

COMMUNITY-CROSS-INSTRUCT: Unsupervised Instruction Generation for Aligning Large Language Models to Online Communities

Anonymous ACL submission

Abstract

Social scientists use surveys to probe the opinions and beliefs of populations, but these methods are slow, costly, and prone to biases. Recent advances in large language models (LLMs) enable creating computational representations or “digital twins” of populations that generate human-like responses mimicking the population’s language, styles, and attitudes. We introduce COMMUNITY-CROSS-INSTRUCT, an unsupervised framework for aligning LLMs to online communities to elicit their beliefs. Given a corpus of a community’s online discussions, COMMUNITY-CROSS-INSTRUCT automatically generates instruction-output pairs by an advanced LLM to (1) finetune a foundational LLM to faithfully represent that community, and (2) evaluate the alignment of the finetuned model to the community. We demonstrate the method’s utility in accurately representing political and fitness communities on Reddit. Unlike prior methods requiring human-authored instructions, COMMUNITY-CROSS-INSTRUCT generates instructions in a fully unsupervised manner, enhancing scalability and generalization across domains. This work enables cost-effective and automated surveying of diverse online communities.

1 Introduction

Social scientists use surveys and focus groups to learn the opinions, needs and concerns of diverse populations. However, designing surveys and recruiting participants is a slow and costly process, limiting the utility of these instruments for probing public opinion. Surveys are prone to biases, such as the social desirability bias (Gordon, 1987), where respondents may alter their responses to sensitive questions to appear more socially acceptable (Bergen and Labonté, 2020), non-response bias (Hill et al., 1997), where participants fail to answer questions, and self-selection bias due to the choices participants make to participate in the survey (Heckman, 1990). In addition, social stigmas

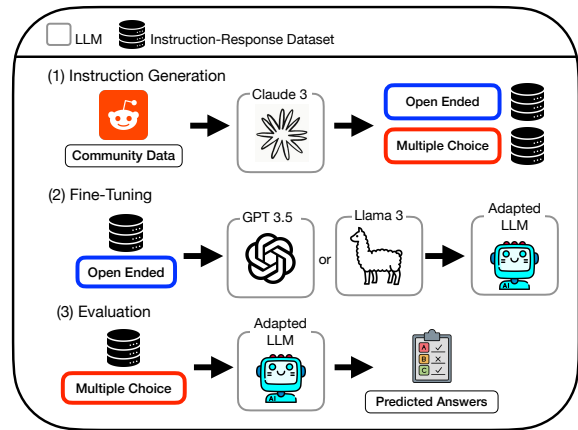


Figure 1: Illustration of COMMUNITY-CROSS-INSTRUCT to align an LLM to a community. (1) Open-ended instructions and multi-choice survey questions are generated by an advanced LLM from the community data. (2) A foundational LLM is aligned to community through instruction-tuning on the open-ended instructions. (3) The alignment of the finetuned LLM to the community is measured on the survey questions.

may taint responses (Goel and Salganik, 2010), especially for hard-to-reach and marginalized groups.

Recent breakthroughs in generative AI and especially large language models (LLMs) enable new capabilities for creating computational representations of human populations — their *digital twins* (El Saddik, 2018) — by ingesting vast textual data they create, for example, in online discussion forums. These LLM-based models generate human-like responses that mimic the language, communication styles, and attitudes of populations they are aligned to, allowing us to probe their worldviews, biases, and sentiments in a cost-effective and automated manner. Previous works have leveraged such LLM-based representations to mine opinions and learn political attitudes of online communities (Jiang et al., 2020; He et al., 2024b). However, they finetune GPT-2 (Radford et al., 2019) directly on textual data from communities, where the fine-

tuned model is not able to answer questions that may be in different format, e.g., multiple choice, as it is not an instruction-tuned model.

To address these challenges, we introduce COMMUNITY-CROSS-INSTRUCT: a fully unsupervised framework for aligning LLMs to online communities through instruction-tuning. The finetuned LLMs serve as digital twins of communities, which can be automatically surveyed to elicit their views (Figure 1).

Specifically, given a corpus of comments and submissions in different forums on Reddit, COMMUNITY-CROSS-INSTRUCT uses an advanced LLM (Claude-3) to automatically curate (1) COMMINST: a set of open-ended instructions (Fig. 2(a)) for **community-specific instruction tuning**, and (2) COMMSURVEY, a set of multi-choice survey questions (Fig. 2(b)). Each instruction in COMMINST and each survey question in COMMSURVEY are paired with answers from different communities. We finetune foundational LLMs (GPT-3.5 or Llama-3) on COMMINST, in order to align them to different communities, and evaluate the finetuned LLMs on COMMSURVEY to measure alignment. See Figure 3 for a high-level overview of the framework. Existing methods for self-supervised instruction generation rely on a seed set of instructions curated by domain experts (Wang et al., 2022; Chen et al., 2024b), which is not generalizable. We overcome this bottleneck by incorporating the readily available community data into the instruction generation pipeline. Our COMMUNITY-CROSS-INSTRUCT framework distills knowledge from communities using an advanced LLM to generate instructions for aligning foundational LLMs.

Our key contributions can be summarized as

- We introduce COMMUNITY-CROSS-INSTRUCT, a novel unsupervised framework for aligning foundational LLMs to online communities, by finetuning them on the automatically curated set of open-ended community-specific instruction-answer pairs (COMMINST). The models’ alignment to communities is measured using another set of automatically generated multiple choice questions and answers (COMMSURVEY).
- Using data from Reddit forums, we show that our method improves the fidelity of community representation (alignment) in two

domains—*politics* and *fitness*—yielding significant alignment improvement over standard persona adaptation methods.

Our work highlights the potential of generative AI to help researchers gain insights from online communities. By leveraging LLMs to create digital twins of these communities, researchers can more accurately and efficiently understand the nuances of public opinion, attitudes, and behaviors. Our framework not only enhances the fidelity of community representation but also paves the way for more effective approaches to studying social phenomena in the digital age.

Clarification on contributions. We aim to align LLMs to online communities through instruction-tuning, so that the aligned LLMs can be flexibly surveyed to probe the communities’ views on different topics. To prepare data for instruction tuning, we propose COMMUNITY-CROSS-INSTRUCT, and the automatic creation of the open-ended instruction-answer pairs (COMMINST) is the core contribution. However, in order to demonstrate that the finetuned LLMs are indeed aligned to communities and can be treated as their digital twins, we propose to automatically generate survey questions and answers (COMMSURVEY) to efficiently evaluate LLM alignment. This is a secondary contribution of this paper, and we do not claim that COMMSURVEY is the best way to measure alignment. Therefore, our main goal is to propose a method to prepare LLMs as a proxy for surveying different online communities, rather than automatically creating such surveys.

On the use of the term *alignment*. Inspired by Santurkar et al. (2023), throughout this paper, we use *alignment* to refer only to the alignment of views and opinions of LLMs and humans.

2 Problem Definition

A topical domain (e.g., *politics* or *fitness*) includes n communities $\{C_1, C_2, \dots, C_n\}$ each with different views and beliefs. Members of each community C_i collectively author text corpus D_i (e.g., discussions on Reddit forums) expressing views and exhibiting behaviors. Our goal is to align an LLM f to each community C_i using its texts D_i , such that the aligned LLM f'_i learns the complex mindset of the community and responds to inputs in the community’s voice. By administering surveys to the aligned LLMs $\{f'_1, f'_2, \dots, f'_n\}$, we obtain responses

from different communities, thereby capturing their ideological differences.

To align an LLM f to a community C , we fine-tune it on a set of demonstrations (instruction-answer pairs) (Wang et al., 2023; Ouyang et al., 2022; Chen et al., 2024b) $I = \{(X_j, Y_j)\}_{j=1}^m$, where the instructions are open-ended questions probing the community’s views on different topics, and the corresponding answers are aligned with each community’s ideology. Figure 2(a) shows an example demonstration in the politics domain. We propose COMMUNITY-CROSS-INSTRUCT (Fig. 3), a framework to automatically generate community-specific demonstrations I with an advanced LLM \hat{f} (Claude-3) based on the community’s text corpus D and use these demonstrations to instruction-tune a foundational LLM f (GPT-3.5 or Llama-3) through a process we call “CROSS-INSTRUCT”.

Instruction: What is your view on vaccine mandates?
Answer from r/Anarchism: Vaccines should be public property, but people should have bodily autonomy in getting vaccinated.
Answer from r/Anarcho_Capitalism: Mandates are authoritarian. Businesses should decide their own vaccine policies.
Answer from r/Conservative: Mandates are government overreach. People should have the freedom to choose.
Answer from r/Republican: Mandates are unconstitutional and an infringement on personal freedom.
Answer from r/democrats: Some mandates may be needed for public health, but people have valid reasons for hesitancy.

(a)

Question: Who do you think has done a better job handling the pandemic?
A. President Biden
B. Former President Trump
C. State governors
D. None of the above
Answer from r/Anarchism: D
Answer from r/Anarcho_Capitalism: D
Answer from r/Conservative: B
Answer from r/Republican: B
Answer from r/democrats: A

(b)

Figure 2: Example of (a) an instruction from COMMINST-POL and (b) a survey question from COMMSURVEY-POL. The instruction/survey question is paired with answers from different communities.

3 COMMINST: A Collection of Community-Specific Instructions

To align LLMs to different communities within each domain, we curate a dataset COMMINST for community-specific instruction tuning. COMMINST-POL and COMMINST-FIT are the two subsets for the *politics* and *fitness* domains with

6,687 and 4,395 unique instructions respectively. Each instruction is an opinion-eliciting question about a topic relevant to the domain (Figure 2(a)), which appears in multiple demonstrations. Each demonstration’s instruction is paired with an open-ended answer from a different community.

3.1 Online Community Corpora Collection

Reddit is a vibrant social media platform hosting discussion forums (subreddits) on a wide range of topics (Hofmann et al., 2022; Chen et al., 2024a). In this paper we focus on two domains: *politics* and *fitness*, which contain distinctive subreddits, or communities, with complex social dynamics. Political subreddits are valuable expressions of diverse public opinions and viewpoints. In the age of rising polarization, LLMs can help researchers track the complex evolving ideological landscape and effectively elicit public opinions. Meanwhile, the fitness subreddits feature a wealth of sensitive, health-related conversations, and the latest diet and fitness fads, often discussed using inscrutable insider jargon. We can track the direction of these discussions, identifying emerging trends, risks, and potential health misinformation. This insight allows public health officials to promptly address harmful health advice and intervene where necessary. Additionally, it provides an early warning system to detect the spread of dangerous health practices, ensuring that corrective measures can be implemented swiftly to protect community health.

We identify a set of representative subreddits for each domain based on personal knowledge and by querying ChatGPT. We manually aggregate and filter results, obtaining the following political online communities: *r/Anarchism*, *r/Anarcho_Capitalism*, *r/Conservative*, *r/Libertarian*, *r/Republican*, and *r/democrats*; For fitness, we investigate: *r/Fitness*, *r/loseit*, *r/keto*, *r/xxfitness*, and *r/GettingShredded*. More details of these communities are presented in Appendix A.1.

We collect comments and submissions from January 2019 to December 2022 and remove those that were deleted by the author or the moderator. The statistics of the collected comments and submissions are shown in Appendix A.1. To balance the number of comments and submissions across different communities, for each community, we keep a maximum of 140K comments and 30K submissions. Therefore, there are at most 170K texts, which makes up the text corpus D , including comments and submissions, for each community.

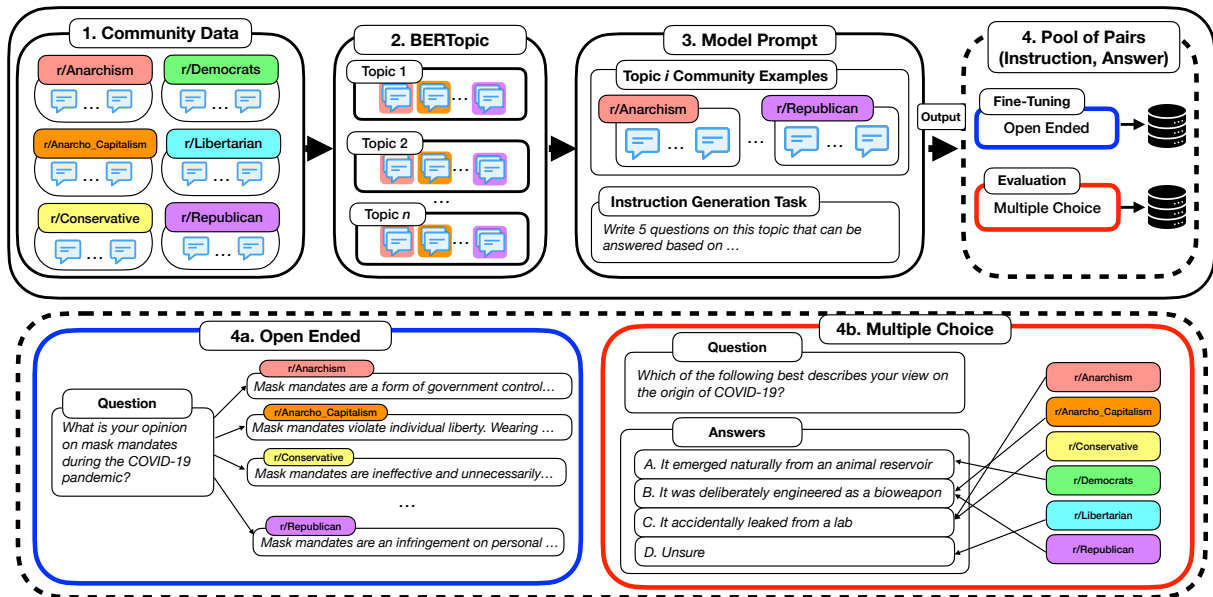


Figure 3: Overview of COMMUNITY-CROSS-INSTRUCT, with an illustrative example of the *politics* domain. (1) Data collection for each community within the desired domain. (2) BERTopic clusters the data and identifies prominent topics. (3) For each topic, the advanced LLM is prompted with (i) on-topic examples from each community and (ii) instruction-answer task definition and explanation. (4) Creation of (a) open-ended instruction-answer pairs and (b) multi-choice survey questions and answers, for fine-tuning and evaluating a sub-population representation foundational LLM respectively.

3.2 Topic Modeling

For a domain, denote the combined corpus from all n communities by $\mathbb{D} = D_1 \cup D_2 \cup \dots \cup D_n$. We use BERTopic (Grootendorst, 2022) on \mathbb{D} to identify topics g . More details about BERTopic can be found in Appendix B.1. After topic modeling, each text d is assigned a topic $g(d)$. The number of topics detected in *politics* and *fitness* are 425 and 628 respectively. The top 10 most frequent topics in *politics* and *fitness* are shown in Appendix B.1 respectively. *Politics* topics include abortion, climate, guns, and racism. *Fitness* topics include body measures, keto diet, and weight lifting.

For each community C_i , we split the text corpus D_i into smaller chunks $D_i = \{\hat{D}_1^i, \hat{D}_2^i, \dots\}$, where each chunk \hat{D} consists of texts belonging to a single topic $g(\hat{D})$.

3.3 Open-ended Instruction-Answer Pair Generation

For a specific domain, starting with an empty demonstration pool, we randomly sample without replacement a text chunk D_i for each topic $t_k \in T$ from each community. We include the sampled text chunks on topic t_k from the n communities into a prompt and then use the prompt to query the advanced LLM to generate open-ended instruc-

tions and answers on the topic. The prompting template is shown in Appendix B.2. We query *claude-3-opus-20240229* using the Anthropic API. In the prompt, we first specify the topic by the topic keywords, and then the comments in the sampled chunks from different communities. Next we ask the model to generate instructions that can be answered based on the texts, and that the instructions should elicit different responses from the n communities. Each generated instruction is paired with different answers from different communities (Figure 2(a)). It is then added to the pool as n demonstrations. Note that some topics may be discussed more in certain communities than others, so some instructions may be paired with answers from less than n communities. We iteratively repeat this process until there are no text chunks left for topic t_k from any community, until we shift to the next topic t_{k+1} . After the iterative generation process, the instruction-answer pool will contain demonstrations covering various topics, which will use to finetune foundational LLMs. Please refer to Appendix A.2 for more details about COMMINST.

For fair evaluating the finetuned LLMs, we split COMMINST-POL in two ways:

- Random split. COMMINST-POL is randomly split into training and eval sets: COMMINST-

289	POL-TRAIN and COMMINST-POL-EVAL, in a	337
290	ratio of 85:15.	338
291	• Topical split. We randomly select 10 topics	339
292	in <i>politics</i> and collect demonstrations related	340
293	to the topics into COMMINST-POL-EVAL-	341
294	TOPIC. The remaining demonstrations are col-	342
295	lected as COMMINST-POL-TRAIN-TOPIC. In	343
296	this way, COMMINST-POL-TRAIN-TOPIC and	344
297	COMMINST-POL-EVAL-TOPIC has no topic	345
298	overlap.	
299	We repeat the same process for COMMINST-FIT.	
300	4 COMMSURVEY: A Collection of	
301	Community-Specific Survey Questions	
302	To measure the alignment of the finetuned founda-	
303	tional LLM to the community, we administer a sur-	
304	vey of multi-choice questions to the model and eval-	
305	uate the agreement between the model’s responses	
306	and the community members’ responses. How-	
307	ever, manually designing surveys and collecting	
308	human responses from online communities is a non-	
309	trivial process, which is costly and time-consuming.	
310	Instead, we curate another dataset called COMM-	
311	SURVEY for evaluating the alignment of the fine-	
312	tuned LLM’s views to the community using survey	
313	questions. COMMSURVEY consists of automati-	
314	cally generated multi-choice survey questions and	
315	answers, where each question is paired with an-	
316	swers from different communities (Figure 2(b)).	
317	COMMSURVEY-POL and COMMSURVEY-FIT are	
318	the two subsets for <i>politics</i> and <i>fitness</i> respecti-	
319	vely, consisting of 4,457 and 2,930 multi-choice	
320	questions respectively, covering a wide range of	
321	topics.	
322	4.1 Multi-choice Survey Generation.	
323	We initialize an empty multi-choice survey pool.	
324	Then, following the open-ended instruction-answer	
325	pairs generation in §3.3, we iteratively generate	
326	multi-choice questions and answers (Figure 2(b))	
327	using the same advanced LLM (Claude-3) and add	
328	them to the pool. We also explored other advanced	
329	LLMs, such as GPT-4 or Gemini, but none of them	
330	was able to generate high-quality questions or	
331	answers as Claude-3. The prompting template is	
332	shown in Figure 8. We assume that the answers	
333	generated by the advanced LLM are the “semi-ground	
334	truths”, and that they faithfully represent the	
335	views of the corresponding communities.	
336	Note that there is a correspondence between	
	instructions in COMMINST and survey ques-	
	tions COMMSURVEY, as they are generated us-	
	ing nearly identical prompts. Following the	
	correspondence, we split COMMSURVEY-POL	
	and COMMSURVEY-FIT following the same two	
	ways for COMMINST. Due to the correspon-	
	dence, there is no information leakage between	
	COMMINST-POL-TRAIN and COMMSURVEY-	
	POL-EVAL, or between COMMINST-POL-TRAIN-	
	TOPIC and COMMSURVEY-POL-EVAL-TOPIC.	
	4.2 Validating Generated Survey Answers	
	We verify the faithfulness of the “semi-ground	
	truths” for the communities via human annotation.	
	For each domain, we randomly sample 20 ques-	
	tions from the survey (see Fig. 9 and Fig. 10 in the	
	Appendix) and ask two expert annotators to answer	
	them from the perspective of the subreddit. We	
	also tried directly posting the surveys to the subre-	
	ddits and having community members answer them.	
	However, our posts were immediately removed by	
	moderators and our accounts were banned from cer-	
	tain subreddits. This further indicates the difficul-	
	ty of directly surveying online communities.	
	For <i>politics</i> , each annotator fills out the survey	
	for three subreddits; and for <i>fitness</i> , two annota-	
	tors answer the questions for three subreddits and	
	two subreddits respectively. For each subreddit, we	
	compare the LLM-generated “semi-ground truths”	
	to human responses, and present the accuracy in	
	Table 1. In both domains, “semi-ground truths”	
	achieve strong agreement with human annotations	
	for most subreddits, which gives confidence that	
	the advanced LLM-generated survey answers can	
	be used as “semi-ground truth” to evaluate fine-	
	tuned foundational LLMs. However, for <i>r/Libertar-</i>	
	<i>ian</i> in <i>politics</i> , the agreement is less satisfactory.	
	After inspecting the online posts from <i>r/Libertar-</i>	
	<i>ian</i> , we find that libertarian principles often empha-	
	size individual freedom and skepticism of govern-	
	ment intervention, which can lead to highly context-	
	dependent and situation-specific responses. This	
	ambiguity can result in different interpretations of	
	the same question for the human annotator and the	
	advanced LLM. Considering the low agreement,	
	we will not report the results for <i>r/Libertarian</i> in	
	§5.	
	5 Experiments	
	We demonstrate the effectiveness of the pipeline on	
	the Reddit <i>politics</i> and <i>fitness</i> domains. We align	
	LLMs to Reddit communities by finetuning them	

politics	r/Anarchism	r/Anarcho Capitalism	r/Conservative	r/Libertarian	r/Republican	r/democrats
	0.75	0.60	0.75	0.45	0.75	0.65
fitness	r/Fitness	r/loseit	r/keto	r/xxfitness	r/GettingShredded	
	0.75	0.70	0.60	0.50	0.65	

Table 1: Agreement between human annotators’ survey responses and the advanced LLM (Claude-3) generated survey answers in different domains and subreddits, measured by accuracy.

on relevant demonstrations from COMMINST. After finetuning, we administer surveys from COMMSURVEY and evaluate the finetuned LLMs by comparing their responses to the “semi-ground truths”, in order to measure alignment.

5.1 Experimental Setup

We experiment with two foundational LLMs – GPT-3.5 and Llama-3.

Finetuning. We finetune the foundational LLMs on COMMINST-POL-TRAIN and COMMINST-FIT-TRAIN. We use the OpenAI finetuning API to finetune *gpt-3.5-turbo-0125* for 1 epoch, as we find that the loss converges within 1 epoch. The batch size is automatically determined by the API, and the finetuning takes ~40mins. For Llama-3, the implementation is based on LLAMAFACTORY (Zheng et al., 2024), and we finetune *Llama-3-8B-Instruct* with batch size 16 for 2 epochs on 4 H100 GPUs. The finetuning takes ~10mins.

Measuring Alignment. We administer survey questions in COMMSURVEY-POL-VEAL and COMMSURVEY-FIT-VEAL to the finetuned foundational LLMs. In the prompt, we provide the question and the four options verbatim, and then add the instruction “Select only one answer by stating either A, B, C, or D. Do not provide any additional explanation or rationale for your choice.”, for the sake of easier matching of the model’s response to the option. For GPT-3.5, the temperature is set to 0.9 and the model provides 5 generations for each question. For Llama-3, temperature is set to 0.9, *top_p* is set to 0.9, and the model provides 10 generations for each question. The majority vote from the different generations for each question is taken. We compare the model responses to the “semi-ground truths” and report the accuracy as a measure of alignment.

5.2 Baselines

Vanilla LLMs. We administer survey questions to the vanilla unfinetuned GPT-3.5 and Llama-3

and evaluate their answers.

Vanilla LLMs+Steering. When prompting the vanilla language models to answer survey questions, we steer them to mimic the community, by specifying in the prompt that “Select only one answer that best aligns with the opinions of members from subreddit r/[subreddit]”. Steering the vanilla LLMs can nudge them to respond for the community. However, it is important to note that **steering only applies to predefined communities that are developed via a predefined tag**, such as subreddits, where we can easily specify community names in the prompt to steer the LLMs. Although in this paper we focus on communities associated with online forums, COMMUNITY-CROSS-INSTRUCT generalizes to other online communities, including organically formed communities in the retweet network (Chu et al., 2024) or the news co-sharing network (Mosleh et al., 2021; He et al., 2024b), as long as their texts are readily available. It is non-trivial to summarize the organically-formed communities concisely in language, but we can still align LLMs to them via COMMUNITY-CROSS-INSTRUCT.

5.3 Main Results

We compare survey answers generated by the finetuned LLMs to the “semi-ground truth” and report the accuracy in Figure 4 as a measure of alignment with the corresponding community. In most cases, steering LLMs towards specific communities creates better alignment by relying on the models’ pre-existing knowledge about the communities. However, such pre-knowledge may be incomplete, inaccurate, or outdated. Therefore, by finetuning LLMs on instructions distilled from the text corpora of communities, COMMUNITY-CROSS-INSTRUCT outperforms steering and achieves the best results, demonstrating its effectiveness in aligning LLMs to different communities.

The base models show worse alignment with *r/Conservative* and *r/Republican* than other Reddit communities. This observation conforms to find-

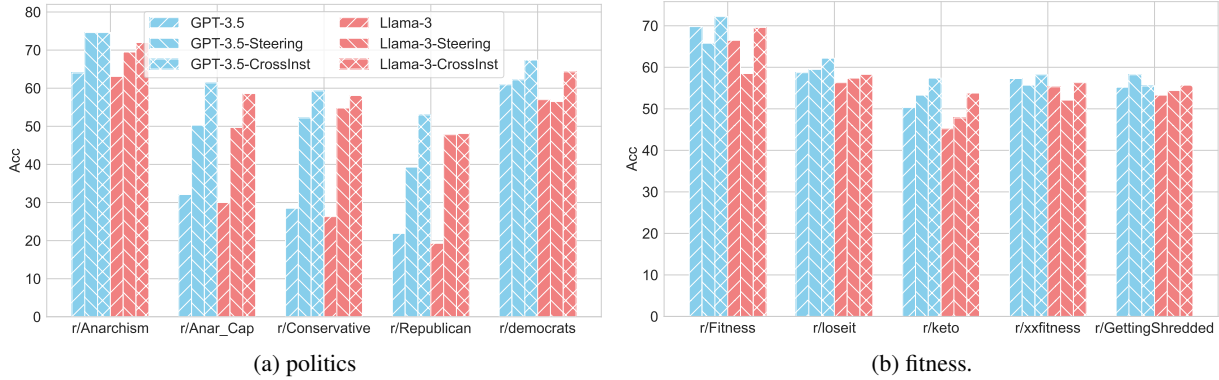


Figure 4: Alignment of finetuned LLMs to the corresponding communities measured by accuracy, by comparing the LLMs’ survey responses to the “semi-ground truths”.

ings by previous works (Santurkar et al., 2023; He et al., 2024a; Chen et al., 2024b) that LLMs tend to display a liberal bias and poor alignment with conservatives. After explicitly steering them towards specific communities, their alignment with the two subreddits significantly increases, but it is still lower than that with other communities. Finetuning the LLMs with COMMUNITY-CROSS-INSTRUCT further improves the alignment, although it is still lower than for other communities. This observation highlights the risks of deploying LLMs in political scenarios due to the entrenched political biases.

For the *r/Anarchism* subreddit, GPT-3.5-CrossInst achieves similar alignment as the steering baseline. We suspect that this is because views about anarchism are captured by the pre-existing knowledge of GPT-3.5. Therefore, infusing such knowledge again by COMMUNITY-CROSS-INSTRUCT barely leads to any gain.

For the *r/Fitness* and *r/xxfitness* communities, steering both LLMs worsens the alignment compared to the vanilla model. *r/Fitness* is a general fitness subreddit and *r/xxfitness* is a fitness community for women, both of which may have a broader and more diverse range of opinions compared to other subreddits. Steering the models to align with a singular “community opinion” might oversimplify the nuanced perspectives within these fitness communities, leading to decreased alignment accuracy. However, *Community-Cross-Instruct* effectively distills knowledge from the community corpora during finetuning. On *r/GettingShredded*, COMMUNITY-CROSS-INSTRUCT is outperformed by the steering baseline for GPT-3.5, but not Llama-3. *r/GettingShredded* has the least amount of comments and posts, producing much fewer demonstrations for finetuning (Appendix 3). The insuf-

ficient data might be less effective for finetuning a larger LLM like GPT-3.5¹, leading to inferior performance.

5.4 Out-of-Topic Generalizability

Our final goal is to create LLMs aligned to different communities, which can be used to answer any survey question from the perspective of the community. In the real world, the surveys may contain questions covering topics that do not appear in the finetuning data COMMINST. In this study, we finetune Llama-3 on COMMINST-POL-TRAIN-TOPIC, and evaluate it on COMMSURVEY-POL-EVAL-TOPIC, to make sure that there is no overlap in topic coverage. The results in Fig. 5 show that COMMUNITY-CROSS-INSTRUCT consistently outperforms both baselines, demonstrating its superiority in aligning with views of different communities, and generalize the learned views to unseen topics.

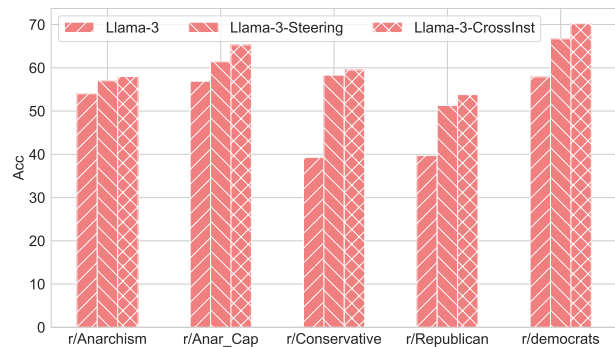


Figure 5: Cross-topic alignment of finetuned LLMs to the corresponding communities. The LLMs are finetuned on demonstrations and evaluated on survey questions on different topics.

¹We assume that GPT-3.5 has more than 8B parameters.

6 Related Works

Self-Improved Instruction Tuning. A survey of instruction-tuning approaches (Zhang et al., 2023) outlines several methods for models to autonomously self-improve their instruction set. These include generating instructions for pre-existing texts (Li et al., 2023), eliciting interaction between different model iterations (Chen et al., 2024c), and bootstrapping from an existing instruction set to generate new ones (Wang et al., 2022). Additionally, a human-in-the-loop framework builds upon self-generalization by iterating between human and machine-generated instructions (Guo et al., 2024). Despite these advances, these strategies require manual input. In this work, we build on *self-instruct*, a method to enhance instruction tuning by eliciting synthetic model instruction generations. We alter the original framework by removing the required set of manually written seed instructions (Wang et al., 2022). This work significantly contributes to the field by offering a scalable and fully autonomous solution to instruction tuning, paving the way for more adaptive and intelligent models.

Community Alignment. Aligning with the dialects and behaviors of online communities is crucial for accurately modeling subpopulations (Dorn et al., 2023, 2024). Subpopulation representative models (SRMs) (Simmons and Hare, 2023) can be used to emulate some characteristics of a particular subpopulation, particularly as LLMs can provide fine-grained, demographically-correlated outputs (Argyle et al., 2023a). Using self-instruct with questions from the American Trans Panel as the seed instruction set, LLMs can be ideologically manipulated to reflect particular political opinions (Chen et al., 2024b). To learn about partisan communities, (Jiang et al., 2022) repeatedly prompt GPT 2 with tweets authored by prominent community members to generate synthetic responses to election survey questions. (Argyle et al., 2023b) find that exposing GPT 3 to thousands of socio-demographic backstories leads the model to obtain a complex understandings of sociological concepts. ‘Media diet models’ train BERT using MLM on news articles, evaluating the alignment of model predictions with a survey of community members who follow the media (Chu et al., 2023). (Feldman et al., 2022) expose GPT 3 to Yelp reviews to expand insights past sentiment information. Prompting language models with (survey question, indi-

vidual ID, survey year) triplets from the Americans in the General Social Surveys has helped social scientists impute missing survey data and predict opinions (Kim and Lee, 2023). These techniques rely on manually created datasets at least as a seed dataset to align the models with the desired communities, limiting SRBMs to high-resource environments.

Surveys. Social scientists use surveys to systematically collect data from populations to characterize their beliefs, attitudes, opinions, and behaviors. While designing the survey, researchers consider the order, wording, and format of questions (open-ended vs multiple-choice) to increase clarity and ensure the validity and reliability of the survey data. Survey design also aims to minimize biases, such as the non-response bias (Hill et al., 1997), fatigue due to overly long surveys (Choi and Pak, 2005), social desirability bias (Gordon, 1987) when asking survey participants questions about sensitive topics (due to the desire to conform to perceived social expectations), or those involving social stigmas (Goel and Salganik, 2010). These issues, as well as the variety of existing biases, call for new approaches to survey design.

7 Conclusion

In this paper, we introduced and explored COMMUNITY-CROSS-INSTRUCT, a fully automated framework to represent online communities and elicit their views. By automating the process of surveying diverse online communities, COMMUNITY-CROSS-INSTRUCT offers a cost-effective and efficient alternative to traditional survey methods used by social scientists. Through finetuning LLMs based on community-specific instructions and answers, COMMUNITY-CROSS-INSTRUCT enables the generation of accurate responses that align with the beliefs and perspectives of different online communities. This innovative framework has demonstrated its effectiveness in representing various communities, including political and fitness forums on Reddit. COMMUNITY-CROSS-INSTRUCT opens up new possibilities for researchers to gain insights into the diverse views and opinions present in online communities, paving the way for deeper understanding and analysis of digital societies. Moving forward, we will apply the framework to model organic online communities, such as those in the retweet network.

625 Limitations

626 Identical LLM for Generating both Datasets.

627 We use Claude-3 for generating both COMMINST
628 for finetuning LLMs and COMMSURVEY for eval-
629 uating LLM alignment, as we couldn't find a dif-
630 ferent advanced LLM that was able to generate
631 high-quality data as Claude-3. This reliance on
632 a single LLM introduces a limitation, as it may
633 lead to a bias where the evaluation dataset (Comm-
634 Survey) is inherently aligned with the model used
635 for instruction generation (CommInst), potentially
636 overestimating the alignment accuracy of the fine-
637 tuned models. To address this limitation, we plan to
638 incorporate a diverse set of advanced LLMs as they
639 become available in future iterations of our frame-
640 work. Additionally, we will include human-in-the-
641 loop validation to ensure the generated datasets
642 maintain high quality and representativeness, mit-
643 igating any biases introduced by the single LLM
644 dependency. Furthermore, we will explore cross-
645 validation techniques and third-party evaluations to
646 benchmark the performance of our finetuned mod-
647 els, ensuring robustness and generalizability of our
648 results beyond the influence of a single LLM.

649 **Group Approximation.** To approximate group-
650 level behavior, community members represented
651 in the minority are inherently excluded. Further,
652 measuring group alignment using a single-answer
653 multiple choice questionnaire does not account for
654 bimodal distribution. We hope to build on this work
655 by experimenting with survey designs that account
656 for more diversity in communities.

657 **Hallucination Potential.** Adapting models to
658 communities poses a risk of language models hallu-
659 cinating or providing misinformation in their com-
660 munity representation. We hope to build upon this
661 work with in-depth experiments on model halluci-
662 nation and misrepresentation in the subgroup rep-
663 resentation task.

664 **Prompt Perturbations.** LLM responses are sen-
665 sitive to slight changes in prompts (Salinas and
666 Morstatter, 2024). In this work, we work primarily
667 with one prompt for instruction generation. We
668 would be interested to see how model's generated
669 instructions shift with different prompting schemas.

670 Ethics Statement

671 Users might not be informed of how their data (re-
672 flected in their posts) are used to produce digital

twins that mirror their voices and the purpose of
the survey constructed based on their data. Further-
more, automatically surveying communities can
reveal unconsented insights of certain individuals
or groups of people online. To address these ethi-
cal concerns, we will implement several measures.
Firstly, we will ensure that all data used for cre-
ating digital twins is anonymized, stripping any
personally identifiable information to protect user
privacy. Secondly, we will seek to aggregate data
in a manner that focuses on community-level in-
sights rather than individual-level analysis, thereby
reducing the risk of unconsented personal exposure.
Thirdly, we will obtain explicit consent from users
where possible, clearly communicating the purpose
and scope of our research. Lastly, we will adhere
to ethical guidelines and institutional review board
(IRB) requirements to ensure that our methods re-
spect the privacy and rights of the individuals and
communities involved.

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829			877
830		The prompting template for generating the multiple choice instruction-answer pairs in COMMSURVEY is shown in Figure 8.	878
831			879
832			880
833	Yizhong Wang, Yeganeh Kordi, Swaroop Mishra, Alisa Liu, Noah A Smith, Daniel Khashabi, and Hannaneh Hajishirzi. 2023. Self-instruct: Aligning language models with self-generated instructions. In <i>Proceedings of the 61st Annual Meeting of the Association for Computational Linguistics (Volume 1: Long Papers)</i> , pages 13484–13508.	C Survey Sample	881
834		Samples of the surveys provided to human annotators for generating “semi-ground truth data” are provided in Figures 9 and 10 (political and fitness domains, respectively).	882
835			883
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849	A Data Details		
850	A.1 Subreddits		
851	We briefly introduce each subreddit in Table 2. Statistics of data from different subreddits are shown in Table 3.		
852			
853			
854	A.2 Statistics of COMMINST		
855	Table 3 describes the number of demonstrations in each subreddit. The variance is due to their different topic coverage. Figure 6 presents the distribution of instruction lengths and answer lengths in COMMINST-POL and COMMINST-FIT.		
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860	B Implementation Details		
861	B.1 Topic Modeling with BERTopic		
862	Following the pipeline of BERTopic (Grootendorst, 2022), we first obtain the text embeddings using <i>all-mpnet-base-v2</i> (Song et al., 2020). The embedding dimensions are reduced with UMAP, with <code>n_neighbors</code> 15 and <code>n_components</code> 5. Then the embeddings are clustered using HDBSCAN, with <code>min_cluster_size</code> 50. After fitting the model, we remove texts that are not assigned any topics. Table 4 and Table 5 present the top-10 most frequent topics in <i>politics</i> and <i>fitness</i> .		
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872	B.2 Prompting Template for COMMINST		
873	The prompting template for generating the open-ended instruction-answer pairs in COMMINST is shown in Figure 7.		
874			
875			

Subreddit	Description
r/Anarchism	r/Anarchism is a forum with 268K members for discussing anarchism, assuming participants are anarchists, allies, or learners.
r/Anarcho_Capitalism	r/Anarcho_Capitalism is a subreddit with 197K members dedicated to discussing free-market capitalist anarchism and related topics, advocating for a society where voluntary interactions enhance liberty and opportunity for all.
r/Conservative	r/Conservative, with 1.1M members, offers the largest space on Reddit for fiscal and social conservatives to explore and discuss political and cultural issues from a distinctly conservative perspective.
r/Libertarian	r/Libertarian is a forum with 506K members focused on libertarianism and the principles of a free society, explicitly rejecting anti-libertarian ideologies like communism.
r/Republican	r/Republican is a partisan subreddit with 191K members specifically designed as a space for Republicans to discuss issues among themselves.
r/democrats	r/democrats is a subreddit with 438K members dedicated to supporting the Democratic Party, offering daily updates, policy analysis, and opportunities to help elect Democrats at all levels.
r/Fitness	r/Fitness is the largest community dedicated to achieving physical fitness goals with 12M members
r/loseit	r/loseit is a supportive community with 4M members for individuals of all sizes to discuss healthy and sustainable weight loss methods
r/keto	r/keto is a community of 3.6M members for sharing experiences and advice about the low-carb Ketogenic diet, which supports a range of health conditions from diabetes to epilepsy
r/xxfitness	r/xxfitness is a community of 2.2M members for female and gender non-binary/gender non-conforming Redditors to discuss fitness
r/GettingShredded	r/GettingShredded is a community of 162K members for anyone aiming to lose body fat, improve their physique, and boost confidence through healthy fat loss and strength training discussions.

Table 2: Reddit forums used in this study. Descriptions of (top) *politics* and (bottom) *fitness* subreddits.

Politics						
	r/Anarch.	r/Anarcho.	r/Conserv.	r/Democr.	r/Libert.	r/Republic.
Comments	182,192	589,354	2,391,745	142,274	1,950,089	140,572
Submissions	31,567	41,264	356,842	90,001	40,967	48,808
Demonstrations	2,430	3,027	2,943	3,159	2,928	2,574
Fitness						
	r/Fitness	r/loseit	r/keto	r/xxfitness	r/GettingShredded	
Comments	907,839	967,645	603,920	420,082	78,053	
Submissions	2,430	3,027	2,943	3,159	2,928	
Demonstrations	3,438	2,793	1,716	2,883	1,215	

Table 3: Dataset size measured by number of comments and submissions for each community in political and fitness communities, and the number of learned open-ended instruction-answer pairs (demonstrations).

idx	Topic Keywords	Frequency
1	covid, vaccinated, masks, vaccines, healthcare, deaths, flu, pandemic, coronavirus, cdc	48,787
2	abortion, fetus, abortions, roe, body, choice, unborn, rights, parenthood, cells	11,256
3	climate, change, solar, emissions, pipeline, fuels, coal, power, supply, grid	9,035
4	guns, firearms, shootings, firearm, amendment, laws, armed, rifles, militia, nra	8,833
5	police, officer, officers, gun, force, law, crime, video, training, situation	7,934
6	kamala, woman, pelosi, vp, hillary, president, herself, biden, party, with	7,879
7	racist, racism, whites, racists, racial, minorities, democrats, privilege, whiteness, discrimination	7,785
8	libertarian, libertarians, libertarianism, party, government, left, ideology, vote, political, conservative	6,666
9	anarchism, anarchy, anarchist, anarchists, anarcho, hierarchies, communism, ideology, government, system	6,311
10	biden, bernie, obama, candidate, voters, debate, election, democrats, hillary, sanders	5,768

Table 4: Top-10 most frequent topics in *politics*. Each topic is represented by the topic-10 keywords.

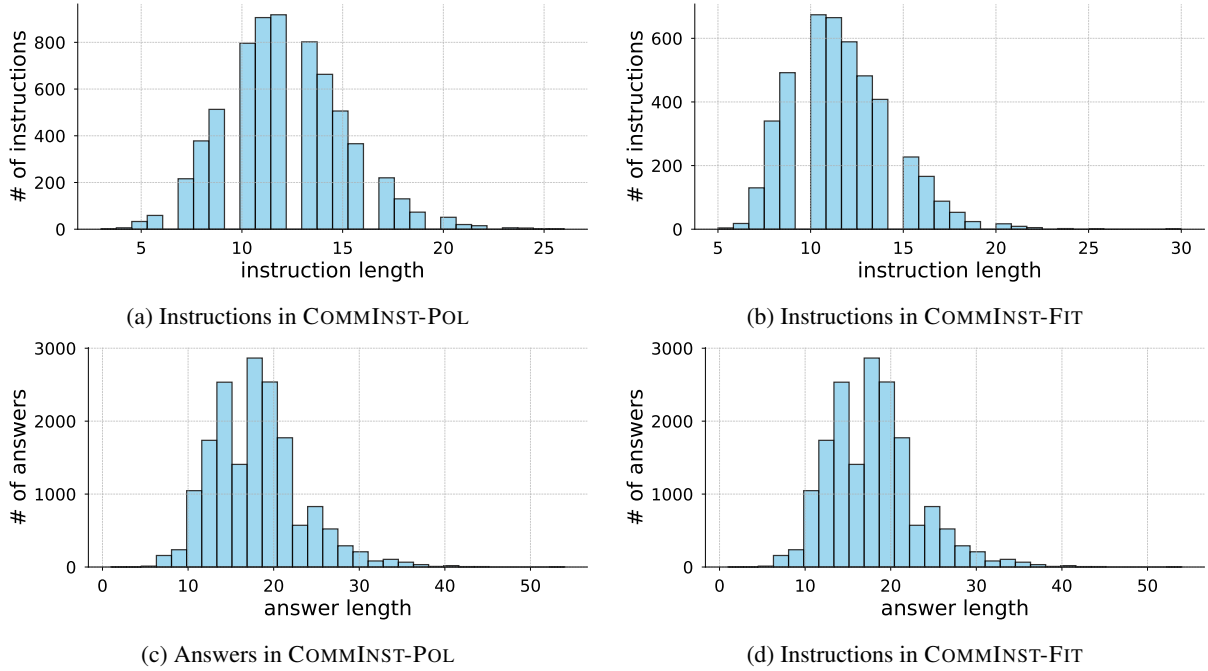


Figure 6: Distribution of instruction and answer lengths in COMMINST-POL and COMMINST-FIT.

idx	Topic Keywords	Frequency
1	lbs, bmi, down, cw, gained, progress, healthy, tips, weeks, started	18,296
2	keto, ketosis, carbs, diet, 20g, protein, macros, started, calories, ketogenic	13,078
3	leggings, clothes, wear, pants, shorts, bras, shirts, clothing, dress, lululemon	7,063
4	motivation, journey, progress, yourself, change, motivated, success, start, proud, back	5,142
5	water, scale, weighing, retention, trend, normal, plateau, fluctuates, gain, weekly	4,880
6	sleep, morning, hours, work, gym, motivation, schedule, waking, exercise, routine	4,486
7	she, people, overweight, weight, obese, comment, healthy, skinny, talk, shaming	4,192
8	bf, percentage, fat, bodyfat, body, lean, bulk, estimates, lbs, pic	3,930
9	reps, sets, program, max, amrap, lifts, ranges, bench, 5x10, hypertrophy	3,788
10	shoulder, elbow, injury, arm, knees, physio, exercises, bicep, curls, heal	3,775

Table 5: Top-10 most frequent topics in *fitness*. Each topic is represented by the topic-10 keywords.

Below are comments from 6 different subreddits related to a topic. The topic can be represented using these keywords: covid, vaccinated, masks, vaccines, healthcare, deaths, flu, pandemic, coronavirus, cdc.

Comments from r/Anarchism
 Comment 1: this is why we need decentralized medicine production.this is a project i am working on right now, a shame the
 ...
 Comment 50: every year people get old and/or sick and die. the old usually go with the whatever cold/flu is prevalent at...

Comments from r/Anarcho_Capitalism
 Comment 1: here's no stockpile of ventilators or ppe, and there are minimal hospital beds because of capitalism...
 ...
 Comment 50: the vaccine has zero negative effectsthat's just bulls**t. i'm not arguing the risks outweigh the benefits (i'm vaccinated), but that's...

Comments from r/Conservative
 Comment 1: the main thing here is that anytime a new virus is popularized it takes the attention of the american people.
 ...
 Comment 50: everyone can agree that this is hypocritical. what is also hypocritical is the reaction from conservatives suddenly offended that someone...

Comments from r/Libertarian
 Comment 1: gathering dozens of people in one place during a pandemic doesn't make someone a hero or a role model...
 ...
 Comment 50: covid-19 tests would be as available as coca-cola by now if the free market was free to make them.

Comments from r/Republican
 Comment 1: we need to stop this chinese diplomacy bulls**t. every f**king virus is out of china. this is how they're crippling...
 ...
 Comment 50: just further proof that - ever since the vaccines were "launched" for public use - that we have been in...

Comments from r/democrats
 Comment 1: it's a political loser because most people don't like radical change. they want pragmatic improvements. pretty much what obama said.
 ...
 Comment 50: you do know that this is a brand new virus right? you do know how science works? we are learning...

Write 3 questions (Q1 through Q3) on this topic that can be answered based on these comments. For a subreddit, each question should be answered in a way that the members from the subreddit would do, and the answers should echo the comments shown above. Do NOT rely on your background knowledge about the specific subreddits to answer the questions. The questions should be low-level, detailed, and trigger different responses that differentiate between different subreddits. Don't ask too high-level questions. The questions should not be in the style of reading comprehension ones, and they are intended for members in the subreddits to answer. The questions should not contain "comment" in them. Each question should be paired with answers from all 6 subreddits. The answers should be concise (fewer than 32 tokens), legible, grammatically correct. Below is the format of generated questions.

Q1: [open-ended question]
 Answer from r/Anarchism: [answer in clean text]
 Answer from r/Anarcho_Capitalism: [answer in clean text]
 Answer from r/Conservative: [answer in clean text]
 Answer from r/Libertarian: [answer in clean text]
 Answer from r/Republican: [answer in clean text]
 Answer from r/democrats: [answer in clean text]

Q3: [open-ended question]
 Answer from r/Anarchism: [answer in clean text]
 Answer from r/Anarcho_Capitalism: [answer in clean text]
 Answer from r/Conservative: [answer in clean text]
 Answer from r/Libertarian: [answer in clean text]
 Answer from r/Republican: [answer in clean text]
 Answer from r/democrats: [answer in clean text]

Figure 7: Template prompt to generate COMMINST.

Below are comments from 6 different subreddits related to a topic. The topic can be represented using these keywords: covid, vaccinated, masks, vaccines, healthcare, deaths, flu, pandemic, coronavirus, cdc.

Comments from r/Anarchism
 Comment 1: this is why we need decentralized medicine production.this is a project i am working on right now, a shame the
 ...
 Comment 50: every year people get old and/or sick and die. the old usually go with the whatever cold/flu is prevalent at...

Comments from r/Anarcho_Capitalism
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 ...
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 Comment 1: gathering dozens of people in one place during a pandemic doesn't make someone a hero or a role model...
 ...
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 ...
 Comment 50: just further proof that - ever since the vaccines were "launched" for public use - that we have been in...

Comments from r/democrats
 Comment 1: it's a political loser because most people don't like radical change. they want pragmatic improvements. pretty much what obama said.
 ...
 Comment 50: you do know that this is a brand new virus right? you do know how science works? we are learning...

Write 2 questions (Q1 and Q2) on this topic that can be answered based on these comments. For a subreddit, each question should be answered in a way that the members from the subreddit would do, and the answers should echo the comments shown above. Do NOT rely on your background knowledge about the specific subreddits to answer the questions. The questions should be low-level, detailed, and trigger different responses that differentiate between different subreddits. Don't ask too high-level questions. The questions should not be in the style of reading comprehension ones, and they are intended for members in the subreddits to answer. The questions should not contain "comment" in them. Each question should be paired with answers from all 6 subreddits. They are multi-choice questions and are associated with four options (A through D). Below is the format of generated questions.

Q1: [multi-choice question]
 A.xxx
 B.xxx
 C.xxx
 D.xxx
 Answer from r/Anarchism: A/B/C/D
 Answer from r/Anarcho_Capitalism: A/B/C/D
 Answer from r/Conservative: A/B/C/D
 Answer from r/Libertarian: A/B/C/D
 Answer from r/Republican: A/B/C/D
 Answer from r/democrats: A/B/C/D

Q2: [multi-choice question]
 A.xxx
 B.xxx
 C.xxx
 D.xxx
 Answer from r/Anarchism: A/B/C/D
 Answer from r/Anarcho_Capitalism: A/B/C/D
 Answer from r/Conservative: A/B/C/D
 Answer from r/Libertarian: A/B/C/D
 Answer from r/Republican: A/B/C/D
 Answer from r/democrats: A/B/C/D

Figure 8: Template prompt to generate COMMSURVEY.

1. What is the best approach for the government to take regarding COVID-19?
 - (a) Impose strict lockdowns, mask mandates, and vaccine requirements
 - (b) Recommend precautions but leave decisions up to individuals
 - (c) Do nothing and let people take personal responsibility for their health
 - (d) Deny the seriousness of the virus and openly resist all restrictions

2. When it comes to abortion laws, which statement do you most agree with?
 - (a) Abortion should be completely illegal in all cases.
 - (b) Abortion should only be allowed in cases of rape, incest, or medical necessity.
 - (c) Abortion should be legal but with some restrictions like waiting periods.
 - (d) Abortion should be legal without restrictions, as an individual choice.

3. Which of the following do you think is the most important consideration in energy policy?
 - (a) Economic costs and affordability
 - (b) Energy independence and security
 - (c) Environmental protection and emissions reduction
 - (d) Technological innovation and progress

4. Which of the following gun control measures do you think would be most effective at reducing gun deaths while respecting rights?
 - (a) Universal background checks on all gun sales
 - (b) Mandatory waiting periods for gun purchases
 - (c) Increased funding for mental health services
 - (d) Armed security in schools and public places

5. Which of the following do you most agree with regarding the phrase "defund the police"?
 - (a) It means completely abolishing all law enforcement
 - (b) It means reallocating some police funds to social services
 - (c) It's a dangerous idea that will lead to more crime
 - (d) It's a poorly chosen slogan that doesn't represent most Democrats' views

6. Which best describes Alexandria Ocasio-Cortez's political positions?
 - (a) Far-left radical socialist
 - (b) Mainstream progressive Democrat
 - (c) Centrist Democrat
 - (d) Closet conservative

7. Do you believe affirmative action policies are an effective way to address racial inequalities?
 - (a) Yes, they help level the playing field
 - (b) No, they are a form of reverse discrimination
 - (c) They are well-intentioned but often misguided
 - (d) The focus should be on socioeconomic status, not race

8. Which statement best describes how libertarianism relates to the left-right political spectrum?
 - (a) Libertarianism is a centrist ideology between the left and right.
 - (b) Libertarianism is a form of far-right extremism.
 - (c) Libertarianism does not fit neatly on the left-right spectrum.
 - (d) Libertarianism is a leftist ideology hijacked by the right.

9. How would you rate Biden's cognitive abilities and mental sharpness?
 - (a) Extremely poor, clearly in cognitive decline
 - (b) Below average for a president, has frequent gaffes and lapses
 - (c) Typical for his age, some slowdown but generally lucid
 - (d) Sharp and fully capable, no major impairments

10. How will history look back on the investigations into President Trump?
 - (a) As a dark period of partisan harassment of a duly elected president
 - (b) As a diligent attempt to hold a corrupt president accountable
 - (c) As an important lesson on the limits of presidential power
 - (d) As an unfortunate distraction from more important issues facing the country

Figure 9: Sample of the multiple choice survey generated for human evaluation in the politics domain.

1. What is the most important factor in successful weight loss?
 - (a) Diet
 - (b) Exercise
 - (c) Sleep
 - (d) Stress management
2. Which type of protein do you prefer for building muscle?
 - (a) Whey
 - (b) Casein
 - (c) Plant-based
 - (d) Beef
3. Which of the following is the most reliable indicator of fat loss progress?
 - (a) Daily weight fluctuations
 - (b) Weekly weight averages
 - (c) Body measurements
 - (d) How clothes fit
4. When is the best time to consume protein for optimal muscle growth and recovery?
 - (a) Immediately before a workout
 - (b) Within 30 minutes post-workout
 - (c) Evenly distributed throughout the day
 - (d) Right before bed
5. What is the primary factor in losing belly fat?
 - (a) Genetics
 - (b) Calorie deficit
 - (c) Cardio exercise
 - (d) Strength training
6. What is your preferred fasting schedule?
 - (a) 16:8
 - (b) 18:6
 - (c) 20:4
 - (d) OMAD (One Meal A Day)
7. How much weight should I aim to lose per week for healthy fat loss?
 - (a) 0.5-1 lbs
 - (b) 1-2 lbs
 - (c) 2-3 lbs
 - (d) 3-4 lbs
8. What is the most significant factor in determining the amount of loose skin after weight loss?
 - (a) Age
 - (b) Amount of weight lost
 - (c) Speed of weight loss
 - (d) Genetics
9. How do cheat meals affect your overall progress towards your fitness goals?
 - (a) They can easily offset a week's calorie deficit if not planned carefully
 - (b) They have no significant impact as long as they are occasional
 - (c) They can boost progress by increasing leptin levels and boosting metabolism
 - (d) They are essential for maintaining muscle mass during a cutting phase
10. Which of the following is a myth about reducing belly fat?
 - (a) You can spot reduce belly fat with specific exercises.
 - (b) A calorie deficit is necessary for belly fat loss.
 - (c) Stress can contribute to belly fat accumulation.
 - (d) Genetics play a role in fat distribution.

Figure 10: Sample of the multiple choice survey generated for human evaluation in the fitness domain.