Granular Analysis of Social Media Users' Truthfulness Stances Toward Climate Change Factual Claims

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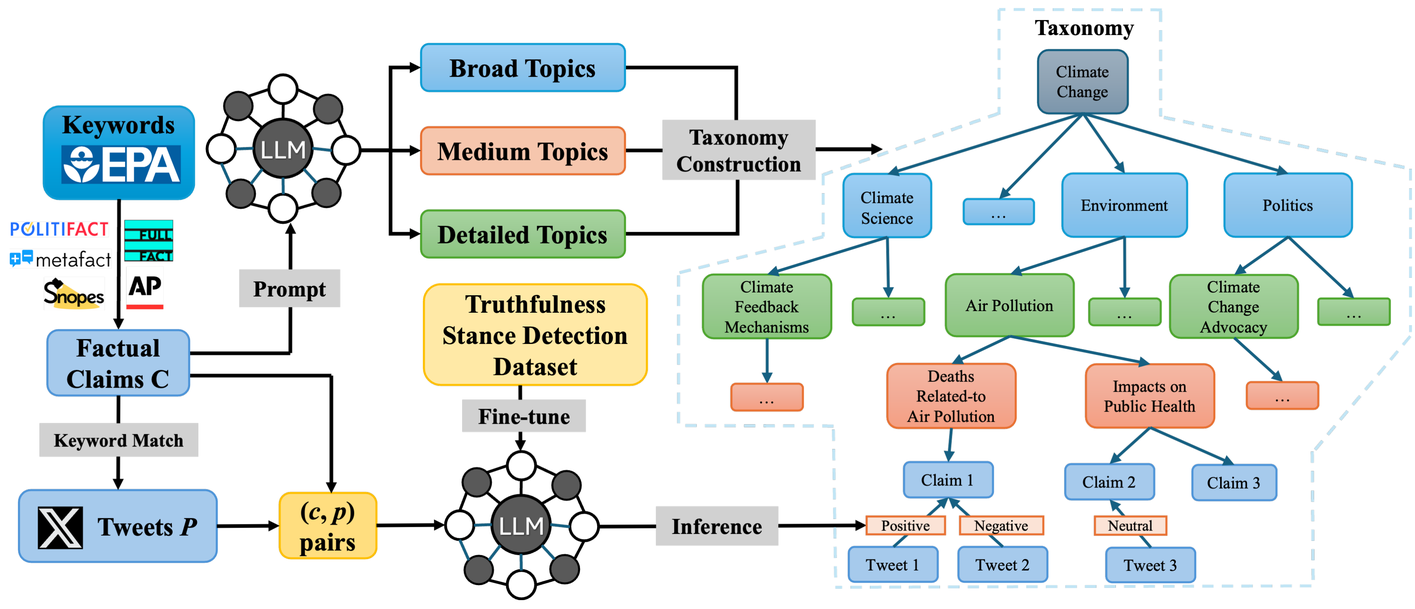
Introduction

- Climate change poses an urgent global problem impacting the environment, economy, and society.
- There is a large volume of discourse on social media reflecting growing public awareness and engagement.
- Understanding and analyzing this discourse is crucial for informing public policy, media strategies, and societal awareness.
- This paper presents a framework aimed at understanding social media users' perceptions of various climate change topics and uncovering the insights behind these perceptions.

Framework Overview



Data Collection

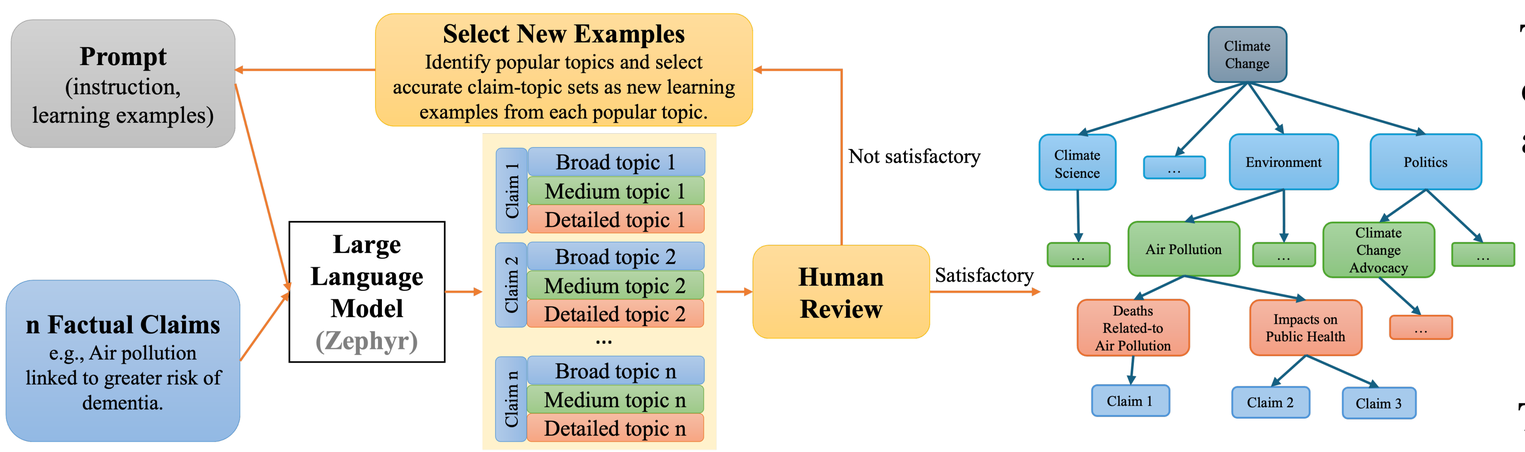
Factual Claim

- Data Source: five credible fact-checking websites including PolitiFact, Snopes, Full Fact, Metafact, AP news.
- Using keywords related to climate change from Environmental Protection Agency to collect claims and their verdicts from those websites.
- Resulting in 1,409 unique factual claims.

Tweet

- Using tokens extracted from factual claims (nouns, verbs, adjectives) to collect tweets from X.
- Resulting in 13,050 tweets for 729 factual claims – (c, p) pairs.

Taxonomy Construction



- Resulting in **9** broad topics, **33** medium topics, and **13** detailed topics.
- Human evaluation: **83%** accuracy for broad topics, **62.5%** for medium topics.

Results

Claim	Tweet	Stance	Broad Topic	Medium Topic	Detailed Topic
Air pollution linked to greater risk of dementia.	People over 50 in areas with the highest levels of nitrogen oxide in the air showed a 40% greater risk of developing dementia than those with the least NOx #airpollution.	⊕	Health	Air Pollution	Impacts on Brain Health
Sen. Lindsey Graham supports the Green New Deal.	Facebook removed an ad by Adriel Hampton showing Sen. Lindsey Graham backing the Green New Deal.	⊙	Politics	Climate Change Advocacy	Politicians' Stance
The Earth is warming because of the sun's changing distance from the Earth, not because of carbon emissions.	Enough with your pseudo-scientific. Actual science has proven the relationship to human carbon emissions and not cycles of sun /earth distance.	⊖	Climate Science	Climate Feedback Mechanisms	Misconceptions

Table 3: Examples of truthfulness stance detection and their corresponding topics in the taxonomy.

Broad Topic	Truth-⊕	Truth-⊖	Misi-⊕	Misi-⊖	Accuracy	Macro F1
Climate Science	81.7% (524)	18.3% (117)	72.5% (377)	27.5% (143)	0.575	0.524
Economy	70.5% (146)	29.5% (61)	72.5% (351)	27.5% (133)	0.404	0.404
Energy	82.2% (264)	17.8% (57)	74.7% (124)	25.3% (42)	**0.628**	**0.530**
Environment	77.5% (533)	22.5% (155)	74.4% (1040)	25.6% (357)	0.427	0.423
Government Policies	83.2% (183)	16.8% (37)	**69.5%** (205)	**30.5%** (90)	0.530	0.514
Health	**88.7%** (180)	**11.3%** (23)	**77.9%** (169)	**22.1%** (48)	0.543	0.493
Politics	**69%** (363)	**31%** (163)	75.7% (1635)	24.3% (525)	**0.331**	**0.329**
Technology	74.8% (86)	25.2% (29)	69.8% (120)	30.2% (52)	0.481	0.473

Table 4: Stance distribution towards **Truth** and **Misi**information across broad topics. Truth-⊕ and Truth-⊖ denote positive and negative stances towards **Truth**, respectively. Misi-⊕ and Misi-⊖ denote positive and negative stances towards **Misi**information, respectively. Note that the topic "*Others*" is not considered in this analysis.

Truthfulness Stance Detection

- Model: Supervised fine-tuning of Zephyr.
- Training Data: 1,871 annotated claim-tweet pairs.
- Predicted Stance: Positive (believing the claim is true), Negative (believing the claim is false), Neutral/No stance.

	Precision	Recall	Macro F1
⊕	0.863	0.911	0.886
⊙	0.783	0.765	0.774
⊖	0.864	0.750	0.803
Avg	0.837	0.808	0.821

Table 1: Performance of truthfulness stance classifier on the annotated dataset. *Positive*, *Neutral/No stance* and *Negative* are denoted as ⊕, ⊖, ⊙.

⊕	⊙	⊖	Total
8,003 (61.33%)	2,668 (20.44%)	2,379 (18.23%)	13,050

Table 2: Truthfulness stance distribution of tweets toward claims.

Conclusion

- Our framework effectively analyzes public judgments on climate change topics.
- The public struggles to distinguish between true and false claims. Public tends to believe claims regardless of their accuracy.
- People's judgements vary across topics. Higher belief in claims related to health. Low accuracy in topics like politics, economy, and environment.
- Need for improved critical thinking and fact-checking interventions.

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