

# Astroturfing as a strategy for manipulating public opinion on *Twitter* during the pandemic in Spain

Sergio Arce-García; Elías Said-Hung; Daría Mottareale

Recommended citation:

Arce-García, Sergio; Said-Hung, Elías; Mottareale, Daría (2022). "Astroturfing as a strategy for manipulating public opinion on *Twitter* during the pandemic in Spain". *Profesional de la información*, v. 31, n. 3, e310310. <https://doi.org/10.3145/epi.2022.may.10>

Article received on December, 10<sup>th</sup> 2021

Approved on April, 11<sup>th</sup> 2022



**Sergio Arce-García** ✉  
<https://orcid.org/0000-0003-0578-9787>  
Universidad Internacional de La Rioja  
Escuela Superior de Ingeniería y  
Tecnología (ESIT)  
Avda. de la Paz, 137  
26006 Logroño, Spain  
[sergio.arce@unir.net](mailto:sergio.arce@unir.net)



**Elías Said-Hung**  
<https://orcid.org/0000-0002-0594-5906>  
Universidad Internacional de La Rioja  
Facultad de Educación  
Avda. de la Paz, 137  
26006 Logroño, Spain  
[elias.said@unir.net](mailto:elias.said@unir.net)



**Daría Mottareale**  
<https://orcid.org/0000-0002-1416-7923>  
Universidad Internacional de La Rioja  
Facultad de Educación  
Avda. de la Paz, 137  
26006 Logroño, Spain  
[daria.mottareale@unir.net](mailto:daria.mottareale@unir.net)

## Abstract

This work aims to establish whether astroturfing was used during the Covid-19 pandemic to manipulate Spanish public opinion through *Twitter*. This study analyzes tweets published in Spanish and geolocated in the Philippines, and its first objective is to determine the existence of an organized network that directs its messages mainly towards Spain. To determine the non-existence of a random network, a preliminary collection of 1,496,596 tweets was carried out. After determining its 14 main clusters, 280 users with a medium-low profile of participation and micro- and nano-influencer traits were randomly selected and followed for 103 days, for a total of 309,947 tweets. Network science, text mining, sentiment and emotion, and bot probability analyses were performed using *Gephi* and *R*. Their network structure suggests an ultra-small-world phenomenon, which would determine the existence of a possible organized network that tries not to be easily identifiable. The data analyzed confirm a digital communication scenario in which astroturfing is used as a strategy aimed at manipulating public opinion through non-influencers (cybertroops). These users create and disseminate content with proximity and closeness to different groups of public opinion, mixing topics of general interest with disinformation or polarized content.

## Keywords

Astroturfing; Disinformation; Hoaxes; Pandemics; Covid-19; Manipulation; Public opinion; Small-world; *Thunderclap*; Spain; Philippines; Nanoinfluencers; Geolocation.

## 1. Introduction

In recent years, the debate around hoaxes and disinformation has become increasingly important in academic and journalistic spheres (Blanco-Alfonso; García-Galera; Tejedor-Calvo, 2019), where the word "*infodemic*" has emerged to describe an excess of information that reflects the increasing power of social networks (Ortega, 2020). The digital stage has become a particularly important space for capturing and influencing public opinion in our society (Campos-Domínguez; Calvo, 2017). Our environments are increasingly characterized by a hybrid communicative ecosystem, in which tra-

ditional and digital media coexist in the outreach efforts of political and social actors (López-García, 2016). This scenario favors the promotion of a culture of disinformation, with rampant promotion of false content intentionally created to condition or manipulate public opinion around certain issues (Wardle; Derakhshan, 2017). This culture is better represented –from our point of view as well as that of international organizations such as the *European Commission* (2018)– through the use of the term *disinformation*, and not similar terms such as *misinformation*. The former focuses on the dissemination of deliberately misleading content, that is, content with malicious intent, confusing, inaccurate and with elements of falsehood; while the latter is not necessarily intentional, and refers to a dissemination of content based on rumors and confusing, inaccurate, unverified or false information (Jack, 2017; Torabi; Taboada, 2019; Hřčková *et al.*, 2019).

Attention should be placed on the type of strategy used to disseminate this type of content through social networks, aided by websites created to make the arguments appear more solid and real

As Guess, Nyhan and Reifler (2018) rightly point out, when analyzing the use of disinformation, attention should be placed on the type of strategy used to disseminate this type of content through social networks, aided by websites created to make the arguments appear more solid and real (Zhao *et al.*, 2020). This content is disseminated and amplified by users (foot-soldiers) who do not fit the profile of an influencer (high follower-count and activity). These non-influencer users appear not to be organized or related to each other, but they act in a coordinated manner, mostly avoiding suspicion due to their “apparent anonymity” in contrast to the activity of clearly identifiable and relevant political and social actors. This approach has come to be known as *astroturfing*, a strategy for promoting content that has been used in politics, public relations and advertising for decades (Sorensen; Andrews; Drennan, 2017), and which, with the rise of social media, has become increasingly relevant for the dissemination of disinformation (Elmas *et al.*, 2021). Thus, *astroturfing* is a campaign to spread information and ideas, centered on an attempt to appear founded on spontaneity and freedom of expression but organized and coordinated (Lits, 2020). This phenomenon would tie in with Granovetter’s (1973) sociological theory of the strength of weak ties, where distant contacts would be highly influential in providing new ideas to groups of people.

Based on the above, social networks have seen the rise of tactics such as the so-called *Thunderclap* technique, where micro- and nano-influencers (Wissman, 2018)– users with 100,000 and 10,000 followers or less, respectively, as classified by Ong, Tapsell and Curato (2019)– considered normal and identifiable by the rest of the population as their peers, “introduce” certain messages into the networks to which they belong (Sorensen; Andrews; Drennan, 2017). *Thunderclap*, derived to the *astroturfing* term for social networks (Mahbub *et al.*, 2019), comes from the marketing world as a form of information dissemination based on a seemingly unconnected crowd (Bradshaw; Howard, 2018), following the name and approach of the British and American bombing operation over Germany at the end of World War II (Davis, 1991).

Under this technique (*thunderclap*) and this disinformation strategy (*astroturfing*), the leading “alpha” users do not follow the client’s account (the influencer) to avoid being detected. They also use a team of “beta” users, who may or may not be bots, and run several different accounts at once. These “beta” users are in charge of: (1) engaging with the interactions generated by the tweets in question, and (2) openly sending the disinformation posted by “alpha” users to influencers (e.g. journalists and media), so as to generate “trending topics”. The campaign is implemented in small world and ultra-small-world networks. Small-world networks are highly dense small groups in which users in social networks tend to participate, and which may have strong interconnections (Milgram, 1967; Himelboim *et al.*, 2017); while ultra-small-world networks have a shorter distance between nodes (Barabasi, 2016; Menczer; Fortunato; Davis, 2020).

Authors such as Ong and Cabañes (2019), Ong, Tapsell and Curato (2019), Bradshaw, Bailey and Howard (2021) have geographically framed these campaigns in countries such as the Philippines, which have a “high capacity” for “cyber-troops” for the application of this type of strategy for business or political purposes. These organized groups have been called “troll farms”, as detected in international media such as the *Los Angeles Times*, *The Washington Post*, and the *BBC* (Bengali; Halper, 2019; Mahtani; Cabato, 2019; BBC, 2020) and were used to disseminate disinformation during the Covid-19 pandemic (Collins; Zadrozny, 2020).

With the onset of the Covid-19 pandemic and the global implementation of lockdowns and policies restricting citizen mobility, the dissemination of disinformation has increased (Aleixandre-Benavent; Castelló-Cogollos; Valderrama-Zurián, 2020; García-Marín, 2020) as the media engage in a battle to perpetuate the controversy and keep ratings at a high level (Cebrián; Balsa-Barreiro, 2021). Citizens have been influenced by the overabundance of information generated during this period, as well as by the deliberate dissemination of false information (Salaverria *et al.*, 2020; Collins; Zadrozny, 2020). This issue has been defined by entities such as the *World Health Organization* (2020) as an “infodemic” and has made it more difficult for citizens to apply enough resources, mechanisms and skills to identify truthful content. This phenomenon amplifies effects such as confirmation bias (Wason, 1960), defined as the favouring of information that confirms or supports previously held beliefs or values (Jerit; Zhao, 2020).

The study about *astroturfing* has defined its phases well, such as co-tweeting (different tweets with a similar message in a short time from different accounts with no apparent connection) and co-retweeting (flood of messages a few hours later), in the work of Keller *et al.* (2020) in the South Korean elections. But also explain its tactics. The phenomenon of

their global expansion in the international political world was analysed (**Schoch et al.**, 2022) and the case of how Russian agencies used these techniques in the 2016 US elections (**Diresta et al.**, 2019). In the Spanish language, studies on this issue are very scarce and mainly conceptual (**García-Orosa**, 2021).

The scenario described so far –information overload and proliferation of disinformation– has favored the rise of a socio-communicative environment defined by panic, confusion and polarization about the health crisis (**Adhanom-Ghebreyesus; Ng**, 2020). In this environment, being well-informed has become a difficult task for citizens in general, especially when they may prefer to avoid confronting the crisis as a coping mechanism (**Aleixandre-Benavent; Castelló-Cogollos; Valderrama-Zurián**, 2020). This avoidance can be achieved through contact with disinformation that is difficult to refute in the short term and which is persistently disseminated through the implementation of astroturfing strategies. The dissemination of content associated with diverse, intermingled, seemingly unrelated topics could be being deliberately promoted outside Spain with a single purpose: to condition Spanish public opinion through social networks.

The hypothesis of this work is: having detected tweets in Spanish, related to Spanish issues, and geographically located in the Philippines –a country with few Spanish speakers– we expect there to be an organized, non-random network structure. This structure would disseminate information through similar techniques to Spain in the same way as shown to South Korea, the United States or other parts of the world as mentioned above.

To corroborate this hypothesis, we selected a series of random users from the same location in the Philippines, who tweet in Spanish. Subsequently, we follow up on these users for several months in order to verify whether the existence of a non-random network can be objectively established.

A secondary objective of this research is to establish the study of themes, topics, and vectorization, as it is understood that the existence of a diversity of opinions on current Spanish affairs from the same a place thousands of kilometers away and of non-with barely any Spanish speakers would be an artificial debate. To this purpose, a form of analysis is established. To this end, we analyze the data through two methods: text mining and analysis of feelings and emotions.

## 2. Methods

This paper aims to establish whether astroturfing was used during the Covid-19 pandemic to manipulate Spanish public opinion through *Twitter*. The study focused on messages published on *Twitter* in Spanish by users geolocated outside Spanish territory –specifically, in the Philippines. This decision was based on statements by authors such as **Bradshaw, Bailey** and **Howard** (2021), who point to this country as one of the main promoters of disinformation during the pandemic.

The study is based on a quantitative approach to the analysis of the tweets, as such:

- We collected tweets in Spanish geolocated within 500 km of the city of Manila, capital of the Philippines. Subsequently, it was possible to better locate the tweets within 100 km of the city of San Jose. The collected tweets were sent in June 12 to 16, 2020. A total of 1,496,596 tweets (475,001 tweets and 1,021,595 retweets) were identified at this stage, using the open-source statistical software *R*, in its *RStudio* environment in version 1.2.5033 and the *RTweet* capture library (**Kearney**, 2018). A total of 491,896 users authored the collected tweets.
- The tweets were geolocated by adding a filter to the query sent to the *Twitter* API by establishing longitude and latitude coordinates (selected through *Google Maps*) and a radius. This procedure made it possible to estimate the radius in kilometers of each of the tweets collected in this stage. Although the results provided by geolocation through the *Twitter* API are not entirely accurate, studies by **Van-der-Veen et al.** (2015), **Holbrook et al.** (2016) and **Lopreite et al.** (2021) have applied this technique and identified an average error of 256 kilometers (**Holbrook et al.**, 2016). This margin of error has a geographical reliability of 83.5% in the Philippines region (**Van-der-Veen et al.**, 2015).
- Using the retweets (N=1,021,595) and users (N=491,896) collected in the previous stage, we used cluster analysis (**Chen; Hossain; Zhang**, 2020) to identify groups (clusters) and affinities between users. In these clusters, we identified users whose in- and outdegrees had values between 2 and 5, that is, users with a medium-low profile of participation, as well as nano-influencer traits. In total, 95,509 users with these traits were identified during this process. These parameters are intended to track users who follow the typical characteristics of low profile astroturfing to be able better to introduce new messages without rejection by other users, as **Keller et al.** (2020) established at the co-tweeting stage.
- From the 95,509 users with these characteristics, a total of 280 users were randomly selected, 20 for each of the 14 main clusters identified. These comprise the total number of case studies in this work. From these users, we collected the total number of tweets posted from 22 July to 2 November 2020 (103 days), namely 309,947 tweets, which comprise the final sample of this study.

The data associated with the final sample of messages published by the 280 users was then analyzed in the following manner:

- Network analysis, using *Gephi* (version 0.9.2), to graphically study the network created by the tweets by applying the *Open Ord* and *Yifan Hu* algorithms (**Martin et al.**, 2011; **Hu**, 2006). This process included an analysis of clusters and their associated influence (**Chen; Hossain; Zhang**, 2020) through the modularity optimization methodology based on the Louvain algorithm (**Blondel et al.**, 2008), as well as modularity and betweenness centrality (**Bastian; Heymann; Jacomy**, 2009), harmonic centrality and eccentricity distribution.

- Using *R* for statistical analysis and determination of bot behavior probability using *Tweetbotornot* algorithm (Kearney, 2018).
- Text mining study using *KH* coder software (version 3.0), based on *R* (Higuchi, 2016), to determine the main frames. We implemented the stemming technique, which is based on trimming the morphemes of the words that provide information and eliminating the empty words or “stop words” in Spanish<sup>1</sup>. We then performed a bivariate multidimensional analysis of the 8 main clusters of words that appeared most frequently in our sample (Arce-García; Menéndez-Menéndez, 2018).
- Analysis of polarity and emotions through the lexicon developed by the *National Research Council of Canada (NRC)* in its 0.92 version in Spanish (Mohammad; Turney, 2010; 2013) through the *Syuzhet* library (Jockers, 2017) in *R*. This lexicon is used to determine the basic feelings –anger, anticipation (expression of rational thinking), disgust, fear, joy, sadness, surprise and trust– in people and their discourses (Sauter et al., 2010). This natural language processing technique is a way of determining the degree of positive or negative subjectivity of each tweet and its intensity. However, although this lexicon is very advanced in English, it has the disadvantage of not being as advanced in other languages (around 70% certainty in Latin languages) (Mohammad, 2016). This analysis will reveal whether there are polarised messages in the language that, on the one hand, will identify messages that are intense and emotional but, on the other hand, easily identifiable.

To determine whether the network is a real structure, we calculated certain variables to compare the behavior of this network to that of a random network. To this end, we attempted to determine whether the network meets the criteria of the so-called small-world effect, or even the ultra-small-world effect. According to Menczer, Fortunato and Davis (2020), an ultra-small-world effect, which they define as the “trademark feature of many real networks”, occurs when there are few hops to navigate the network, small average distance values (compared to the value of 5 that they establish as average for *Twitter*), and high modularity values (considered above 0.6 as good and 0.8 as very good by Lantz (2019)). On the other hand, Barabasi (2016) establishes the relationship between the distance between a network scale network versus the distance of a random equivalent network. He thus establishes that a small-world network will have an average distance comparable to  $\ln N$  ( $N$  = number of nodes), and an ultra-small-world effect equivalent to  $\ln(\ln N)$ . For values even lower than an ultra-small-world, Barabasi (2016) interprets this as a hub-and-spoke, where the nodes are so close that they are interconnected to the same central hub. Other elements, such as the temporal study of the evolution of the average degree of the network and the average clustering coefficient, were also observed to determine behavior.

### 3. Results

First of all, we must point out the distribution of the 1,496,596 messages collected between 12/06/2020 (16:53 hrs.) and 16/06/2020 (08:11 hrs.) in our first stage of identification and classification. After cluster analysis of retweets, we identified a total of 5,338 different clusters, 14 of which include 72.63% of the tweets analyzed in this work. Table 1 shows how, beyond the diversity of topics addressed in these tweets, how topics (ecosystems) associated with ideological issues, certain political parties, religious, scientific or related to law enforcement represent 26% of the tweets studied here; while the rest focus on seemingly superficial topics associated with models, youth, animals, influencers, humor or other leisure and/or entertainment activities (video games, football, music).

The network analysis (figure 1) of all the retweets posted by the 491,896 users shows a high modularity value (0.787). This reflects a high level of association between users, despite the wide diversity of clusters or groupings of the topics addressed by them, represented by the 458,029 nodes and 738,981 edges that comprise the networks in which each of these tweets were located. These networks have an average diameter of 29 hops, an average path length of 8.775 and an average degree per account of 1.613.

In Figure 1, we can see all the groups identified through cluster analysis surround each other, with hardly any separation between them. This is to be expected among highly polarized groups, as has been pointed out in other studies by authors such as Vila-Márquez and Arce-García (2019).

The polarization observed in Figure 1 can especially be seen, above all, between the far-right and left-wing groups, with, on the one hand, messages with many references and retweets of messages from the official accounts of Santiago

Table 1. Main clusters identified

Cluster	Central themes addressed by cluster	Percentage
1	Models	15.80
2	Far-right	13.71
3	Teenagers and animals	8.13
4	Left-wing parties ( <i>Podemos-PSOE</i> )	7.47
5	Influencers	6.98
6	Humor	4.95
7	Videogames	4.80
8	Law enforcement (Police / Civil Guard / Army)	2.34
9	Football	2.17
10	Music	2.02
11	Science	1.69
12	K-Pop	1.52
13	TV, Film, and Streaming	1.48
14	Religion	1.07

Abascal, president of *Vox* (eigenvector = 0.518 and indegree 17,184), and the rest of this far-right political party, as well as news from ultra-conservative digital newspapers and blogs. Likewise, there are also numerous news items retweeted from web portals aimed at propagating disinformation, such as *Caso Aislado*<sup>2</sup> (eigenvector = 0.046 and indegree 1,531) or *Mediterráneo digital*<sup>3</sup> (eigenvector = 0.0389 and indegree 1,296). On the other hand, in this same polarization, there are also numerous accounts with followers of left-wing Spanish political parties, mostly followers of *Unidas Podemos* (eigenvector = 0.132 and indegree 4,386) and to a lesser extent of the Spanish socialist workers' party (*PSOE*)<sup>4</sup> (eigenvector = 0.063 and indegree 2,109). Users who are followers of these parties repeatedly confront the tweets published by those associated with ultra-conservative parties such as *Vox*, in a possible false flag operation. This almost continuous monitoring, continuation and response between users associated with ultra-conservative parties and those close to *Unidas Podemos* and *PSOE* causes the *Open Ord* and *Yifan Hu* algorithm to determine that these groups are closely related, as seen in Figure 1.

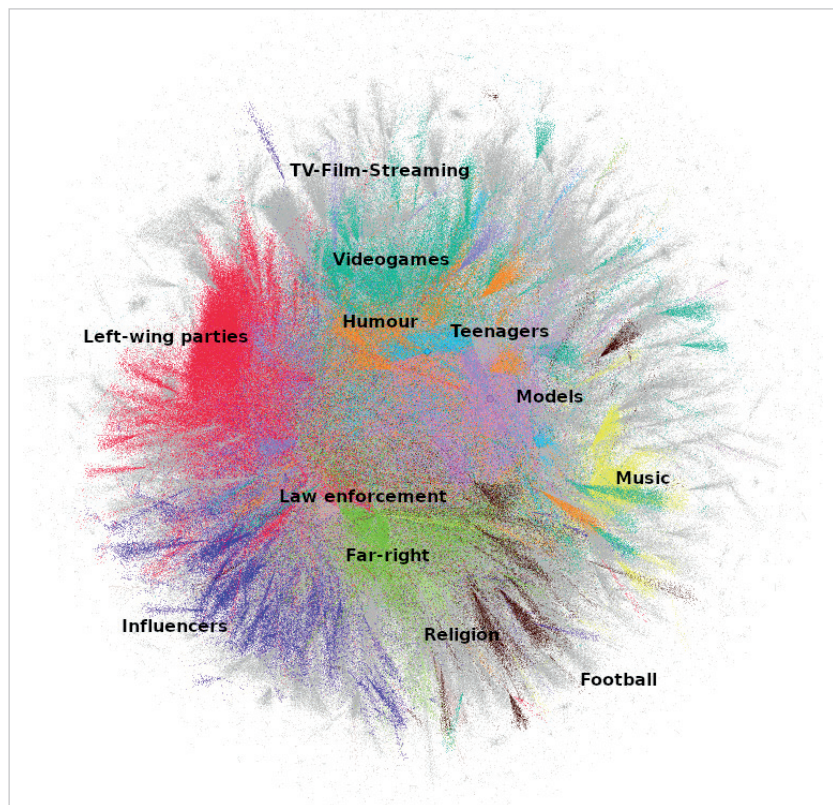


Figure 1. Graph of retweets collected geolocated within the Philippines

It is striking that less than 1% of all the tweets analyzed alluded to or had a direct association with other political parties in Spain (*Ciudadanos*, with an eigenvector of 0.027 and indegree 892). None of the tweets we collected were associated with the *Partido Popular* (@populares)<sup>5</sup> or other parties (@Esquerra\_ERC, @JuntsXCat, @MasPais\_Es or @eajpnv).

The centre of the network of retweets of the messages analyzed, determined by the eigenvector value, is found around user accounts that write emotive messages, such as @rauwarejandopr (eigenvector = 1.0) or @MykeTowers\_ (eigenvector=0.779). These users fulfill a nano-influencer role, as they have a low number of followers (around 500), as in the case of @radxime. But other user profiles were also identified, some of which were subsequently suspended for not complying with *Twitter* rules<sup>6</sup>, for security or authenticity reasons (e.g., @nxhi\_ with eigenvector = 0.573), or for being related to accounts of Spanish political actors, such as Santiago Abascal (@Santi\_Abascal with eigenvector = 0.518), president of the far-right *Vox* party.

Around the cluster of models or young girls posing and/or taking selfies –the largest group of users detected in terms of tweet traffic– there are also some users who were subsequently suspended from *Twitter* for breaking the rules (e.g. @Oficialcazzu). The centrality of the network of retweets continues in the far-right cluster, surrounded in the graph in Figure 1 by close connections of tweets directly associated with the cluster that we have come to call “Law enforcement” (tweets that allude directly and indirectly to the police, the Civil Guard or the Spanish army), as well as the cluster of tweets with religious content.

The data observed from the network analysis also show that there are highly interrelated clusters with a high density of interconnected accounts, with messages about teenagers and animals, humor (mainly through the rebroadcasting of tweets from satirical humor magazines such as @eljueves or @elmundotoday), videogames, music (with a prominent subgroup dedicated to K-Pop style groups) or television, film or streaming platforms. The topics covered by these clusters are mostly associated with or allude to content directly linked to Spain, published by users geographically located in that country; although small groups (each representing approximately 1% of the total number of messages in this cluster) deal with topics covered by users from other countries (Argentina, Mexico or Venezuela).

A betweenness centrality analysis reveals the users that connect the various clusters. Of the 50 users with the highest intermediation value (all of them above 900,000), of the total of 491,896 users responsible for the 1,496,596 tweets collected between 12 June 2020 and 16 June 2020, 50% are located in the far-right cluster, expressing in their

“ This strategy was undertaken by users geolocated in the Philippines, interested in promoting content associated with the Spanish agenda setting, clearly intended to influence public opinion ”

tweets sympathy or affinity to the political party *Vox*; 12% are located in the left-wing cluster and the rest of the users (38%) are located in the teenagers and animals and models clusters. This data allows us to see how these four clusters structure the flow of information in the entire network.

After randomly selecting 280 users (20 from each of the 14 main clusters), 309,947 tweets were collected from 22 July 2020, 12:36 hrs. to 2 November 2020 09:20 hrs. (GMT time), except for 1 August, when we were not able to collect data for a few hours due to a connection failure.

In this phase of the work, 115,482 tweets and 194,465 retweets were collected from 266 accounts. The remaining 14 accounts were excluded from the analysis because they were suspended from *Twitter* or had no activity.

As for the frequency of posting, in figure 2 we see a continuous flow of tweets posted by the 280 users under analysis. There are no changes associated with a higher flow of messages published by these users at the level of the 14 clusters that concentrate most of the messages analyzed in this study.

The number of tweets per cluster and their main features can be seen in Table 2. This table shows how, in terms of the number of concentrated messages:

- Most of the clusters that exceed the average daily number of messages published during the period of data collection addressed in this study (214 daily messages) are those associated with clusters related to leisure and/or entertainment (e.g. music, TV and film, and influencers). The clusters associated with music have the highest average daily number of messages published (462 messages if we consider the average number of daily messages published in the music and k-pop clusters).
- Among the clusters that structure the flow of information, only the left-wing cluster has a higher average number of messages (299 tweets per day) than the general average (214 tweets per day) in the rest of the clusters, which account for 72.63% of the tweets analyzed. Of the rest of the clusters that make up this group, the models cluster remains within the general average observed at the level of the 14 main clusters, while the far-right and teenagers and animals clusters have a clearly lower average number of tweets per day (150 and 131 messages, respectively).

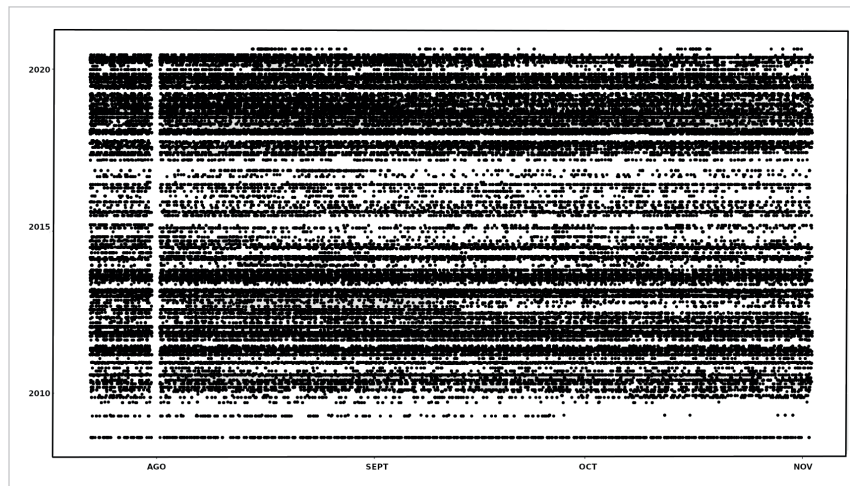


Figure 2. Tweets sent throughout the analyzed period, ordered by the accounts' date of creation

Table 2. Tweet data of the 280 accounts analyzed

Cluster	Number of tweets issued period	Average number of tweets per day	Average bot probability	Followers		Follows		Historical favorites		Historical tweets sent		Account creation date	
				Average	Median	Average	Median	Average	Median	Average	Median	Average	Median
Models	22,046	214	0.301	499.2	368	402.2	354	33,440	27,101	33,424	26,696	13/03/2015	20/02/2013
Far-right	15,481	150	0.395	211.9	183	416.2	416	8,329	6,980	15,749	7,873	15/10/2015	15/08/2017
Teenagers and animals	13,537	131	0.332	1,020	503	774.8	382	14,527	12,858	22,443	9,286	30/12/2015	02/05/2016
Left-wing	30,817	299	0.490	1,590	859	1,256	1,139	29,442	27,366	33,325	24,566	09/03/2015	26/11/2015
Influencers	24,211	235	0.360	554.2	273	457.8	306	34,180	20,281	34,842	17,807	13/09/2015	10/05/2017
Humor	18,120	176	0.522	5,366	177	2,040	514	15,734	7,390	23,644	29,672	26/07/2013	07/03/2013
Videogames	9,700	94	0.348	345.1	257	306.9	325	83,604	41,412	31,135	28,313	07/06/2013	22/07/2013
Law enforcement	10,612	103	0.318	1,654	900	582.5	533	45,570	21,493	42,489	14,581	04/11/2014	18/10/2013
Football	16,870	164	0.352	792.9	662	1,032	980	28,209	20,398	72,234	50,571	06/12/2011	06/10/2011
Music	65,874	640	0.521	875.6	540	877.8	705	68,967	51,453	64,635	24,032	18/05/2017	17/08/2018
Science	3,893	38	0.332	253.1	142	419.6	120	39,070	60,308	15,536	22,554	29/05/2012	04/12/2010
K-pop	29,280	284	0.547	1,061	1,121	1,531	1,832	43,958	41,873	38,059	14,392	10/01/2017	05/07/2018
TV, film, and streaming	30,588	297	0.394	3,411	2,525	2,462	1,092	35,529	21,597	38,624	33,283	07/04/2016	14/01/2018
Religion	18,948	184	0.347	3,404	453	3,149	905	15,087	17,811	34,216	24,131	05/11/2013	17/11/2011

In terms of followers, only the left-wing cluster has an average number of followers similar to the general average observed in the 14 clusters identified (1,503 followers), while the rest have a clearly lower average number of followers, with the far-right cluster having the lowest average (211 followers). In the rest of the cases, it is striking to see that:

- Clusters with a high daily volume of published messages, such as those associated with music, have a lower average number of followers (968 followers).
- Clusters such as law and order and religion, despite not being among the most active in terms of messages, are among those with the most followers (1,654 followers and 3,404 followers, respectively).

As for who the users related to the main clusters identified follow, the data in Table 2 also show that the left-wing cluster has an average number of users who actively follow the user and are not followed back (1,256 followers), slightly higher than the general average (1,122 followers). In the rest of the clusters that structure the information flow, the same trend described above prevails, especially in the case of the far-right cluster –users associated with this group are among those who follow the fewest number of users.

The historical number of tweets posted column in Table 2 also shows how the clusters that structure the flow of information have a lower average than the 14 main clusters identified (35,740 messages). In these four clusters, the average time since account creation is between 4 (in the case of the far-right cluster) and 6 years (in the case of the teenagers and animals cluster), with a total average for the four clusters of 5 years. This average account age is slightly lower than the average the clusters which account for 72.63% of the messages collected (6 years).

Regarding bot-like behavior in users associated with each cluster, the 14 clusters can be classified into three main groups:

- Clusters with a high probability (50%) of bot presence: Music, k-pop, and left-wing.
- Clusters with a medium probability (40%) of bot presence: Far-right and tv-film.
- Clusters with a low probability (30%) bot presence include the rest of the identified clusters.

The network analysis carried out on the 280 users studied in this work revealed a network of retweets comprised of 42,216 nodes and 71,687 edges, with a modularity of 0.791. This network comprises 34 communities, with an average maximum distance between their furthest ends of 3 hops, and an average path length of 1.116. The high modularity values and very low average path length shows us the presence of small-worlds around the network generated from the messages posted by the 280 users analyzed in this work, as described by **Milgram** (1967) and **Himmelboim et al.** (2017). Therefore, these 280 users, beyond being distributed in different identified clusters, can be considered as a group with a strong linkage and analogous network behavior. According to an analysis of connected components in *Gephi* using **Tarjan's** algorithm (1972), of a total of 71,687 edges or connections, 42,214 are strongly connected, only 9 are weakly connected; and the rest (29,464 edges) have connections within normal parameters.

In Figure 3 we can see that most tweets have harmonic closeness centrality values near or equal to 1, which reflects a high density and proximity between nodes. This is confirmed by the very low eccentricity values (distance or hops between the farthest nodes from each node) observed in this figure (most of them between 1 and 3 hops). This distribution of such small distances and proximities would not only confirm the presence of small-world networks, mentioned above, but also the existence of ultra-small-world networks resulting from the proximity between randomly chosen nodes from different topics with no apparent connection, but which actually define the existence of a real, interconnected network structure (**Menczer; Fortunato; Davis**, 2020). Following the interpretation of **Barabasi** (2016), the calculation for ultra-small-world systems with  $N=280$  would be  $\ln(\ln N) \approx 1.73$ , which would be the closest to the average distance calculated in the network (1.116). But even according to their definition, it would be closer to the hub-and-spoke phenomenon, which defines the possible presence of a central hub.

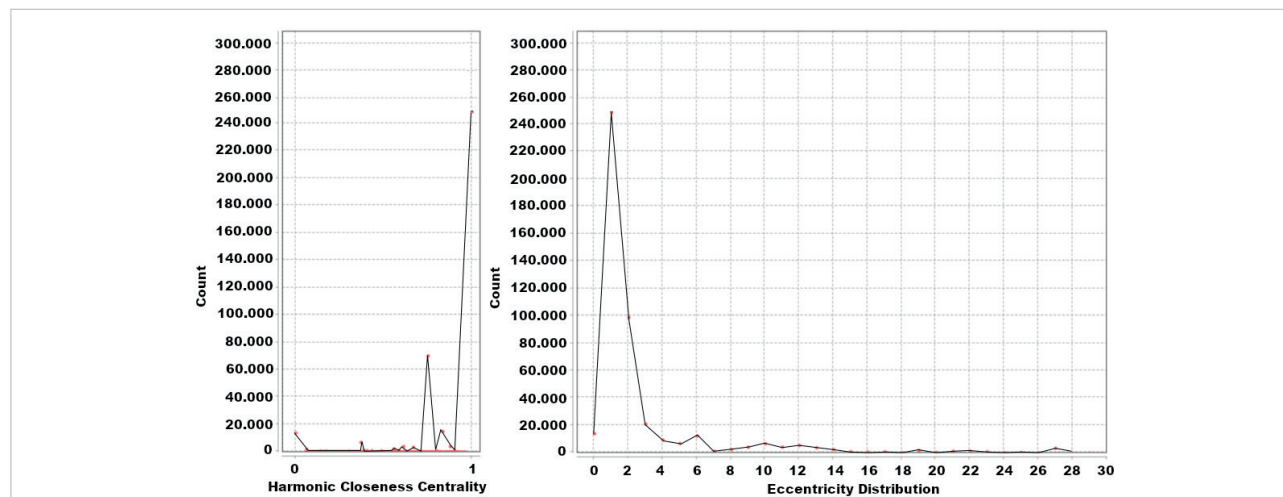


Figure 3. Distribution of harmonic closeness centrality and eccentricity values

The graph created from the retweets of the N=280 accounts (Figure 4) allow us to estimate the existence of several highly interconnected clusters as well as ramifications that connect them. In Figure 4 we can see, at the centre of the graph, a cluster of accounts dedicated to humorous tweets. For instance, @elmundo-today is very close to other groups, such as the far-right cluster, due to the type of content it promotes, and @eljueves has more followers on the political left. Other accounts that connect different clusters together are those associated with video games and influencers (@lbaiLlanos, which fits in with the teenagers cluster), those which deal with Covid-19 (e.g. @Coronavirus19 and @navedel-misterio, which tweet humorous and conspiratorial content around the pandemic), or websites focused on the promotion of disinformation (e.g. ActualidadRT is Russia Today in Spanish, represented in Figure 4 as “media”, and very close to the models and teenagers and animals clusters).

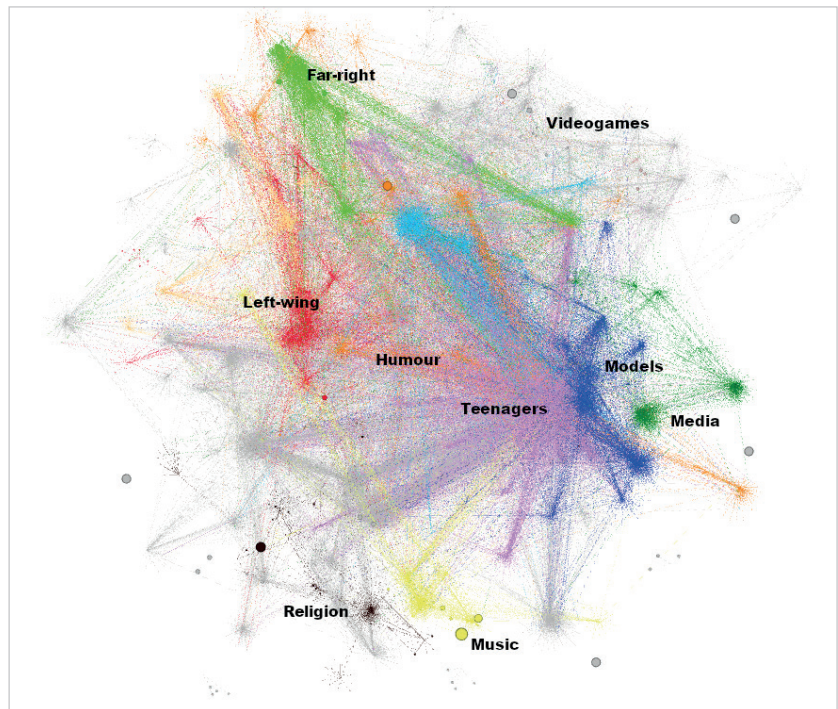


Figure 4. Graph of the retweets of the 280 users accounts in the sample

In Figure 4 there is a noticeable absence of distinct blocks, as is usual in polarized debates. Remarkably, the same type of graph was observed throughout the period of collection of the messages analyzed, with no new features or new connections emerging with new actors, but only a linear increase in the total in- and out-degree of each node. The stability of the network structure over time, shown in Figure 5, can be seen through the constant increase in the average degree in the accounts, and the increase in the average coefficient of the clusters at the end of the period of collection of the messages analyzed in this work. Small stepwise jumps and constant plateaus of mean value with no gradual increase could be observed throughout the collection period.

An eigenvector analysis of the retweets network of accounts followed by our selected sample shows how the center falls around a group of young video game influencers (e.g. @lbaiLlanos, eigenvector = 1); followed by media accounts (e.g. @el\_pais 0.928, @elmundoes 0.681, @ElHuffPost 0.666, @La\_Ser 0.654); accounts related to law enforcement (e.g. @ policia 0.734 and @policia 0.734); and teen influencers or accounts about humor or animals (e.g. @sussoos 0.907, @ moadbarghout 0.737, @Gordito\_Perrito 0.468 or @gatitos\_qctd 0.445). When determining *Pagerank*, many of these users lose visibility to others, such as: @ActualidadRT (pagerank = 0.0029 second media account after @A3Noticias with 0.003), @minsugacheonye (0.0051, with a high visibility in the k-Pop cluster), @oracion\_milagro (0.0045 with high visibility in the Religion cluster), @CallofDutysEs (0.0044, with a high visibility in the Videogame cluster) and other users with nano-influencer profiles (fewer than 7,000 followers) such as @Charo\_ocejo, @lor1812, @JcQuer or @DianaMata, with visibility in the Humor cluster, 0.0044, 0.0035 and 0.0044, respectively.

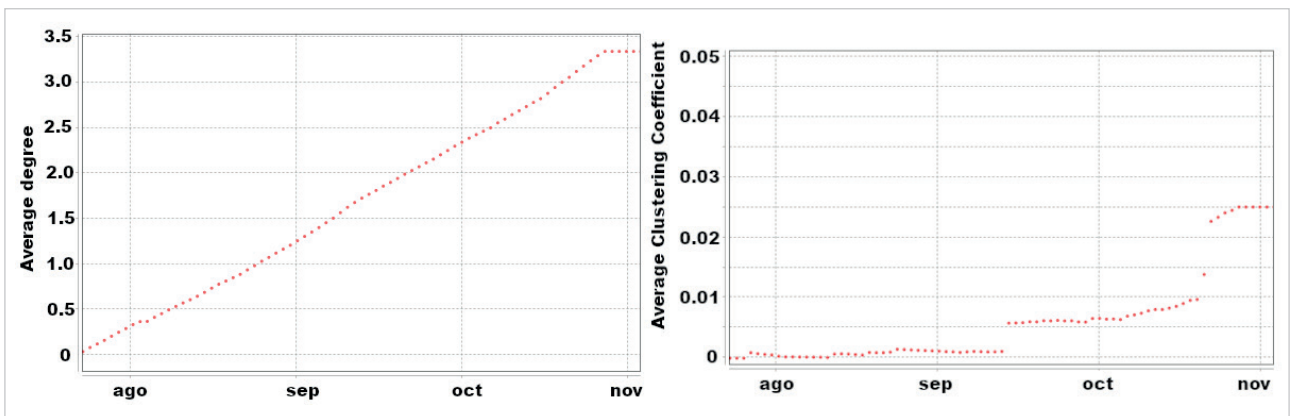


Figure 5. Average degree per node and average clustering coefficient identified with the 280 users analyzed



The betweenness centrality values allow us to identify 13 accounts that connect the network: @IvanGomezTero1, @mar-taxvalues, @Godisalbareche, @soygrito, @DieBoer95 (account subsequently disappeared), @Josepmariajosep, @Fran\_Rodri\_guez, @ElMolecula23 (account subsequently disappeared), @Cavitaxxx, @SoyAmargada (account suspended for not complying with *Twitter* rules), @CinezinCZN, @mspinto92 and @jinhitrules (account subsequently disappeared). These accounts are concentrated in certain clusters: Music and K-Pop (six users with values between 3.353 and 1389.5), far-right, humor, tv-Film, football, law enforcement and left-wing, with lower values (seven users with values between 15 and 550). The observed connections allow us to visualize the relationships between different nodes of the network through this sort of users, who are in charge of “connecting” clusters. This is even though these users present small centrality or eigenvector values (between 0.209 and 0.036) but high closeness centrality values (between 0.527 and 1). This would help us to show how little-known nodes (not the main ones) are the ones who build bridges between clusters.

The words derived from the morphemes extracted by the algorithm using the stemming techniques described in the methodology reveal some common tweets between clusters (Table 3) beyond the usual topics addressed by each cluster. In the case of the far-right or videogame clusters, football discussions are introduced, while religious conversations appear in the k-pop cluster. Similarly, in the law-and-order cluster, television programmes on mysteries, beliefs and conspiracy theories are discussed. Mentions of health and emotional states are also observed in several clusters (e.g. music, k-pop, teenagers and animals, influencers and models), associated with the Covid-19 pandemic. These tweets refer to having to stay home and describe the situation as “shit”. However, other tweets associated with beliefs and gratitude are also present.

Table 3. Main topics by co-occurrence analysis

Group	Main topics by co-occurrence analysis
Models	Because-person-life-be-good-people-want-me-do-more-wrong Better-friends-I- need-sleep-arrive-home Nothing-someone-much-thinks-something Pleasure-love-say-say-say-are-look With-me-always-nobody -talk-feels This-very-years-good-today Time-world-listen-listen-count-do-until-some-each-cry-live -win-now Power-happy-we- out-of-shit-days-where- end
Far-right	Mother-can-because-sunshine-years-lot-bearing-power So-you- your-very-best-life-my-good-me Psoe-Iglesias-against-people-million-Spanish-government-country-Spain-Sanchez-state-new-king Now-we- home-will-today-lead- end-month-except-two-twice Leave-day-forever-put-thanks- good-here Where-also-call-must-want- talk- self-believe-see Communicate-measures-policy-public-page Barça-Messi-people-last-bad-thing-bad-work-nothing-that-was
Teenagers and animals	You-much-just-have-life-people-when-people-want-know-because- are-thing Power-home-years-leave-us-friend-day-have-child-until-mum-leave-day-study Reach-need-help-thanks-work-also-months-today Going-out-nothing-talking-good-nobody-is-wrong-tell-that-something Say-someone-always-never-think-feel-every-cry-look-place Take-better-believe-do-taste-this-see Time-say-will-want-that-neighbor-who-win-go
Left	Pass-be-all-podemos-more-there-has-because Health-month-two-new-hour-latest-Madrid-must-Spain-case-was-until-finish-call Life-family-hope-thanks- good-know-want-better-want- leave Government-now-PP-politics-right-Vox-same-vote-Pablo-have When-say-they-say-talk-go-out-time-less King-who-take-count-people-work-years-today-days-sure-who Way-about-common-public-Ayuso-million-pandemic-against-Spanish-president-state Stay-people-good-place-believe
Influencers	Thing-people-life-passes-people-when-because-be-sunny-toward-everything Someone-want-good-talk-good- am- am- self-know-bad-friend-take See-stay-good-years- boy-Madrid-looks- less World-gives-pleasure-better-nothing-live-think-some Have-arrive-call-home- can-leave-finish-days Nobody- my-believe-feel-say-will-say-something Say-am-sometimes-always-never-need- true-cry-win -do Also-look- little-now-photo-whore-now-who- are
Humor	Can-sun-have-friends-until-two-continue Something-say-nothing-people-very-create-because- can-much-have Person-thing- have-know-when- always-am-this-can-someone Leave-want- see-like- better-win Part-Madrid-after-child-needs-from-work-home-day-years-good-come-new-our-thanks -hours Never-be-bad-live-well-should Send-design-participate-submit-sweepstakes-giveaway-shipping-follow Finish-was- stay-story-now-leave-call-where -went

(cont.)

Group	Main topics by co-occurrence analysis
Videogames	Win-want-sunshine-see-lot-leave-day-can-be-better-me Our-last-new-to-here-power-first-two-come-next Pass-when-say-good-people-time-know-put-say- done-am-something Play-part-good-final-exit-Madrid-finish-same-year-culers-Barça-fcblive Like-stay-no-bitch-kinggrizzi-well Because-very-xd-always-seems-bad-nothing- inhabit-guardiolista4-less Let's-history-about-thanks -wait-game-today-3-2-us Friend-years- also-talk- life-bring-home-person-someone
Law enforcement	Know-better-good-day-night-good-day Have-alone-much-be Madrid-mask-mask-greater-month-two-people-communist-means-against-state-some-case Life-today-see-have-mayor Idiazayus-politician-country-Sánchez-Spain-government-now-wants-duty Can-nothing-take-work- matter-years-help-hour-about-child Wrong-less-same-wait-believe-people-go-out-well-seems-always-also-navedelmisterio-carmenporter_-secret-go Lolamaiz-they-are-living-our-arrival-are-so
Football	Player-Barcelona-club-Messi-leave-team-two- play-match-today Some-similarity-say-nothing- when-have-time More-pass-all-very-sun-there- be -lot Official-signing-season-last-morning-destination-wait-new-days-wait-first Goal-football-ideal_granadacf-our-first-home-win-power-finish Years-good-day-know- be-same-always-see-take FCB-Barcelona-report-agreement-Koeman-Suárez-signing-Bartoméu-Luis Stay-want -Madrid-account-next-year-about-talking-about-must-now
Music	Concert-good-day-out-maybe-will-see-let -be When-alone-can-lot-all-be-want I'm-ahahahah-weep-look- finish-my-am-now-little Like-song-thanks-cepeda-listen-arrive-album-music-also-win Cepedaoficial-can-want- tomorrow-night-wait-here-again-vote-hello Same-her-always-person-people-know-can-always-better-life-love Truth-bad-say-say-thing-nothing-good-something Photo-dawn-video-Madrid-days-sub-sing-two
Science	Do-can- have-just-more-be-when- work- are-people Pandemic-leave-years-good-some-take-better-come Today-our-about-until-power-day-was-see-page Vote-public-merin-against-vacations-president-state-politics-part-deberber-congress-Peru Want-there-no-country-this-believe-where-bad-good-go Family-need-favour-help-seek-very-thanks- someone-have That-becuase-have-new-change-nothing-put Bring-this-people-time- once-healthy-me-you
K-pop	Wait-also- bts-day-boy-can-just-be-leave Like-good-have-want- right-when-know For-true-bad-something-nothing-people-talk-believe-now-have-see Love-exaarmy-exabff-life-thank -world-people-always-better-same Song-army-dynamit-bangt-our-new-days-video-new-album-bts-today-votes-mtvhottest We- counting-we- stay-getting-time God- am-my-cry- are-go Namjoon-years-jungkook-jimin-yoogi-photo-hil
TV, film and platforms	Anything-can -much-more-be But-good-believe-always-little-nothing-like- see-stay When -have- day- live-hope-someone-wants- look-live-only- once Thanks- this-story-series-movies-film-best- is-let Spain-days-people-public-first-duty-work-years-done Covid-19-doctor-health-last-greatest-part-time People- going- seem-stay-thing-two-bad-game-something @isabellegaz-@famartinez2001-@jgrevert-@rebecaceld-@dioniososabell-agballest-@auroragilt-@car73x-@jacano56-@jasanv
Religious	God-life-hope-life-live-good-lord-love-Jesus-Christ-Christ-peace-father-forever-ours Should- can-sun-have-when-well-be- know Jehovah-psalm-word-heart-son-path-thing-man-green-seek-holy-bible-kingdom-1960 Help-lot-person-get-matter-better-you-take-arelysshaw Go-out-doctor-home- country-people-until Faith-brother-blessing-amen-bless-days-thanks- new Time-same-talk-nothing-is-bad-can-believe-now-was-say-where- leave Family-each- today-friends-health-follow

Table 3 is complemented by the exploratory and intentional choice of words associated with current affairs present in Spanish media during the period of data collection. Table 4 further reveals how some of these topics appear in more than one cluster, reinforcing positions not necessarily associated with the central topics of each cluster, but taking advantage of these topics to insert content aimed at promoting disinformation related to Covid-19, the Spanish government and its political actors, and issues around immigration and “okupas”, squatters who occupy abandoned houses in Spain.

Table 4. Words associated with topical issues collected in identified clusters

Words associated with current affairs	No. of tweets	Description
Chlorine	354	In the science (12) and teenagers and animals (9) clusters we detected tweets warning about problems with the use of chlorine and its derivatives to cure Covid-19. By contrast, in the religion cluster there were many more tweets spreading misinformation about its supposed beneficial uses (318).
Vaccine	620	Conversations on vaccine side effects, "big pharma", humor or criticism of the government take place in the teenagers (19), models (29), influencers (11), videogames (18), law enforcement (25), humor (54), religion (68), tv-film (114), far-right (44) and left-wing (76) clusters. Only the Left-wing and Science groups were seen to be in favor of vaccination, although their tweets are attacked.
Pedro Sánchez	853	194 tweets from the far-right cluster, 51 tweets from the law enforcement cluster and 11 tweets in the models and teenagers and animals clusters focused on attacking the Prime Minister. 340 tweets were located in the left-wing cluster, supporting him against Vox or the Community of Madrid.
Immigrant or immigration	444	Spread across all clusters, especially law enforcement (59), far-right (163), football (10) and TV-film (12). Sentiment is always negative, speaking of problems caused by immigration or migrants being infected by coronavirus.
Pablo Iglesias	1,109	A target of attacks by all groups, especially the far-right cluster (390 tweets). In the left-wing cluster, 516 tweets were identified defending this Spanish politician.
Fernando Simon	223	A target of attacks in the Far-right (50) cluster, as well as music (16), law enforcement (24) and humor (17). The left-wing cluster produced 116 tweets in his favor.
Pablo Casado	1,470	A target of attacks mainly from the left-wing cluster (1,100 tweets), but also from the far-right (100 tweets) and law enforcement (60 tweets) clusters.
"Okupa" (Squatters)	405	Complaints about squatting in the teenagers (8), TV-film (30), K-pop (6), law enforcement (47), football (22), and far-right (162) clusters. In the left-wing cluster (98), possible campaigns to put squatting on the agenda setting are attacked.
Covid	4,712	Tweets warning of calamities, misfortune, or losing a job or a family member because of Covid-19 appear, most notably, in: teenagers (122), models (861), tv-film (1,389), k-pop (32), law enforcement (332), influencers (78), videogames (12), humor (311), religion (493), left-wing (229) and far-right (323).

The vectorization study, shown in Figure 6, presents two main aspects: the tweets present a significant polarization in 12.11% of the messages (with values in *NRC* lexicon equal to or higher than 3 or -3 in positive and negative discourses respectively) (Fitzgerald, 2017), with maxima and minima of +17 and -18. Over time, no variations are observed and the mean remains constant (represented by a blue line in the figure and with a mean value of 0.132). This percentage of 12.11% is similar to Vidgen's estimate of 15% of English far-right party supporters (2019), with the intention of showing a seemingly moderate discourse and to be

"less likely to be deleted by the social media platform, and less likely to attract the eye of law, it stayed online for much longer, if not indefinitely" (Williams, 2021).

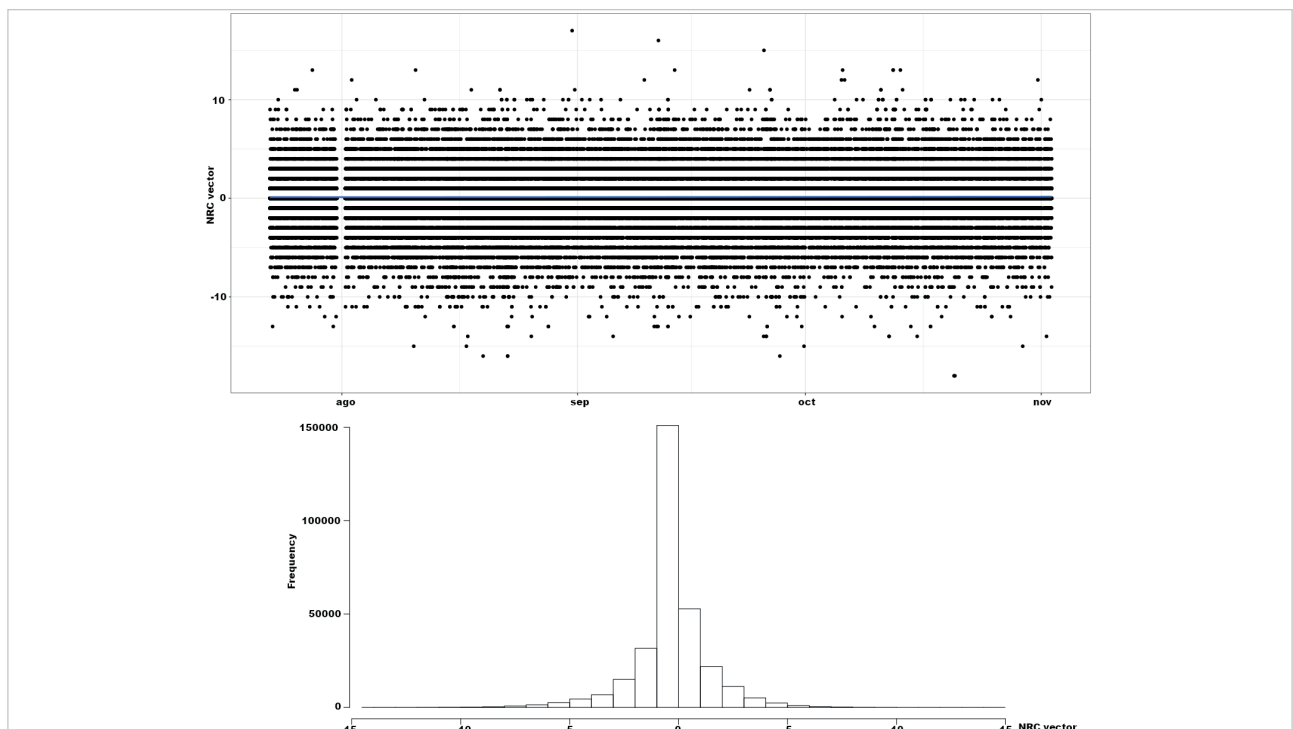


Figure 6. Sentiment vector analysis over time and intensity-frequency histogram analyzed

The analysis of emotions linked to discourse determined the presence of the following: trust, 19.52%; sadness, 15.47%; fear, 14.56%; anticipation, 13.58%; joy, 12.09%; anger, 9.63%; disgust, 8.22%, and surprise, 6.93%. Although trust is the main element, the next most important are sadness and fear. The analysis does not reveal a high level of polarization or emotional intensity, but in a set of users whose interest was to enter different discussion groups or bubble filters, discourses that were easily detectable as extremes (Pérez-Colomé, 2020) would generally be avoided to deceive *Twitter*. The percentage that shows clear polarization is highly polarized.

#### 4. Conclusions

The study of the tweets posted by our randomly selected 280 *Twitter* users reveals how astroturfing was used during a period of time dominated by the Covid-19 pandemic in Spain. This strategy was undertaken by users geolocated in the Philippines, interested in promoting content associated with the Spanish agenda setting, clearly intended to influence public opinion. In this strategy, tweets were aimed at very specific social groups or collectives (teenagers, security forces or political entities), and widely disseminated topics (humor, sex, religion, football, music or television). The targeting of messages towards teenagers has already been highlighted by Williams (2021), who exposes the so-called “red-pilling” of people in the United States and England by the alt-right. The term “red pill” is a reference to the *Matrix* films, whose characters take a red pill to “wake up” from a deceptive reality.

The results of this research have determined the very possible presence of network, which is not only non-random, but ultra-small-world, that comes close to the quasi existence of a single possible hub, consistent with the initial hypothesis. This is evidence of the existence of a network that posts thousands of tweets a day in the Spanish language about Spanish issues from the other side of the world, and that its global structure can be proven to be a single network. The text mining, polarity and sentiment studies result in many everyday tweets, close to each of the groups, as well as few, but intense, highly polarised messages, so as not to be so easily identified.

The modus operandi observed in this study is consistent with strategies for disseminating disinformation as described by the authors considered in this paper (Wissman, 2018; Sorensen; Andrews; Drennan, 2017; Zhao *et al.*, 2020; Guess; Nyhan; Reifler, 2020). Through a continuous flow of tweets, micro and nano-influencers rely on content published on websites dedicated to satire and the promotion of disinformation, and directly mention influencers (e.g., @Ibaillanos; @navedelmisterio or @Santi\_Abasal) in order to disseminate and promote certain tweets. These tweets address topics that are relevant to each of the clusters identified in this work, while also helping foster a communicative framework aimed at increasing the debate around specific political actors (Spanish government, *Unidas Podemos* and *Vox*), as well as theories and opinions against Covid-19 health policies, and positions against immigration. This strategy, for example, intends to foster a sense of social alarm around the “okupa” movement of squatters occupying houses in Spain. This action is based on accounts associated with the Far-right cluster, which would be acting as the pivot or articulating force of the debate.

Above the limitations inherent to the study presented here, in our analysis of tweets posted in a limited period of time dominated by the Covid-19 “infodemic” our findings do reveal a digital communication scenario where astroturfing is being used in Spanish *Twitter*. This strategy could well have been fostered by organizations dedicated to the promotion of disinformation from outside the country, in places like the Philippines. This could be demonstrating the presence of an organised industry with the capacity to mobilize non-influencer users (cyber-troops), in the terms described by Bradshaw, Bailey and Howard (2021), for the creation and dissemination of a large amount of disinformative and polarised content. Tweets and users in apparent direct opposition create conflict aimed at attracting other users, which end up being used to encourage or discourage certain ideas or actions in Spanish society.

Beyond establishing that astroturfing was indeed used during the Covid-19 pandemic to promote certain issues in Spanish public opinion via *Twitter*, this study is merely a first glance at a research horizon that should be explored more deeply. It is important to establish whether these strategies are used on an *ad hoc* basis (in specific moments or with specific groups) or whether they are used consistently, spreading over time and over different groups in Spain.

#### 5. Availability of data and materials

The datasets generated during the current study are available in the *Figshare* repository at: <https://cutt.ly/GTEbWpo>

“The results of this research have determined the very possible presence of network, which is not only non-random, but ultra-small-world, that comes close to the quasi existence of a single possible hub, consistent with the initial hypothesis”

The percentage that shows clear polarization is highly polarized.

“This is evidence of the existence of a network that posts thousands of tweets a day in the Spanish language about Spanish issues from the other side of the world, and that its global structure can be proven to be a single network”

The data concerning the identification of the sending users has been removed due to privacy restrictions of the social network *Twitter*.

## 6. Notes

1. For this study, we used the stopword library located at:  
<https://www.ranks.nl/stopwords/spanish>
2. For more information, access to:  
<https://casoaislado.com>
3. For more information, access to:  
<https://www.mediterraneodigital.com>
4. The *PSOE* is the party of the current Prime Minister of Spain, Pedro Sánchez.
5. Main political opposition party in Spain, located in the right-wing political ideological spectrum.
6. For more information access to:  
<https://help.twitter.com/es/rules-and-policies/twitter-rules>

## 7. References

- Adhanom-Ghebreyesus, Tedros; Ng, Alex** (2020). "Desinformación frente a medicina: hagamos frente a la 'infodemia'". *El país*, 18 febrero.  
[https://elpais.com/sociedad/2020/02/18/actualidad/1582053544\\_191857.html](https://elpais.com/sociedad/2020/02/18/actualidad/1582053544_191857.html)
- Aleixandre-Benavent, Rafael; Castelló-Cogollos, Lourdes; Valderrama-Zurián, Juan-Carlos** (2020). "Información y comunicación durante los primeros meses de Covid-19. Infodemia, desinformación y papel de los profesionales de la información". *Profesional de la información*, v. 29, n. 4, e290408.  
<https://doi.org/10.3145/epi.2020.jul.08>
- Arce-García, Sergio; Menéndez-Menéndez, María-Isabel** (2018). "Aplicaciones de la estadística al *framing* y la minería de texto en estudios de comunicación". *Información, cultura y sociedad*, v. 39, pp. 61-70.  
<https://doi.org/10.34096/ics.i39.4260>
- Barabasi, Albert-László** (2016). *Network science*. Cambridge, United Kingdom: Cambridge university press. ISBN: 978 1 107 07626 6
- Bastian, Mathieu; Heymann, Sebastien; Jacomy, Mathieu** (2009). "Gephi: An open source software for exploring and manipulating networks". *Proceedings of the international AAAI conference on web and social media*, v. 3, n. 1, pp. 361-362.  
<https://ojs.aaai.org/index.php/ICWSM/article/view/13937>
- BBC** (2020). "Philippines Troll Patrol: The woman taking on trolls on their own turf". *BBC news*, 26 September.  
<https://www.bbc.com/news/world-asia-54275891>
- Bengali, Shashank; Halper, Evan** (2019). "Troll armies, a growth industry in the Philippines, may soon be coming to an election near you". *Los Angeles Times*, 19 November.  
<https://www.latimes.com/politics/story/2019-11-19/troll-armies-routine-in-philippine-politics-coming-here-next>
- Blanco-Alfonso, Ignacio; García-Galera, Carmen; Tejedor-Calvo, Santiago** (2019). "El impacto de las *fake news* en la investigación en Ciencias Sociales. Revisión bibliográfica sistematizada". *Historia y comunicación social*, v. 24, n. 2, pp. 449-469.  
<https://doi.org/10.5209/hics.66290>
- Blondel, Vicent D.; Guillaume, Jean-Lup; Lambiotte, Renaud; Lefebvre, Etienne** (2008). "Fast unfolding of communities in large networks". *Journal of statistical mechanics: Theory and experiment*, v. 10.  
<https://doi.org/10.1088/1742-5468/2008/10/P10008>
- Bradshaw, Samantha; Bailey, Hannah; Howard, Phillip** (2021). *Industrialized disinformation. 2020 global inventory of organized media manipulation*. Computational Propaganda Research Project. Oxford, United Kingdom: Internet Institute.  
<https://comprop.oii.ox.ac.uk/research/posts/industrialized-disinformation>
- Bradshaw, Samantha; Howard, Philip N.** (2018). *Online supplement to working paper 2018.1. Challenging truth and trust: A global inventory of organized social media manipulation*. Computational Propaganda Research Project. Oxford, United Kingdom: Oxford Internet Institute.  
[https://blogs.oii.ox.ac.uk/wp-content/uploads/sites/93/2018/07/ct\\_appendix.pdf](https://blogs.oii.ox.ac.uk/wp-content/uploads/sites/93/2018/07/ct_appendix.pdf)
- Campos-Domínguez, Eva; Calvo, Dafne** (2017). "La campaña electoral en internet: planificación, repercusión, y viralización en *Twitter* durante las elecciones españolas de 2015". *Comunicación y sociedad*, n. 29.  
[http://www.scielo.org.mx/scielo.php?script=sci\\_arttext&pid=S0188-252X2017000200093](http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0188-252X2017000200093)

- Cebrián, Manuel; Balsa-Barreiro, José** (2021). "La enésima ola". *El país*, 9 abril.  
<https://elpais.com/opinion/2021-04-09/la-enesima-ola.html>
- Chen, Jundong; Hossain, Shafaeat; Zhang, Huan** (2020). "Analyzing the sentiment correlation between regular tweets and retweets". *Social network analysis and mining*, v. 10, art. 13.  
<https://doi.org/10.1007/s13278-020-0624-4>
- Collins, Ben; Zadrozny, Brandy** (2020). "Troll farms from North Macedonia and the Philippines pushed coronavirus disinformation on Facebook". *NBC news*, 29 May.  
<https://nbcnews.to/3vc2fVo>
- Davis, Richard G.** (1991). "Operation 'Thunderclap': The US Army Air Forces and the bombing of Berlin". *Journal of strategic studies*, v. 14, n. 1, pp. 90-111.  
<https://doi.org/10.1080/01402399108437441>
- Diresta, Renee; Shaffer, Kris; Ruppel, Becky; Sullivan, David; Matney, Robert; Fox, Ryan; Albright, Jonathan; Johnson, Ben** (2019). *The tactics & tropes of the internet research agency*. U.S. Senate documents. Congress of the United States.  
<https://digitalcommons.unl.edu/senatedocs/2/>
- Elmas, Tuğrulcan; Overdorf, Rebekah; Furkan-Özkalay, Ahmed; Aberer, Karl** (2021). "Ephemeral astroturfing attacks: The case of fake Twitter trends". In: *IEEE European symposium on security and privacy 2021*.  
<https://doi.org/10.48550/arXiv.1910.07783>
- European Commission (2018). *A multi-dimensional approach to disinformation*. Luxembourg: Publications Office of the European Union. ISBN: 978 92 79 80419 9  
<https://data.europa.eu/doi/10.2759/739290>
- Fitzgerald, Jonathan D.** (2017). "Sentiment analysis of (you guessed it!) Donald Trump's tweets". *Storybench*, 17 December.  
<https://www.storybench.org/sentiment-analysis-of-you-guessed-it-donald-trumps-tweets>
- García-Marín, David** (2020). "Infodemia global. Desórdenes informativos, narrativas fake y fact-checking en la crisis de la Covid-19". *Profesional de la información*, v. 29, n. 4, e290411.  
<https://doi.org/10.3145/epi.2020.jul.11>
- García-Orosa, Berta** (2021). "Disinformation, social media, bots, and astroturfing: The fourth wave of digital democracy". *Profesional de la información*, v. 30, n. 6, e300603.  
<https://doi.org/10.3145/epi.2021.nov.03>
- Granovetter, Mark S.** (1973). "The strength of weak ties". *American journal of sociology*, v. 78, n. 6, pp. 1360-1380.  
<http://www.jstor.org/stable/2776392>
- Guess, Andrew; Nyhan, Brendan; Reifler, Jason** (2018). *Selective exposure to misinformation: evidence from the consumption of fake news during the 2016 U.S. presidential campaign*.  
<https://about.fb.com/wp-content/uploads/2018/01/fake-news-2016.pdf>
- Higuchi, Koichi** (2016). *KH coder 3*.  
<https://kxcoder.net/en/index.html>
- Himmelboim, Itai; Smith, Marc A.; Rainie, Lee; Shneiderman, Ben; Espina, Camila** (2017). "Classifying Twitter topic-networks using social network analysis". *Social media + society*, v. 3, n. 1.  
<https://doi.org/10.1177/2056305117691545>
- Holbrook, Erik; Kaur, Gupreet; Bond, Jared; Imbriani, Josh; Nsoesie, Elaine; Grant, Christian** (2016). "Tweet geolocation error estimation". *International conference on GIScience short paper proceedings*, v. 1, n. 1, pp. 130-133.  
<https://doi.org/10.21433/b3110wf6w9p9>
- Hrčková, Andrea; Srba, Ivan; Móro, Robert; Blaho, Radoslav; Šimko, Jakub; Návrát, Pavol; Bielíková, Mária** (2019). "Unravelling the basic concepts and intents of misbehavior in post-truth society". *Bibliotecas. Anales de investigación*, v. 15, n. 3, pp. 421-428.  
<http://revistas.bnjm.cu/index.php/BAI/article/view/109>
- Hu, Yifan** (2006). "Efficient, high-quality force-directed graph drawing". *The mathematica journal*, v. 10, n. 1, pp. 37-71.  
[http://yifanhu.net/PUB/graph\\_draw.pdf](http://yifanhu.net/PUB/graph_draw.pdf)
- Jack, Caroline** (2017). *Lexicon of lies: Terms for problematic information*. New York, United States: Data & Society.  
[https://datasociety.net/pubs/oh/DataAndSociety\\_LexiconofLies.pdf](https://datasociety.net/pubs/oh/DataAndSociety_LexiconofLies.pdf)
- Jerit, Jennifer; Zhao, Yangzi** (2020). "Political misinformation". *Annual review of political science*, v. 23, pp. 77-94.  
<https://doi.org/10.1146/annurev-polisci-050718-032814>

- Jockers, Matthew** (2017). *Syuzhet, extracts sentiment and sentiment-derived plot arcs from text*.  
<https://rdr.io/cran/syuzhet>
- Kearney, Michael W.** (2018). *Tweetbotornot: An R package for classifying Twitter accounts as bot or not*.  
<https://github.com/mkearney/Tweetbotornot>
- Keller, Franziska G.; Schoch, David; Stier, Sebastian; Yang, Junghwan** (2020). "Political astroturfing on *Twitter*: how to coordinate a disinformation campaign". *Political communication*, v. 37, n. 2, pp. 256-280.  
<https://doi.org/10.1080/10584609.2019.1661888>
- Lantz, Brett** (2019). *Machine learning with R*. Birmingham, United Kingdom: Packt publishing. ISBN: 978 1 78216 214 8  
[https://edu.kpfu.ru/pluginfile.php/278552/mod\\_resource/content/1/MachineLearningR\\_\\_Brett\\_Lantz.pdf](https://edu.kpfu.ru/pluginfile.php/278552/mod_resource/content/1/MachineLearningR__Brett_Lantz.pdf)
- Lits, Brieuc** (2020). "Exploring astroturf lobbying in the EU: The case of responsible energy citizen coalition". *European policy analysis*, v. 7, n. 1, pp. 226-239.  
<https://doi.org/10.1002/epa2.1086>
- López-García, Guillermo** (2016). "'New" vs. 'old' leaderships: the campaign of Spanish general elections 2015 on *Twitter*". *Comunicación y sociedad*, v. 29, n. 3, pp. 149-167.  
<https://doi.org/10.15581/003.29.3.sp.149-167>
- Lopreite, Milena; Panzarasa, Pietro; Puliga, Michelangelo; Riccaboni, Massimo** (2021). "Early warnings of Covid-19 outbreaks across Europe from social media". *Scientific reports*, v. 11, art. 2147.  
<https://doi.org/10.1038/s41598-021-81333-1>
- Mahbub, Syed; Pardede, Eric; Kayes, A. S. M.; Rahayu, Wenny** (2019). "Controlling astroturfing on the internet: a survey on detection techniques and research challenges". *International journal of web and grid services*, v. 15, n. 2, pp. 139-158.  
<https://doi.org/10.1504/IJWGS.2019.099561>
- Mahtani, Shibani; Cabato, Regine** (2019). "Why crafty internet trolls in the Philippines may be coming to a website near you". *The Washington Post*, 26 July.  
<https://wapo.st/3xpR522>
- Martin, Shawn; Brown, W. Michael; Klavans, Richard; Boyack, Kevin W.** (2011). "OpenOrd: An open-source toolbox for large graph layout". In: *Proceedings SPIE. Visualization and data analysis 2011*, v. 7868.  
<https://doi.org/10.1117/12.871402>
- Menczer, Filippo; Fortunato, Santo; Davis, Clayton A.** (2020). *A first course in network science*. Cambridge, United Kingdom: Cambridge University Press. ISBN: 978 1 108 47113 8
- Milgram, Stanley** (1967). "The small world problem". *Psychology today*, v. 1, n. 1, pp. 61-67.  
<http://snap.stanford.edu/class/cs224w-readings/milgram67smallworld.pdf>
- Mohammad, Saif M.** (2016). "Sentiment analysis: Detecting valence, emotions, and other affectual states from text". In: *Emotion measurement*. Elsevier, pp. 201-237. ISBN: 978 0 08 100508 8  
<https://doi.org/10.1016/B978-0-08-100508-8.00009-6>
- Mohammad, Saif M.; Turney, Peter D.** (2010). "Emotions evoked by common words and phrases: Using mechanical Turk to create an emotion lexicon". In: *Proceedings of the NAACL-HLT 2010 workshop on computational approaches to analysis and generation of emotion in text*, pp. 26-34.  
<https://aclanthology.org/W10-0204.pdf>
- Mohammad, Saif M.; Turney, Peter D.** (2013). "Crowdsourcing a word-emotion association lexicon". *Computational intelligence*, v. 29, n. 3, pp. 436-465.  
<https://doi.org/10.1111/j.1467-8640.2012.00460.x>
- Ong, Jonathan-Corpus; Cabañes, Jason-Vicent A.** (2019). *Politics and profit in the fake news factory. Four work models of political trolling in the Philippines*. Riga, Latvia: NATO strategic communications, centre of excellence. ISBN: 978 9934 564 54 3  
[https://stratcomcoe.org/cuploads/pfiles/5december\\_report\\_philippines.pdf](https://stratcomcoe.org/cuploads/pfiles/5december_report_philippines.pdf)
- Ong, Jonathan-Corpus; Tapsell, Ross; Curato, Nicole** (2019). *Tracking digital disinformation in the 2019 Philippine Mid-term Election*. Camberra, Australia: New Mandala.  
<https://www.newmandala.org/wp-content/uploads/2019/08/Digital-Disinformation-2019-Midterms.pdf>
- Ortega, Andrés** (2020). "Infodemic and mediademic". *Real Instituto Elcano*, 31 marzo.  
<https://blog.realinstitutoelcano.org/en/infodemic-and-mediademic>

- Pérez-Colomé, Jordi** (2020). “‘Yo fui un bot’: las confesiones de un agente dedicado al engaño en *Twitter*”. *El país*, 21 mayo.  
<https://elpais.com/tecnologia/2020-05-20/yo-fui-un-bot-las-confesiones-de-un-agente-dedicado-al-engano-en-twitter.html>
- Salaverría, Ramón; Buslón, Nataly; López-Pan, Fernando; León, Bienvenido; López-Goñi, Ignacio; Erviti, María-Carmen** (2020). “Desinformación en tiempos de pandemia: Tipología de los bulos sobre la Covid-19”. *Profesional de la información*, v. 29, n. 3, e290315.  
<https://doi.org/10.3145/epi.2020.may.15>
- Sauter, Disa A.; Eisner, Frank; Ekman, Paul; Scott, Sophie K.** (2010). “Cross-cultural recognition of basic emotions through nonverbal emotional vocalizations”. *Proceedings of the National Academy of Sciences*, v. 107, n. 6, pp. 2408-2412.  
<https://doi.org/10.1073/pnas.0908239106>
- Schoch, David; Keller, Franzisca B.; Stier, Sebastian; Yang, Jung Hwan** (2022). “Coordination patterns reveal online political astroturfing across the world”. *Scientific reports*, v. 12, art. 4572.  
<https://doi.org/10.1038/s41598-022-08404-9>
- Sorensen, Anne; Andrews, Lynda; Drennan, Judy** (2017). “Using social media posts as resources for engaging in value co-creation: The case for social media-based cause brand communities”. *Journal of service theory and practice*, v. 27, n. 4, pp. 898-922.  
<https://doi.org/10.1108/JSTP-04-2016-0080>
- Tarjan, Robert** (1972). “Depth-first search an linear graph algorithms”. *Siam journal on computing*, v. 1, n. 2, pp. 146-160.  
<https://doi.org/10.1137/0201010>
- Torabi, Fatemeh; Taboada, Maite** (2019). “Big data and quality data for fake news and misinformation detection”. *Big data & society*, v. 6, n. 1.  
<https://doi.org/10.1177/2053951719843310>
- Van-der-Veen, Han; Hiemstra, Djoerd; Van-den-Broek, Tijs; Ehrenhard, Michel; Need, Ariana** (2015). “Determine the user country of a tweet”. *Social and information networks*.  
<https://arxiv.org/abs/1508.02483>
- Vidgen, Bertram** (2019). *Tweeting Islamophobia*. Doctoral thesis, University of Oxford. British Library Ethos (E-theses online service).  
<https://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.786187>
- Vila-Márquez, Fátima; Arce-García, Sergio** (2019). “Fake news y difusión en *Twitter*: El caso de Curro, el perro ‘condenado’”. *Historia y comunicación social*, v. 24, n. 2, pp. 485-503.  
<https://doi.org/10.5209/hics.66292>
- Wardle, Claire; Derakhshan, Hossein** (2017). *Information disorder: Toward an interdisciplinary framework for research and policy making*. Brussels, Belgium: Council of Europe.  
<https://rm.coe.int/%20information-disorder-toward-an-interdisciplinary-framework-for-researc/168076277c>
- Wason, Peter-Cathcart** (1960). “On the failure to eliminate hypotheses in a conceptual task”. *Quarterly journal of experimental psychology*, v. 12, n. 3, pp. 129-140.  
<https://doi.org/10.1080/17470216008416717>
- Williams, Matthew** (2021). *The science of hate*. London, United Kingdom: Faber & Faber. ISBN: 978 0 571 35706 2
- Wissman, Barrett** (2018). “Micro-influencers: The marketing force of the future?”. *Forbes*, 2 March.  
<https://www.forbes.com/sites/barrettwissman/2018/03/02/micro-influencers-the-marketing-force-of-the-future/#6b90cd756707>
- World Health Organization** (2020). “Working together to tackle the ‘infodemic’”. *World Health Organization*. Regional Office for Europe, June 29.  
<https://bit.ly/385qLAK>
- Zhao, Zilong; Shao, Jichang; Sano, Yukie; Takayasu, Hideki; Takayasu, Misako; Li, Daqing; Wu, Junjie; Havlin, Shlomo** (2020). “Fake news propagates differently from real news even at early stages of spreading”. *EPJ data science*, v. 9, n. 7.  
<https://doi.org/10.1140/epjds/s13688-020-00224-z>