

# How to Talk about Climate Change: Network and Content Analysis of Croatian Digital Sources

Darijo Čerepinko\*, Lovorka Gotal Dmitrović, and Nikola Jozić

**Abstract**—The world has entered the digital sources era in which Internet is the main source of news. The disruptive effects of internet on communication and public sphere were observed in many aspects of social life and distracting existing social institutions and the social systems. Discussion in public sphere on many global problems, such as environmental issues arising from global warming and climate change is clouded by divided and opposite views and beliefs, caused, as research that is presented in the article demonstrates, by the nature of the online communication platforms which humankind use to access the news. Aim of this article is to describe communication practices and discourse use connected to the term of climate change in Croatian online media-sphere through the application of semantic and content analysis of the online communication. In this paper are propose effective communication procedures and messages to enhance civil discussion and public engagement on the issue. This research shows the importance of professional media outlets and the importance of singular voices with broad community and huge number of followers on social media sites. Conclusions of this paper are that in presenting novelty it's essential to avoid sensationalism (the ground for trivialization and denial) and publish exhaustive facts, research data and findings. and left the public to reach their own conclusion. To promote scientifically grounded stories on climate change and all the other environmental issues online, engagement of the scientists and professionals in the field of environmental protection is essential for delivering trustworthy and scientifically proven information to the public. Information provided through social media should, present facts connected to the issues, in a neutral manner to avoid unwanted strategies of reducing cognitive dissonance presented in this paper.

**Index Terms**—Communication procedures and messages, online communication, semantic and content analysis, sensationalism

## I. INTRODUCTION

For the first time since starting their report on global state of journalism as a profession, Reuters Institute for the Study of Journalism reported in 2017 that majority of the survey respondents were acquiring their news from online sources [1] and similar findings were reported in the following years respectively [2, 3]. The world has entered the new era in which digital sources are the main source of news with all the opportunities and problems that internet brings along. The disruptive effects of internet on communication and public sphere were observed much earlier and number of

scholars warned that the consequences could be dire in many aspects of social life and distracting existing social institutions and the social systems.

For example, Brants [4] and Tsfaty and Ariely [5] noticed declining trust in journalism, Allcott and Gentzkow [5] reported on disruptive power of online sources on election process, Kata [6] described influence of online sources on growing number of anti-vaccine activism and Norris [7] explained how all these factors relate to declining trust in social institutions. Even before the significant rise of the internet use Castells [8] and Morozov [9] predicted that new communication platform shall significantly change the public sphere—a space in which, as Habermas [10] explained, private individuals negotiate on the level of institutional interventions into their everyday lives. Public sphere, mediated through mass media was supposed to be the arena for nonviolent discussion and consensus on most important problems a society is facing and prerequisite for it to be successful was to embrace and acknowledge all the important voices and positions and find, through mediated and civil discussion a general agreement on how to deal with those issues.

However, discussion in public sphere on many global problems, such as environmental issues arising from global warming and climate change, global health during the latest COVID-19 pandemic or global security concerns caused by, among others, the war in Ukraine is clouded by divided and opposite views and beliefs, caused, as research that will be presented later in the article demonstrates, by the nature of the online communication platforms humankind use to access the news. Aim of this article is to describe communication practices and discourse use connected to the term of climate change in Croatian online media-sphere through the application of semantic and content analysis of the online communication to propose effective communication procedures and messages to enhance civil discussion and public engagement on the issue.

## II. ONLINE CONTENT SHARING

Most of the online content producers seek to increase impressions throughout the network to maximize the income from various sources, be it advertisers, sponsors, or any other form of monetization of content [11, 12]. Impressions and engagement are the indicators of the content value both for individual users and for various algorithms that drive online traffic and as Albright [13] points out most of both rely on emotional appeal.

Berger and Milkman [14] showed that in general positive emotions such as interest, surprise or sharing practical value generate more sharing (as well as humour [15]) but in their research negative emotion of anger also generated significant

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response. Vosoughi, Roy and Aral [16] examined the ratios of speed and depths of sharing true and false stories online and came to conclusion that top 0.01% of false stories fostered with negative emotions such as disgust or anger “diffused eight hops deeper (...) than the truth” and that “false political news travelled deeper and more broadly, reached more people, and was more viral than any other category of false information”.

Like Berger and Milkman, Vosoughi, Roy and Aral have also found that true stories are fuelled throughout the network by the positive emotions but the main factor arising from their research for both categories was novelty. They also reported that “users who spread false news had significantly fewer followers, followed significantly fewer people, were significantly less active, were verified significantly less often, and had been on (SNS) for significantly less time”. However, research on spread of misinformation on social networks regarding COVID-19 pandemic showed that small number of users (as small as dozen) could be responsible for most of the false stories shared online [16].

### III. COGNITIVE DISSONANCE, FALSE INFORMATION AND COGNITIVE BIAS

When presented with information that contradicts their beliefs or behaviour individuals could often experience a state of psychological distress called cognitive dissonance [17], a state of mental discomfort caused by disbalance of their actions and their beliefs, ideas, and values. In order to solve it, individuals employ different strategies [18] such as: Attitude change, Change of behaviour, Distraction and forgetting, Trivialization and self-affirmation, Denial of responsibility, Adding consonant cognitions and Act rationalization. While the preceding two strategies could be considered desirable outcomes of information exposure, rest of the following strategies are problematic in terms of social dialogue and problem solving because they use strategies of normalization of unwanted behaviour and self-deception.

In the internet era, distraction and forgetting, a strategy that is based on willing non-exposure to information that could induce cognitive dissonance, is easily achieved through engagement with various online content already optimized to attract as much attention from users as possible [19] by use of eye catchers and other similar techniques [20]. Other four strategies are grounded in selective exposure that greatly reduce the chance of confronting challenging views or information such as selective information seeking to confirm existing beliefs and attitudes [21] or communicating with homogenous groups of like-minded individuals in so called echo-chambers and filter bubbles [22]. Persuasion often doesn't work in such an environment and researchers [23] predict that wrong online persuasive strategies could produce a contra-effect and alienate individuals with opposing views even further. Yet, other findings [24–26] suggest that persuasion could be effective when the social circle or social network is heterogenous, especially “if they are connected to network partners that have taken similar actions” [27].

To build an effective communication strategy for dealing with abovementioned issues and efficiently communicating the environmental topics through avoiding dissatisfaction

and frustration of individuals with opposing views on climate change [28] first step of the research needs to include the analysis of the topics, issues and sentiments connected to the subject of climate change.

### IV. METHODOLOGY

Data collection and basic sentiment analysis of the sample is administered through MediaToolikt Online media monitoring software [29]. Data were collected from regular web sites (including news organizations, blogposts and internet forums) and social network sites Facebook, Instagram, Twitter and YouTube. To analyse the emotional response the software used basic semantic analysis of the emotional engagement [30] measuring following variables: Reach, Virality, Engagement rate, Interactions, Followers count, Like count, Comment count, Share count, Tweet count, Love count, Wow count, Haha count, Sad count, Angry count, Total reactions count, Favorite count, Retweet count, View count, Dislike count, Repost count, Reddit type, Reddit score, Influence score and Tweet type. Further inquiry identified key influencers for at length content analysis [31] to single out most discussed posts and articles within the broader subject of climate change and describe communication approaches applied in topic presentation. To verify software coding, manual human coding was used for a sample of 100 random units, and it showed high reliability (Crombach's Alpha: 0.951) of results.

Data collection is carried out during the month of January 2023 totalling in 960 units of analysis containing the term of climate change in Croatian (*cro. klimatske promjene*) that gained 2.4 million impressions.

### V. RESULTS AND DISCUSSION

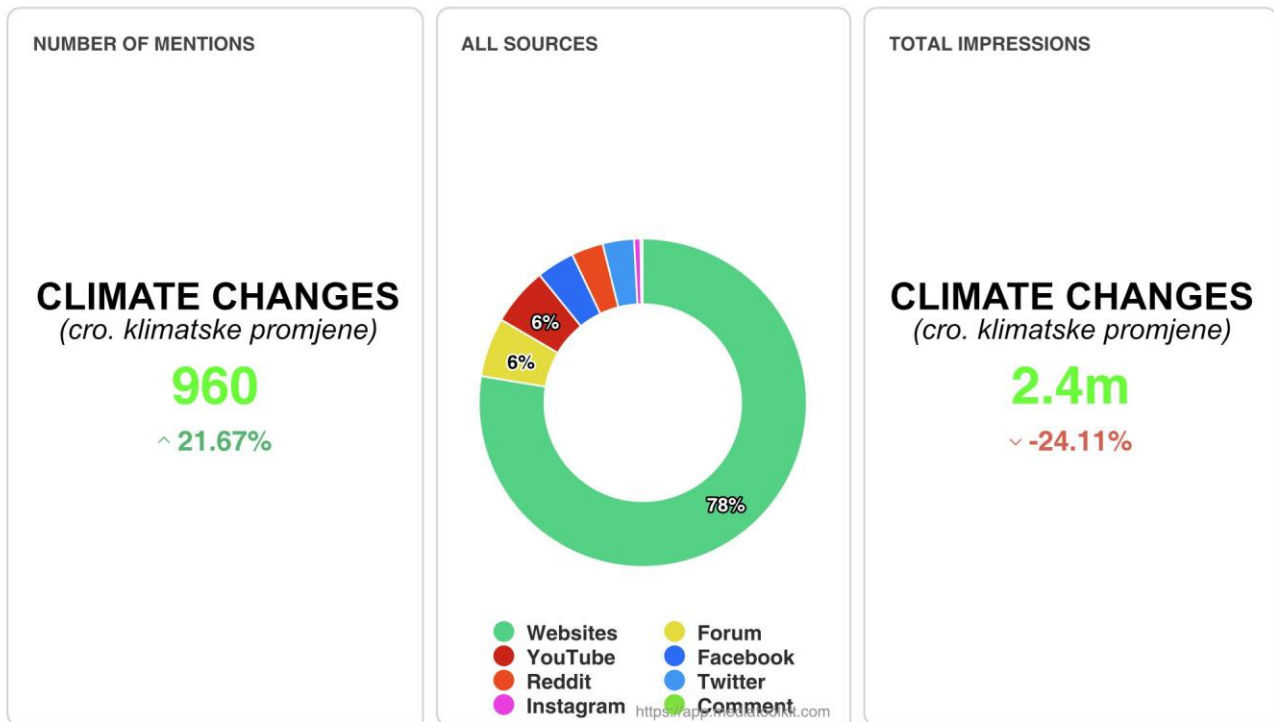
As shown in Fig. 1, most of the mentions in observed period were noticed, cumulatively, on the various news websites although the discussions on the website of internet forum (forum.hr) produced most of the mentions when individually observed. Most YouTube videos were published by Croatian version of Creative Society Project (*cro. Kreativno društvo*). Three mentioned channels attained 90% of all analyzed content. 80% of top 10 sources with most mentions (forums and social network sites included) and 100% of top 10 sources regarding websites (forums excluded) belong to official Croatian news organizations. Regarding social networks sites results are very much alike across sources with limited number of sources (only 4) publishing more than one post in the observed period.

Main YouTube source—Creative Society Project (*cro. Kreativno društvo*)—is mostly focused on catastrophic predictions of the end of the world and its variations, of which the climate change is just one of the examples or evidences. However, it doesn't attract much engagement in the comments section and number of impressions of their videos is almost insignificant. Equal conclusion could be made regarding top influencers on Facebook.

As shown in Fig. 2 and explained later in the chapter, although the page of animal protection group Friends of the animals (*cro. Prijatelji životinja*) (Fig. 1) has more post

mentioning the climate change, most impressions gather one post published by Croatian conservative TV host Velimir Bujanec.

On Twitter, most influential profiles, aside from news organizations were individuals with less than 3.5 thousand followers but their reach is insignificant for the analysis.



TOP INFLUENCERS BY NUMBER OF MENTIONS		TOP INFLUENCERS BY SOURCE							
		Websites	Forum	YouTube	Facebook				
forum.hr	55	dnevnik.hr	39	forum.hr	55	Kreativno Druš...	38	Prijatelji životi...	3
dnevnik.hr	39	hrt.hr	30	stripovi.com	1	Non stop	3	AgroKlub.com	2
Kreativno Društvo	38	n1info.hr	28			Boje Zemlje	2	Eko zona	2
hrt.hr	30	glasistre.hr	27			Večernji list	2	Forum za slobo...	2
n1info.hr	28	index.hr	25			Glas Amerike	1	Agencija za mo...	1
glasistre.hr	27	jutarnji.hr	23			Hrvatska radiot...	1	Bijeljina Caffè	1
index.hr	25	slobodnadalma...	21			N1	1	DalmacijaDa...	1
jutarnji.hr	23	glas-slavonije...	16			O Kanal	1	DalmacijaNews	1
slobodnadalmacija.hr	21	prigorski.hr	16			PIXSELL	1	Dubrovački vjes...	1
glas-slavonije.hr	16	green.hr	14			Socijaldemokrati	1	Dubrovniknet ...	1

Fig. 1. Number of mentions of Climate Change term and its distribution across sources.

Most of the negative sentiment, over 74.5% of all posts on forum website were negatively accentuated and, as shown in Fig. 3, usually concentrated within a span of 24 hours which

could be explained by the daily affairs and news events. Similar although lower percentages were observed also concerning most of the top influential sources (Fig. 2)

TOP INFLUENCERS BY SENTIMENT			
Negative		Positive	
forum.hr	41	dnevnik.hr	13
Kreativno Društvo	26	forum.hr	9
dnevnik.hr	20	glasistre.hr	7
hrt.hr	19	green.hr	6
index.hr	19	dalmacijanews.hr	5
n1info.hr	17	hrt.hr	5
glasistre.hr	14	prigorski.hr	5
jutarnji.hr	13	dalmatinskiportal.hr	4
slobodnadalmacija.hr	12	radiodalmacija.hr	4
nacional.hr	11	slobodnadalmacija.hr	4

TOP INFLUENCERS BY REACH				
Websites		Facebook	Twitter	Instagram
dw.com	100.9k	Velimir Bujanec 39.8k	@hrtvijesti 2.1k	anonymous_user 98.3
priznajem.hr	25.5k	Večernji list 30.3k	@recina790 254	
aljazeera.net	23.5k	Njuškalo 24.1k	@ipuljic57 170	
index.hr	19.3k	Željko Lacković 14.2k	@HREnertrans 142	
jutarnji.hr	12.2k	Slobodna Dalma... 11.2k	@Carthage_ghost 134	
green.hr	11.8k	HRT Vijesti 10.1k	@agroklub 82	
antenzadar.hr	11k	Hrvatske šume doo 8.9k	@JJJ_of_Kuslat 76	
24sata.hr	9.3k	DalmacijaNews 6.7k	@SimGold 75	
vecernji.hr	9.1k	Institut Ruđer Bošković 5.3k	@eTwinningHR 66	
slobodnadalmacija.hr	8.3k	AgroKlub.com 4.9k	@_mala_nu_ 40	

Fig. 2. Top sources by sentiment and reach

It is also noticeable that this trend is not consistent over the observed period (Fig. 3) and further data analysis showed that observed peaks were connected to news stories published across the news websites e.g., cost of climate change on Croatian economy on January 2nd; report on 2022 as second warmest year in Europe on records on January 10th; Eurobarometer report on rise of the cost of living that also

mentions climate change as one of the top problems seen by European citizens surveyed in the report on January 12th; story on the need for revision of EU budget fueled by the statement of the Croatian politician Dubravka Šuica, Vice-President of the European Commission on January 19th and the break of the giant iceberg on Antarctica on January 24th.

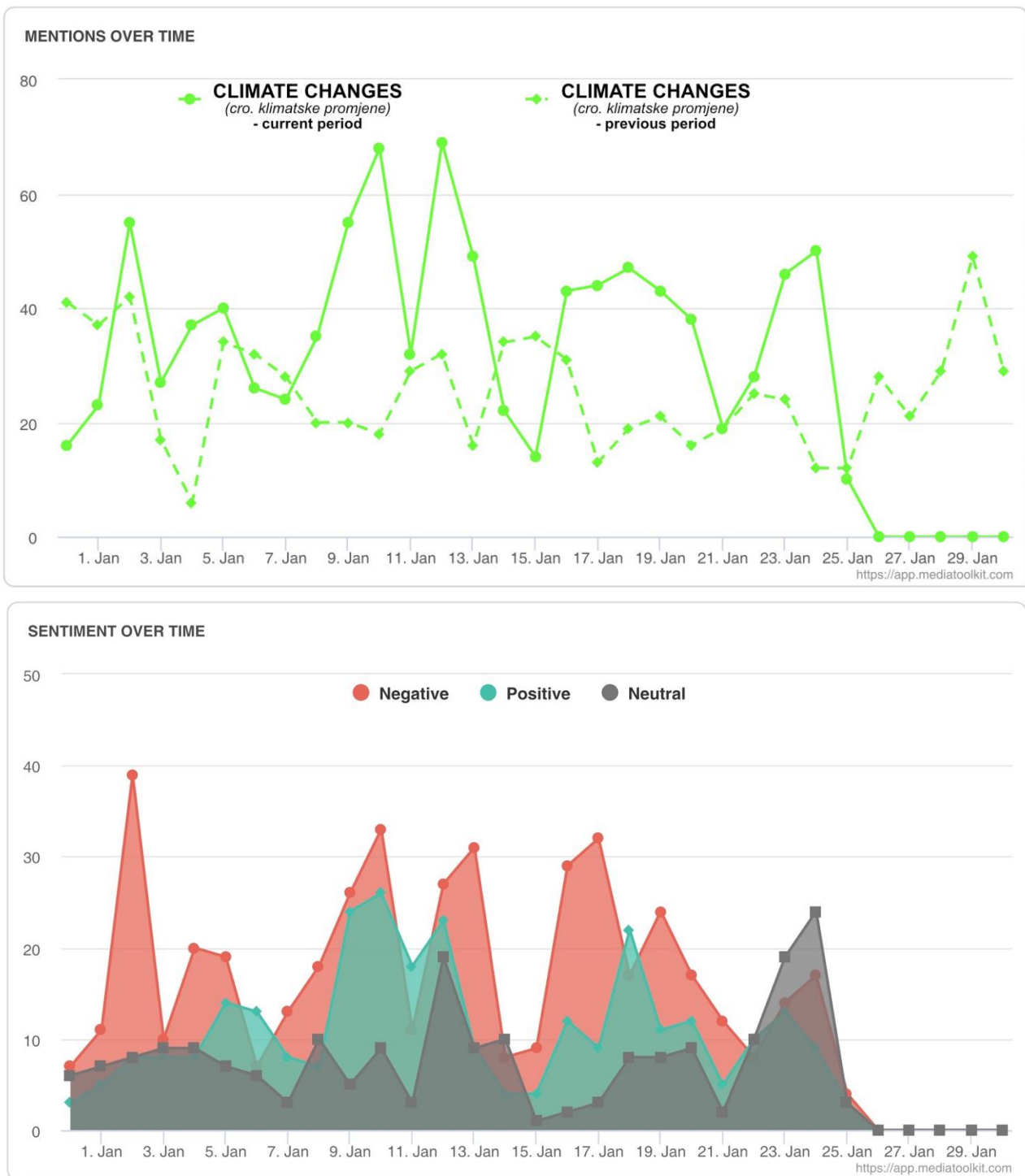


Fig. 3. Daily frequencies and sentiment.

Further thorough analysis of data showed that in 32% of the sample the climate change was main topic of the post or comment and in 68% it was mentioned regarding different subjects. Of the articles having climate change as their main topic, 75% were marked negative, 18.75% neutral and only 6.25% positive in sentiment, respectively. When compared with posts in which climate change is only mentioned, results are significantly different with 44.1% positive, 41.2% negative and 14.7% neutral sentiment, respectively. Negative sentiment in the comments of the mentioned posts is mainly focusing on climate change as a hoax construct purported by corrupt government, liberal left, and other popular conspirators such as Freemasons or Jewish lobby.

Analysis of the posts on Facebook showed that the post with the most reach was the photograph published by Velimir Bujanec, conservative TV host in which he poses with a dog on a snow with caption: “BIG” CLIMATE CHANGES: Winter walk with Max... #oldNORMAL. Post is originally published in Croatian (cro. “VELIKE” KLIMATSKE PROMJENE: U zimskoj šetnji s Maxom... #staroNORMALNO) on January 22nd and MediaToolkit analysis showed a reach of over 39 thousand impressions, number larger than any observed news site has reached in the period of data collection. Most of the comments on the post were referring to the dog in the picture or showing affection for the pair but several it called for further action needed to

rise against globalization and its shadow rulers or plainly ridiculing the idea that climate changes are real quoting the snow in the photograph in the wintertime as “climate change proof”.

The caption itself plays a trope of the “old normal” connecting it to a broader conspiracy theories field. Less than 1% of comments were contesting the overall tone and notion of the post.

While this was the only post concerning climate change, number of posts were related to the new waste management system introduced in capitol of Croatia by the new progressive municipal government with captions and comments causing disgust and anger.

The findings presented above are consistent with previous research on the matter [13–16] confirming that negative topics cause more engagement, especially when presented within a broader field of ideological positions. As seen in case of Bujanec, satire, bordering humour [15] also incite the engagement of users. Comment sections additionally showed that users use the content to confirm their own beliefs, similarly to [19–22] and the notion is further enhanced by the number and nature of the users’ reactions to the content on social networks sites (such as likes, shares, love etc.) that are included in sentiment analysis. Those findings could be explained by employment of different cognitive dissonance reduction strategies as presented in [18]. Results showed importance of singular voices of highly influential individuals who could shape the tone and direction of public discussion as shown in [32]. Finally, novelty is still one of the most important factors of user’s engagement as seen in Fig. 1 and presented in [16], mostly prompt by the daily news which provide some room for optimism regarding the still existing influence of mainstream media organizations and their digital outlets.

## VI. CONCLUSION

While this research shows the importance of professional media outlets as still one of the guiding forces of public sphere, it also shows the importance of singular voices with broad community and huge number of followers on social media sites.

As presented above, novelty is still the number one attribute that drives human interest and engagement, and information seeking is one of the top reasons of users’ online activities. In presenting novelty, it’s essential to avoid sensationalism, both for the media outlets and individual influencers because sensationalism could provide the ground for trivialization and other forms of denial. Best strategy to do so is to publish exhaustive facts, research data and findings and left the public to reach their own conclusion. The language used should be appropriate to the users’ level of understanding and authors should be prepared to explain the incomprehensible elements further, as well as broader context, methods, and the field from which the story arises.

To promote scientifically grounded stories on climate change and all the other environmental issues online, engagement of the scientists and other professionals in the field of environmental protection is essential for delivering trustworthy and scientifically proven information to the public. Information provided through social media should, if

possible, present facts connected to the issues, in a neutral manner to avoid unwanted strategies of reducing cognitive dissonance presented in this paper (e.g., information avoidance and boomerang effect of dismissing all the opposing views). Information and facts on subjects of expertise should be posted often and explanation should be provided in follow up, either through new posts or through comment sections.

Comments should be civil and avoid any emotional language or emotion escalation. Concerning positive emotions that could improve the reach of the post, author should consider interest, surprise or sharing practical value.

While humour is highly welcome, other traits such as satire or condescending jokes should be avoided. If emotional stimuli of the negative spectrum, such as anger or disgust, is used, dialogue needs to be monitored and unacceptable discourse for all the participants established, if possible, prior to the publishing of the emotionally negative post.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

## AUTHOR CONTRIBUTIONS

NJ conducted the research and data collection; LGD statistical processing and data analysis; DČ wrote the paper and made a major contribution to the theoretical part of the paper; all authors approved the final version.

## REFERENCES

- [1] N. Newman, “Journalism, media, and technology trends and predictions 2017,” Reuters Institute for the Study of Journalism, 2017.
- [2] N. Newman, R. Fletcher, A. Kalogeropoulos, and R. Nielsen, “Reuters institute digital news report 2019,” Reuters Institute for the Study of Journalism, 2019.
- [3] N. Newman, “Journalism, media, and technology trends and predictions 2020,” Reuters Institute for the Study of Journalism, 2020.
- [4] K. Brants, “Trust, cynicism and responsiveness in Chris Peters,” in *Rethinking Journalism: Trust and Participation in a Transformed News Landscape*, M. J. Broersma, Eds. London: Routledge, 2013, pp. 15–27.
- [5] Y. Tsfati and G. Ariely, “Individual and contextual correlates of trust in media across 44 countries,” *Communication Research*, vol. 41, no. 6, pp. 760–782, 2014.
- [6] H. Allcott and M. Gentzkow, “Social media and fake news in the 2016 election,” *Journal of Economic Perspectives*, vol. 31, no. 2, pp. 211–236, 2017.
- [7] A. Kata, “Anti-vaccine activists, Web 2.0, and the postmodern paradigm—An overview of tactics and tropes used online by the anti-vaccination movement,” *Vaccine*, vol. 30, no. 25, pp. 3778–3789, 2012.
- [8] P. Norris, *Democratic Deficit*, New York, NY: Cambridge University Press, 2011.
- [9] M. Castells, “Communication, power and counter-power in the network society,” *International Journal of Communication*, vol. 1, no. 1, p. 29, 2007.
- [10] E. Morozov, *The Net Delusion: How Not to Liberate the World*, Penguin UK, 2011.
- [11] M. Zajc, “The social media dispositive and monetization of user-generated content,” *The Information Society*, vol. 31, no. 1, pp. 61–67, 2015.
- [12] S. Kopf, “ ‘Rewarding good creators’: Corporate social media discourse on monetization schemes for content creators,” *Social Media+ Society*, vol. 6, no. 4, 20969877, 2020.
- [13] J. Albright, “Welcome to the era of fake news,” *Media and Communication*, vol. 5, no. 2, pp. 87–89, 2017.
- [14] J. Berger and K. L. Milkman, “What makes online content viral?” *Journal of Marketing Research*, vol. 49, no. 2, pp. 192–205, 2012.
- [15] S. Campo, N. M. Askelson, E. L. Spies, C. Boxer, K. M. Scharp, and M.

- E. Losch, “‘Wow, that was funny’ the value of exposure and humor in fostering campaign message sharing,” *Social Marketing Quarterly*, vol. 19, no. 2, pp. 84–96, 2013.
- [16] S. Vosoughi, D. Roy, and S. Aral, “The spread of true and false news online,” *Science*, no. 359, 6380, pp. 1146–1151, 2018.
- [17] L. Festinger, “Cognitive dissonance,” *Scientific American*, vol. 207, no. 4, pp. 93–106, 1962.
- [18] A. McGrath, “Dealing with dissonance: A review of cognitive dissonance reduction,” *Social and Personality Psychology Compass*, vol. 11, no. 12, e12362, 2017.
- [19] S. Aral and P. S. Dhillon, “Social influence maximization under empirical influence models,” *Nature Human Behaviour*, vol. 2, no. 6, pp. 375–382, 2018.
- [20] B. W. Wirtz, R. Piehler, and S. Ullrich, “Determinants of social media website attractiveness,” *Journal of Electronic Commerce Research*, vol. 14, no. 1, p. 11, 2013.
- [21] M. del Vicario, A. Scala, G. Caldarelli, H. E. Stanley, and W. Quattrociocchi, “Modeling confirmation bias and polarization,” *Scientific Reports*, vol. 7, no. 1, 40391, 2017.
- [22] S. Flaxman, S. Goel, and J. M. Rao, “Filter bubbles, echo chambers, and online news consumption,” *Public Opinion Quarterly*, vol. 80, no. S1, pp. 298–320, 2016.
- [23] M. Kaptein and D. Eckles, “Heterogeneity in the effects of online persuasion,” *Journal of Interactive Marketing*, vol. 26, no. 3, pp. 176–188, 2012.
- [24] J. L. Nelson and J. G. Webster, “The myth of partisan selective exposure: A portrait of the online political news audience,” *Social Media+ Society*, vol. 3, no. 3, 17729314, 2017.
- [25] L. Jasny, J. Waggle, and D. R. Fisher, “An empirical examination of echo chambers in US climate policy networks,” *Nature Climate Change*, vol. 5, no. 8, pp. 782–786, 2015.
- [26] E. Colleoni, A. Rozza, and A. Arvidsson, “Echo chamber or public sphere? Predicting political orientation and measuring political homophily in Twitter using big data,” *Journal of Communication*, vol. 64, no. 2, pp. 317–332, 2014.
- [27] M. L. Barnes, P. Wang, J. E. Cinner *et al.*, “Social determinants of adaptive and transformative responses to climate change,” *Nat. Clim. Chang.*, vol. 10, pp. 823–828, 2020. <https://doi.org/10.1038/s41558-020-0871-4>
- [28] M. Taddicken and L. Wolff, “‘Fake News’ in science communication: Emotions and strategies of coping with dissonance online,” *Media and Communication*, vol. 8, no. 1, pp. 206–217, 2020.
- [29] Determ API v1. [Online]. Available: <https://apidocs.mediatoolkit.com/>
- [30] C. Goddard, *Semantic Analysis: A Practical Introduction*, Oxford University Press, 2011.
- [31] K. Krippendorff, “Content analysis,” in *International Encyclopedia of Communication*, E. Barnouw, G. Gerbner, W. Schramm, T. L. Worth, and L. Gross, Eds. New York, NY: Oxford University Press, 1989, vol. 1, pp. 403–407.
- [32] Center for Countering Digital Hate. (2021). The disinformation dozen: Why platforms must act on twelve leading online anti-vaxxers. [Online]. Available: [https://www.counterhate.com/\\_files/ugd/f4d9b9\\_b7cedc0553604720b7137f8663366ee5.pdf](https://www.counterhate.com/_files/ugd/f4d9b9_b7cedc0553604720b7137f8663366ee5.pdf)

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