

# Modeling the Danish cultural information space during Covid-19

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News media coverage of Covid-19 is a natural experiment in cultural information systems respond to catastrophes.



**MELLEM LIV OG DØD PÅ INTENSIV**  
Sygdommen covid-19 rammer hårdt på den københavnske vestegte, der har landets højeste smittetæl. Politikens Anders Legarth Schmidt har gennem tre dage i slutningen af april haft adgang til Hvidovre Hospital, hvor flest er indlagt. Vi kommer bedt ind på intensivafdelingen og tæser på epidemien i en reportage-serie på fem kapitler. Lars første kapitel i dag. PS side 4-7

<p>Begavede kloger og hjertevarme Three Pines-mysterier af Louise Penny</p>	<p><b>OUERE HØJSKOLE</b> Hold din sommerferie i Danmark</p> <ul style="list-style-type: none"><li>• UngdomsCamps [teenagere]</li><li>• Højskolekurser [voksne]</li><li>• Familiekurser</li></ul> <p>Læs mere på <a href="http://www.ouere.dk/summerkurser">www.ouere.dk/summerkurser</a></p>	<p><b>GLEM LIGE AT ALT ER PLANTE BASERET</b></p> <p>simple feast</p>	<p><b>LYNTEST</b></p> <ol style="list-style-type: none"><li>1. Hvad laver jeg om 10 år?</li><li>2. Hvor finder man lykken?</li><li>3. Hvem bliver mine bedste venner?</li><li>4. Hvordan tænker mennesker?</li><li>5. Hvad er meningen med livet?</li></ol> <p>Resultat: Hvis du kan svare på bare tre af spørgsmålene, så har du ikke behov for et pusterum til at overveje, hvad du vil bruge dit liv på. Du slipper dermed for en kamp og livsvarig oplevelse på Grundtvigs Højskole.</p> <p><a href="http://grundtvigs.dk">grundtvigs.dk</a></p>
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# Pipeline

Full text data from **print version** of 8 newspapers provided by



INFOMEDIA

DATLAB  
CENTER FOR DIGITAL SOCIAL RESEARCH

- Berlingske, BT, Information, Ekstrabladet, Jyllands Post, Kristeligt Dagblad, Weekend Avisen, Politiken

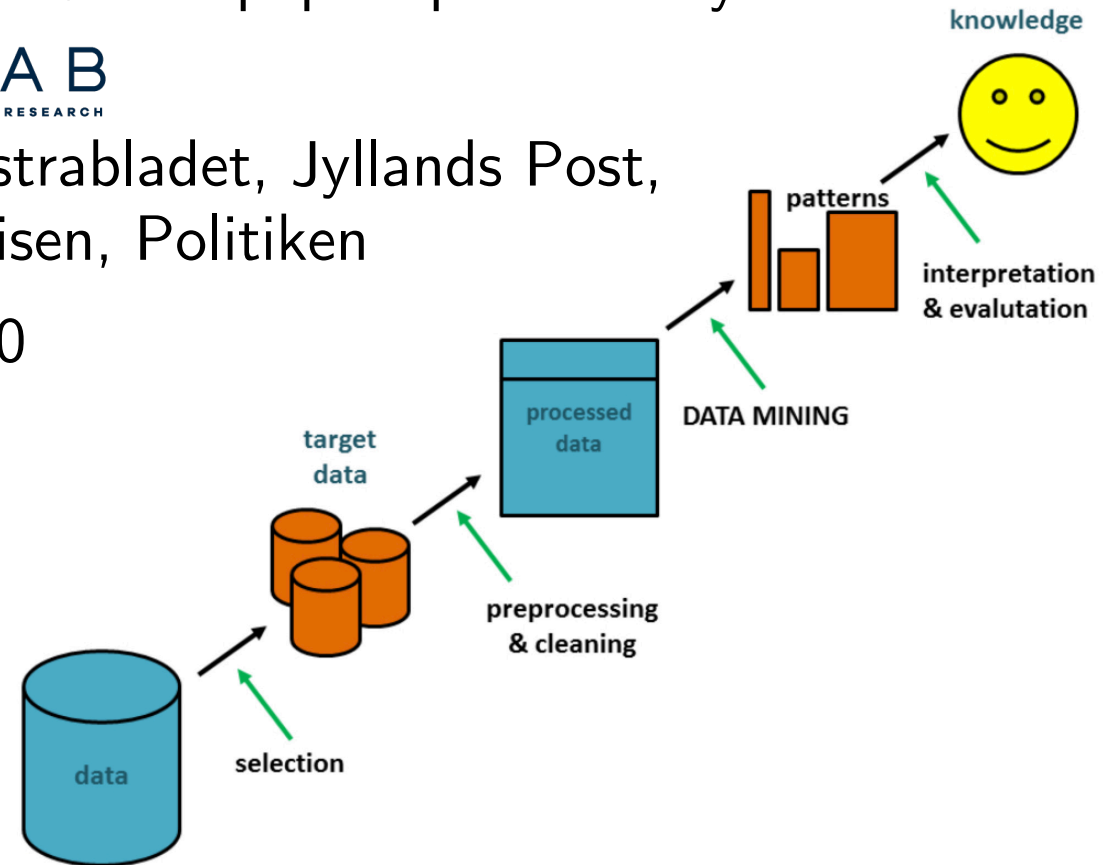
Front pages from December 2019-June 2020

## Preprocess

- Remove ads, metadata, stopwords
- Lemmatize, casefold, tf-idf weighting

## Vectorize

- Bag of Words
- Bag of words topic model (latent dirichlet allocation) to generate a dense low-rank representation of each document



- Applying **windowed relative entropy** to thematic text representations to generate two primary signals: **novelty** and **resonance**
  - **Novelty**: reliable content difference from the past
  - **Resonance**: the degree to which future information conforms to said novelty
- **Variation** in the novelty-resonance association can predict significant change points in historical data

### Novelty

- How different the content in an article  $s^{(j)}$  is from **past** articles in window  $w$

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

### Transience

- How different the content in an article  $s^{(j)}$  is from **future** articles in window  $w$

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

### Resonance

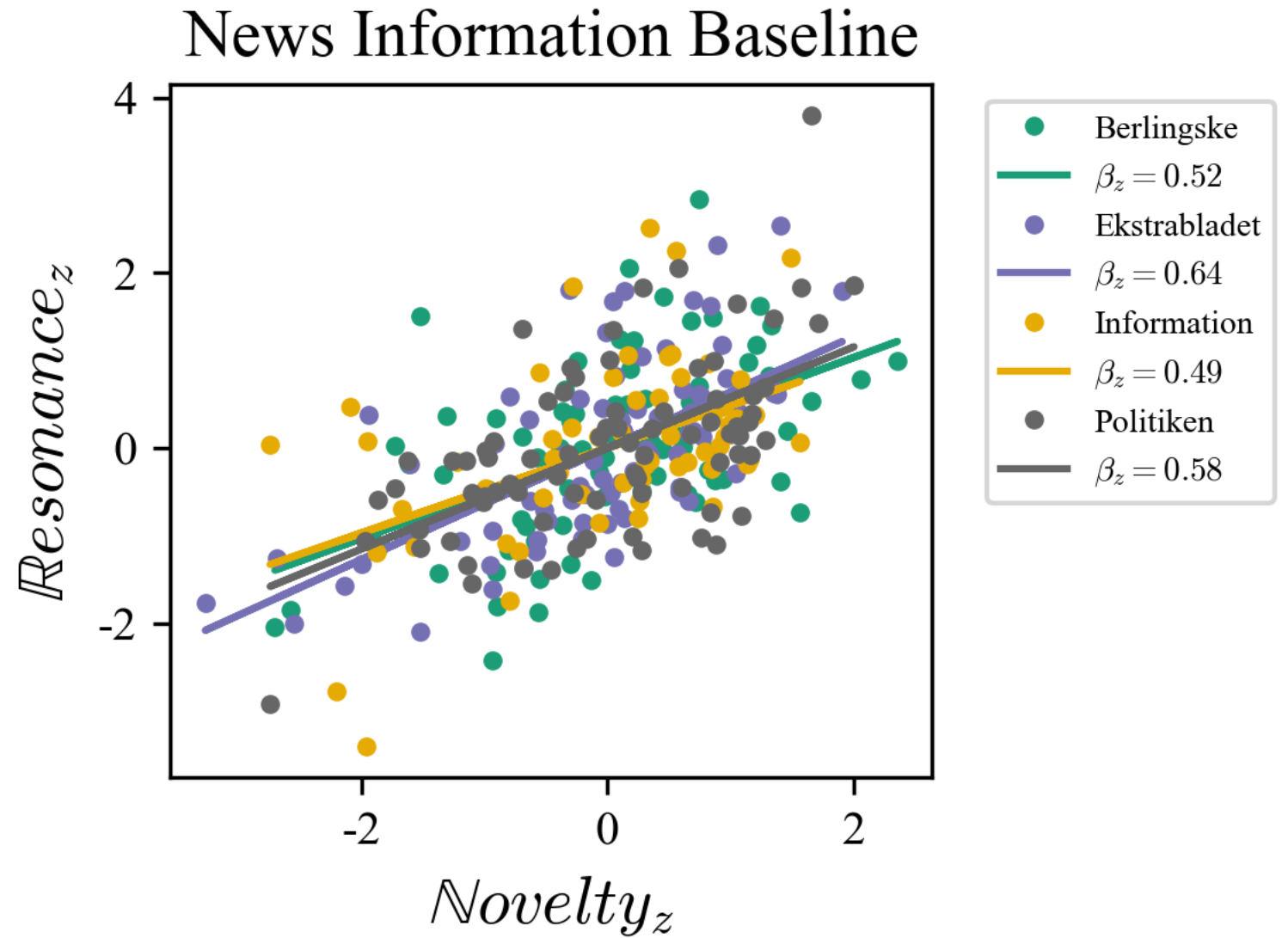
- The degree to which future articles conform to  $s^{(j)}$ 's novelty

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

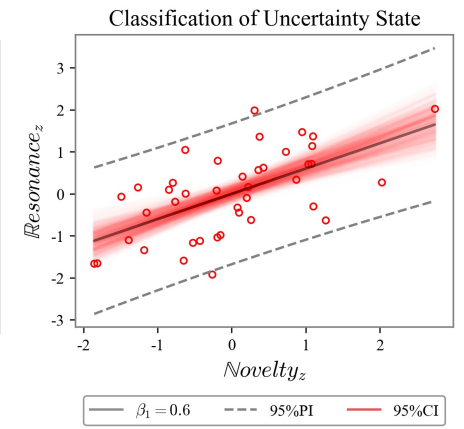
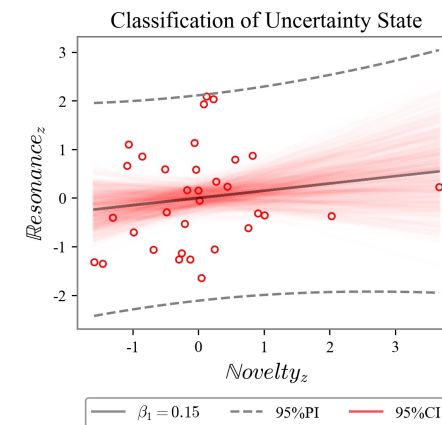
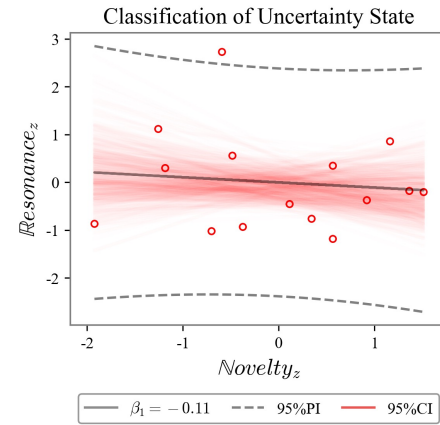
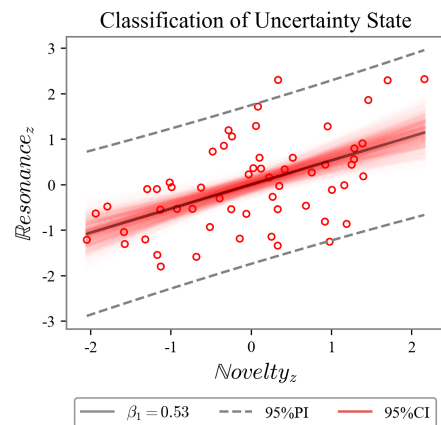
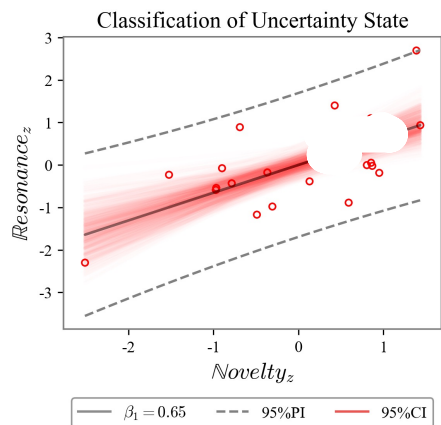
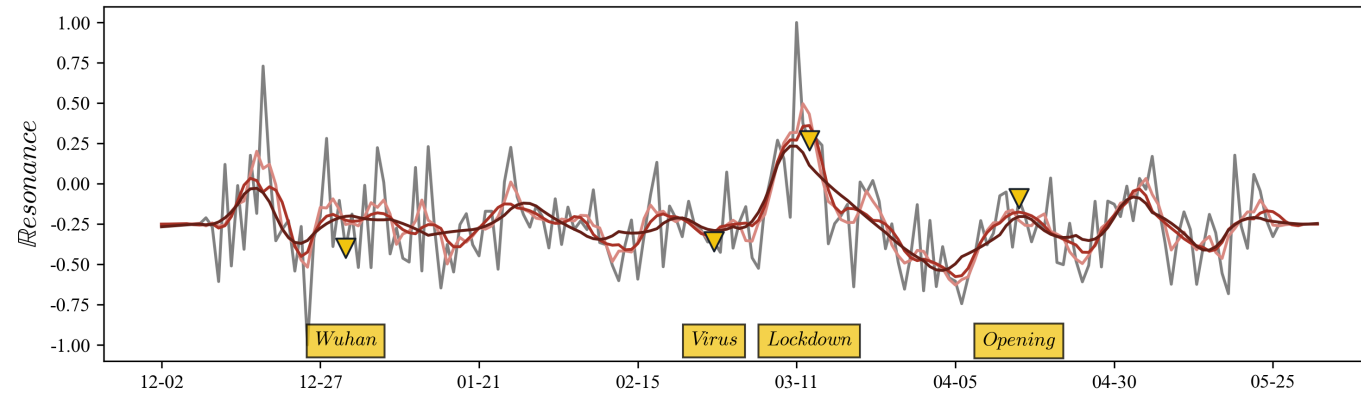
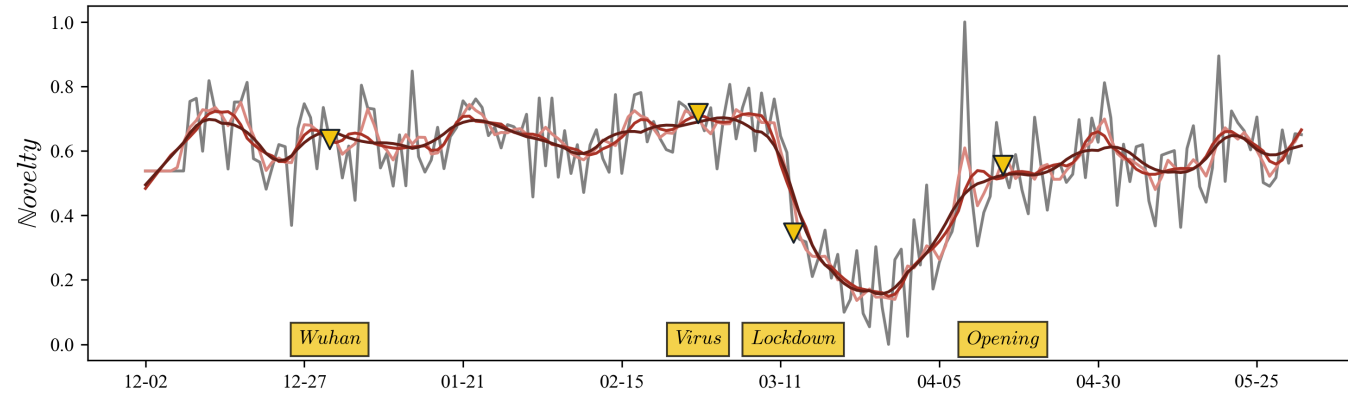
# Baseline dynamics

Begins December 1,  
2019

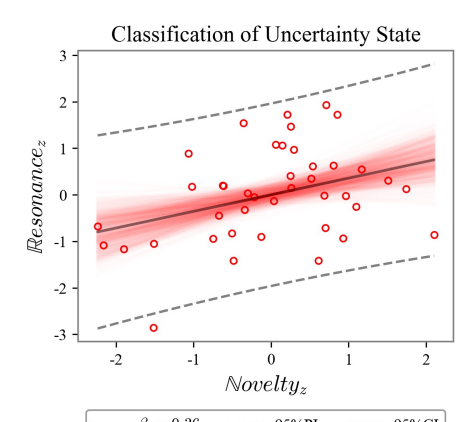
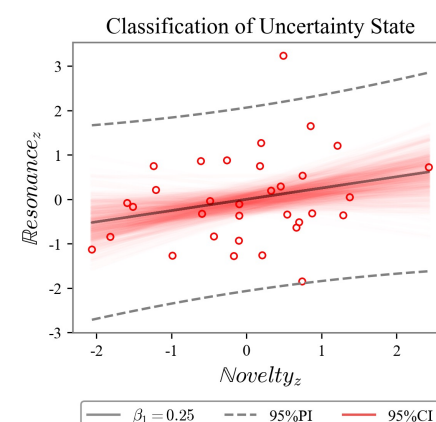
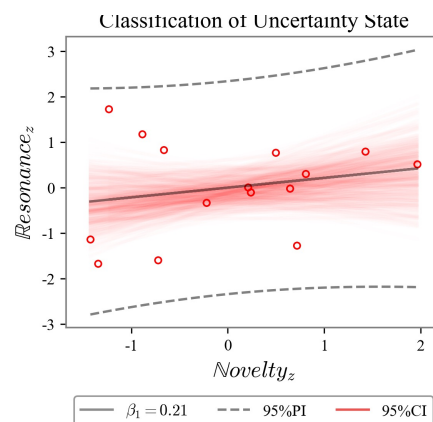
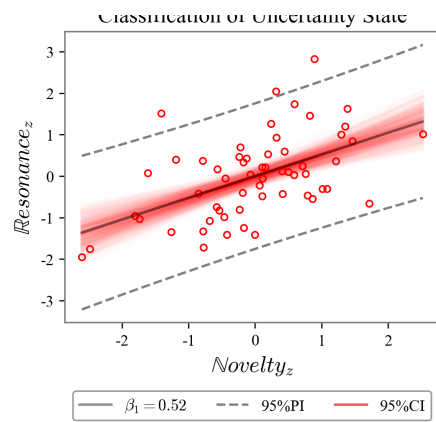
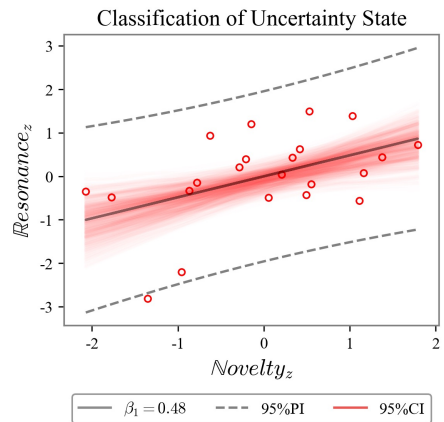
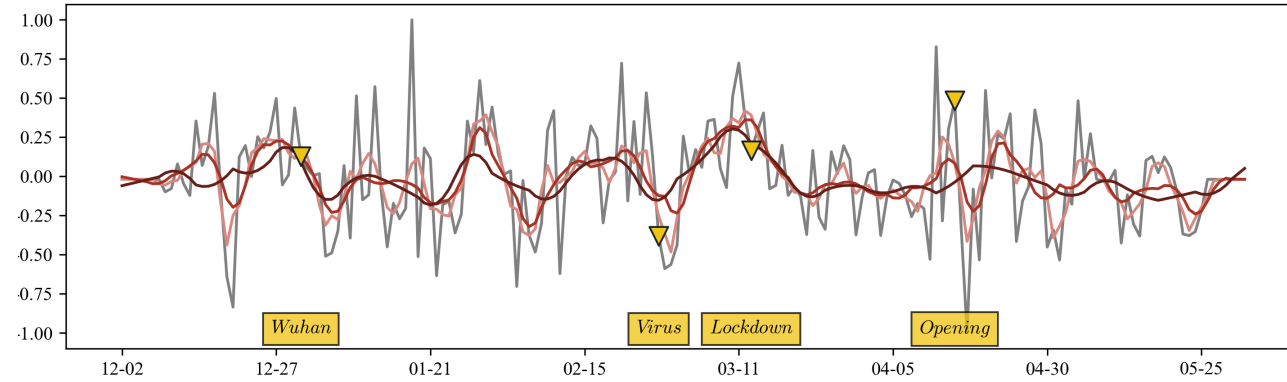
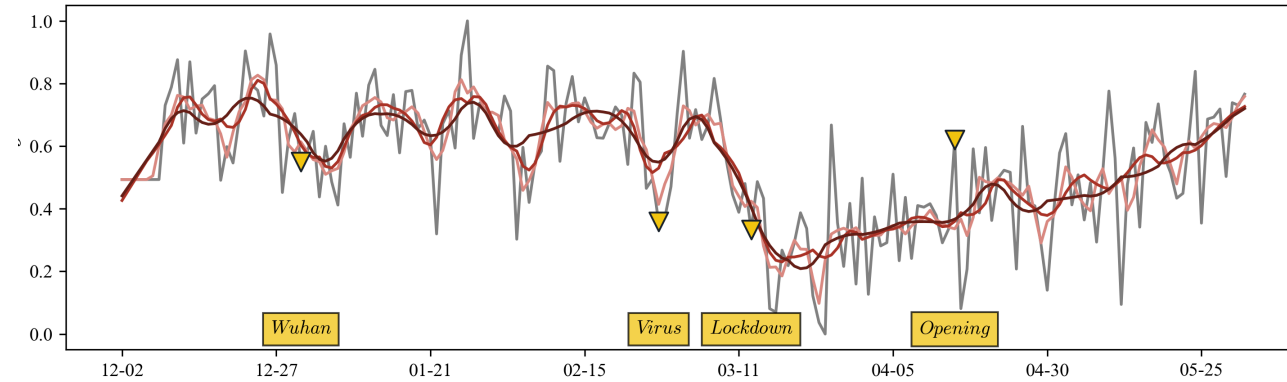
Cut-off at February 27,  
2020



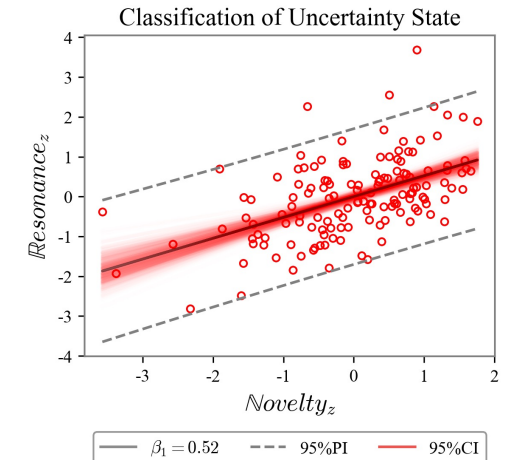
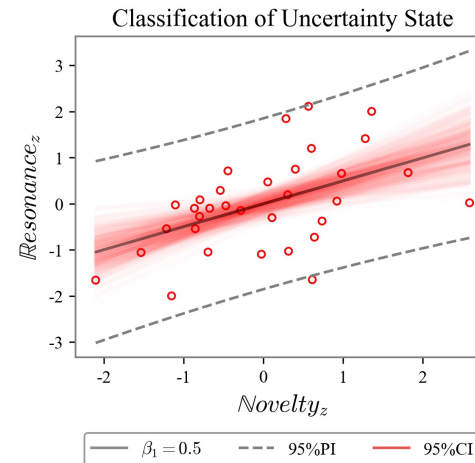
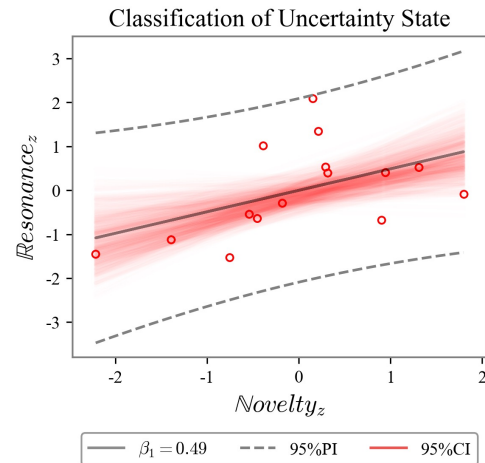
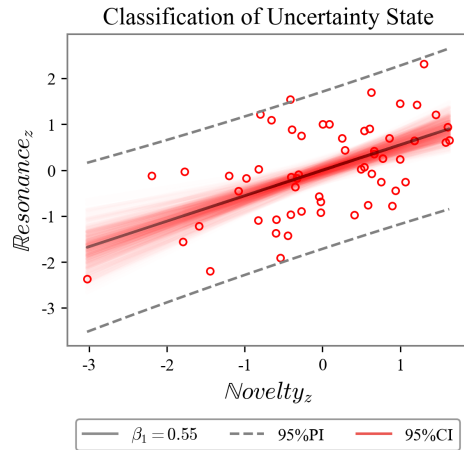
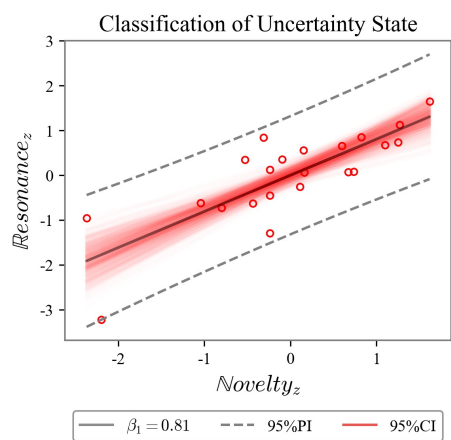
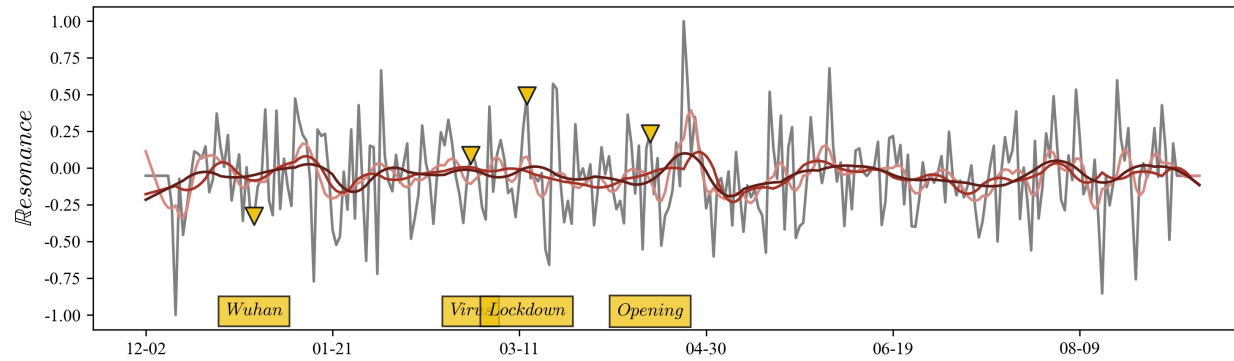
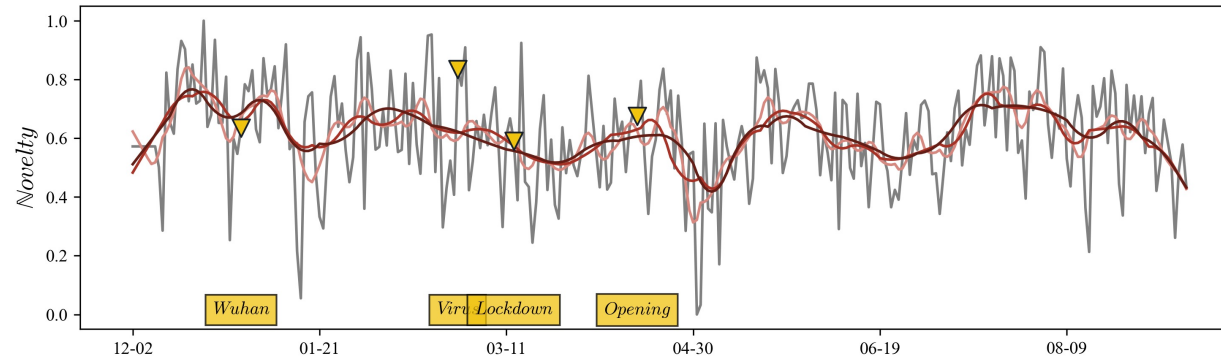
# Politiken Front Pages



# Berlingske Front Pages



# Ekstrabladet Front Pages

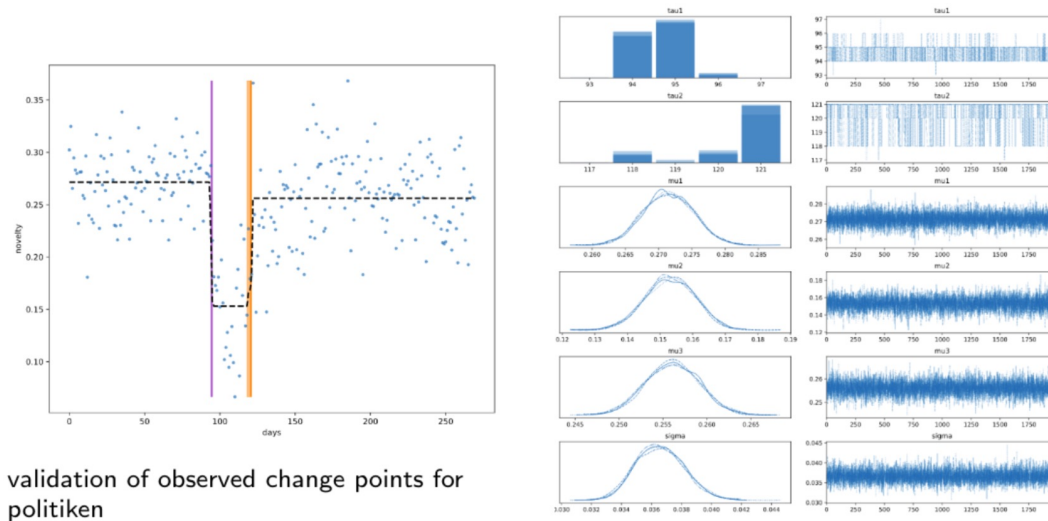




# The information signature of a crisis

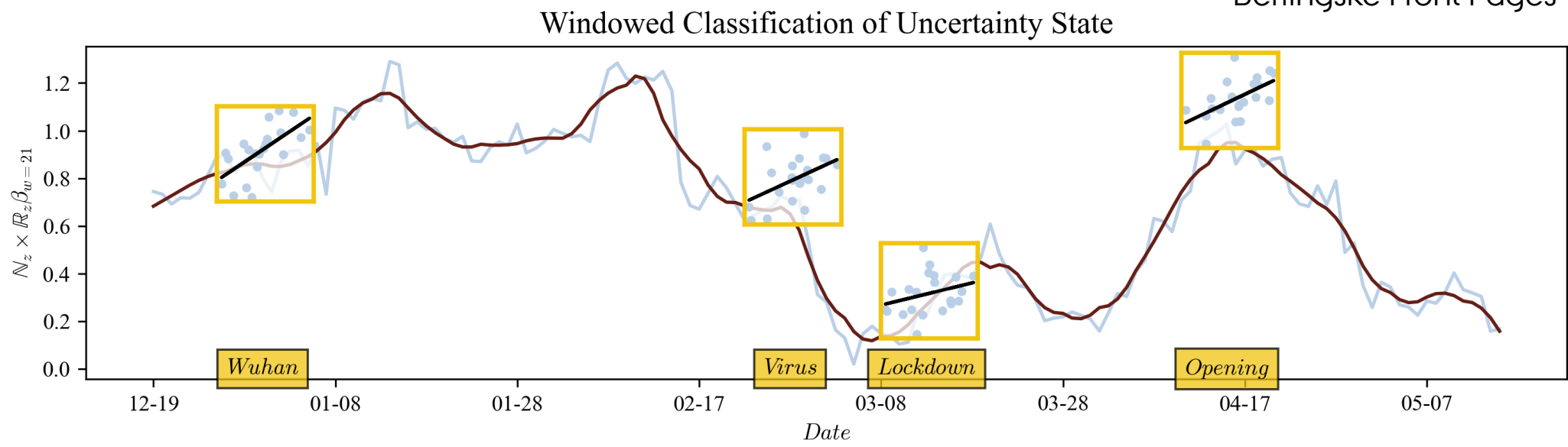
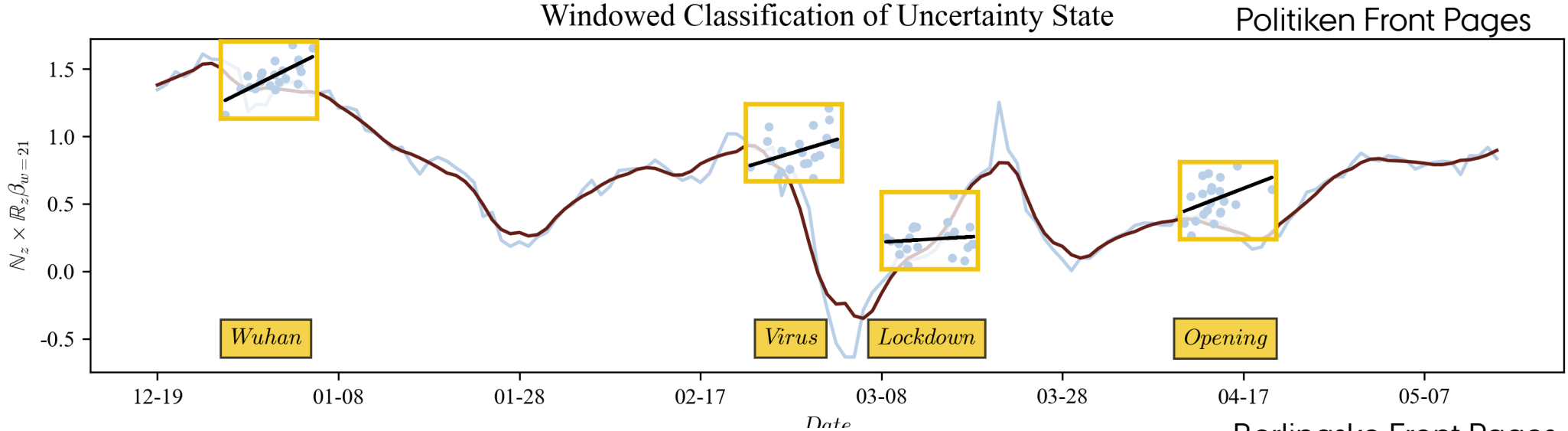
## Principle of **News Information Decoupling** (NID)

- A catastrophe initially disrupts ordinary information dynamics by decoupling **Novelty** and **Resonance**
- The content novelty decreases as media focus monotonically on the catastrophic event, but the resonant property of said content increases as its continued relevance propagates throughout the news information system.



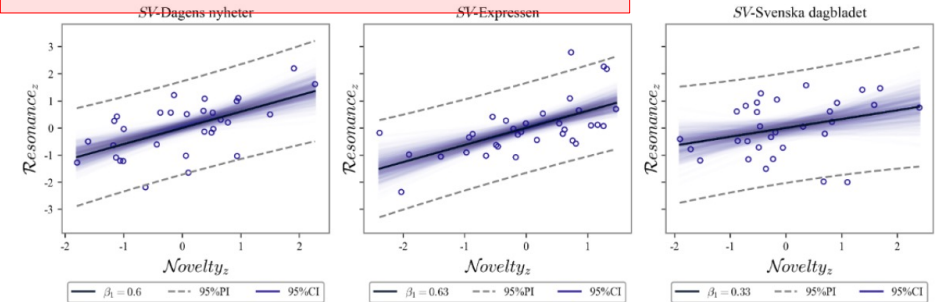
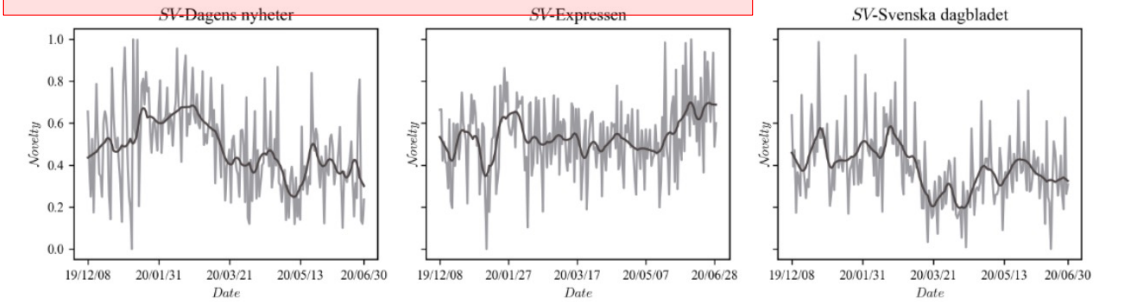
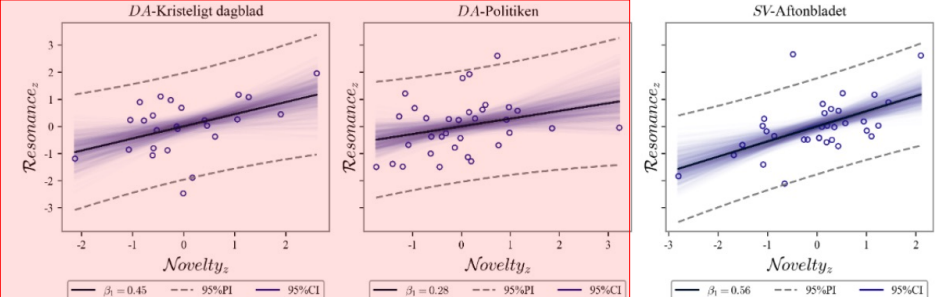
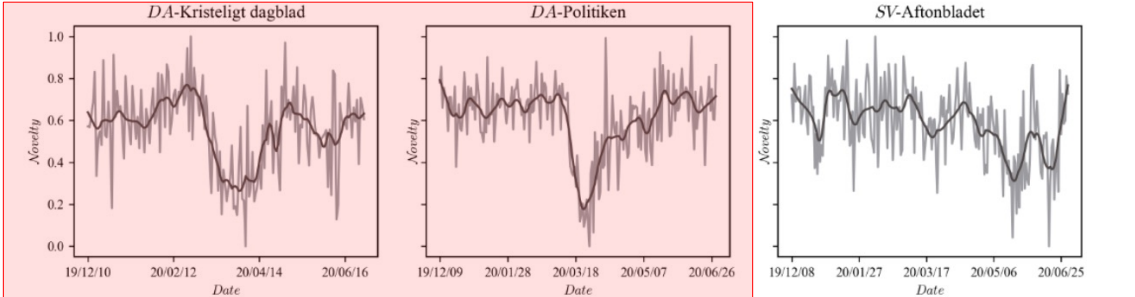
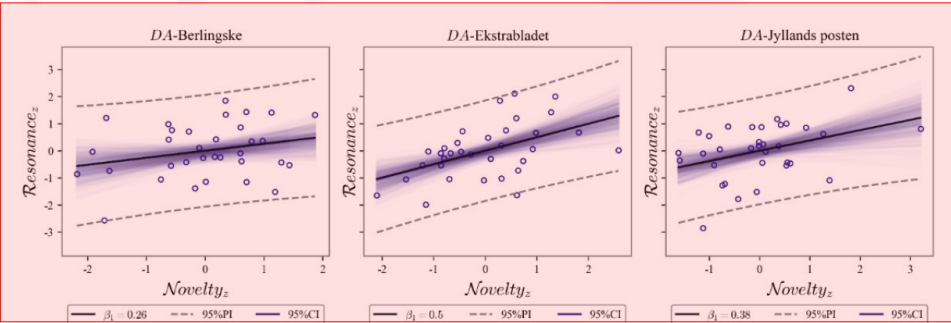
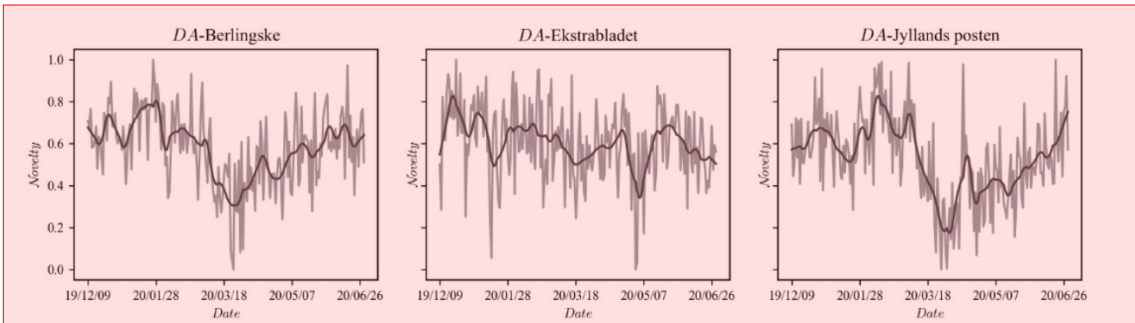
trace plots for politiken change points

# Crisis can be natural...or social/political



Slope  $\beta$  of  $N \times R$  model windows of length  $w = 21$  with maximal overlap

# A crisis in Denmark...but not in Sweden



# From news to social media

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Infodynamics and “emodynamics”



SCHOOL OF COMMUNICATION AND CULTURE

AARHUS UNIVERSITY

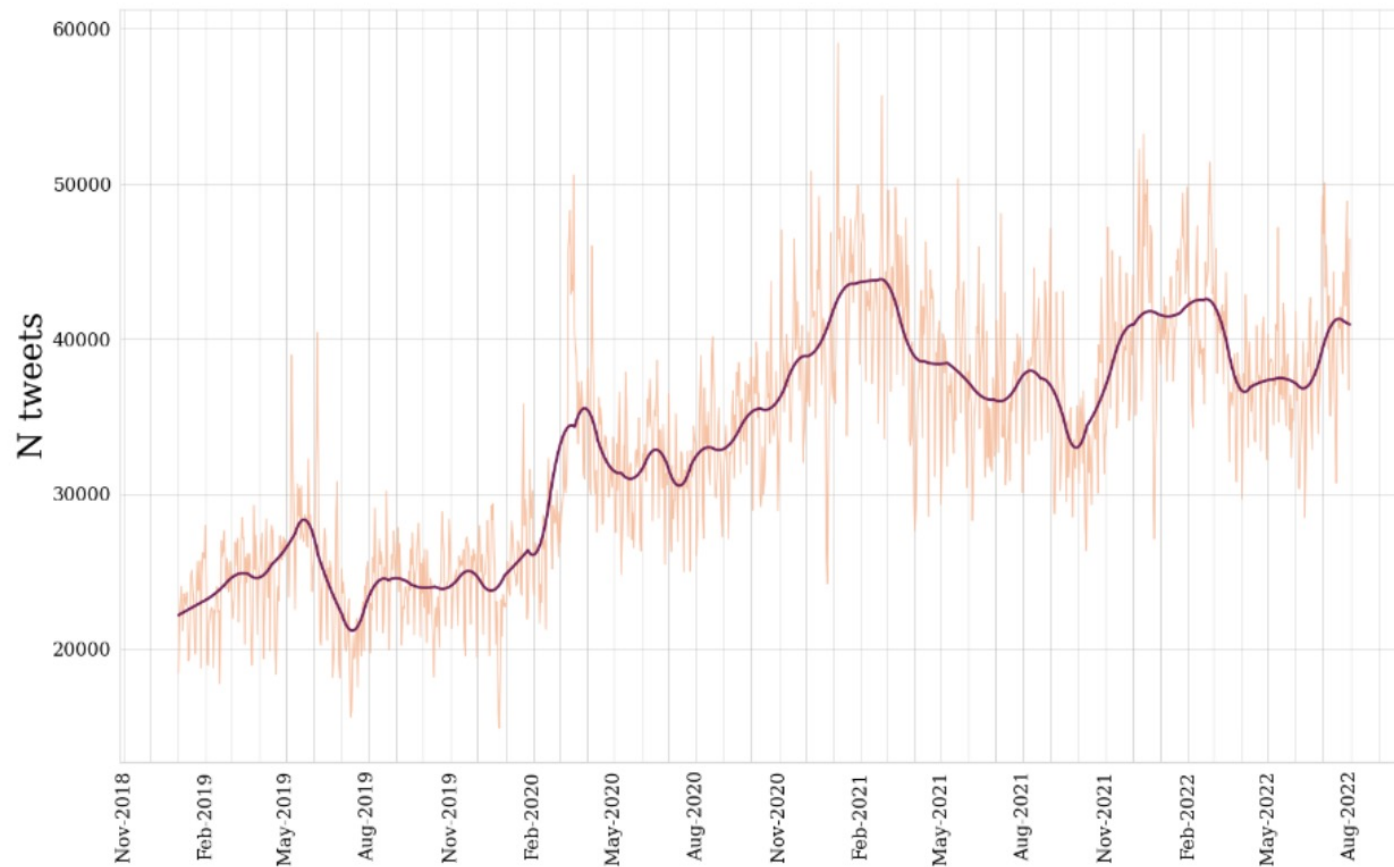
IMC TUESDAY TALK  
8 SEPTEMBER 2020

REBEKAH BRITA BAGLINI  
ASSISTANT PROFESSOR

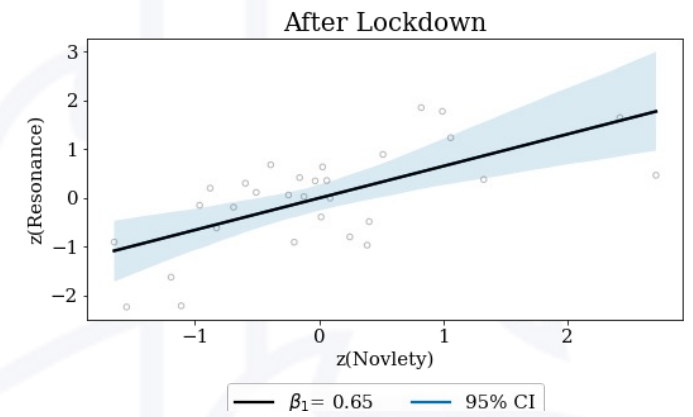
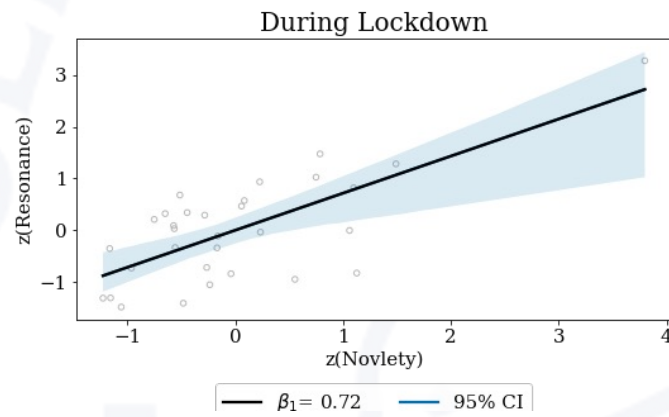
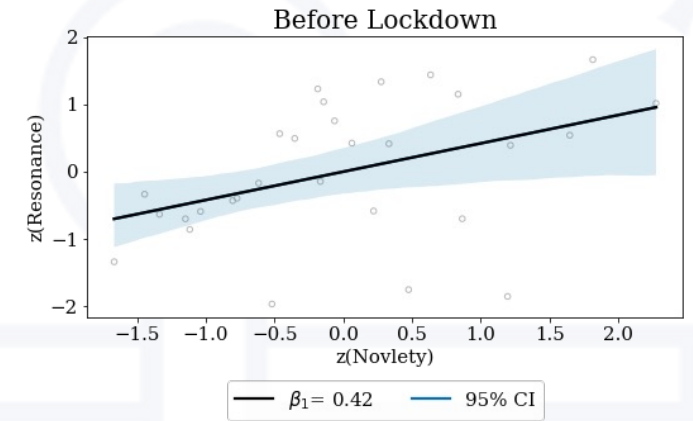
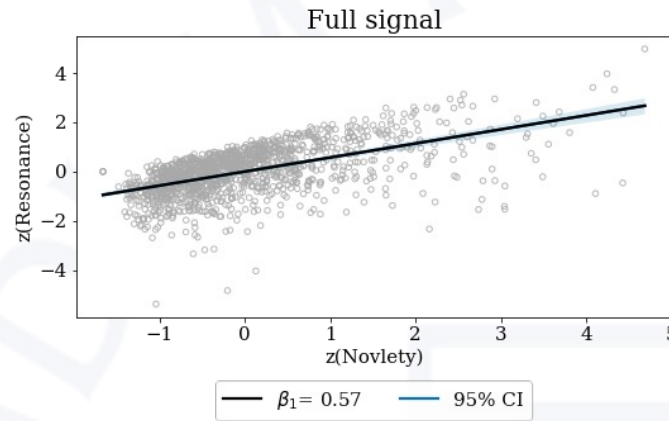
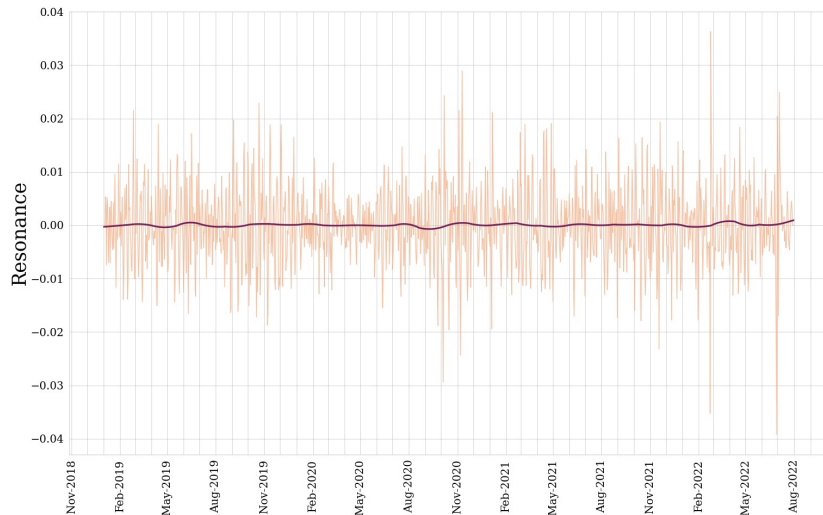
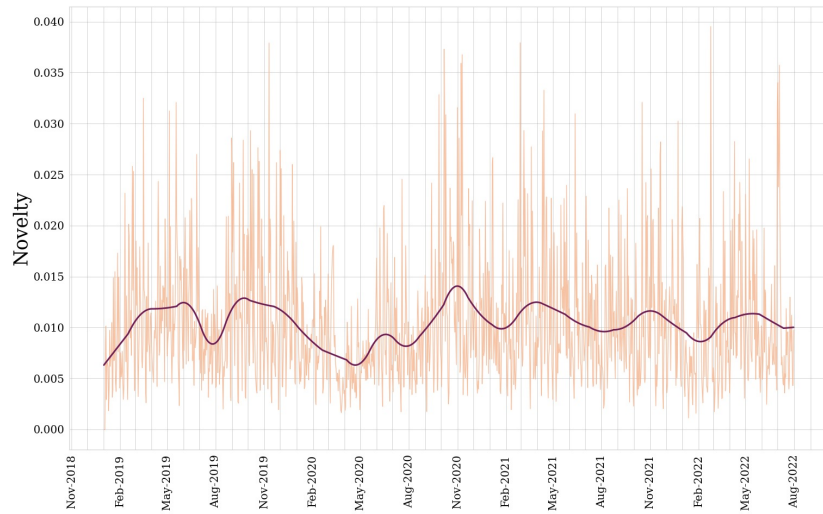


# Dataset

- 47 million Danish tweets (excluding retweets)
- Spans January 1 2019-present\*



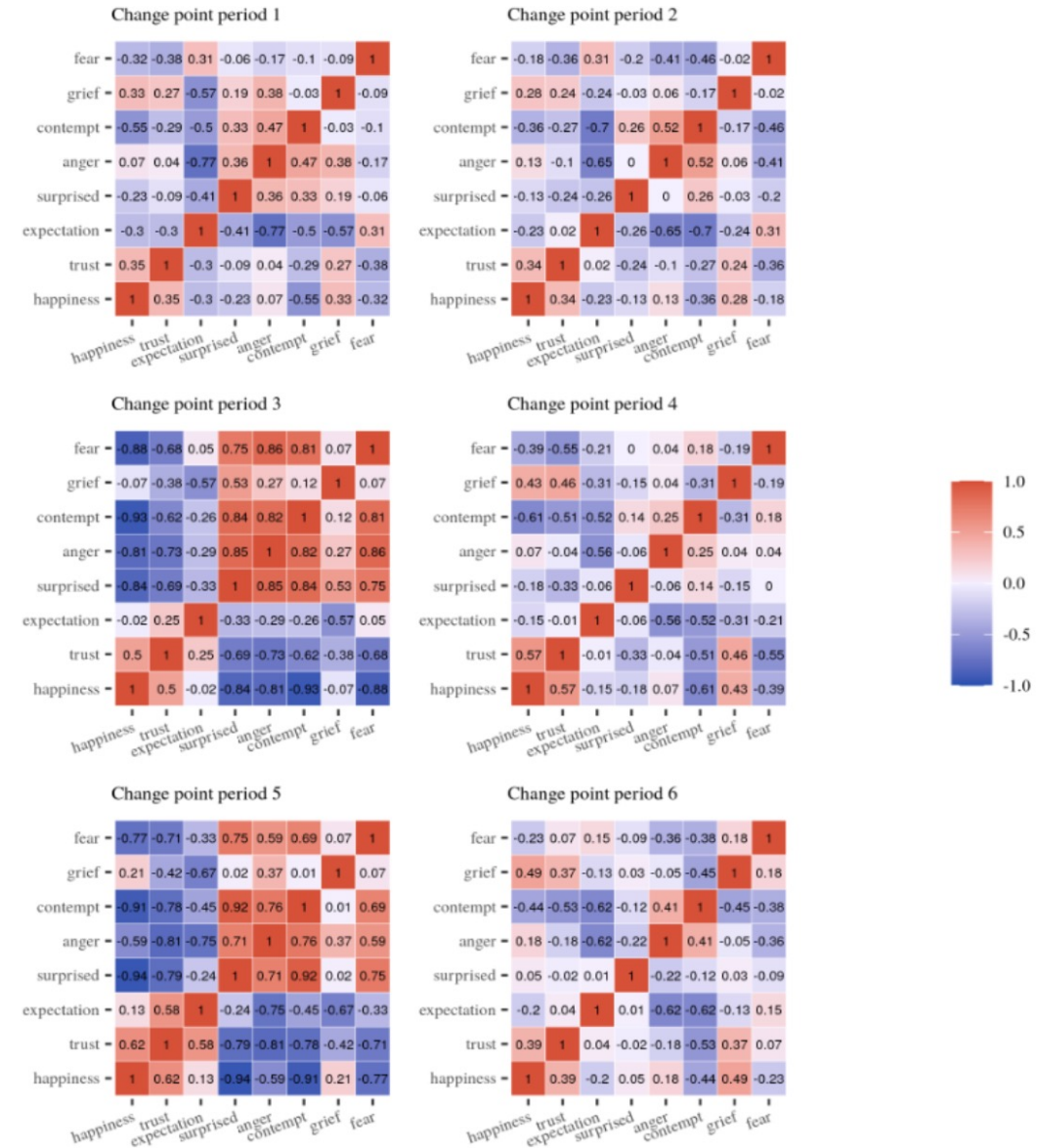
# Infodynamics on Twitter



# From infodynamics to emodynamics

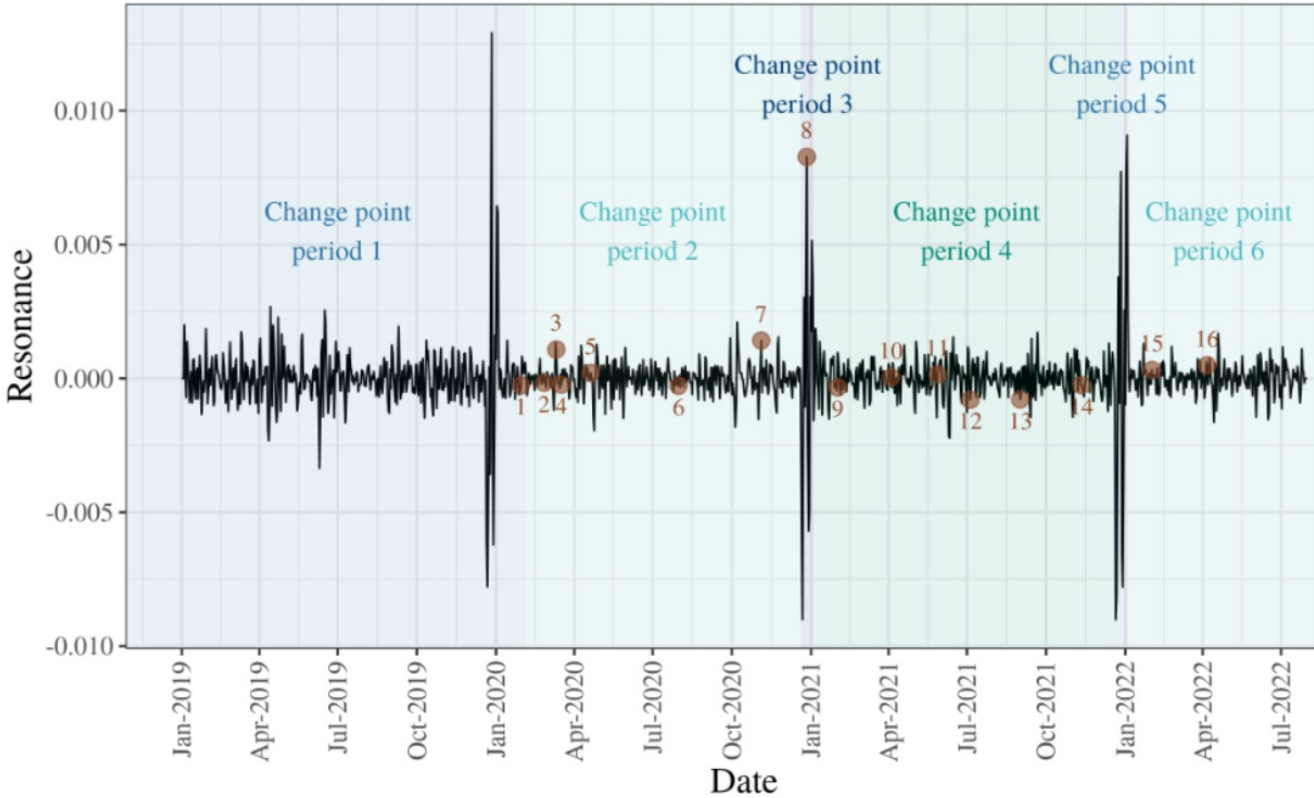
Using DaNLP's pretrained BERT Emotion models, generate predictive emotion distribution for each tweet which serves as the document representation for the extraction of information signals.

Danish Labels	Translations
Glæde/Sindsro	Happiness/Calmness
Tillid/Accept	Trust/Acceptance
Forventning/Interesse	Expectation/Interest
Overasket/Målløs	Surprised/Speechless
Vrede/Irritation	Anger/Irritation
Foragt/Modvilje	Contempt/Reluctance
Sorg/Trist	Grief/Sadness
Frygt/Bekymret	Fear/Worry



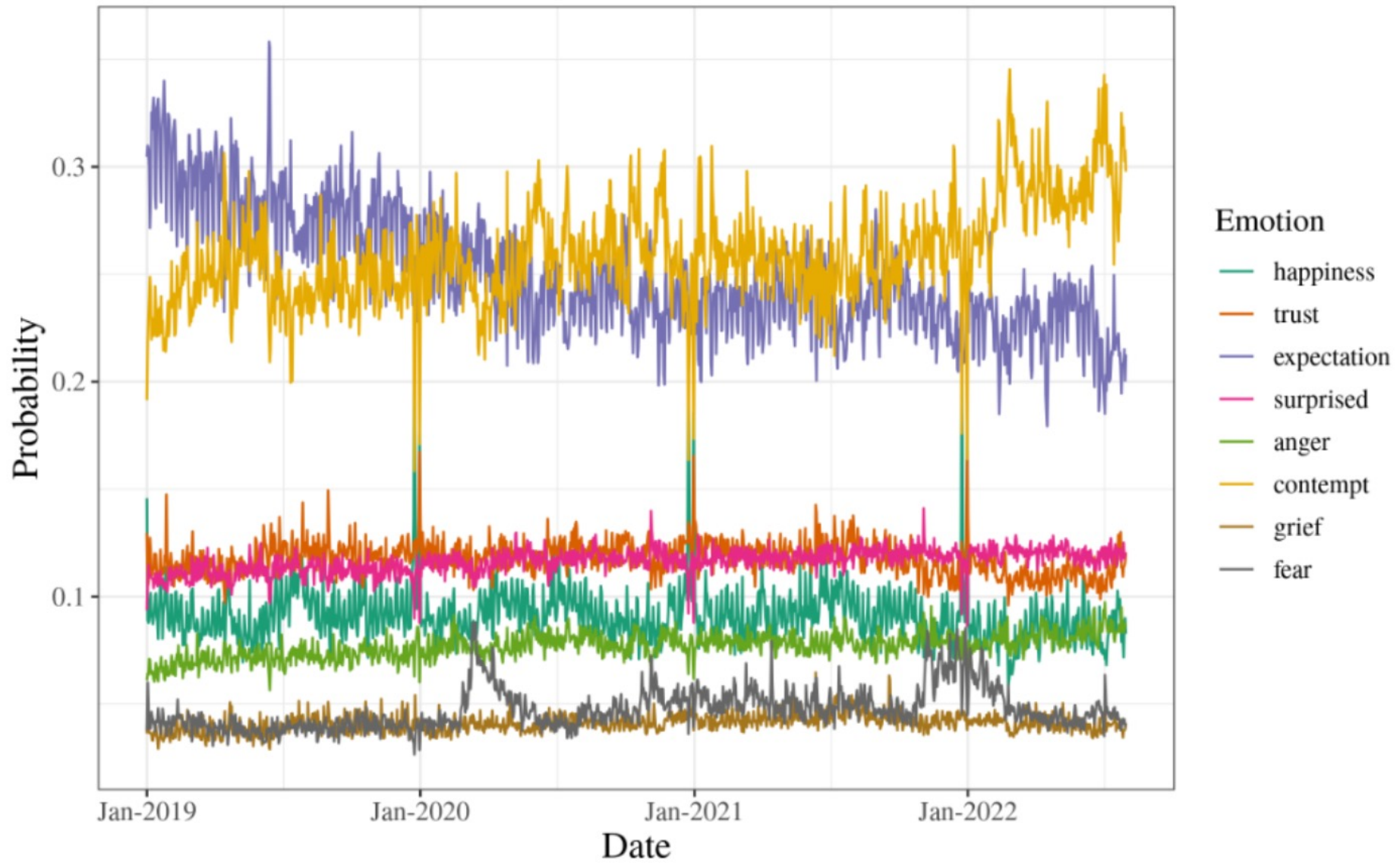
# Change point detection

Resonance, change points and selected events



No.	Period	Date	Description
1	1	2020-01-30	The outbreak of the virus is declared a threat to global health by WHO.
2	2	2020-02-26	The first Danish citizen is tested positive for COVID-19.
3	2	2020-03-11	The Danish prime minister has her second press conference and she announces a two-week lockdown in Denmark. All schools, daycares and institutions are closing. Assembly ban for more than 100 people is introduced. Public employees with a non-critical functionality are sent home.
4	2	2020-03-17	The Queen of Denmark speaks to the public about the COVID-19 crisis.
5	2	2020-04-20	Partial reopening. Driving schools, hair dressers, research laboratories, and certain other liberal professions together with youngest grade levels and outdoor sport activities without body contact is allowed to reopen.
6	2	2020-07-31	Danish health authority recommend wearing face masks in public transportations if there are many people.
7	2	2020-11-04	The government decides to put down all mink on Danish mink farms due to an outbreak of a COVID-19 mutation.
8	3	2020-12-27	The first Danish citizens are vaccinated using the Pfizer/BioNTech vaccine.
9	4	2021-01-28	The lockdown in Denmark, which was introduced in December 2020, is prolonged until February 28, 2021.
10	4	2021-04-14	The AstraZeneca vaccine is withdrawn completely from the Danish vaccination program.
11	4	2021-05-28	The Danish coronapas app can now be downloaded in the App store.
12	4	2021-07-05	The Delta variant now dominates in Denmark. Before this, the alpha variant dominated.
13	4	2021-09-10	Covid-19 is no longer described as a socially critical disease in Denmark.
14	4	2021-11-11	Covid-19 is again a disease critical to society in Denmark.
15	6	2022-02-01	The restrictions are lifted and covid-19 is changed to no longer be a critical illness. Requirements for tests upon entry to Denmark are retained.
16	6	2022-06-03	The rapid test centers close.





**Figure 2:** Mean daily value for each of the summarized emotion categories.

# Takeaways

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- **NID behavior** in is a reliable signal of a catastrophe in legacy news media
  - But **not** in social media
- In other words: **no news is bad news**, when the lack of novel content persists!
- **More research** ahead: information dynamics applied to different types of text corpora, different types of textual variables

# Thank you!

Questions, comments, further exchange welcome!

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## News Information Decoupling: An Information Signature of Catastrophes in Legacy News Media

Kristoffer L. Nielbo<sup>a,b,c</sup>, Rebekah B. Baglini<sup>c</sup>, Peter B. Vahlstrup<sup>a,b</sup>, Kenneth C. Enevoldsen<sup>a</sup>, Anja Bechmann<sup>b</sup> and Andreas Roepstorff<sup>c</sup>

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<sup>b</sup>DATALAB, School of Communication and Culture, Aarhus University, Helstingforsgade 14, DK-8200 Aarhus N, Denmark

<sup>c</sup>Interacting Minds Centre, Jens Chr. Skous Vej 4, Building 1483, 3rd floor, DK-8000 Aarhus C, Denmark

<https://arxiv.org/abs/2101.02956>

Pandemic news information uncertainty - News dynamics mirror differential response strategies to COVID-19

Kristoffer Nielbo<sup>1,2\*</sup>, Kenneth Enevoldsen<sup>1</sup>, Rebekah Baglini<sup>1,2</sup>, Elena Fano<sup>3</sup>, Andreas Roepstorff<sup>2</sup>, Jianbo Gao<sup>4,5</sup>

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**2** Interacting Minds Centre, Aarhus University, Aarhus, Denmark

**3** National Library of Sweden, 102 41 Stockholm, Sweden

**4** Center for Geodata and Analysis, Faculty of Geographical Science, Beijing Normal University, Beijing, China

**5** Institute of Automation, Chinese Academy of Sciences, Beijing, China and International College, Guangxi University, Nanning, China

## Emodynamics: Detecting and Characterizing Pandemic Sentiment Change Points on Danish Twitter\*

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<sup>3</sup>Center for Humanities Computing, Aarhus University





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