



COMMUNITIES OF ATTENTION NETWORKS AROUND COVID-19 PAPERS IN BRAZIL: a preliminary study

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Resumo: Communities of attention networks represent clusters of individuals or groups who are actively discussing, sharing, or engaging with specific research topics or publications. This work applies social network analysis to understand the groups interested in research on COVID-19 shared in Brazil during the pandemic (2020-2022) on Twitter (X). We identified 17,649 papers being mentioned in 234,346 tweets from 62,979 users. The mapped communities of attention networks are made up of 236 clusters. The four main clusters analyzed present similar self-presentation elements and different forms of interaction, whether with the research topic they mention, the users they engage with and the content they share.

Palavras-Chave: Communities of attention networks. Altimetrics. Covid-19. Brazil. Twitter (X).



1 INTRODUCTION

Scientists and researchers collaborated globally to gain a deeper understanding of COVID-19. The coronavirus pandemic prompted a direct and extraordinary response from the scientific community around the world, as seen by the rapid expansion of research, clinical trials, and scientific information produced on the subject. An illustration of this can be found in the World Health Organization's (WHO) registration of just over 768,142 thousand papers in its Global Research Database on COVID-19 until December 2022.

The COVID-19 poses a public health threat and ranks among the largest health and humanitarian emergencies of the twenty-first century worldwide (Werneck; Carvalho, 2020). During the pandemic, scientific research outputs were very important, and so it was the dissemination of scientific results to the public and/or governing bodies.

In terms of scientific contributions, decisions on containment and adaptation to the pandemic could be made using scientific and technical data in public management. Regarding the disseminating scientific discoveries to and by the public, it would promote compliance and awareness of required behaviors. In a pandemic scenario academics must work much harder, not only to produce sound and relevant scientific results, but also to address the public's reception of science and debate about the research. The tension between the creation of new knowledge and the social debates around it can be seen as a fundamental challenge for science communication in a pandemic scenario. Therefore, it can be argued that monitoring how scientific results and knowledge related to critical topics like COVID-19 are circulated on social media and reach broader audiences it is as vital as the generation of the scientific knowledge itself.

The present study was prepared with this monitoring point of view in mind, focusing on the following research question: which interest groups in Brazil during the coronavirus pandemic interacted with research on COVID-19? Our main objective is to investigate the communities of attention networks (CAN) that were generated around the sharing of this research.

In the context of altmetrics studies, CAN represents clusters of individuals or groups of users who are actively discussing, sharing, or engaging with specific research topics or publications. The analysis of communities of attention refers to the analysis of different communities of active users on social media platforms and their interactions with scientific outputs or entities, and offers a conversational perspective to altmetrics (Araújo, 2020).

Comprehending CAN in altmetrics research can shed light on the dissemination of knowledge within academic or public communities, the popularity of research topics, and the impact of digital communication channels on scholarly communication. According to Araújo *et al.* (2023) research that understands the phenomenon of the spread and viralization of COVID-19, as well as its implications, is crucial to follow the public debate on the topic and formulate strategies to combat not only the disease, but also any science disinformation associated with it.

Studies on altmetrics have explored and provided certain theoretical and methodological viewpoints that have shown to be significant; nonetheless, more research is needed to confirm their po-

tential. Starting from the point of view of the evaluation framework of interactions between science and society in multiple directions, called heterogeneous couplings, conceptualized as the co-occurrence of scientific and non-scientific objects, actors and interactions in online media environments (Costas; Rijke; Marres, 2017).

Based on these, some researchers have proposed what they call the “second generation of social media metrics”; this would support the altmetrics locus of analysis as indicators used to define these communities, as well as metrics of interaction and dissemination of scientific knowledge in various communities of attention (Díaz-Faes; Bowman; Costas, 2019). Van Schalkwyk, Dudek and Costas, (2020) proposed the use of altmetric data to explore the interests of non-scientific audiences in science, configured around communities of interest and cognitive bridges among them. Araujo (2020) proposed the use of conversational approaches when analyzing the Twitter visibility of scientific papers, by examining the degree of endorsement and distribution in the sharing of the articles, as a means to understand the interactions between the groups that surround the content (Araujo, 2020).

These communities analyzed in previous studies can be identified through various methods, including social network analysis, which examines patterns of interaction and communication between users on platforms such as Twitter, Facebook, or academic social networks. In our study, we considered data from Twitter (X), a social media platform that usually stands out when compared to other altmetric sources.

2 MATERIALS AND METHODS

COVID-19 publications were collected from the Dimensions database using the full search option and the string: “2019-nCoV” OR “COVID-19” OR “SARS-CoV-2” OR (“coronavirus” OR “corona virus”). The data was exported as a .CSV file and the list of DOIs was imported into Altmetric.com to collect the altmetric data of the publications. In Altmetric.com we applied the filter to obtain only mentions on Twitter (X) from Brazil and exported a .CSV file with data from each user <user_ID> and each tweet <tweet_ID>. In addition, we retrieved the Twitter (X) information about each user (name, location, bio info, etc.) and post content (mentions, replies, RTs, etc.) for the posts between 2020 and 2022. This Twitter data was stored in an in-house database available at the Centre for Science and Technology Studies (CWTS), Leiden University.

Approximately 17,6k out of the 1,7 M publications on COVID-19 that were found were mentioned at least once on Twitter. Thus, amounting to a total 62,979 twitters who together provided 234,346 tweets. Social networks and their basic statistical descriptions are used in this article to study the CAN. This is done by mapping the links that connect users to one another (by mentions, replies and retweets) and their interactions with the papers. Users’ biographical information and tweets are analyzed by word frequency, and users’ data is clustered using Gephi algorithms in order to identify CAN.



3 RESULTS AND DISCUSSIONS

In our dataset there are a total of 62,979 users from Brazil mentioning, replying, or reposting another 27,682 different users from Brazil. These users were mapped into communities of attention networks, containing 90,661 nodes and 198,611 edges. Statistical information about the network that allows us to understand some of its characteristics is included in Table 1 and its visualization can be seen in Figure 1. The observed average degree is 2.19, indicating that, on average, each node is connected to approximately 2 other nodes; the density of 0.002 suggests that the graph is quite sparse, with few edges compared to the maximum possible connections; the diameter of 15.0 means that the longest path between any two users in your graph consists of 15 edges.

Table 1 - Properties of the CAN around COVID-19 shared papers in Brazil (2020-2022).

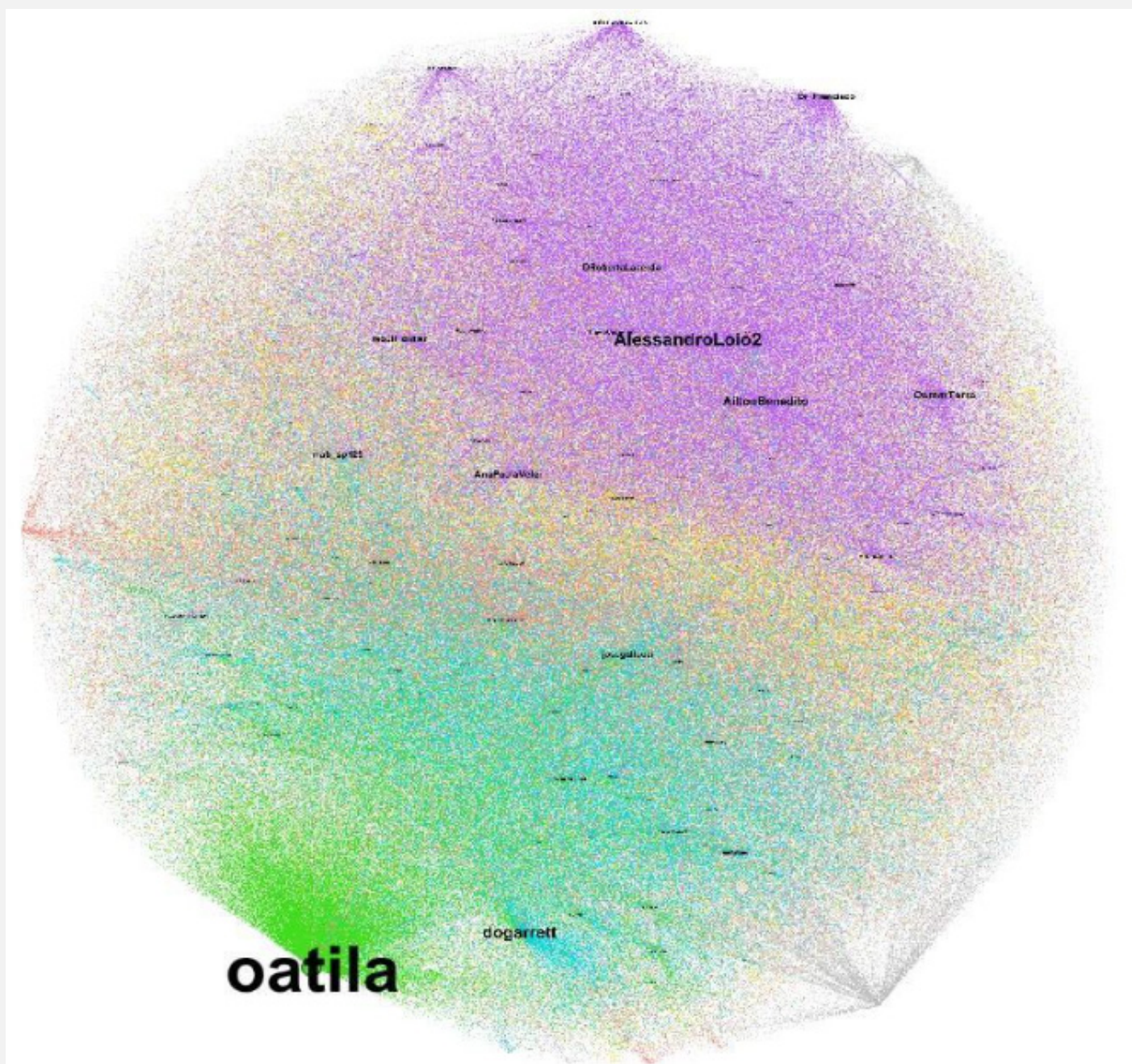
Index	Description	Values
Average Degree	Represents the average value at which each user connects to another	2,191
Density	Defines the quantity between one user and another (largest shortest path), expressing how close the graph is to becoming complete.	0.002
Diameter	Represents the length of the longest path (in number of edges) between two nodes (users).	15.0
Avg. Path length	Average path distance between users.	5,094
Avg. Clustering Coefficient	Connection probability between users when grouped close to a given user.	0.563
Modularity	Identifies the presence of communities among users.	0.606

Source: Research data (2024).

The average path length indicates that it takes approximately 5,094 steps to travel from one user to another; a coefficient of 0.563 suggests a relatively high level of clustering. The modularity of 0.604 indicates a relatively high degree of community structure, meaning that nodes are more densely connected within their communities than with nodes outside their communities.

The rendering layout used in Gephi for visualizing the community of attention network is Force Atlas 2, with application of 'dissuade hubs', 'LingLog mode', and 'Approximate repulsion'. The tolerance (speed) values = 5.0 and Approximation = 1.2. For tuning, sizing = 500.0 and gravity = 1.0 were parameterized.

Figure 1 - Community of attention network around COVID-19 shared papers in Brazil (2020-2022).



Source: Research data (2024).

There are 236 clusters in the mapped CAN, although the majority only have a few connected other nodes, and 76% of the connections are made in the seven primary clusters. The four major clusters – which account for 61.1% of connections – were taken into consideration for the CAN analysis in terms of characterizing users and content. Table 2 describes general aspects per cluster such as the number of users, their representation, the number of articles mentioned, number of tweets, and the most frequent words in the biographical Twitter description of the users, as well as the words used in their tweets mentioning COVID-19.

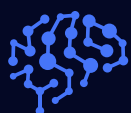


Table 2 - Main characteristics of the four central CAN clusters.

Cluster	Nodes	(%)	Papers	Tweets	Top10 words from user's Bio	Top10 words from tweets
1 (purple)	18,997	20,95	2,068	79,948	god (994); Brazil (891); conservative (854); above (653); right-wing (652); patriot (607); Christian (556); family (539); Bolsonaro (458); father (367)	covid/covid19 (2,407); study (1,634); treatment (902); hydroxychloroquine (845); patients (814); article (436); early (353); vaccine (340)
2 (green)	17,144	19,91	1,877	40,877	professor (393); phd (197); doctor (188); life (171); journalist (159); father (141); mother (137); politics (129); Brazil (127); science (127)	covid/covid19 (1,905); study (906); article (458); patients (401); pandemic (346); oati-la (345); Brazil (332); vaccine (321); virus (313); mask (238)
3 (light blue)	10,048	11,08	4,136	36,734	professor (440); journalist (266); life (257); mother (178); politics (172); father (177); world (147); science (136); law (122); Brazil (151)	covid/covid19 (4,747); study (1,816); patients (1,033); article (950); vaccine (755); pandemic (622); Brazil (597); risk (588); sarscov2 (519); use (518)
4 (red)	9,233	10,18	8,275	27,422	professor (426); doctor (161); science (247); student (134); Brazil (209); university (188); health (127); researcher (146); medical (98); federal (85)	covid/covid19 (12,570); patients (2,521); study (2,229); sarscov2 (1,589); pandemic (1,786); coronavirus (1,285); vaccine (1,215); risk (1,158); health (1134); people (982)

Source: Research data (2024).

Results in Table 1 show that, as it could be expected, clusters with more users tend to also have more tweets. This is clearly the case for the first four clusters. However, when it comes to the number of publications tweeted in each of the clusters, the relationship with the number of tweets and users is not linear. For instance, the third and fourth clusters had triple and quadrupled the number of publications, respectively, while having around half as many users as clusters 1 and 2.

Comparing the most common terms throughout clusters 1 through 4, it appears that there are disparities in the characterization of users, with more personal, religious, and political aspects on the one hand, and more professional and academic aspects on the other. Cluster 1's keywords are consistent with the catchphrase from former president Jair Messias Bolsonaro's inaugural speech, "Brazil Above Everything. God Above Everyone". This would serve as the foundation for his ultra-right government's relationship with religion and politics, contextualizing it within the growth of political-religious fundamentalism in Latin America and strengthening the unprecedented partnership with a sizeable



segment of the evangelical population in Brazil (Cunha, 2023).

The most used terms in tweets might point us toward the discursive content of the users and, in certain cases, can also suggest emphasis, focus, or communication style. All clusters share the scientific narrative, which indicates that various interest groups employed this kind of narrative as a communication tactic. The word “study,” which appears 22,931 thousand times in the four clusters – more than the term “Covid-19,” which appears 21,629 thousand times – is primarily used by the groupings to indicate a particular foundation for their narratives. In response to any potential disagreements about protection and control methods during the pandemic, “show me the study” seems to have been a common response (Alves *et al.*, 2021) from individuals who disagreed.

Political polarization generates an “us versus them” mentality (Viscardi, 2020), and depending on the opinion expressed, people can be seen as allies to be protected or as enemies to be fought. In this dispute, a cursory analysis of the data shows how @oatila’s profile (scientist, biologist and science communicator), was mentioned often in the form of questioning and attacks by users from cluster 1 (n=41), while defended or questioned by users from cluster 2, in which he is a central figure mentioned/retweeted 30,626 times. Considering aspects of popularity, authority and articulation his profile topped the list of the most influential scientists in Brazil during the pandemic (Meirelles, 2020).

The analysis of frequent words in the tweets also suggests important differences between the clusters. The defense of medicinal drugs such as hydroxychloroquine as miracle cures for COVID-19 in the form of “early treatment” (with unproven treatment) and the discouragement of prevention measures through vaccines were at the center of the dimensions of Bolsonaro’s cruel populism (Farias; Casarões; Magalhães, 2022), and this is evident in cluster 1. Cluster 1 exhibits a high occurrence of the keywords ‘hydroxychloroquine’ and ‘early treatment’. This is one of the primary areas of concentration for the group, with tweets regarding vaccines coming in second. The other groups include much more often ‘health’ issues and the use of ‘masks’.

4 CONCLUSIONS

This study investigated the Communities of Attention Networks centered on COVID-19 research that was posted on Twitter (X) during Brazil’s pandemic. The data supports the existence of substantially distinct communities (clusters of users) that interact with the papers and with each other in various ways.

To further understand the particularities of each cluster (or community), future research will examine the degree of similarity between the titles and abstracts of publications and tweets about them. It will also delve deeper into each cluster’s analysis. Additionally, the study will look at how users interacted with one another on particular subjects like “social distancing,” “wearing a mask,” and “vaccination,” as well as by user type like “teacher,” “doctor,” etc.

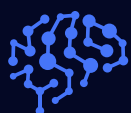


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