Shots and Shocks: How Vaccine-related Media Coverage Changed During COVID-19

Evidence from Utah Media Outlets

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Introduction

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We study shifts in vaccine-related media coverage in Utah, 2017–2024, using two major online outlets (Deseret News, KSL).
Goal: test whether coverage shifted toward **economic** framing after COVID-19.

Political Background

Vaccine discourse evolved during COVID-19. We provide **Utah-specific** evidence using two politically centrist statewide outlets with full-text online archives.

Research Question

Research question: Did Utah vaccine-related news shift from public health to economic concerns after COVID-19?
Hypothesis: The prevalence of *economic* framing increased post-COVID.

Methodology

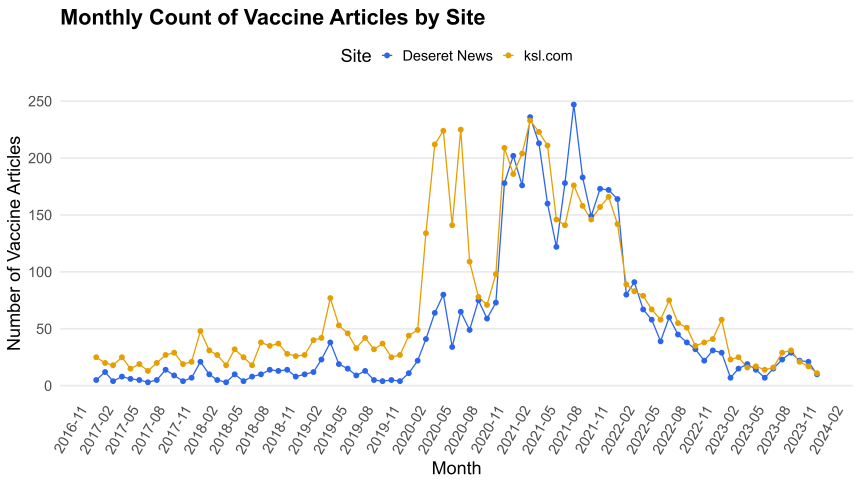
Sampling Methodology Overview

1. Sampling Frame Construction
2. Stratification Design
3. Preliminary Sample
4. Power Simulation w/ Neyman Allocation
5. Full Sample w/ LLM Coding

Sampling Frame Construction

- Scrape public sitemap data from KSL and Deseret News
  - $2,606,491$ published article URLs
- Filter between January 1, 2017 to January 1, 2024
- Find all published vaccine-related articles through a pre-defined vaccine lexicon
  - $4,259$ DN articles
  - $5,927$ KSL articles
  - $10,186$ total

Vaccine Media Over Time



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Zero-shot LLM coding with Google Gemma

1. 'A' = health framing
2. 'B' = economic framing
3. 'C' = balanced health/economy
4. 'D' = unrelated to health or economy

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- **One Solution**: Decrease variance by using multiple prompts!
  - Five different independent prompt variants
  - Take mode classification

Stratification Design

1. Stratify by site/domain (KSL, DN)
2. Stratify by time
   - Stratify by year for sparse years (2017, 2018, 2019, 2022, 2023)
   - Stratify by quarter for dense years (2020Q1,...,2020Q4, 2021Q1,...,2021Q4)
3. 2 sites $\times$ $(5 + 8)$ temporally partitioned strata $=$ 26 total strata

Why Sample at All?

- Census is expensive (lots of API calls to LLM!)
- Time constraints
- Sampling may be sufficient for research question

Preliminary Sample

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Table: Preliminary stance proportions by COVID period

	Before COVID	**During COVID**	**After COVID**
strata	1–3, 14–16	4–11, 17–24	12–13, 25–26
$\hat{p}^{(A)}$	0.809 (0.393)	0.680 (0.467)	0.703 (0.457)
$\hat{p}^{(B)}$	0.0588 (0.235)	0.133 (0.339)	0.0110 (0.104)
$\hat{p}^{(C)}$	0.0735 (0.261)	0.155 (0.362)	0.187 (0.390)

Results from a preliminary sample using $n = 468$ total samples from proportional allocation relative to stratum size. Estimates $\hat{p}^{(A)}$, $\hat{p}^{(B)}$, $\hat{p}^{(C)}$, correspond to the estimate probability of an article being coded stances A–C, respectively, within each strata. Standard errors of Bernoulli variances (e.g. $\sqrt{\hat{p}(1-\hat{p})}$) are shown in parentheses.

Power Simulation

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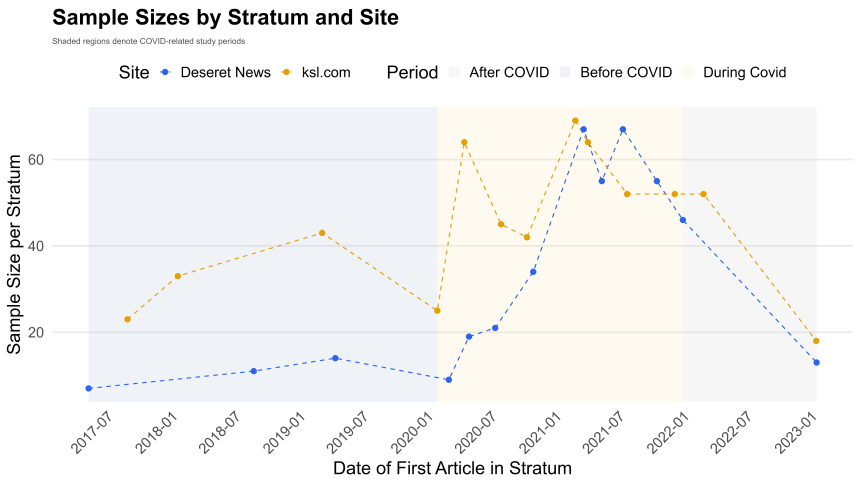
$\Longrightarrow$ 746 total observations needed (round up to 1,000)

Neyman Allocation for Full Sample

- Use Neyman allocation with estimated population variances for each strata ($n = 1,000$)

$$n_h = n\frac{N_h S_h}{\sum_{j=1}^{H} N_j S_j}, \qquad S_h = \sqrt{p_h^{(B)}(1 - p_h^{(B)})}$$

Allocated Sample Sizes



Inference

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- **One Solution**: model the framing sentiment parametrically! (see Lohr (2019) pg. 95)

Model: Bayesian Interrupted Time Series (ITS) Model

For an article j in stratum h,

$$
\begin{aligned}
Y_{hj} &= \mathbb{1}(\text{Stance}_{hj} = \text{B}) \sim \text{Bern}(p_{hj}) \\
g(p_{hj}) &= \beta_0 + \mu_h + x'_{hj}\beta + \mathbb{1}(t_{hj} < 0) f^{(\text{pre})}(t_{hj}) + \mathbb{1}(t_{hj} \geq 0)[\gamma + f^{(\text{post})}(t_{hj})], \\
\text{where } f^{(\text{pre})}(t_{hj}) &= \alpha_1^{(1)} t_{hj} + \alpha_2^{(1)} t_{hj}^2, \\
f^{(\text{post})}(t_{hj}) &= \alpha_1^{(2)} t_{hj} + \alpha_2^{(2)} t_{hj}^2, \\
\text{and } g(\cdot) &= \Phi^{-1}(\cdot) \text{ is the standard Normal inverse CDF}
\end{aligned}
$$

Parameter of Interest

- We want to measure the *shock* in framing sentiment exactly at the time of COVID-19 to measure the effect the pandemic had on how sentiment changed
- Use January 20, 2020 as COVID-19 threshold
- Mathematically,

$$\Delta := \lim_{t \to t_0^+} p_{hj}(t) - \lim_{t \to t_0^-} p_{hj}(t),$$

$$p_{hj}(t) = \Phi\Big(\beta_0 + \mu_h + x_{hj}'\beta + \mathbb{1}(t < 0) f^{(\text{pre})}(t) + \mathbb{1}(t \geq 0)\big[\gamma + f^{(\text{post})}(t)\big]\Big)$$

$$\implies \Delta = \Phi\Big(\beta_0 + \mu_h + x_{hj}^{\star\prime}\beta + \gamma\Big) - \Phi\Big(\beta_0 + \mu_h + x_{hj}^{\star\prime}\beta\Big)$$

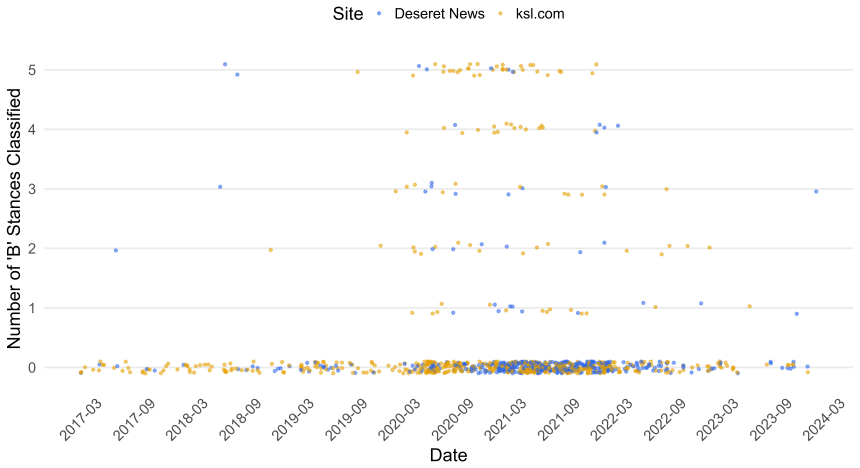
Results

Recorded Data

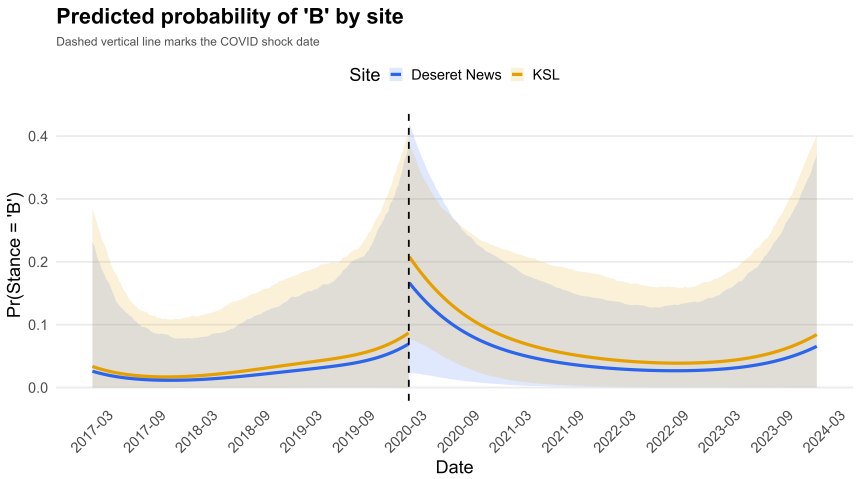
Table: Observed first ten sampled articles by site, date, and stance classification.

Obs.	Title	Site	Date	Stratum	A	B	C	D	Main Stance
1	Nation of Islam jewelry, clothing and documents slated for auction	Deseret News	2017-05-10	1	0	2	0	3	D
2	Letter: Vaccinate children	Deseret News	2017-05-15	1	5	0	0	0	A
3	Two human cases of West Nile virus reported in Utah	Deseret News	2017-08-24	1	5	0	0	0	A
4	Peter Morici: America is on the cusp of a golden age	Deseret News	2017-12-29	1	0	0	5	0	C
5	Suicide bomber strikes Damascus justice building, killing 30	Deseret News	2017-03-15	1	4	0	1	0	A
6	Jay Evensen: Think the U.S. should cut foreign aid? Think again	Deseret News	2017-09-21	1	5	0	0	0	A
7	BLM plans removal, treatment for wild horses	Deseret News	2017-01-10	1	1	0	1	3	D
8	Ay Chihuahua! Taylorsville home condemned after up to 125 dogs found living inside	Deseret News	2018-08-24	2	5	0	0	0	A
9	Protests as Congo leader warns of Ebola election 'disaster'	Deseret News	2018-12-29	2	5	0	0	0	A
10	Canyons School District to begin online registration Aug. 2	Deseret News	2018-07-05	2	0	0	1	4	D

Observed Economic Framing Over Time



Fitted Probabilities Over Time

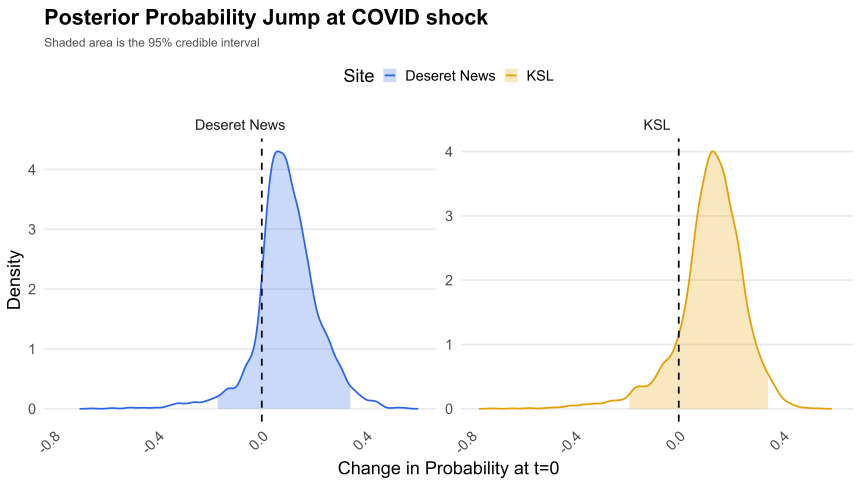


Posterior means with 95% CrI; dashed line at $t = 0$.

Posterior Jump (Δ) at COVID-19 Shock

Site	$\mathbb{E}[\Delta \mid \mathcal{D}]$	Median	95% CrI	$\Pr(\Delta > 0 \mid \mathcal{D})$
Deseret News	0.110	0.105	$[-0.193, 0.373]$	0.860
KSL	0.123	0.130	$[-0.144, 0.329]$	0.877
Pooled	**0.117**	0.118	$[-0.161, 0.350]$	0.868

Posterior Densities of Δ



Summary

Conclusion

- We used a **stratified random sample** of 1,000 Utah news articles to study how vaccine coverage changed during COVID-19
- Articles stratified by news outlet and time period using **Neyman allocation** w/ minimum sample size determined by **power simulation**
- After COVID began, news stories were about **11-12% more likely** to focus on economic impacts
- This increase was non-negligible ($\approx$ **87% chance** of a positive shift) but gradually faded over time

Possible Explanations

- **Audience Tailoring:** Economic framing may resonate with Utah's largely conservative population, who may respond better to pragmatic or financial appeals than institutional authority or scientific evidence

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- **Institutional Influence:** The Church of Jesus Christ's ownership of Deseret News and KSL may have promoted pro-vaccine narratives emphasizing community welfare and economic stability
- **Value Alignment:** Coverage framed vaccination as supporting responsibility, unity, and recovery rather than partisanship

Limitations

- Only analyzed two Utah news outlets, results may not represent all media sources
- Article labels created by a language model, which can make mistakes
- ITS model makes some simplifying assumptions about how trends changed before and after COVID-19

Appendix

Data & Code

Repository: https://github.com/SamLeeBYU/vaccine-sentiment-utah

References I

Lohr, S. L. (2019). *Sampling: Design and analysis* (2nd ed.). Chapman; Hall/CRC.