News Information Decoupling

An Information Signature of Catastrophes in Legacy News Media

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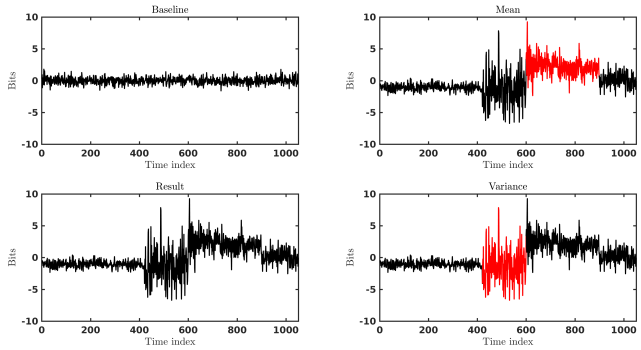
outline

background

HOPE

how democracies cope with COVID-19 a data-driven approach is an national research project that is part of the (DK) national pandemic monitoring program.



research team interested in cultural dynamics, in particular **how events impact cultural information systems**

use news media coverage of COVID-19 as a proxy for how cultural information systems respond to **unexpected and dangerous temporally extended events**.

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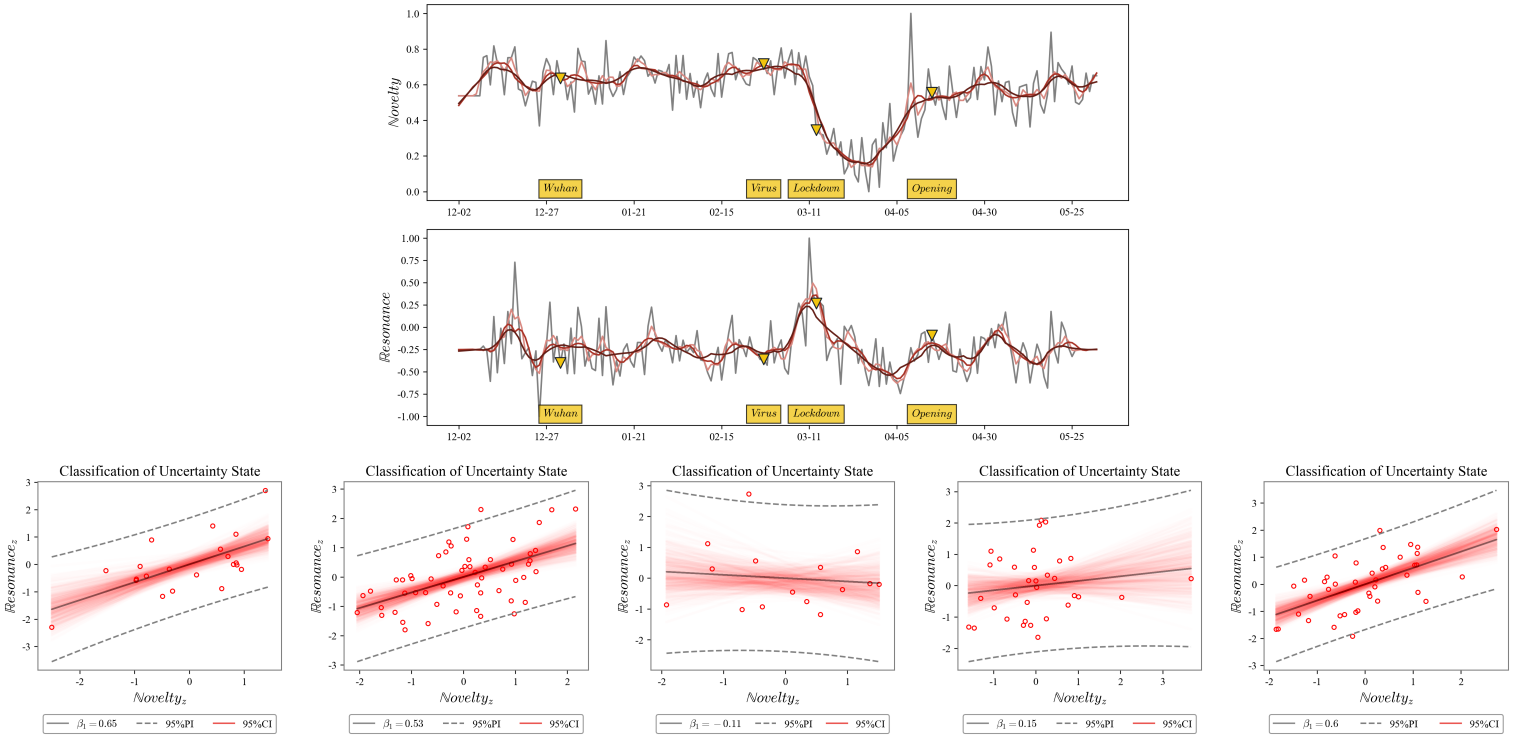
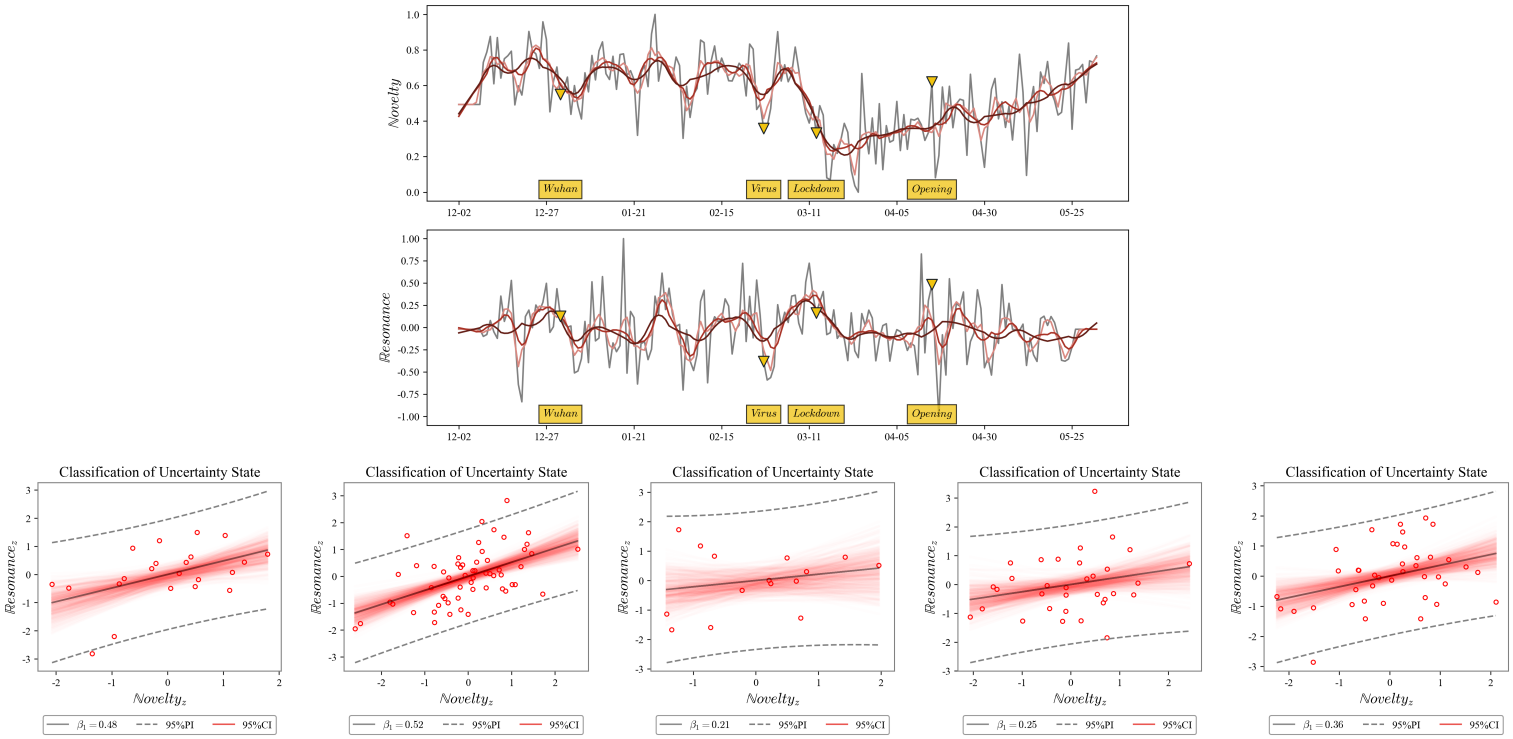


front page information from broadsheet newspaper *Politiken* during COVID-19 phase 1.

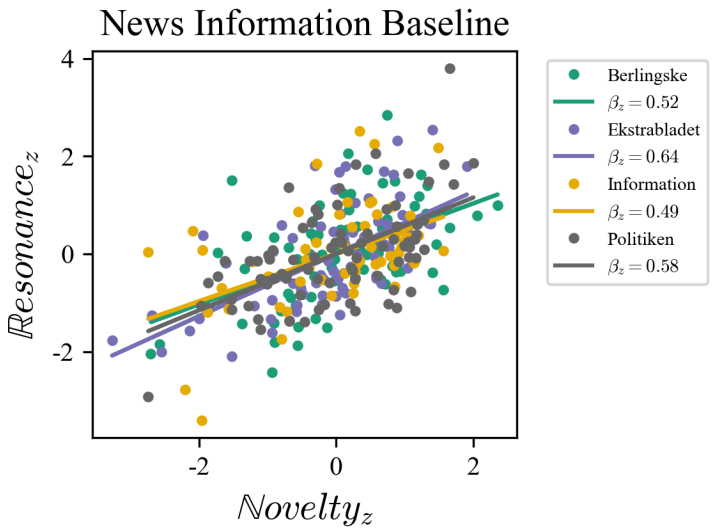
in response to unexpected and dangerous temporally extended events, the ordinary information dynamics of news media are (initially) decoupled such that the **content novelty decreases as media focus monotonically on the catastrophic event, but the resonant property of said content increases as its continued relevance propagate throughout the news information system**



front page information from broadsheet newspaper *Berlingske* during COVID-19 phase 1.

although NID can be observed both in center-left and center-right newspapers, differences in post lockdown behavior may reflects political alignment. Because the Danish government during the lockdown was center-left, the center-right newspapers were more sceptical towards the government's implementation of an opening than the center-left.

validation



$\mathbb{N} \times \mathbb{R}$ baseline models for danish legacy media

- **validate NID observations** with a more formal approach to change detection
- **compare national newspapers**
  - np-type: *broadsheet*//*tabloid*
  - np-political: *left*//*right*
- ultimate goal: media monitoring system

K. L. Nielbo, R. B. Baglini, P. B. Vahlstrup, K. C. Enevoldsen, A. Bechmann, and A. Roepstorff (2021) "News Information Decoupling: An Information Signature of Catastrophes in Legacy News Media," arXiv:2101.02956 [cs]

K. L. Nielbo, F. Haestrup, K. C. Enevoldsen, P. B. Vahlstrup, R. B. Baglini, and A. Roepstorff, "When no news is bad news - Detection of negative events from news media content," arXiv:2102.06505 [cs]

data, normalization, and representation

DATA
linguistic content (title and body text) from **front pages of six DK national newspapers** (2*xtabloid*, 4*xbroadsheet*).
sampled during COVID-19 phase 1 (december 1, 2019 to july 1 2020)
NORMALIZATION
advertisements and metadata removed
lemmatization, tf-idf weighting, casefolding
REPRESENTATION
bag-of-words model (LDA*) to generate low-rank representations of front pages
variables were estimated for **windows of one week** ($w = 7$).

$\mathbb{N}$: novelty as article $s^{(j)}$'s reliable difference from past articles $s^{(j-1)}, s^{(j-2)}, \ldots, s^{(j-w)}$ in window w:

$$\mathbb{N}_w(j) = \frac{1}{w} \sum_{d=1}^{w} JSD(s^{(j)} \mid s^{(j-d)})$$

$\mathbb{R}$: resonance as the degree to which future articles $s^{(j+1)}, s^{(j+2)}, \ldots, s^{(j+w)}$ conforms to article $s^{(j)}$'s novelty:

$$\mathbb{R}_w(j) = \mathbb{N}_w(j) - \mathbb{T}_w(j)$$

where $\mathbb{T}$ is the transience of $s^{(j)}$:

$$\mathbb{T}_w(j) = \frac{1}{w} \sum_{d=1}^{w} JSD(s^{(j)} \mid s^{(j+d)})$$

we propose a symmetrized and smooth version by using the Jensen–Shannon divergence (JSD):

$$JSD(s^{(j)} \mid s^{(k)}) = \frac{1}{2} D(s^{(j)} \mid M) + \frac{1}{2} D(s^{(k)} \mid M)$$

with $M = \frac{1}{2}(s^{(j)} + s^{(k)})$ and D is the Kullback-Leibler divergence:

$$D(s^{(j)} \mid s^{(k)}) = \sum_{i=1}^{K} s_i^{(j)} \times \log_2 \frac{s_i^{(j)}}{s_i^{(k)}}$$

Assume two change points, τ_1 and τ_2 and an otherwise stable series that follow a normal distribution with varied mean, μ_i, and singular variance, σ. This gives us the following model given the observed Novelty, $\mathbb{N}_i$:

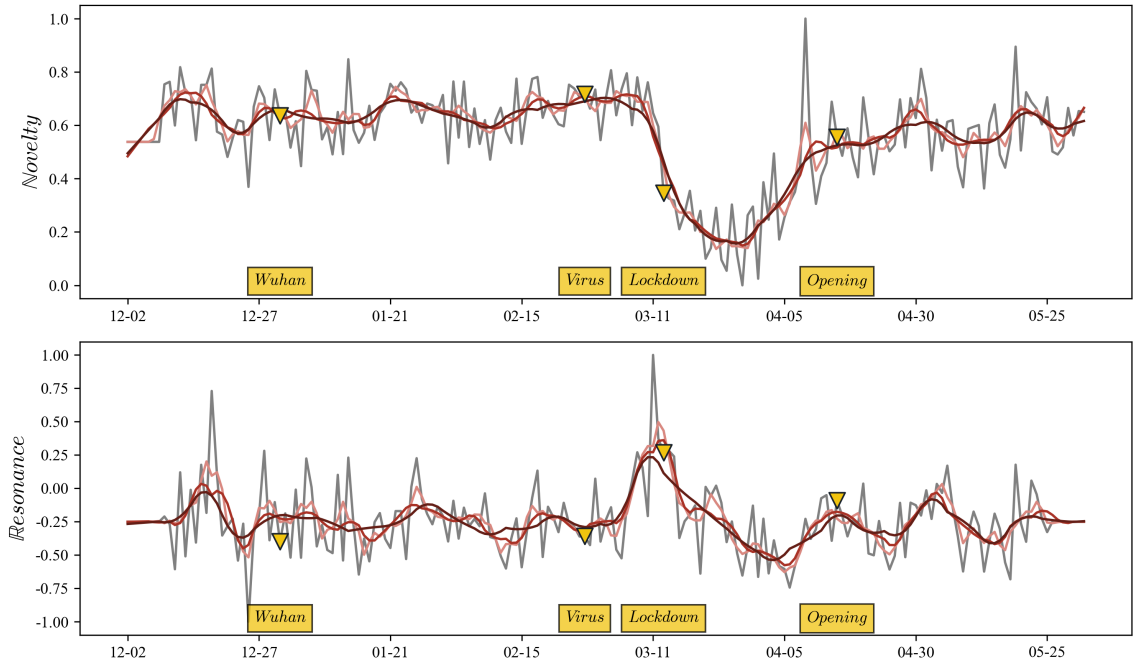
$$\mathbb{N}_t = \begin{cases} \mathcal{N}(\mu_1, \sigma) \text{ for } t < \tau_1 \\ \mathcal{N}(\mu_2, \sigma) \text{ for } \tau_1 \leq t < \tau_2 \\ \mathcal{N}(\mu_3, \sigma) \text{ for } t \geq \tau_2 \end{cases}$$

Estimate the location of τ_i, means μ_i and variance σ, i.e. the following posterior:

$$P(\mu_i, \sigma, \tau_i | \mathbb{N}_t) = P(\mu_1, \mu_2, \mu_3, \sigma, \tau_1, \tau_2 | \mathbb{N}_t)$$

Estimation was carried out with NUTS and the assumptions were modelled using the following priors:

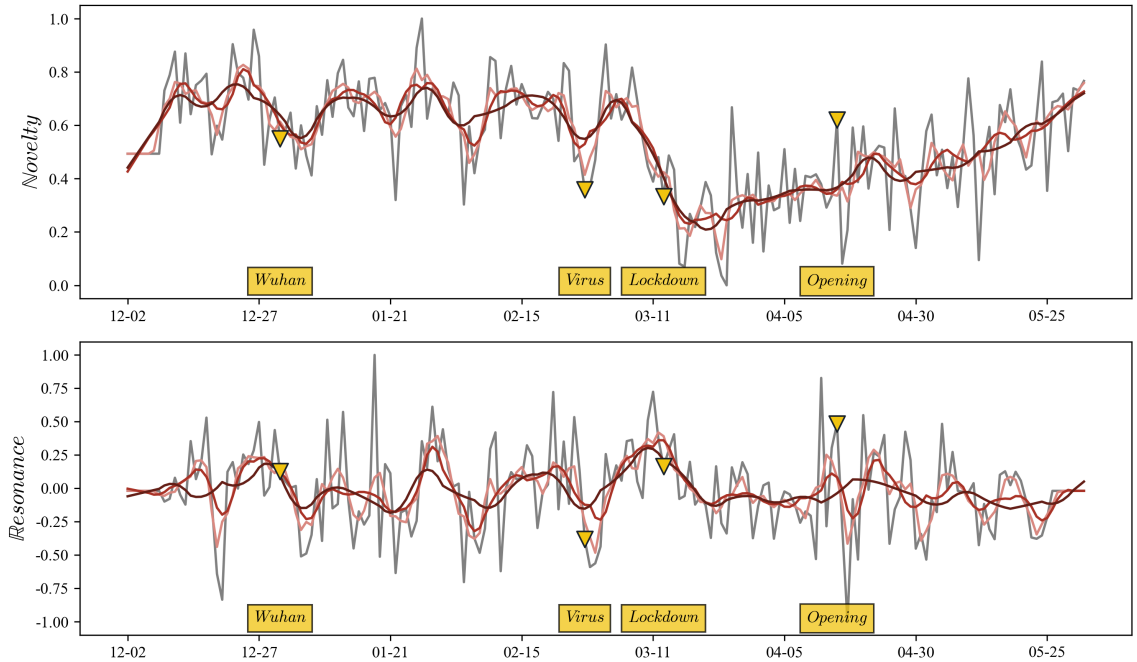
$$\begin{aligned} \mu_i &\sim \mathcal{N}(0, 0.5) \\ \sigma &\sim \text{Half Cauchy}(0.5) \\ \tau_1 &\sim \text{Uniform}(0, \max(\mathbb{N}_t)) \\ \tau_2 &\sim \text{Uniform}(\tau_1, \max(\mathbb{N}_t)) \end{aligned}$$



Novelty (upper panel) and resonance (lower panel) for the center-left newspaper *Politiken* before and during Covid-19 phase 1.

Source	Class	*NID* Start	*NID* End	*NID*
Berlingske	*B*	03.07 [03.03, 03.09]	04.28 [04.09, 05.08]	*True*
BT	*T*	04.10 [12.30, 09.01]	07.25 [04.22, 09.03]	*False*
Ekstrabladet	*T*	01.28 [01.02, 03.17]	05.08 [01.16, 07.22]	*False*
Jyllands-Posten	*B*	03.10 [03.08, 03.14]	05.25 [05.21, 06.06]	*True*
Kristligt Dagblad	*B*	03.07 [03.05, 03.12]	04.15 [04.11, 04.17]	*True*
Politiken	*B*	03.13 [03.12, 03.13]	04.08 [04.05, 04.08]	*True*

Estimated temporal change points at 94% HDIs for novelty. Column one contains the name of the newspaper, columns two its class (*B*roadsheet or *T*abloid).



Novelty (upper panel) and resonance (lower panel) for the center-right newspaper *Berlingske* before and during Covid-19 phase 1.

Source	$\mathbb{N}_{pre}$	$\mathbb{N}_{NID}$	$\mathbb{N}_{post}$
Berlingske	0.36 [0.35, 0.37]	0.29 [0.27, 0.31]	0.34 [0.34, 0.35]
Jyllands-Posten	0.29 [0.28, 0.30]	0.23 [0.22, 0.24]	0.27 [0.26, 0.28]
Kristligt Dagblad	0.27 [0.26, 0.28]	0.19 [0.18, 0.21]	0.26 [0.25, 0.27]
Politiken	0.27 [0.26, 0.28]	0.15 [0.14, 0.17]	0.26 [0.25, 0.26]

Novelty values at 94% HDIs before during and after the lockdown for the four broadsheet newspapers that supported the NID principle..

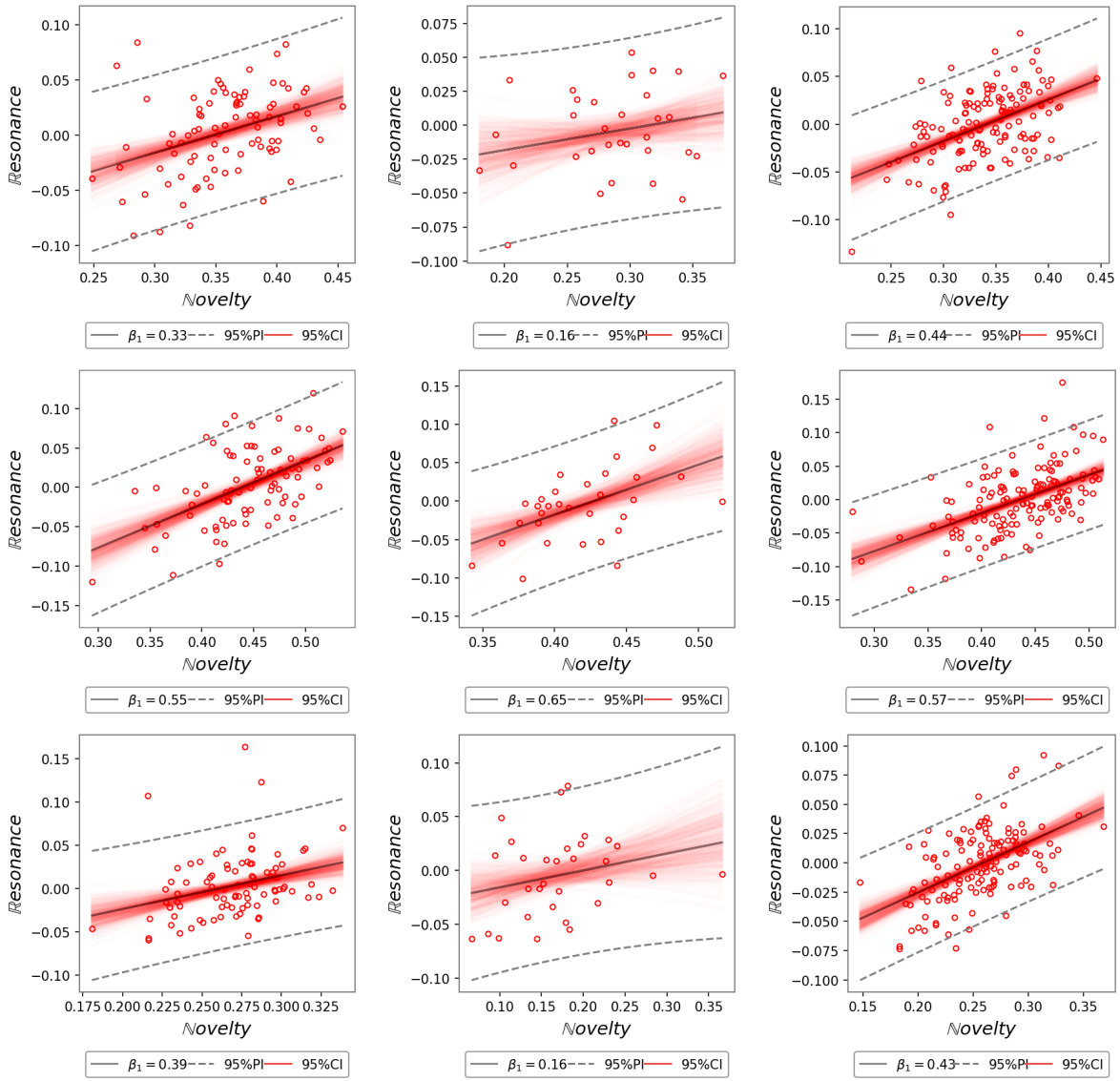


Figure: $\mathbb{N} \times \mathbb{R}$ slopes before during and after the lockdown for Berlingske (upper row), Ekstrabladet (middle row), and Politiken (lower row) during Covid-19 phase 1.

in conclusion...

"Nothing travels faster than the speed of light with the possible exception of bad news, which obeys its own special laws." (D. Adams – Hitchhiker's Guide)

in the case of pandemic information dynamics,

- variation in $\mathbb{N}$*reliably* detected *lockdown* and *opening*
- $\mathbb{N} \times \mathbb{R}$ slopes indicated a decoupling of resonance from novelty during the lockdown
- lockdown interval indicated that lockdown can be be predicted from the first incident
- opening interval may reveal political observation
- tabloids follow different dynamics

THANKS

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SLIDES

knielbo.github.io/files/kln_eadh21.pdf

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