

**Don't spread
fake news about
#covid19**



Understanding and Combating 'Infodemic'

A Corpus Linguistic Approach to
Analyzing COVID-19 Misinformation

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Contagious Words/Epidemic Behaviours Workshop

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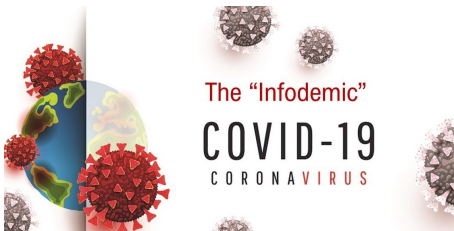
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PART I: Introduction



Background



- **COVID-19:** a pandemic, spread all over the globe, a major public health challenge.
- **Misinformation:** false claim, spread rapidly in social media, damages the authenticity balance of news ecosystem.
- **Infodemic:** information pandemic (WHO 2020), people's false belief about COVID-19 related myths.



Negative Impact of Infodemic



RVAIDYA2000
@rvaidya2000

WAU--Reliable?

Wuhan's corona virus cured by a bowl of freshly boiled garlic water.Chinese doctor says.Many patients benefited.Eight (8)cloves of chopped garlics add seven(7)cups of water &bring to boil.,Eat & drink the boiled garlic water, overnight improvement & healing. RT

9:28 AM · Feb 1, 2020 · Twitter for Android

- **Cause Confusion**

e.g. Taking excessive vitamin C, smoking, wearing multiple surgical masks and self-medicating with antibiotics.

- **Threaten Lives**

e.g. An Arizona man was dead and his wife was hospitalized after the couple ingested a form of Chloroquine to prevent COVID-19.

- **Disrupt Society**

77 cell phone towers have been set on fire due to the conspiracy that 5G mobile networks can spread COVID-19.



URGENCY

The urgency of finding COVID-19 misinformation can be attested by scores of already published papers (e.g. **Brennen et al. 2020**, **Pennycook et al. 2020**) and constant discussion in press and in social media.

- To **understand its key properties** (e.g. linguistic generalization patterns) before taking right actions.
- To **prevent inadequate responses and fears** from the population so as to **mitigate its risks** to the society.



Challenges

Fighting this infodemic is typically thought of in terms of **factuality**, but there are several problems for gauging it:

- **Diversity**: much broader as malicious content includes not only fake news, rumors, myths and conspiracy theories, but also promotion of fake cures, panic, racism, xenophobia, and mistrust in the authorities, among others.
- **Complexity**: more complex in terms of information structure, flow, propagation, source, purposes, user groups, etc.
- **Dynamic**: it is changing according to time, the situation, its life cycle, the government control, the prominent figure, the community, etc.

PART II: Related Work



- **Misinformation/Fake News Detection:**
Rely mostly on computational ways of misinformation detection without in-depth analysis of how misinformation is constructed (e.g. Guacho et al. 2018, Torabi & Taboada 2019);
- **COVID-19 Misinformation Analysis:**
Discuss issues of mental health, treatment, policies, social engagement, etc. from the perspective of journalism, medical science and social communication (e.g. Cao 2020, Fauci et al. 2020, Nishiura et al. 2020)
- **Corpus-based Linguistic Analysis:**
Focus on applying corpus linguistics tools to analyzing COVID-19 texts without dealing with information factuality (e.g. Wolfer et al. 2020)

Language Matters

The previous studies of automatic detection of misinformation, which usually regards it as a binary classification task, do not contribute to **our understanding of the generalization pattern of misconception in the language** and it is not a task of white-and-black. There are some interesting grey areas worth introspection.

In addition, automatic textual classification studies by themselves do not help to **pinpoint the fake part of the myth/news or how these falsehood misinform and affect the target population groups**, not alone to ameliorate the negative effect of misinformation to the society.

Common Linguistic Devices

- **Lexical:** ngrams of characters or words (Mihalcea & Strapparava 2009, Ott et al. 2013, Fornaciari & Poesio 2014, Yu, et al. 2015), bag-of-words (Al Asaad, B., & Erascu, M. 2018).
- **Syntactic:** parts of speech (Zhou et al. 2004, Li et al. 2014, Yu et al. 2015), syntactic structure (Burgoon et al. 2003, Bachenko et al. 2008, Feng et al. 2012, Yancheva & Rudzicz 2013), measures of syntactic complexity (Perez-Rosas & Mihalcea 2015, Yancheva & Rudzicz 2013).
- **Abstract:** stylometric features (Burgoon et al. 2003, Yoo & Gretzel 2009, Kruger et al. 2017), semantically-related keyword lists (Burgoon et al. 2003, Mihalcea & Strapparava 2009, Li et al. 2014, Perez-Rosas & Mihalcea 2015), psychologically-motivated keyword lists (Burgoon et al. 2003, Hirschberg et al. 2005, Bachenko et al. 2008, Yu et al. 2015), sentiment (Yoo & Gretzel 2009, Yu et al. 2015), discourse structure (Santos & Li 2010, Rubin & Vashchilko 2012), and named entities (Kleinberg et al. 2017), among others.

The later two aspects of linguistic features haven't been attested in studies of COVID-19 related misinformation (corpus-based approaches in particular), either analytical-wise or applicational-wise.

The Current Research Scope

This paper aims at teasing out the respective **linguistic characteristics** of misinformation, as well as sorting out **the prominence of the various linguistic cues** for differentiating false information from true information.

PART III: Methodology

Theoretically Motivated

There are effective **linguistics mechanisms** (language leakages) for sharing misleading information and belief, that are **Cognition-** (Bronstein et al. 2019, Su 2018) and **Psychology-based** (Vogler & Pearl 2020), including for instance,

- lexical categories,
- syntactic constructions,
- formality and complexity,
- specific details,
- sentiment,
- logical incongruities,
- metaphorical expressions, etc.

Corpus Analytical Tools

- Linguistic annotation tools (e.g. [Stanford CoreNLP](#): POS tagging, syntactic parsing);
- Concordancing, ([KWIC](#), [Sketch Engine](#));
- Lexical analysis: [LIWC \(Linguistic Inquiry Word Count\)](#);
- Metaphor labeling: [MIPVU \(Metaphor Identification Procedure VU University Amsterdam\)](#);
- Sentiment analysis: [NLTK \(Natural Language Toolkit\)](#);
- Statistical analysis and visualization: [R](#), etc.



Two Important Quantitative Metrics

To measure the **distinctiveness** of certain items occurring in the comparison groups, i.e. facts and myths:

- DP (Gries 2008, Lijffijt & Gries 2012)

$$DP = 0.5 * \sum_{i=1}^n \left| \frac{V_i}{f} - S_i \right|; DP_{nom} = \frac{DP}{1 - minS}$$

- PS Scaling (Pearl & Steyvers 2012, Vogler & Pearl 2020).

$$PS_Scale = \log\left(\frac{p(\frac{f_v}{T})}{p(\frac{f_v}{D})}\right)$$

PART IV: The Corpus



The Data

- Many datasets about fake news (e.g. LIAR, FEVER, CRED BANK)
- Many datasets about COVID19 general information (e.g. [GeoCoV19](#), [COVID-19-TweetIDs](#), [CORD-19](#))
- Very few data of COVID19 related information with gold truth labels.

Table 1. The corpus components and data size

Sub-corpus	Short Claims (Token)		News or Posts (Token)		Sub-total
	FALSE	TRUE	FALSE	TRUE	
CoAID	600 (6,798)	1,757 (19,899)	573 (29,650)	1,591 (61,503)	4,521 (117,850)
Corona.Fake	312 (2,808)	298 (2,981)	584 (20,440)	575 (14,386)	1,769 (40,615)
CoMyth	183 (2,013)	-	-	183 (7,139)	366 (9,152)
Total	1,095 (11,619)	2,055 (22,880)	1,157 (50,090)	2,349 (83,028)	6,656 (167,617)

Figure: The corpus information of this study



Subset 1: CoAID

CoAID (COVID-19 Healthcare Misinformation Dataset) is an on-going collection of covid19 misinformation by Cui & Lee (2020) with diverse COVID-19 healthcare misinformation on websites and social platforms. The data includes 1,896 news, 183,564 related user engagements, 516 social platform posts about COVID-19, which have been be classified with ground truth labels. We include the short claims, news and posts in our corpus.

	fact_check	news_url	title				
100000	medicalne	https://wv	"Spraying chlorine or alcohol on the skin kills viruses in the body"				
100001	medicalne	https://wv	"Only older adults and young people are at risk"				
100002	medicalne	https://wv	"Children cannot get COVID-19"				
100003	medicalne	https://wv	"COVID-19 is just like the flu"				
100004	medicalne	https://wv	"Everyone with COVID-19 dies"				
100005	medicalne	https://wv	"Cats and dogs spread coronavirus"				

Figure: Sample Data of False Short Claims in CoAID



Subset 2: Corona.Fake

Corona.Fake was collected by Susan Li over 1,100 news articles and social network posts on COVID-19 from a variety of new sources, such as [Lead Stories](#), [Poynter](#), [FactCheck.org](#), [Snopes](#), [EuVsDisinfo](#) that monitor, identify and fact-check disinformation that spread across the world, then labeled with binary truth values.

title	text	source	label
Due to the recent outbreak for the Corona	"You just need to add water, and the dru	coronavirusmedicalkit.co	FAKE
Breaking news: China will admit coronaviru	"As the "novel" coronavirus originated in	https://gnews.org/	FAKE
Exposing yourself to the sun or to tempera	"You can catch COVID-19, no matter how	https://www.who.int/em	TRUE
Drinking alcohol does not protect you again	"Frequent or excessive alcohol consump	https://www.who.int/em	TRUE
Are hand dryers effective in killing the new	"No. Hand dryers are not effective in kill	https://www.who.int/em	TRUE
Why Hand-Washing Really Is as Important	"Washing your hands decreases the num	https://www.snopes.com	TRUE


Figure: Sample Data of Corona.Fake



Subset 3: CoMyth

We collected 183 COVID19 myths and respective debunked facts from online sources of [FullFact](#), [New York Times](#), [CBS News](#), [Snopes](#), [Forbes](#), [World Health Organizations](#), [The Guardian](#), etc. (Data available at [Clara's Github](#))


CURES **PREVENTION** **SPREAD** **DIAGNOSIS** **DEADLINE** **THE VIRUS** **MISC** **RESET**



Facemasks don't help

The advice is still conflicting, depending on your area. But studies show masks reduce the spread of infection.


source: World Health Organization



It was created in a lab & deliberately spread

DNA sequencing strongly suggests the virus originated in pangolins or bats - or both.


source: World Economic Forum



The coronavirus is less deadly than the flu

There is some uncertainty about mortality rates at this stage, but coronavirus appears to be more deadly than seasonal flu.

source: World Health Organisation



Spray alcohol/chlorine on yourself

Won't kill viruses already in the body, and may be harmful.

source: World Health Organisation

Data are mainly downloaded from:

[Information is beautiful](#) & [COVID-19: Myths Versus Facts](#)

PART V:
Results and Analysis



Outline of the Analysis

Table 2. Structure of the analysis

Linguistic Device	Feature	Aim
Lexical	Word	Distinct vocabulary
Grammatical	POS	Prominent categorical and generalization patterns
Beyond Grammar	Stylistic	Complexity & Formality
	Conceptual	Lexical word pairs
	Psychological	Specific details

PART VI:
Conclusion and Future Work



Conclusion

- Most concerned topics of COVID19 myths: origination, prevention, spreading, diagnosis, treatment, death, etc.
- People tend to believe short and affirmative claims with negative emotion which easily arouses upset feelings of the population and causes panic in the society;
- People are exposed to negative emotions with inherent sympathy and anxiety for particular people and/or especially vulnerable groups;
- Fake information also demonstrates stylistic, conceptual and psychological differences from true information, which tend to be more dynamic, less formal, less complex, and less specific;
- Abstract linguistic features, such as Formality, complexity and specificity are useful features for misinformation detection.



Work to Complete

- Check the confusion matrix and conduct **error analysis** for each type of feature for a in-depth introspection;
- Annotate the data with more in-depth linguistic features in terms of **metaphorical expressions** etc.
- Conduct **ablation analysis** of the individual features of finer categories to further disclose the most salient linguistic patterns for indexing misconceptions.
- Build **automatic detection system** of misinformation using the current linguistic features in combination with sota DL models.