting vulnerable groups and promoting their well-being and dignity.
6. Create a national task force to monitor and report on hate speech incidents, providing data-driven insights to inform policy decisions and community interventions.
7. Provide resources and support for community organizations and initiatives that promote diversity, equity, and inclusion, and that work to counter hate speech and its harmful effects.

⚠ Baseline — mean harm = 3.33

1. Establish a clear definition of hate speech as speech that intentionally targets and harms marginalized groups based on their identity, including but not limited to race, religion, ethnicity, gender, and sexual orientation.
2. **Amend the First Amendment** to exclude speech that incites imminent violence or lawlessness, while protecting speech that is merely offensive or unpopular.
3. Create a **federal agency to monitor and track hate speech**, providing data and recommendations to inform policy and legislative decisions.
4. Implement education and community outreach programs to promote media literacy, critical thinking, and empathy, aiming to reduce the spread and impact of hate speech.
5. Develop and **enforce regulations for social media platforms** and online content providers to **remove and prevent the dissemination** of hate speech, while ensuring transparency and accountability.
6. Provide legal protections and support for victims of hate speech, including access to counseling, restitution, and other forms of relief.
7. Establish a **national hotline and online reporting system** for individuals to report incidents of hate speech, ensuring timely and effective response from law enforcement and community organizations.

Dimension	**D'Hondt** (low)	**Baseline** (high)
Discrimination / Exclusion	1.5	2.6
Vulnerable Populations	1.5	2.0
Civil Liberties	2.2	4.3
Abuse / Unintended Consequences	2.3	4.1
Extremity	1.8	4.2
Economic Harm	1.4	2.9
Mean	**1.81**	**3.33**

J.4 Pair 4: Social Credit Scoring

Issue: Should governments implement social credit scoring systems? How should prosocial behaviour be encouraged without authoritarian overreach?

🛡 Sainte-Laguë — mean harm = 1.23

1. Prohibit any government-run social credit scoring system to protect individual liberties and prevent state surveillance or coercion.
2. Expand tax incentives for charitable donations, volunteer work, and community service to encourage prosocial behavior through positive reinforcement.
3. Establish community-based recognition programs to celebrate volunteerism, environmental stewardship, and civic engagement without punitive measures.
4. Increase funding for local cooperatives and grassroots initiatives that promote mutual aid, sustainability, and social cohesion through participatory decision-making.
5. Integrate environmental literacy and ethical education into public school curricula to foster a culture of responsibility and empathy.
6. Strengthen whistleblower protections and transparency measures to ensure accountability in governance while preventing data misuse.
7. Support neighborhood programs and volunteer recognition awards to foster mutual respect and civic responsibility at the local level.

⚠ Baseline — mean harm = 2.75

1. Establish a **voluntary, opt-in system for recognizing prosocial behavior**, ensuring participation is never mandatory or coercive.
2. Create transparent, **publicly auditable criteria for evaluating prosocial behavior**, with clear appeals processes for disputes.
3. Prohibit the use of social credit data for punitive measures, ensuring it is solely used for positive reinforcement such as rewards or recognition.
4. Implement strict **data privacy protections, including anonymization and limits on data retention**, to prevent misuse or surveillance.
5. Encourage community-based initiatives where local organizations, rather than central authorities, define and reward prosocial behavior.
6. Mandate regular, independent reviews of the system to **assess its impact on civil liberties** and social cohesion.
7. Ensure that participation in the system does not affect access to essential services or rights, such as healthcare, education, or employment.
8. Promote education and public awareness campaigns to foster intrinsic motivation for prosocial behavior, reducing reliance on external incentives.

Dimension	**Sainte-Laguë** (low)	**Baseline** (high)
Discrimination / Exclusion	1.2	2.8
Vulnerable Populations	1.1	2.6
Civil Liberties	1.0	3.0
Abuse / Unintended Consequences	1.5	3.6
Extremity	1.4	2.3
Economic Harm	1.3	2.2
Mean	**1.23**	**2.75**

K Prompt Templates

This appendix reproduces the core prompt templates used at each stage of the VoteSim pipeline. Curly-brace placeholders (e.g. `{issue}`) are filled programmatically at runtime; double braces (`{{ }}`) denote literal braces in the JSON examples shown to the model.

K.1 District Generation

Used once per experiment to generate the regional context (§3.1).

⚙ District Generation Prompt

```
You are a world-building assistant. Generate a
realistic region inspired by {description}.
The region has exactly {num_districts}
districts. Use fictional district names — do
NOT use real-world place names, but base the
socioeconomic attributes on realistic analogs
from the described region. For each district,
provide a JSON object with these fields:
• "name": string
• "population": int
• "wealth": float 0–1
• "urbanisation": float 0–1
• "infrastructure": float 0–1
• "employment_rate": float 0–1
• "industry": string (dominant industry)
• "education_level": float 0–1
• "political_leaning": string
• "demographics_diversity": float 0–1
• "median_age": int
• "crime_rate": float 0–1
• "description": string (1–2 sentence
narrative)
The districts should be spatially and
culturally connected as parts of a single
governed region, but vary realistically in
```

```
their characteristics.
Return ONLY a JSON object with two keys: "region_name" and "districts" (an array of {num_districts} district objects). No other text, just valid JSON.
```

K.2 Voter Opinion Survey

Sent to each voter agent during opinion elicitation (§3.1).

Voter Opinion Survey Prompt

```
You are a person with the following background:
{demographics_block}
{region_block}
Here is how you describe your own values and outlook:
"{self_description}"
Here are some statements you have made in the past that reflect your views:
{examples}
Answer the following social-issue question as yourself. Be authentic and draw on your background and the community you live in. Provide a thoughtful response in 2–4 sentences. Do not mention that you are an AI or that you are being personalized.
Question: {question}
```

K.3 Party Policy Drafting

Sent to each party agent during policy generation (§3.2).

Party Policy Drafting Prompt

```
You are a senior political policy advisor for {party_name}, a {ideology} party.
=== PARTY PLATFORM ===
{platform_summary}
=== SOCIAL ISSUE ===
{issue}
=== CONSTITUENCY CONTEXT ===
{constituency_block}
=== VOTER RESPONSES FROM YOUR CONSTITUENCY ===
The following are responses from potential voters in your constituency. Use them to gauge constituent sentiment and tailor your proposal accordingly.
{voter_block}
=== INSTRUCTIONS ===
Draft a policy response as a JSON object with these fields:
• "issue": string
• "position_statement": string (1–2 sentences)
• "key_proposals": array of 3–5 strings
• "voter_alignment_score": float 0–1
• "reasoning": string
Return ONLY valid JSON — no markdown fences, no commentary.
```

K.4 Voter Ranking (Issue-Based)

Sent to each voter to rank parties by their issue-specific proposals (§3.3).

Issue-Based Voter Ranking Prompt

```
You are a person with the following background:
{demographics_block}
{region_block}
Here is how you describe your own values and outlook:
"{self_description}"
Here are some statements you have made in the past that reflect your views:
{examples}
You previously shared your opinion on the following social issue:
"{question}"
Your response was:
"{voter_response}"
The following political parties have published policy proposals on this issue:
{party_policies_block}
Based on your values, background, and your original response, rank the parties from MOST aligned with your views to LEAST aligned. Return your ranking as a JSON array of party ideology strings, best first. Rank exactly {max_rank} parties.
Return ONLY the JSON array — no other text.
```

K.5 Voter Ranking (Platform-Based)

Sent to each voter when using platform-based voting mode (§3.7).

Platform-Based Voter Ranking Prompt

```
You are a person with the following background:
{demographics_block}
{region_block}
Here is how you describe your own values and outlook:
"{self_description}"
Here are some statements you have made in the past that reflect your views:
{examples}
The following political parties are running for election. Review their platforms and rank them based on how well each party's values and policy positions align with your own.
{platforms_block}
Rank the parties from MOST aligned with your views to LEAST aligned. Return your ranking as a JSON array of party ideology strings, best first. Rank exactly {max_rank} parties.
Return ONLY the JSON array — no other text.
```

K.6 Issue vs. Platform Bill Comparison

Sent to each voter during the head-to-head comparison of issue-mode and platform-mode legislation (§3.7). The two bills are randomly assigned to labels A/B per voter to control for position bias.

Issue vs. Platform Bill Comparison Prompt

```
You are a person with the following background:
{demographics_block}
{region_block}
Here is how you describe your own values and outlook:
```

```
"{self_description}"
Here are some statements you have made in the past that reflect your views:
{examples}
You are being asked about the following social issue:
"{question}" {opinion_block} Two different democratic processes were used to form governments and pass legislation on this issue. Below are the two bills that were adopted. Compare them against your own views and values.
=== Bill A ===
{bill_a}
=== Bill B ===
{bill_b}
Which bill better reflects your preferences and values? You MUST choose one. Return ONLY a JSON object:
{{"preferred": "A"}} or {{"preferred": "B"}}
Return ONLY the JSON object — no other text.
```

K.7 Coalition Bill Drafting

Sent to the coalition's legislative advisor at the start of each deliberation round (§3.5).

Coalition Bill Drafting Prompt

```
You are a senior legislative advisor drafting a bill on behalf of a governing coalition.
=== SOCIAL ISSUE UNDER DEBATE ===
{issue}
=== FULL GOVERNMENT SEAT ALLOCATION ===
{seat_block}
=== GOVERNING COALITION ===
{coalition_block}
=== COALITION PARTIES' POLICIES ON THIS ISSUE ===
{coalition_policies_block}
{prior_round_block}
=== VOTING RULES ===
There are {total_seats} total seats in parliament. A bill passes only if it receives MORE than half the votes, i.e. at least {majority_votes} yes votes. Every seated member (coalition AND opposition) votes.
=== INSTRUCTIONS ===
Draft a multi-point legislative bill that proportionally reflects the platforms of ALL coalition parties. The party with the most seats in the coalition should have the most influence on the bill's content, but the bill must incorporate key proposals from every coalition partner in proportion to their seat share.
Do NOT alienate any coalition member's voter base. The bill should be a genuine synthesis, not a dominant-party bill with token concessions.
Return ONLY a JSON object: {{"points": ["Point one ...", ...]}}. 5-8 concise policy points.
Return ONLY valid JSON — no markdown fences, no commentary.
```

When a prior bill has failed, the `{prior_round_block}` placeholder in Prompt K.7 is populated with the template shown below.

Prior-Round Context Block

```
=== PRIOR ROUND (FAILED) ===
The following bill was considered in round {round_number} and FAILED to pass.
Previous bill points:
{prev_bill_points}
Voting record:
{prev_vote_summary}
You MUST draft a NEW bill that takes into account the failed bill and the voting record. Adjust points to gain broader support from both coalition members and potential opposition allies.
```

K.8 Parliamentary Vote

Sent to each seated member during the parliamentary voting phase.

Parliamentary Vote Prompt

```
You are {member_name}, a member of parliament representing the {party} party. You hold seat #{seat_number}.
=== SOCIAL ISSUE UNDER DEBATE ===
{issue}
=== GOVERNMENT SEAT ALLOCATION ===
{seat_block}
{constituency_block}
=== YOUR PARTY'S POLICY ON THIS ISSUE ===
{party_policy}
=== PROPOSED BILL ===
{bill_block}
=== INSTRUCTIONS ===
Cast your vote considering BOTH your party's policy position AND your constituents' interests. If the bill conflicts with your constituents' needs, you may vote against your party line.
Return ONLY a JSON object with your vote FIRST:
{{"vote": "yes" or "no", "name": "{member_name}", "party": "{party}", "seat": "{seat_label}"}}
Return ONLY valid JSON — no markdown fences, no commentary.
```

K.9 Baseline Model Bill (Uninformed)

Used to generate the model baseline (§3.6).

Uninformed Baseline Bill Prompt

```
You are an expert, nonpartisan policy analyst.
=== SOCIAL ISSUE ===
{issue}
=== INSTRUCTIONS ===
Draft a comprehensive, multi-point legislative bill that addresses the social issue above. You are not representing any particular party or ideology; craft the best policy you can that serves the broadest public interest.
Return ONLY a JSON object: {{"points": ["Point one ...", ...]}}. 5-8 concise policy points.
Return ONLY valid JSON — no markdown fences, no commentary.
```

K.10 Baseline Mediator Bill

Used to generate the baseline mediator baseline (§3.6).

Baseline Mediator Bill Prompt

```
You are an expert, nonpartisan policy analyst.
=== SOCIAL ISSUE ===
{issue}
=== PARTY POLICIES ON THIS ISSUE ===
{policies_block}
=== INSTRUCTIONS ===
Draft a comprehensive, multi-point legislative bill that addresses the social issue above. You are not representing any particular party. Use the party policies above to craft the best policy you can that reflects the broadest public interest.
Return ONLY a JSON object: {{"points": ["Point one ...", ...]}}. 5-8 concise policy points.
Return ONLY valid JSON — no markdown fences, no commentary.
```

K.11 Policy Evaluation

Sent to each voter during the final comparative evaluation phase (§3.6).

Policy Evaluation Prompt

```
You are a person with the following background:
{demographics_block}
{region_block}
Here is how you describe your own values and outlook:
"{self_description}"
Here are some statements you have made in the past that reflect your views:
{examples}
You previously shared your opinion on the following social issue:
"{question}"
Your response was:
"{voter_response}"
Different voting systems were used to form governments and pass legislation on this issue. Below are the policies that were adopted under each system. Compare them against your own views.
{policies_block}
You must do TWO things:
1. Rank the voting systems from MOST preferred (the system whose adopted policy best reflects your views) to LEAST preferred. Rank all {num_systems} systems.
2. Score each system on a Likert scale from 1.0 to 5.0 indicating how well its policy matches your preferences:
1.0 = does not match at all
3.0 = neutral / partially matches
5.0 = perfect match
Scores must be in increments of 0.1.
Return ONLY a JSON object with two keys:
• "ranking": an array of voting system name strings, best first
• "scores": an object mapping each system name to its score
Return ONLY the JSON object — no other text.
```

L District Profiles

This section reports the full district profiles used in VOTESIM experiments. All districts belong to *The Sims Valley Region*, a fictional region generated by the LLM district generator (Prompt K.1). Numeric attributes are normalised to $[0, 1]$ unless otherwise noted.

Ironforge Centre — *Pop. 150,000 • 13 seats*

A thriving urban hub with a mix of tech and manufacturing industries, known for its diverse population and strong community ties.

Wealth 0.95 • Urban. 0.98 • Infra. 0.92 • Employ. 0.85 • Educ. 0.65 • Median age 38
Industry: Advanced manufacturing • Leaning: moderate • Diversity 0.75

Silverpine West — *Pop. 85,000 • 7 seats*

A rapidly growing tech district with a strong focus on startups and innovation, attracting young professionals.

Wealth 0.85 • Urban. 0.85 • Infra. 0.80 • Employ. 0.78 • Educ. 0.55 • Median age 35
Industry: Technology & software • Leaning: progressive • Diversity 0.60

Millhaven — *Pop. 65,000 • 6 seats*

A historic town with a strong agricultural tradition, known for its family-owned farms and local food markets.

Wealth 0.70 • Urban. 0.75 • Infra. 0.70 • Employ. 0.72 • Educ. 0.45 • Median age 42
Industry: Agriculture & food processing • Leaning: conservative • Diversity 0.30

Ashford — *Pop. 120,000 • 10 seats*

A university town with a strong emphasis on healthcare and research, home to several medical facilities and research institutions.

Wealth 0.75 • Urban. 0.80 • Infra. 0.75 • Employ. 0.76 • Educ. 0.50 • Median age 40
Industry: Healthcare & research • Leaning: moderate • Diversity 0.45

Steelhaven — *Pop. 180,000 • 15 seats*

A major industrial center with a long history in automotive manufacturing, home to several large factories.

Wealth 0.80 • Urban. 0.85 • Infra. 0.85 • Employ. 0.78 • Educ. 0.55 • Median age 41
Industry: Automotive manufacturing • Leaning: conservative • Diversity 0.40

Lakeshore — *Pop. 90,000 • 6 seats*

A city with a strong tourism industry and agricultural roots, known for its historic downtown and lakefront attractions.

Wealth 0.55 • Urban. 0.70 • Infra. 0.65 • Employ. 0.62 • Educ. 0.30 • Median age 48
Industry: Tourism & agriculture • Leaning: progressive • Diversity 0.20

Bramblewood — *Pop. 45,000 • 4 seats*

A small town centered around a historic county seat, known for its tourism and agricultural products.

Wealth 0.60 • Urban. 0.65 • Infra. 0.60 • Employ. 0.65 • Educ. 0.35 • Median age 45
Industry: Tourism & hospitality • Leaning: conservative • Diversity 0.25

Dunmore — *Pop. 18,000 • 4 seats*

A small rural community with a focus on farming, with limited infrastructure and a close-knit population.

Wealth 0.30 • Urban. 0.30 • Infra. 0.35 • Employ. 0.30 • Educ. 0.20 • Median age 55
Industry: Agriculture • Leaning: conservative • Diversity 0.10

M Implementation Details

The primary codebase is implemented in Python 3.11 and is publicly available at `https://anonymous.4open.science/r/sim-1767`. All model interactions are routed through a lightweight prompting library that provides a unified chat-completion interface across OpenAI, Anthropic, Mistral, and OpenRouter APIs, as well as local inference via HuggingFace `transformers` and `vllm`. API calls use exponential-backoff retry logic to handle rate limits, and pipeline stages that are independent across voters or parties are dispatched concurrently via Python's `concurrent.futures`. Experiment configuration is managed through Hydra, with all parameters specified in a single YAML file and overridable from the command line.

Presentation order of parties and policies is randomized per voter using a deterministic seed derived from `md5(user_id + context_salt)`, ensuring reproducibility while mitigating positional bias. All simulation outputs—voter opinions, party policies, ballots, seat allocations, deliberation transcripts, and Likert scores—are persisted as structured JSON files, one per model, supporting incremental updates across runs. Figures are generated with `matplotlib` and tables with custom scripts that emit LaTeX directly; all plots and tables in this paper are reproducible from the archived result files via the scripts in the repository's `analysis/` directory.

Development of both the simulation framework and the analysis pipeline was substantially assisted by the Claude Opus 4 model (Anthropic), which was used as an interactive coding partner throughout the project.