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COVID-19 vaccine disinformation on YouTube: analysis of a viewing network

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Abstract

COVID-19 has generated a social crisis that has required the production of vast amounts of information of various types, including medical. In this scenario, hoaxes and fake news about health issues have also increased, encouraging disobedience of lockdown restrictions and opposition to vaccination against the disease. At the same time, because of their structure and functioning, social media networks have facilitated the production and distribution of such false information. YouTube has also been identified as a source of medical information including COVID-19 hoaxes. This research focusses on an analysis of a video viewing network on YouTube to trace the connection between various videos recommended on the platform and determine the content of the videos that compose that network. To achieve this, we carry out a content analysis supported by specialised software to extract and analyse the videos. The results reveal a limited network of videos about COVID-19, strongly related to each other. Its *amateur* aesthetic stands out, as well as the frequent appearance of certain personalities who, as opinion leaders in a scenario of the delegitimization of traditional institutions, become catalysts for hoaxes and fake news that call for civil disobedience and, sometimes, show links with the extreme right.

Keywords

Social media, hoaxes, fake news, coronavirus, health, vaccination.

1. Introduction

Whilst disinformation has frequently been linked to political processes in different domains (Bastos & Mercea, 2019; Cervi & Carrillo Andrade, 2019), the COVID-19 crisis has also been accompanied by the production and circulation of false content of various types (Salaverría *et al.*, 2020). These flows of disinformation are likely to provoke people's reactions, from decisions about their health to acts of civil disobedience (Lynas, 2020; Moreno Castro *et al.*, 2021), to the detriment of health systems and political stability.

This research addresses COVID-19 disinformation on YouTube, a platform previously identified as a source of medical information for citizens on the Internet. Various studies have pointed to the existence of multiple and viral misleading videos that threaten the knowledge of the population about the disease and the possible treatments to combat it (Bora *et al.*, 2018; Hernández-García & Giménez-Júlvez, 2021). In the case of the coronavirus, anti-vaccine

content has also been frequently and easily accessible in YouTube videos about vaccination (Sued, 2020).

The reason for choosing to analyse the publication of disinformation on YouTube in this study is two-fold. Firstly, we consider it necessary to pay special attention to fake news in video format because, so far, there has been a preference for research on textual rather than audiovisual content (Wardle, 2018). Social media networks have attracted significant interest in the study of fake news (Dias & Sippitt, 2020), so we perceive the need to complement such research on Twitter and Facebook with work on other digital platforms such as YouTube because it can also facilitate the creation and rapid distribution of specific messages (Bakir & McStay, 2018).

Secondly, we perceive the need to research social media networks and disinformation whilst considering the algorithms used on the platform. In recent times, notions such as the filter bubble (Pariser, 2011) have emphasised the importance of analysing how recommendation mechanisms on the Internet ensure that fake news reaches specific audiences that are willing to believe it (Molina *et al*., 2021). Therefore, we propose to work on issues such as the characteristics of the content, the behaviour of the creator, the sources used or the specific popularity of a message based on the logic of the YouTube algorithm.

Research on the circulation of hoaxes of all kinds on the Internet has often focussed on analyses of textual content. Herein, we want to focus our attention on fake news about COVID-19 in video format, especially when related to the dissemination of information about vaccines. We established a series of general and specific aims for the corpus of selected videos. In general terms, the aim of this research is to understand the logic of the suggestion mechanism used by the video aggregator and social media network YouTube. The dissemination and viralisation of false information depend mainly on human mediation (Vosoughi, Roy & Aral, 2018), but it is assumed that this technological tool can also facilitate emotional contagion and further drive this type of thoughtless behaviour.

Considering these issues, we define the following general objectives: (1) to visualise the network of recommendations made to a user on the basis of a video including disinformation about vaccines and COVID-19 and (2) to analyse the type of content related to the topic by simulating what a viewer would watch when continuing to consume videos related to such a topic of interest. We propose to analyse the type of actors starring in the videos, determine which type of content is linked to discourses of a disinformative nature and analyse their most outstanding characteristics, and describe the type of formats most related to the dissemination of disinformative videos, whilst also analysing their most relevant characteristics. The analysis proposed above is based on a two-pronged approach combining quantitative and qualitative methods.

1.1. *Fake news during the COVID-19 crisis*

Fake news has attracted increasing social attention and public scrutiny due to its renewed prominence in political processes internationally. This importance has led to a boom in scientific analyses of this phenomenon, thereby multiplying the number of conceptual proposals used to define it (Guo, 2020). Each of these attempts to define the blurred borders between false information and other types of misleading content circulating on the Internet such as polarised messages, satire, disinformation, commentaries or persuasive information (Molina *et al*., 2021).

In their theoretical review, Tandoc *et al*. (2018) proposed two dimensions that ontologically constitute fake news: inaccurate facts and the conscious aim to lie. Thus, these can be described as "false, inaccurate, or misleading information designed, presented and promoted to intentionally cause public harm or for profit" (Kirchner & Reuter, 2020, p. 2). At the same time, fake news is not created or consumed in a vacuum (Weidner *et al*., 2020). Furthermore, this phenomenon is related to more significant social changes, such as the

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decline of journalism, socio-political disorders, and the massive use of technologies (Amazeen, 2019).

Along this line, fake news is intertwined with a crisis of institutional confidence that drives a multipolar information system to construct morally authoritative sources (Flew, 2019). This disengagement of public institutions and mass media has led to the spread of populist political movements and alternative information channels that mobilise citizens towards more radical and sceptical positions (Bennett & Livingston, 2018). Meanwhile, citizens run the risk of becoming disinformed, more polarised and emotionally outraged after consuming such disinformation (Bakir & McStay, 2018).

Whilst disinformation has frequently been linked to official policy issues, whether at the national level (Cervi & Carrillo Andrade, 2019) or internationally (Bastos & Mercea, 2019), detrimental consequences for democratic systems also occur regarding disinformation about COVID-19. The pandemic has witnessed an alarming spread of medical disinformation on digital platforms (Ramez Kouzy *et al*., 2020) and alternative websites without a clear scientific basis (Cuan-Baltazar *et al*., 2020). Indeed, people with less scientific knowledge and trust in institutions find it more challenging to identify COVID-19 disinformation (Pennycook *et al*., 2020). In Spain, a country that was seriously affected by this health crisis, hoaxes, exaggerations, and false news circulated, sometimes with the explicit objective of misleading the population (Salaverría *et al*., 2020).

In general, "extensively studied topics involving disinformation are vaccination, cancer, nutrition, and smoking" (Kapantai *et al*., 2020, p. 4). In the specific case of the COVID-19 pandemic, Doctors for Truth was one of the organisations that contributed to generating a scenario of disinformation (Milhazes-Cunha & Oliveira, 2021), through denigration of the public health system, medical delegitimisation, dissemination of denialist information and promotion of incendiary statements against lockdown and protective measures against the disease. Through social media networks such as Facebook, its presence extended to more than a dozen countries, including Spain. In this country, misleading messages encouraged the consumption of various natural or synthetic substances that could actually have aggravated the situation of the country's medical system due to the side effects of these remedies, such as burns or poisoning (Moreno-Castro *et al*., 2021).

COVID-19 raised many issues that could be instrumentalised with partisan intent (Pérez-Dasilva *et al*., 2020). For example, the idea that authorities exaggerated the data on the number of infections and deaths encouraged disobedience of preventative and social distancing measures (Lynas, 2020). In the specific case of YouTube, a search on vaccination reveals disinformative content on this issue, related to comments on the injection of a 5G chip or by public figures who argued against vaccination, amongst others (Sued, 2020). Videos on this social media network treated vaccination against COVID-19 in a poor and unlimited fashion, except for those from educational channels managed by health professionals (Chan *et al*., 2021).

Although strictly lying beyond the health sphere, fake news that focussed on discrediting the government, organisations or public figures involved in measures against COVID-19 was also likely to promote anti-system discourse (Gutiérrez-Coba *et al*., 2020). Other theories were also instrumentalised by far-right opinion to mobilise the population in favour of their policies and viewpoints; For example, some conspiracy theories promulgated racist messages that directly attacked migrant populations, suggesting that they imported the virus to decimate privileged White classes (Wallner & White, 2020). For all these reasons, COVID-19 is key in communication research on disinformation, not only because of the central role of this pandemic in recent times but also because of the importance of false information in terms of increasing scepticism, distrust in political systems and the promotion of social division (Ferrara, 2020).

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1.2. *Technological dimension of disinformation studies*

The Internet has undergone a profound transformation over recent decades because of the expansion of social media networks, where much content is now generated and circulated online, to the detriment of websites (Flew, 2019). The centrality of these social media networks has led to the consideration of the Internet as a platformised system. This infrastructure is characterised by digital platforms that often reach vast scales and constitute the fundamental spaces of socialisation and interaction of the connected society (Plantin *et al*., 2018).

This environment has often been considered when studying the generation and distribution of fake news. Some authors point to a rapid circulation of information through multiple websites and social media networks based on the possibility of viralisation of content (Vosoughi *et al*., 2018). This process must be understood within the so-called economy of emotions (Bakir & McStay, 2018), by which advertising revenues depend on the attention and viewing time of online content. Thus, the current Internet system offers incentives for creating fake news, since such partisan and emotional content is easily consumed and disseminated (Guo, 2020).

Therefore, this large-scale dissemination also applies to fake news (Bounegru *et al*., 2017), which benefits from a polarised public and the development of artificial intelligence and the coordinated actions of troll armies. In the first case, audience studies have warned that such content may motivate a partisan and emotional audience to create and distribute it further, if they match their prior views (Lewandowsky *et al*., 2017). In the second case, software-controlled accounts (i.e., bots) can automatically interact with and share specific hoaxes when programmed to do so (Powers & Kounalakis, 2017). In the third case, like the behaviour of bots, some accounts may be coordinated by real people who adjust to the situation and follow a concrete strategy (Bradshaw, Bailey & Howard, 2021).

These two features complicate the multiple forms of interaction with information (Wardle, 2018) and are especially relevant when citizens consume content online via social media networks instead of from trusted news sources (Weidner *et al*., 2020). Simultaneously, the decrease in the cost of producing and distributing online news has paved the way for the creation of alternative websites that are likely to gain political and economic resonance (Clayton *et al*., 2020).

Such alternative producers spread misleading content and rely on prior such material to support it and thereby multiply the appearance of certain fake news (Bounegru *et al*., 2017). The infrastructure of the Internet thus provides a network on which fake news coexists with journalistic production in a continuous flow of information that results in the saturation of citizens and exhaustion when it comes to deciding whether it is true (Bharali & Goswami, 2018).

In this context, communication research has increasingly bridged the gap between this branch of knowledge and research on digital platforms to understand how the Internet system affects the distribution of disinformation (Anderson, 2020). Similarly, technology corporations are currently experiencing increasing pressure to tackle fake news on their websites (Weidner *et al*., 2020). Platforms such as Facebook, Twitter and Instagram have already proposed measures to curb such dissemination by *collaborating with fact-checking* initiatives or implementing red-flag systems to report certain content (Kirchner & Reuter, 2020).

In summary, the debate on fake news and the Internet extends to a reflection on the concrete impact of the platformisation of this environment: "it is the taken-for-granted mediating capacities of digital infrastructures –to commensurate, quantify, order and assemble– which give rise to uncanny effects in the case of 'fake news,' prompting uncertainty and concern" (Gray *et al*., 2020, p. 322). Thus, the technological dimension of the study of fake news addresses a complex system that one must understand in all its dimensions (Wardle,

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2018). In the case of YouTube, previous research has revealed a complex algorithmic structure where controversial and dissident content enjoys greater presence in search results (Rieder *et al*., 2018) and in recommendations after viewing a specific video (Matamoros-Fernández *et al*., 2012). The aim of the current study is to analyse the evidence for these effects in the case of COVID-19 vaccines.

2. Materials and methods

To analyse the network of video recommendations that YouTube makes from a given video, we first selected an entry point to the universe of YouTube videos. Specifically, we selected the video repeated most times and with the most views in public Telegram groups of COVID-19 deniers. We chose this video because we believe that, in this way, the resulting data will simulate the possible viewing path of a user of this social media network starting from a specific origin.

Starting from this source video spreading disinformation about COVID-19 vaccination, we extract the resulting video network using YouTube Data Tools (Rieder, 2015). The collection period was the first week of March 2021. Specifically, in the configuration of the extraction through the Video Network mode, the *crawl depth* was reduced to modular, being set at its maximum level (2), because when starting from the *seed* of the selected video, the rest of the options of the tool do not affect the search. The search was therefore not limited to a specific time. The resulting network consisted of 1890 nodes (YouTube videos), with an average degree of 12.1 (each node being connected to an average of 12 videos on the network). The centrality measures of the network were (a) diameter of 18, (b) radius of 0 and (c) average length of 6.47. We used it to perform two types of action.

On the one hand, we performed a manual content analysis of all the videos to identify those related to COVID-19 or vaccination. Thereafter, with that encoding added as metadata at the nodes, we visualised the result in Gephi (Bastian, Heymann & Jacomy, 2009) using the ForceAtlas 2 algorithm (Jacomy *et al*., 2014). We could thus isolate and examine the thematic *cluster* and analyse its distribution. Once the *thematic cluster* of videos addressing COVID-19 or vaccination (n = 184) had been identified, we carried out a manual content analysis using formal variables (video duration, channel author, type of protagonist (depending on the information appearing in the video), origin of the dialogue, type of publication), variables focussed on the discourse (type of source, use of scientific language, the body that is delegitimised, whether it discourages vaccination) and variables focussed on disinformation (veracity of the content, type of deception used). The codebook and reference studies from which the variables and categories were obtained are presented in Annex I. To ensure the quality of the coding, the authors in charge of this task performed several pre-tests and adjusted the codebook until the α value for the results of all variables was higher than 0.8 in the Krippendorff α test. Moreover, we also analysed all the videos in the video *cluster* to identify the prominent hoaxes and their arguments. During the analysis period, one video was no longer available. Therefore, the *cluster* contained 184 videos, but 183 in some parts of the research.

3. Analysis and results

The network stemming from the input video, including videos related to the source video whilst simulating possible viewing patterns from the different content, was pervasive (1890 nodes) and highly compartmentalised since the *network clusters* were highly delimited (Figure 1). However, according to its content and not the composition of the network, the *thematic cluster* formed from the videos related to COVID-19 and vaccination (shown in red in the figure) was composed of 184 nodes, representing 9.74% of the general network and having an average degree of 8.3 [centrality measures: (a) diameter of 12, (b) radius of 0 and (c) average length of 4.29]. This subnet is very limited and small in comparison with the whole volume of

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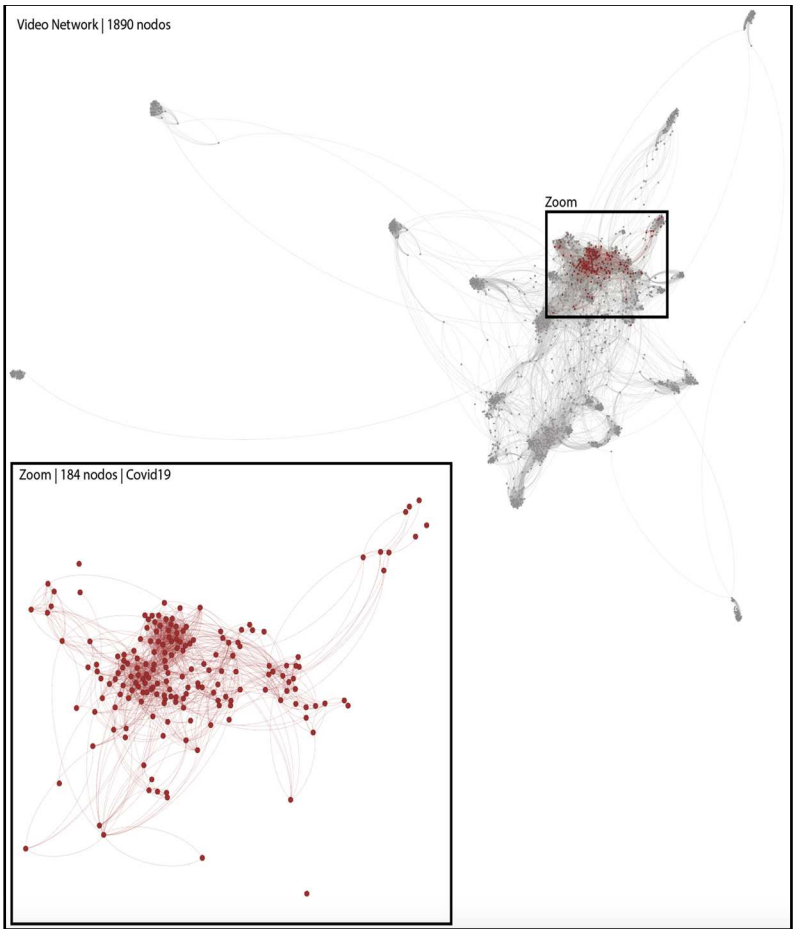
videos. Users would enter in it and continue to play videos related to COVID-19 or vaccination, following the playback of the source video.

Figure 1: General graph of the video network and zoom of the thematic cluster on vaccination and COVID-19.



Source: Own elaboration.

These videos are characterised by being published mainly by news agencies and media (43%) and independent users (38%) (Table 1). The predominant group of protagonists is the medical collective (39%), being the main one for independent channels. Other public figures such as journalists and media profiles (22%) as well as advocates of alternative therapies (9%) are also prominent. In practically all the videos, the source was accurate (97%) and the origin of the data was the person themselves (the actor who speaks in 98%) (Table 2).

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Table 1: Type of author of the channels and type of protagonist of the videos (*n* = 183).

Channel author/protagonist	Doctor	Scientist	Health worker	Advocate of alternative therapies and conspiracies	Politician or health authority	Another type of public figure	Anonymous citizen	Other	Total
News and media agency	21 (29%)	6 (46%)		2 (12%)	16 (73%)	30 (73%)		3 (75%)	**78 (43%)**
Independent users	41 (57%)	4 (31%)		6 (35%)		7 (17%)	11 (100%)		**69 (38%)**
For-profit companies	5 (7%)		1 (33%)	8 (47%)		1 (2%)		1 (25%)	**16 (9%)**
Government agencies	1 (1%)	1 (8%)			6 (27%)	1 (2%)			**9 (5%)**
Non-profit organisations	3 (4%)	2 (15%)		1 (6%)		2 (5%)			**8 (4%)**
Scientific and university bodies			1 (33%)						**1 (1%)**
Other	1 (1%)		1 (33%)						**2 (1%)**
TOTAL	**72 (100%)**	**13 (100%)**	**3 (100%)**	**17 (100%)**	**22 (100%)**	**41 (100%)**	**11 (100%)**	**4 (100%)**	**183 (100%)**

Source: Own elaboration.

Table 2: Type of source and presentation of the message (*n* = 183).

Source/first person	Speaker	Referenced/ cited material	Not applicable	Total
Real	160 (98.16%)	14 (82.35%)	3 (100%)	**177 (96.72%)**
Fictitious	1 (0.61%)	2 (11.76%)		**3 (1.64%)**
Other	1 (0.61%)	1 (5.88%)		**2 (1.09%)**
Anonymous	1 (0.61%)			**1 (0.55%)**
TOTAL	**163 (100%)**	**17 (100%)**	**3 (100%)**	**183 (100%)**

Source: Own elaboration.

In the specific thematic subnet, 47% of the videos contained disinformation. If we focus on their typology, hoaxes were present mainly in the conference format (more than 1 h long) and interviews (Table 3). The most common deception techniques were manipulated (53%) or false context (16%), followed by exaggeration (12%), fabricated content (7%) and false connection (6%).

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Table 3: Type of publication according to the veracity of the content (*n* = 183).

Type/veracity	True	Clickbait	Hoax	Total
Conference	29 (33.72%)	2 (18.18%)	35 (40.70%)	**66 (36.07%)**
Interview	14 (16.28%)	2 (18.18%)	32 (37.21%)	**48 (26.23%)**
News	34 (39.53%)	2 (18.18%)	11 (12.79%)	**47 (25.68%)**
Other	7 (8.14%)	1 (9.09%)	5 (5.81%)	**13 (7.10%)**
Announcement	1 (1.16%)	4 (36.36%)	1 (1.16%)	**6 (3.28%)**
Documentary	1 (1.16%)	–	2 (2.33%)	**3 (1.64%)**
TOTAL	**86 (100%)**	**11 (100%)**	**86 (100%)**	**183 (100%)**

Source: Own elaboration.

Scientific language was hardly used in the videos (Table 4). The vast majority of videos against vaccines used everyday language and avoided specialised words to sell their argument. The content of the discourse of the videos was aimed at delegitimising the system in general (39%), leaders (23%), vaccines in particular (14%) or the health system (12%).

Table 4: Use of scientific language and position on vaccination (%) (*n* = 183).

Language/position	Anti-vaccines	Pro-vaccines	Other	Total
Everyday language	41 (89.13%)	50 (73.53%)	65 (94.20%)	**156 (85.25%)**
Scientific language	5 (10.87%)	18 (26.47%)	4 (5.80%)	**27 (14.75%)**
TOTAL	**46 (100%)**	**68 (100%)**	**70 (100%)**	**183 (100%)**

Source: Own elaboration.

In the videos containing hoaxes, the protagonists themselves narrated and presented the argument of the message in all types of formats (Table 5). It is surprising that the average duration of the most widely used format, i.e., conferences, was 1 h 23 m.

Table 5: Type of publication of hoaxes and presentation of message (%) (*n* = 86).

First person/type	News	Interview	Announcement	Conference	Documentary	Other	**Total**
Direct speech	7 (63.64%)	32 (100%)	1 (100%)	34 (97.14%)	2 (100%)	**4 (80%)**	**80 (93.02%)**
Referenced/cited	4 (36.36%)			1 (2.86%)		1 (**20%**)	**6** (**6.98%**)
TOTAL	**11 (100%)**	**32 (100%)**	**1 (100%)**	**35 (100%)**	**2 (100%)**	**5 (100%)**	**86 (100%)**

Source: Own elaboration.

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Based on the information they provide, the actors starring in the videos were usually some kind of authority figure that generates trust, such as doctors, lawyers, or journalists. In addition, it is surprising how often certain personalities who are celebrities in the movement appear as collaborators across different channels. On this basis, we identified up to six non-exclusive characteristics, which are repeated in most messages. We list them here, not necessarily in order of global relevance.

First, the *amateur* aesthetics of the videos stand out. The protagonists are usually presented in family environments, homes or workplaces. Living rooms or poorly lit spaces are often used, and the sound is often not of high quality. The video composition fosters an image of closeness, far from the professionalism projected particular by audiovisual media.

In addition, plain language is used, without stylistic complexities and often lacking verifiable information or data. The structure tries to follow argumentative discourses of affirmation, reasoning, evidence (ARE) type, but almost always omitting the 'E.' References to 'real life,' 'people' and 'common sense' are also numerous and constitute an element that reinforces proximity with the followers.

Related to the previous point, the connections between vaccines and the supposed problems they generate are established by evidence for which there is no proof. In this sense, claims such as that vaccines cause widespread 'sterility,' 'blindness,' 'cancer,' 'neurotoxicity' or 'damage to the genome' are never accompanied by studies or scientific analysis to corroborate them.

Moreover, there is a general preference to refer to obscure interests that often cannot be identified with anyone in particular or any particular institution or entity. Whilst it is true that organisations such as the World Health Organization (WHO), United Nations (UN), Social Security, or the Spanish National Research Council (Consejo Superior de Investigaciones Científicas-CSIC) are sometimes mentioned in the case of Spain, their specific role in the 'scam' of the pandemic is never explained. The 'struggle' is thus against an enemy that is consciously invisible within the discourse. Generic attacks based on the 'state,' 'politicians,' the 'system,' the 'dominant elites,' 'the henchmen of the new world order' or a decontextualised 'them' as responsible for an alleged massive deception thus predominate.

Likewise, we note the presence of label concepts and clichés that are not very descriptive and do not refer to any tangible reality. Each channel owner, with different levels of nuance, highlights or refers to one of these labels in their speeches. Typically, there are references to 'conspiracy theories,' 'lack of freedom of thought,' 'anti-system movements,' a 'world plot,' the 'alleged pandemic,' a 'plandemic,' 'sects,' 'alleged outbreaks,' etc.

Finally, we find links between denialism and the populist discourses of far-right parties, including racist insinuations of an alleged responsibility of 'immigrants.' Sexist statements point to the responsibility of 'feminists on March 8, 2020' as responsible. There are also allusions to 'geopolitical' or 'global social engineering' interests that limit the 'sovereign power' of states. Also, in some cases, there are links with ultra-Catholic groups.

4. Discussion and conclusions

The phenomenon of the platformisation of the Internet explains the existence of the centrality of social media networks as spaces for interaction and social discussion. Within the loop of recommendations generated by such platforms from a single video, we find a relatively small content cluster addressing the theme of COVID-19 or vaccination. Like other social media networks, the behaviour of users on YouTube is guided by emotions and the attention economy (Bakir & McStay, 2018; Guo, 2020).

Regarding its first objective, this research reveals the complexity of the algorithms on YouTube in the case of the discourse against COVID-19 vaccination in Spain. The results reveal that not all disinformation videos adopt the same type of content, but the connection between

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them is straightforward and robust. One can thus talk about specific communities of disinformation that share the same objectives and theories.

Spain is one of the countries in the world in which vaccination campaigns promoted by public health authorities have been most successful. In this work, we did not detect many videos related to the movement against COVID-19 vaccination. There may be different ways to interpret this result, but one of the most likely is related to YouTube's mechanisms for removing disinformative content from channels, in line with measures adopted by other social media networks (Kirchner & Reuter, 2020). In this sense, it may be relevant to determine how this type of community dedicated to the production of disinformation manages to avoid the rules of digital platforms and whether they instrumentalise such mechanisms as censorship against the truth. On the other hand, it is worth mentioning the greater reluctance of the population as a whole to be seduced by unscientific discourses (Fecyt, 2019).

Concerning the second objective of this work, compared with the network of recommendations obtained, the discourses identified show that spreading such disinformation mat be potentially harmful. The predominance of inaccurate facts with the conscious purpose of lying is discovered. The repetition of decontextualised, exaggerated or manipulated content is prominently observed, with actors repeating the same ideas as a kind of mantra. These findings reinforce results on COVID-19 content distributed via other Internet spaces (Salaverría *et al*., 2020). From a discursive point of view, these ideas also corroborate the work of Tandoc *et al*. (2018).

Lies on the net are designed to go viral. Short messages propose simple explanations to complex issues and arouse "indignation, surprise or disbelief' in users" (Samper, 2021). These characteristics explain why people exposed to these types of messages are more likely in certain circumstances to share and disseminate hoaxes (Vosoughi, Roy & Aral, 2018). As shown by this research, their simplicity is also achieved by eliminating all reasoning based on evidence and data. The current quantitative and qualitative analyses reveal that these characteristics are systematically repeated in the content that contributes to spreading lies about COVID-19 vaccination.

We also highlight the repetition of the same personalities who star in the videos and seek to capture the attention of the communities of followers. The actors in the videos cultivate an image of independence in the face of supposed powers that seek to silence their discourse. Likewise, unlike the dissemination of other hoaxes, these actors do not hide their identity but rather attempt to construct a brand. In a scenario where multiple subjects have moral influence (Flew, 2019), new leaders emerge and can bring together certain users who believe them and share their content. Institutional distrust also opens the possibility of generating trust through proximity and formats that are not necessarily journalistic.

Concerning the protagonists of the videos, we recognise that one of the most relevant contributions of this study is the visibility of the disseminators of lies. Unlike other analyses of hoaxes (Moreno-Castro *et al*., 2021), in the dissemination of false information, the actors are specific people who cultivate their personality and identity amongst a group of followers to encourage them to consume and disseminate their videos. These actors commonly include people who claim to perform professions with social prestige such as doctors, lawyers or journalists. Their active presence on YouTube may correspond to a search for an alternative dissemination channel. However, in some specific cases, the actors also have a presence and impact in conventional media.

The videos used by the actors imitate the typologies associated with scientific dissemination. They are usually interviews or monologues (Vizcaíno-Verdú, de-Casas-Moreno & Contreras-Pulido, 2020), where interactions in the chat are limited to followers of the channel. In contrast to what is expected for other YouTube formats, this study identified the presence of videos of considerable duration, also associated with a specific type of

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scientific dissemination format (Davis & León, 2018). Regarding the length of the videos, the most likely reason for this is the hope of the channel owners to appear as experts who speak directly and without censorship to their audience in a context of freedom.

Finally, there has been little elaboration regarding the complexity of anti-vaccine discourses, which resort to exaggeration, decontextualisation and manipulation without evidence to support their message reliably. This type of content contributes to previous literature on disinformation regarding the COVID-19 pandemic (Bora *et al*., 20218; Hernández-García & Giménez-Júlvez, 2021; Sued, 2020). Such lies aim to motivate people not to be vaccinated and to take action against the sanitary measures enacted by the various governmental institutions. In addition, such videos sometimes show a connection with the extreme political right, as already shown in previous research (Wallner & White, 2020).

Disinformation, beyond political issues, permeates various moments of social conflict, as previously proposed (Amazeen, 2019), and tries to influence them with ideological and economic objectives. For this reason, publications on COVID-19 run the risk of leading to anti-system behaviour (Gutiérrez-Coba *et al*., 2020). The literature on communication, in collaboration with other technological approaches (Anderson, 2020), must thus consider the social environment to understand not only the forms of production of hoaxes and fake news in their various formats but how these information flows are significant for the development of the contemporary public sphere. Future research may delve into these communities' discursive frameworks and online interactions on YouTube and other social media networks. Network analysis remains, in this sense, the key to understanding the interactions and connections between profiles with similar interests and focus.

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Annex I

Codebook of the variables analysed in the study

1. Duration (video minutes): indicate number
2. Author of the channel (from Bora *et al*., 2018)
    a. Government agencies
    b. News and media agency
    c. Scientific and university bodies
    d. Non-profit organisations
    e. For-profit companies
    f. Independent users
    g. Other

3. Type of protagonist, according to his presentation in the video (from Moreno-Castro *et al*., 2021)
    a. Doctor
    b. Scientist
    c. Healthcare worker
    d. Advocate of alternative therapies and conspiracies (even if appearing to be or is a doctor)
    e. Someone defending therapies
    f. Politician or health authority
    g. Other type of public figure
    h. Anonymous citizen
    i. Other

4. Does the actor present the message in the first person? (from Moreno-Castro *et al*., 2021)
    a. Direct speech (first person)
    b. Referenced/cited (third person)
    c. Does not apply (when there is no reference to the actor)

5. Type of publication (Hernández-García & Giménez-Júlvez, 2021).
    a. News (origin in the media)
    b. Interview
    c. Announcement
    d. Conference
    e. Documentary
    f. Other

6. Veracity of the information (Lemos *et al*., 2020).
    a. True: The content is truthful, the sources are given, the agents are recognised authorities (journalists or scientific journalists), the content is factual and offers different points of view of the phenomenon and the objective is to inform.
    b. Clickbait: Videos with titles and descriptions that exploit the theme to attract viewers and generate 'likes' without necessarily addressing the topic in the headline. They make mistakes and divert the focus from the topic at hand to increase the visibility of the channel.
    c. Hoaxes. Videos with false connections and sensationalist content that seek to destroy or manipulate public opinion about a party, institution, person or

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phenomenon. Videos that amplify false content propagated by official, political and governmental bodies; videos with decontextualised facts that seek to confuse, reinforce contrary attitudes, stimulate polarisation or deny scientific facts through speculation and conspiracy theories.

7. Deception technique (Gutiérrez-Coba *et al*., 2020)
    a. False connection: Headlines, images or captions that do not confirm the content.
    b. False context: Genuine content that is disseminated with false context information.
    c. Manipulated content: Genuine information or images that are manipulated to deceive.
    d. Exaggeration: Based on real data but increasing their scope.
    e. Manufactured content: New content designed to deceive and harm.
    f. Other technique.
    g. Not applicable.

8. Source (Salaverría *et al*., 2020)
    a. Anonymous. The issuer is not disclosed, nor is the information supported by any person or entity.
    b. Fictitious. Imaginary or fabricated identity.
    c. Real. A persons or entity who is correctly identified, even if the information is false.
    d. Impersonated. Falsely claiming to come from an official or business source. Those persons or entities to which some type of reference or false attribution of information is made.

9. Use of scientific language (from Moreno-Castro *et al*., 2021)
    a. Yes: Use of technicalities without further explanation.
    b. No: Simple language without using technicalities, or using them and explaining them later in a simple way.

10. Disauthorisation (from: Moreno-Castro *et al*., 2021)
    a. Of vaccines
    b. Of the healthcare system
    c. Of leaders
    d. Of the system in general
    e. Does not delegitimise

11. Explicitly supports not getting vaccinated (from Moreno-Castro *et al*., 2021)
    a. Yes
    b. No
    c. Other: when the video does not state a position on vaccination

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