The AstraZeneca *affair*. How the junk news regime affected the public debate on the COVID-19 vaccination controversy in Italy

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Abstract
In recent years, there has been a notable increase in the presence of techno-scientific issues within public discourse, particularly during the COVID-19 pandemic. This proliferation has been attributed to the pervasive attention economy, which drives actors in hybrid media ecosystems to seek attention-grabbing topics. Socio-technical issues, known to evoke strong emotions like outrage and rivalry, have become recurring themes in both news and social media discussions. However, the regulatory mechanisms of the attention economy often impede the full exploration of these controversies in the public sphere, as news cycles and audience attention accelerate due to the prioritization of engaging content on social media platforms. This trend towards attention-driven content has compelled news organizations to adapt their business models, resulting in an environment where citizens may rely on confirmation bias, ultimately leading to polarization of public opinion. Consequently, effectively addressing controversies in today's public debate has become increasingly challenging. To understand the extent of influence exerted by junk news – a transient form of content that distracts rather than nourishes public discourse – we conducted a case study focused on the controversy surrounding the adverse and lethal side effects of the AstraZeneca COVID-19 vaccine during the vaccination campaign in Italy. Our analysis, based on a comprehensive dataset of 798,954 tweets and 31,169 news articles spanning a six-month period, reveals three interconnected information disorders. Firstly, the vaccine debate displayed a relatively stagnant progression punctuated by sporadic spikes of attention. Secondly, the peaks of the debate involved sensationalized coverage in journalism and amplified discussions on Twitter, primarily centred around suspected vaccine-related deaths. Lastly, reports of these deaths by legacy media accounts on Twitter correlated with an increasing ideological and partisan reaction from social media users over time, contributing to polarization. These findings shed light on how the junk news regime can impede the shaping of public debates, particularly on contentious socio-technical issues such as vaccination campaigns. The implications of this research extend to the broader understanding of public engagement with science and the challenges posed by attention-driven media ecosystems.

Keywords
public debate; socio-technical controversies; junk news; vaccination campaigns; COVID-19; AstraZeneca; digital methods.

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1. Introduction

Since the 2000s, and even more so during the COVID-19 pandemic, several studies have pointed out an increasing proliferation of techno-scientific issues in public debate (Bucchi and Mazzolini 2003; Marres 2007; Pulido et al. 2020; Fleerackers et al. 2022). According to the perspective of the "attention economy" besides goods or services scarcity, also the attention of individuals can be framed as a scarce resource (Simon 1971). In this context, attention is considered a valuable commodity, and businesses and organisations compete for it to promote their products, services, or ideas. The journalism industry has been heavily impacted by the attention economy. With so many different sources of information available to consumers, it can be difficult for traditional news organisations to capture and hold the attention of their audience.

Indeed, influenced by the pervasive attention economy, the actors of hybrid media ecosystems (Chadwick 2017) are constantly and relentlessly looking for topics that can attract and retain attention (Venturini and Munk 2021). In this atmosphere, socio-technical issues can promote high-activation feelings, such as outrage and rivalry, which are very effective in capturing attention (Nguyen and Catalan-Matamoros 2020). As a result, controversies tend to be recurring central themes both in the news and social media's discussions.

Nevertheless, the regulatory mechanisms of the attention economy simultaneously hinder the public unfolding of these very same socio-technical controversies. Indeed, one of the main lateral consequences of the attention economy is the acceleration of both news cycles and the related audience's attention towards topics and issues (Lorenz-Spreen et al. 2019). A further perspective that informs the analysis of these phenomena is the "public arenas" model, as it has been also recently mobilized in public communication of science literature (Neresini et al. 2023; Neresini et al. 2019; Dudo 2015). According to Bosk and Hilgartner (1988), public arenas arise when various stakeholders, including scientists, policymakers, interest groups, and the public, engage in debate and struggle over the meaning and implications of scientific findings. These stakeholders often hold divergent perspectives, interests, and values, and they may have different levels of expertise and authority. Public arenas provide a platform for these stakeholders to voice their concerns, challenge established norms and practices, and seek to influence the policymaking process. Broadly speaking, public arenas can arise also across media ecosystems when a particular issue or controversy gains significant media attention and generates widespread public debate and discussion. This may happen, for example, when a news story or investigative report raises ethical or social concerns, or when a social movement gains traction and captures the attention of the media and the public. The result has been that many news organisations have shifted their focus towards creating content designed to grab and hold the attention of readers or viewers, often at the expense of more in-depth or investigative reporting. This trend towards attention-grabbing content has been fuelled in part by the rise of social media platforms, which prioritise content that generates the most engagement and sharing. As a result, a lot of news organisations have been forced to adapt their business models to compete in this new attention-driven landscape.

Against the current backdrop, it is worth noting that news circulating through media ecosystems are not necessarily trustworthy or based on reliable sources (according to the prevailing scientific demarcation criteria). Considering the increasing pluralization of information sources,

especially online based, that may deliberately produce inaccurate or fraudulent news (Bory et al. 2022; Crabu et al. 2023), it is relevant to ask what the returns are for the public. This acceleration in the formation and dissolution of public arenas may force citizens to rely on confirmation bias and, as a result, could create the basis for the polarisation of public opinion (Del Vicario et al. 2017). Therefore, even if controversies are spreading more widely and more rapidly than ever before, it seems increasingly difficult to address them effectively in today's public debate.

Drawing on these considerations, we seek to understand how and to which extent certain regime of news, that can be labelled as junk news (Castaldo et al. 2022), may influence the public debate concerning socio-technical controversies. Indeed, junk news are contents that are built to fade away as quickly as they rose; as a results, they distract public debate rather than nourishing it (Id). Junk news can be considered an example of information disorder, an umbrella term that encompasses misinformation, disinformation and malinformation that affects quality of news available across media ecologies (Wardle and Derakhshan 2017). To achieve this aim, we selected a representative case study: the controversy that arose during the COVID-19 vaccination campaign in Italy. The case in question is that of the adverse and lethal side effects of the AstraZeneca vaccine that affected very few people worldwide (Liu et al. 2021).

More precisely, our analysis seeks to highlight how the junk news regime could hamper the shaping of public debates, especially when such debates concern controversial socio-technical issues (e.g., vaccination campaigns). To achieve this objective, we collected 798,954 tweets and 31,169 news articles related to the adoption of the AstraZeneca COVID-19 vaccine in Italy for a period of six months (1st January 2021 – 30th June 2021). Our analysis reveals three different but intertwined information disorders: first, the vaccine debate exhibited a flat progression with a few condensed spikes of attention (acceleration); second, the two main peaks of the debate involved both journalistic coverage and Twitter discussions generated from news and social media's hypes of the suspected deaths related to AstraZeneca (sensationalisation); finally, the reports of suspected deaths by legacy media accounts on Twitter correlated with an increasing ideological and partisan reaction from social media users over time (polarisation).

2. The Italian context for vaccination campaign against COVID-19: information disorder and connected processes

The vaccination campaign against COVID-19 started in Italy in the last days of December 2020 and expanded to the whole national population from late February 2021. In early March, some cases of possible strong adverse reactions to the vaccine patented by AstraZeneca were first reported. As a result, the government decided to stop the campaign (from 16th – 19th March) and restarted it only after the Italian Drugs Agency certified the absence of any link between the signalled deaths and the seized AstraZeneca vaccine batches. However, a few weeks later (April 7th) the European Medicines Agency published a document that confirmed a weak correlation between rare thrombosis and AstraZeneca, suggesting the vaccine's use only for the part of the population older than 60 years. Following the EMA's warning, the Italian vaccination campaign resumed by prioritising the over-60s, but left unaffected the possibility of using AstraZeneca, previously renamed Vaxzervria, also for younger citizens. In

late spring, after participating in an open vaccination event, an 18-year-old girl died in Genoa from a rare thrombosis linked to AstraZeneca. The day after this dramatic event, the administration of AstraZeneca vaccine stopped for anyone under 60 years old (June 11th).

From an empirical viewpoint, the AstraZeneca *affair* can be identified as an exemplary case to explore how controversies unfold in contemporary hybrid media ecosystems and how the junk news regime could affect public debate concerning socio-technical issues.

To study whether and how such junk news regime may have influenced the public debate on the AstraZeneca vaccine, we have chosen to study three different processes related to information disorder that may arise from this regime. Indeed, information disorder refers to a broad category of processes related to the circulation, consumption, and interpretation of information in digital and online contexts. It encompasses a range of problems concerning the effects of these processes on the quality of public debate (Wardle and Derakhshan 2017). It is easy to recognize these features in the selected case study; the whole analysis takes into consideration three processes connected to information disorder.

The first process of information disorder that we want to analyse is that of the *acceleration* of public debates (Castaldo et al. 2022). The junk news regime could indeed result in a constant but scarcely followed day-to-day journalistic coverage, which, however, is disrupted by sudden accelerations in both the production of news and the specular conversations on social media.

A second process of information disorder we will investigate is the *sensationalisation* of information and discussions. As argued by Bosk and Hilgartner (1988), the formation and dissolution of public arenas exhibit a characteristic temporal pattern, whereby the dramatisation of events is essential to keep audiences' attention on a given topic. Since different social problems are constantly competing for attention, within the junk news regime a particular issue may only emerge when it is over-dramatised.

Finally, a last process of information disorder associated with the junk news regime is the *polarisation* of public opinion. By saturating online public debate with continuous bursts of sensationalist news and messages, the junk news regime leaves little time to discuss each of them (Venturini 2019). This dynamic creates the basis for the use of heuristic shortcuts and confirmation bias in the discussion of an issue. Consequently, partisan or ideological positions are often used to maximise newsworthiness or visibility, but these strategies may lead to the polarisation of public opinion.

Starting from the above discussed processes driving to information disorder, in this article we will map the AstraZeneca controversy using a digital methods approach (Marres 2015; Bounegru et al. 2018) and subsequently we will discuss how its news cycle obstacle the formation of a stable public arena in which to properly discuss such a crucial socio-technical issue.

3. Research Design and operationalization of information disorder processes

To investigate the debate around AstraZeneca we decided to collect all the online news and tweets in Italian referring to the vaccine for a period of six months (1st January 2021 – 30th June 2021). Within the many social media, we decided to focus on Twitter for two different reasons. First, Twitter had one of the most rapid and expansive growth in social media's usage

during the initial phase of the pandemic (+34% as for 2020 official report), mainly due to the influx of new users seeking a digital arena where to discuss issues related to COVID-19. Secondly, we focused on Twitter because of its peculiar news-driven nature (Kwak et al. 2010).

We utilised the Twitter v2 search API to obtain 798,954 Italian tweets containing the terms "AstraZeneca", "Astra Zeneca", or "Vaxzevria". Concurrently, we collected 31,169 news articles from the repository "Explorer | Media Cloud" using the same keywords and language parameters. This dataset includes the titles and URLs of news articles produced by 143 distinct Italian journalistic websites, including newspaper, newscasts, radio, and natively digital blog. It is worth noting that "Explorer | Media Cloud" includes all the major news websites in the country.

To examine the progression of the AstraZeneca controversy, we first analysed the flow of information overtime. We determined the temporal distribution of both tweets and news, which enabled us to identify the *peaks* of attention refer to periods of heightened activity and interest surrounding a particular topic or event (Boydstun et al. 2014). Researchers identify important events or turning points in a given discourse or narrative and can provide insight into how information spreads and evolves over time in different media channels (Id). To identify these peaks, we utilised a well-established formula and identified any time point with a residual value greater than two times the standard deviation of its time series residuals as a spike (Blázquez-García et al. 2021). In the case of news, a peak was identified as a distribution of more than 300 news articles per day, while on Twitter peaks must exceed 25,000 tweets per day. Based on this calculation, the peaks of attention were identified as occurring from 11th – 12th March, from 15th – 18th March, and from 10th – 11th June.

To detect a possible process of sensationalisation we decided to circumscribe a sub-sample of the Media Cloud dataset using some specific keywords (namely "morta/e/i/o"; English translation: "death/s"). This allowed us to select 2332 news items. In this term, the general claims that vaccination is equal to deadly risks produced a diverse set of news. These articles range from the reports of suspected deaths ("*Dead after vaccine, experts: Correlation between dose and death*"[1]), to debunking pieces ("*So does the AstraZeneca vaccine really cause fatal thrombosis? For now, the answer to keep in mind is no. But, says the EMA, the possibility exists. Here's why*"[2]), to pure click-baiting news ("*Died after Astrazeneca vaccine, her life worth 70K*"[3]). It should be said that actual deaths connected to vaccines were very few – roughly in line with other typology of vaccines, such as the mRNA ones – and that this scientific information was available at the time of the vaccination with AstraZeneca (Liu et al. 2021). In other words, most articles reporting deaths linked to AstraZeneca did so in a communication context in which it was very clear, according to the available scientific evidence, that the vaccine was safe enough. So, to our research goal, we can use the interest in (mostly spurious) deaths as a marker (or proxy, in other words) for sensationalism.

To test a possible correlation between Twitter attention spikes and the news subsamples we calculated their Pearson coefficient[4]. In addition, we also performed a Granger causality test[5] to see if there is evidence of a statistical cause-to-effect direction between any of the three considered distributions (i.e., tweets, total news, news about deaths).

A last point of interest in our study concerns the potential polarisation of the public arena. To operationalize this concept, we relied on the networked reaction of Twitter's users as a proxy for the polarisation of the debate. Due to the extensive nature of the conversation on

Twitter, a comprehensive quali-quantitative mapping would have resulted in an overwhelming and unproductive outcome. Therefore, we opted to focus our analysis on the specific topical moments related to the AstraZeneca *affair*, namely the peak weeks of March and June.

To disentangle the communities of users involved in the AstraZeneca controversy we leverage on retweet networks. This choice entails an assumption, namely that retweeting something means, most of the time, an endorsement of the original tweet. While some Twitter users routinely state that "retweeting is not endorsement" there is substantial empirical evidence of the contrary (Metaxas et al. 2015).

Starting from this assumption, to get a rough measurement of ideological affinities within the retweets networks we implemented a visual network analysis with Gephi (Bastian et al. 2009) using the output of its force-directed layout to intercept the emergence of homogeneous communities (Jacomy et al. 2014). A force vector layout works according to a physical analogy: nodes receive a repulsive force that pulls them apart, while edges act as springs that bind the nodes they connect. In a network spatialized by forces spatial distance acquires meaning. Indeed, two nodes are closer the more directly or indirectly connected they are. Spatialization of forces can effectively re-materialize notions of graph mathematics. It was shown, for example, that visual clustering in networks spatialized by forces is directly equivalent to clustering with modularity algorithms. Centrality, betweenness, diameter, density, structural separation, and many other concepts recover their graphical meaning. They cannot only be calculated, but graphically visualised (Venturini, Jacomy and Jansen 2021).

Finally, the 500 most shared tweets were selected and manually analysed to further triangulate the computational results with richer and deeper qualitative insights. While five hundred tweets may seem a small sample it should be said that retweets are distributed in the discussion following a typical power-law distribution. In our specific case the Gini index[6] measuring retweet concentration is 0.76 for the entire period – meaning that a few selected voices have control over the framing of the debate on Twitter (Barberà and Rivero 2015) – and hence legitimise the choice of a close reading of the top messages instead of using computational techniques to model or classify all tweets.

4. Results

By using news and tweets timestamps we depicted the general temporal trend, and we intercepted either the pace and the possible accelerations in the production of journalistic pieces or tweets. Assuming that Twitter discussions are eminently event-based, it was of paramount importance to detect the peaks of attention and their relative position in both social and legacy media trending curves. To ease interpretation, while accounting for the fact that social and legacy media have different throughput capacities (i.e., the former is being measured in tens of thousands of tweets while the second in hundreds of news), we have normalised volumes in rank order to compare the time series on a common scale.

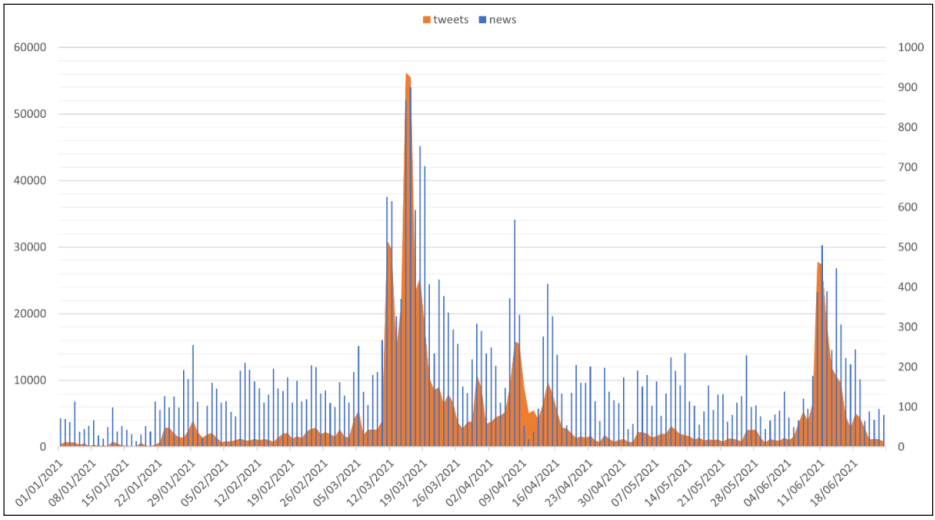

Figure 1.
Tweets (left axis) vs news (right axis)[7].

By comparing Twitter and Media Cloud time series it is possible to distinguish different patterns on the attention paid to AstraZeneca vaccine. As shown in Figure 1 the debate on AstraZeneca shows a fluctuating progression all over the six months we considered.

A first relevant finding when comparing news and tweets is that legacy media coverage of AstraZeneca is more evenly distributed than Twitter discussions. Indeed, on average, we can count about 150 news articles per day (roughly 0.5% of the total) with a maximum coverage of 901 items in a day (around 3% of the total). Conversely, on average 4,565 tweets per day are published (again 0.5% of the total), but the day of highest activity contains 56,264 tweets (14% of the total). These insights are also supported by the Gini index calculated on the concentration of news and tweets per day, that corresponds respectively to 0.52 and 0.81.

In the light of these two initial findings, we can argue that in the case of Twitter it occurred a flat progression interrupted by three rapid accelerations of the debate during the "peaks" of attention. An equivalent acceleration, instead, is less visible for legacy media. However, also in this case few events seem to attract a considerable part of the production effort concerning news coverage of the AstraZeneca vaccine.

Having assessed the different rhythms at which messages travel on news sites and Twitter, we want to assess a possible sensationalisation of the controversy surrounding the debate about vaccine safety.

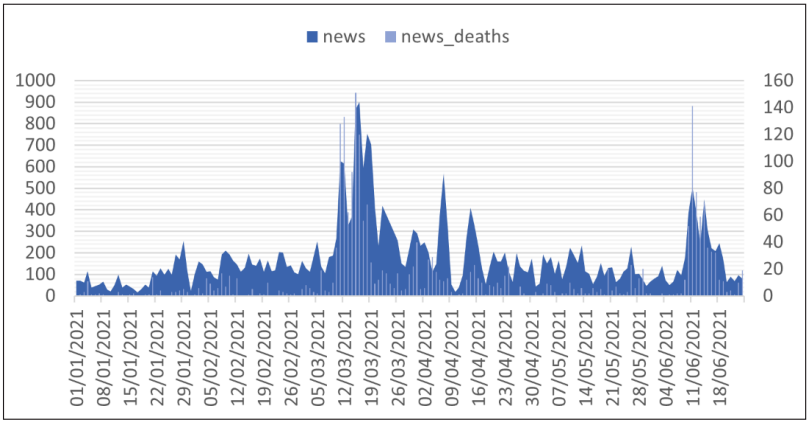

Figure 2.
News about AstraZeneca (left axis) vs. news about suspect deaths (right axis).

Figure 2 compares press coverage for the totality of AstraZeneca news and for the subset of news about the death links. In March and June peaks the stories about suspect deaths take a central stage, appearing respectively in 15% and 20% of total headlines. On the contrary, the smaller spikes in attention of April's seems to be generated by a long tail of the diatribe regarding the optimum age range in which to administer the vaccine. Indeed, between April 6th and 8th, it was firstly issued a rumour on the possibility of administering AstraZeneca only to people over 60 years and then it was reported the official EMA communication about the correlation between rare thrombosis and the vaccine.

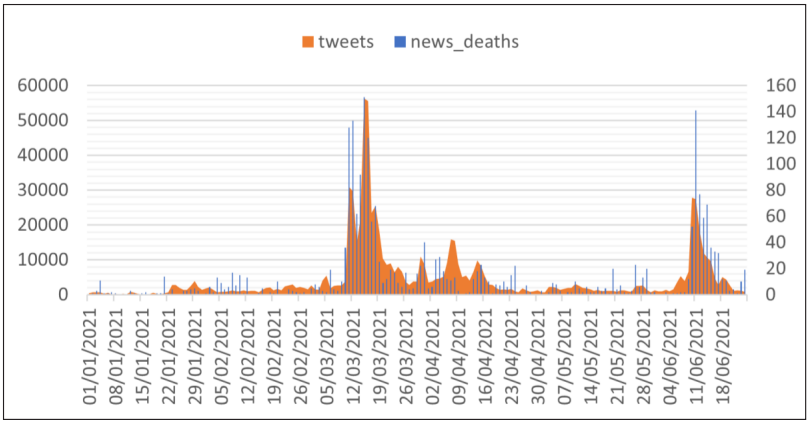

Figure 3.
Tweets (left axis) vs news about suspect deaths (right axis).

Figure 3 shows that in the context of Twitter, the attention toward AstraZeneca issues is higher and more concentrated on periods in which journalistic outlets reported the stories of suspect deaths. A specular interpretation is that news coverage about the deaths follows the hype on this issue in Twitter. To find which one of the two hypotheses would have been more accurate we perform a Granger causality test, but we did not find any evidence of a robust statistical cause-to-effect direction. Nevertheless, correlation is higher for Figure 3 (i.e., "tweets vs. news reporting deaths" equal to 0.89) than for Figure 1 (i.e., "tweets vs. news" equal to 0.78).

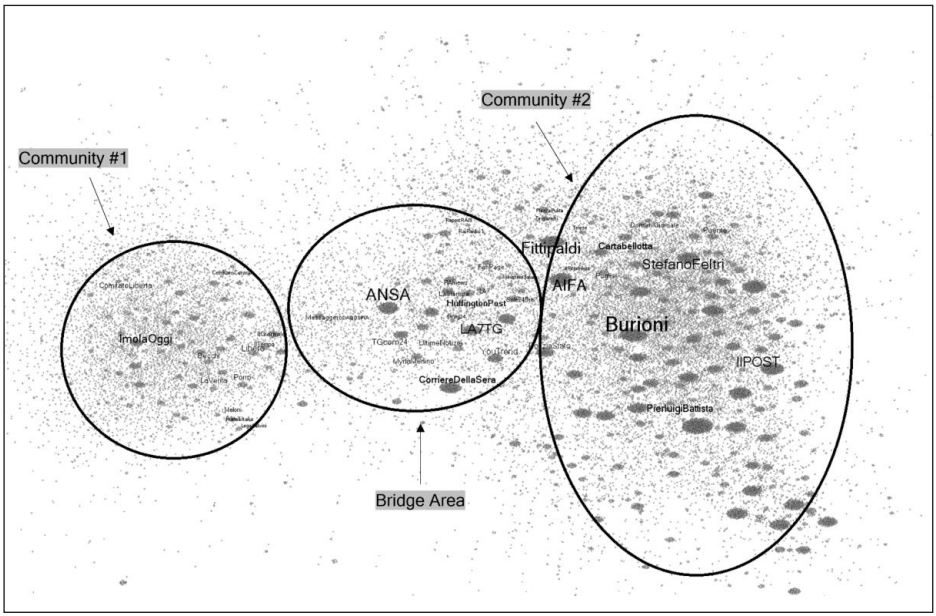

Figure 4.
11th – 19th March retweets network visualisation.

A last point of interest for our analysis concerns the potential polarisation of the digital arena.

By looking at the forced-directed network visualisation in Figure 4, it is possible to notice how, during the first peak of March, the discussion on Twitter is divided into two distinguishable communities with a less dense bridge-area in the middle. Each node represents a user, while an arch between two nodes, whose value is unitary, indicates a retweet of a specific tweet by the user to whom the arc is directed. To visualise and analyse the data we used Gephi (Bastian et al. 2009), an open-source software for the analysis and treatment of social networks. The image reported was obtained using "Force Atlas 2" visualisation algorithm (Jacomy et al. 2014). The size of the labels is proportional to the number of retweets received.

The first community is located on the left of Figure 4 and is composed of both a few newspapers and politicians belonging to the Italian right-wing parties, as well as openly no-vax users.

The second community, on the right, is instead composed of a multiplicity of different types of accounts. The most retweeted users are major Italian newspapers and television channels, the official pages of the Italian Police and of the Italian Drug Agency, and a wide variety of opinion leaders consisting of physicians, scientists, and journalists.

Finally, a last and smaller bridge group is located at the centre-right of the scheme. This group is made up of legacy media pages. Its position suggests that they should have been retweeted by users of both the two opposite graph areas.

Digging deeper into more details, the discourse that can be traced through the analysis of the most shared tweets confirms a polarisation not only at the structural network level, but also with regard to content.

Within Community #1, it is possible to trace two different discursive matrices. The first and most evident is what we could define as a "no-vax" narrative, which is defined by an open accusation against the "powers that be" (i.e., Italy, Europe or drug firms), who, aware of the risks or damages, want people to be vaccinated anyway.

> The very harsh words of Mrs. Battaglia's son: My mom was fine, she was healthy! Two days after the AstraZeneca vaccination she went into a coma from cerebral thrombosis. The state cannot use human beings to experiment with something like this.[8]

> The #AstraZeneca issue is simple: if the vaccine is safe and it's a trade war against Britain for the EU, it's a huge scandal. If the vaccine is not safe and the Swiss were right not to put it out there, it is an even bigger scandal for the EU.

A second narrative within this community is carried out by right-wing politicians and is based on an invective discourse against the Italian government considered guilty of having made a mistake in the choice of vaccine administration to the point of causing deaths.

> #FratelliD'Italia calls for Health Minister Roberto Speranza to come immediately to Parliament to report on the #AstraZeneca affair. Citizens demand and deserve transparency and clear information. We cannot afford to leave Italy in uncertainty.

Regarding Community #2, as already suggested by the recognition of its users, the discourse is more jagged. First, there is a discourse led by newspapers, which after reporting the suspect deaths continue to update this storyline.

Other tweets concern the official announcements of the stop in the administration of the AstraZeneca vaccine which are posted by institutional accounts such as the Ministry of Health and the Italian Drugs Agency.

> Piedmont suspends AstraZeneca vaccine administration following the death of a teacher a few hours after the drug was inoculated #ANSA.

> All reservations with #AstraZeneca vaccines have been suspended with immediate effect until further notice from AIFA. For those who have already booked we will send an SMS to inform them about it.

Finally, the last and most prevalent discourse in terms of significance relates to the ways in which sensationalist news are considered informational material to be debunked. On the one hand, journalists, physicians, and scientists develop a set of rationalising arguments that show how the risk of death linked to AstraZeneca is actually the same as that of many other common drugs. On the other hand, the same debunking strategy is carried out in a more ironic way by common users that manage to get viral thanks to their sarcastic tweets.

> #fakenews A false statement from the Italian Medicines Agency @Aifa_official is circulating on the Net where it is communicated that multiple lots of #AstraZeneca vaccine against #COVID19 is banned. The #AIFA has denied it, the only batch is nr. ABV2856.

> Dear girls and boys, right now adults (the ones who run the world) are going crazy over 0.00022% problematic #Astrazeneca vaccines, so when you ask yourself, why do I need to study maths? Remember it's so I don't become like them.

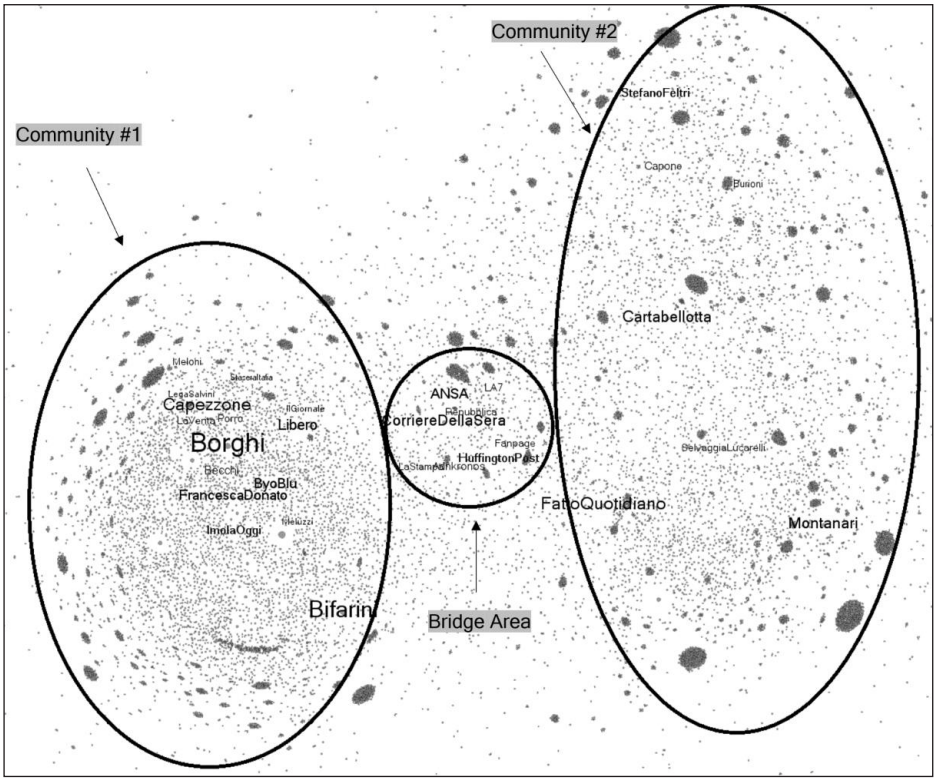

Figure 5.
10th – 18th June retweets network visualisation.

The discussion peak of June presents characteristics that are very similar to the March one. It is indeed composed of two distinguished communities and a smaller bridge area in the centre of the network.

Looking more in detail at the composition of users, the enlarged Community #1 on the left of Figure 5 is made up of politicians, journalists and newspapers that are linked to right-wing and nationalist political parties, while at the same time we can recognize an increasing number of users retweeting to hoax sites, as ImolaOggi and Byoblu (Bory et al. 2022).

The small bridge-area in the middle of the visualisation is instead composed of a multitude of mainstream media ("ANSA", "Corriere della Sera", "Repubblica", "LA7", to name a few).

Finally, on the right of Figure 5 the most prominent figures of Community #2 are physicians and pundits already noted for their debunking campaigns, flanked by a separate set of journalists and social media's influencers.

Part of this users that populate Community #2 react to the news of the suspicious death by trying once more to debunk an excessive exaggeration of the link between AstraZeneca and the thrombosis' deaths using a caustic discourse:

> Fatal cases per 100,000 doses administered as of May 26: Pfizer 0.96 Moderna 1.99 AstraZeneca 0.79 Johnson 0.79. And irresponsible people fuel panic over AstraZeneca? From politicians I don't expect anything, but from journalists I do.

> Venous thrombosis rate oral contraceptive pills: 5 to 12 women in 10,000. Thrombosis rate at atypical sites Astrazeneca vaccine: 1 person in 100,000. I expect you to at least stop asking women to take the pill because the condom "tightens".

At the same time, however, in the same community an opposite current of thought emerges from the retweets of the talk show "Ottoemezzo" in which it was questioned the risks of vaccinating kids, thus showing signs of an increasing fragmentation of views:

> #ottoemezzo #AstraZeneca @marcotravaglio: Why do we vaccinate kids? If Camilla had been German, she would still be alive. And it's not just her. Commissioner Figliuolo must answer for this madness.

On the opposite Community #1, the debate is instead led by a common rejection of the way in which the vaccination campaign was settled and builds upon the same narrative already emerged in March. A first discourse is indeed based on the same accusation to "the System"[9], that deliberately experiments on people:

> Be sure to continue to be a megaphone for the vaccine business, preyed upon by Big Pharma, news outlets and various journalists! You don't seem to care much about other people's lives anyway!

> Dear young people, who have vaccinated so carefree and enthusiastically, urged on by the enslaved media and your favourite influencers, don't you feel you are being taken for a ride?

> Are you beginning to understand what kind of world you live in? This is truly a brutal test of maturity. #AstraZeneca

In parallel, politicians and journalists insist again for the resignation of the Italian health minister, guilty of messing with health citizens.

> Yet another spin on the #AstraZeneca vaccine, after being administered even to the very young during open days. Enough is enough, no more chaos and approximation. The government reports back to Parliament. We demand clarity: don't mess with the health of citizens.

Finally, a last and minoritarian discourse is perpetuated by some politicians and pundits from the liberal right-wing area.

> While I defend the freedom to NOT vaccinate for those who do not want to, I inform my friends that this morning, according to the established rota for my age group, I received my first dose of vaccine (in my case, of #AstraZeneca). This seems to me to be the best method: everyone respects everyone.

These users claim that the state should defend the freedom of taking or not the vaccine. While this may appear to be a balanced or diplomatic approach, there are concerns that this stance is potentially misleading. On one hand, acknowledging the right to choose whether to vaccinate or not is an important aspect of individual freedom and autonomy. It is crucial that individuals have the ability to make informed decisions about their own health and well-being, based on their own values and beliefs. However, promoting vaccination while defending those who choose not to get vaccinated may be seen as contradictory, as it implies a lack of commitment or conviction in the value of vaccination. This may suggest an underlying propaganda strategy, in which politicians are trying to keep together conspiratorial positions and truly sceptical views using a seemingly balanced statement as a way to avoid taking a clear position.

5. Conclusions

The controversy surrounding the AstraZeneca vaccine provided a valuable opportunity to examine how the junk news regime impacts public debates on socio-technical issues. This allowed us to explore how a specific cycle of junk news, affects and is affected by a far larger number of actors and technical affordances than usually conceived. Our study revealed that sensationalistic news peaks, fuelled by the junk news regime, cause disruption in the digital arena of Twitter, resulting in the exhaustion of users' attention and the exacerbation of the pre-existing polarisation related to COVID-19 in Italy (Caliandro et al. 2020).

Our study found that spikes in news and tweets were tightly connected, with legacy and social media's temporal dynamics influencing each other. This suggests that acceleration and sensationalisation are two sides of the same coin, caused by the saturation of public debate by the junk news regime (Castaldo et al. 2022). As a result of this regime, public at-

tention shifts towards more emotionally extreme content, such as sensationalist news (Venturini 2019). In the case of AstraZeneca, the attention towards the controversy depends on its dramatisation, which in turn activates the confirmation biases already embedded in the technical affordances that structure Twitter discussion.

While significant progress has been made in analysing COVID-19 controversies, there is still much to learn about the patterns of public debate surrounding this issue. A growing body of research has focused on the role of the media and public communication in shaping public perception and understanding of scientific issues. For instance, other studies already investigated the relationship between the Italian media system and public understanding of science. With this regard, Crabu et al. (2021) found that traditional news sources in Italy tend to prioritise political considerations over scientific accuracy, which can impact public understanding of scientific issues. Meanwhile, Campus and Saracino (2022) explored how experts are transformed into celebrities in the media, and the impact of this form of science communication on the public debate related to COVID-19.

In this view, our research has shown how the Italian press has been found to prioritise reporting on suspicious deaths during the peaks of attention rather than providing an accurate reconstruction of the various risks and benefits of AstraZeneca. This overemphasis on sensationalised news related to suspicious deaths can be viewed through the lens of an increased politicisation of the COVID-19 news coverage (Crabu et al. 2021). Furthermore, our study also found evidence of the role of celebrity experts in shaping public opinion on COVID-19 in Italy. Twitter analysis showed that several physicians were acting as influencers in the communities related to debunking COVID-19 misinformation. However, while engagement in such polarised debates can increase the visibility of scientific communication, it can also increase the risk of superficial forms of scientific communication, as highlighted in previous studies of television talk shows (Campus and Saracino 2022).

Although the Italian case could be a valuable starting point, more work needs to be done to understand how these patterns vary across different countries and how different political contexts can impact the public debates concerning COVID-19 controversies. As a matter of fact, and as highlighted by other studies focused on COVID-19 communication crisis (Sacco et al. 2021; Pilati et al. 2022), the results concerning the AstraZeneca affair may vary considerably depending on the cultural, social, and political contexts.

Furthermore, another possible avenue for improvement is to expand our analysis to incorporate a multimedia or cross-platform approach (Venturini et al. 2018). This approach would involve mapping the same events across various mediums and platforms in order to determine whether different communication environments yield similar results. For example, do traditional news sources such as radio, television, and newspapers provide the same coverage as social media platforms like Facebook, Twitter, and YouTube? Additionally, can we track how influencers and the public interact in different contexts, and what information they release and consume?

By taking a comprehensive approach to analysing COVID-19 controversies, we can gain a more nuanced understanding of how these debates play out in different contexts and use this knowledge to inform future research and help mitigate the negative effects of the junk news regime on public debates.

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Notes

[1] https://www.rainews.it/tgr/sicilia/articoli/2021/05/sic-vaccino-astrazeneca-morte-stefano-paterno-siracusa-1b41803d-f54c-4ce7-8967-04a925f05bc3.html.

[2] https://www.esquire.com/it/lifestyle/tecnologia/a36076270/vaccino-astrazeneca-trombosi/.

[3] https://www.ansa.it/liguria/notizie/2022/05/15/morta-dopo-dose-astrazeneca-la-sua-vita-vale-70-mila-euro_12579a49-eabf-40bb-9f33-71fa201e8bfe.html.

[4] Pearson correlation coefficient, also known as Pearson's R, is a measure of the linear relationship between two variables, and it ranges from -1 to 1. A value of 1 indicates a perfect positive correlation, meaning that as one variable increases, the other variable increases in a linear fashion. A value of -1 indicates a perfect negative correlation, meaning that as one variable increases, the other variable decreases in a linear fashion. A value of 0 indicates no correlation between the two variables.

[5] Granger causality is a statistical method used to determine whether one time series is useful in forecasting another. It is based on the idea that if a time series X helps predict another time series Y, then X "Granger-causes" Y. The method involves comparing the predictive power of two models: one that includes only past values of Y as predictors, and another that includes both past values of Y and past values of X as predictors. The Granger causality test involves estimating two regression models: one with only lagged values of the dependent variable (Y), and another with both lagged values of Y and lagged values of the independent variable (X). The null hypothesis is that X does not Granger-cause Y, which can be tested using a statistical F-test.

[6] The Gini index is a measure of statistical dispersion used to represent the distribution of wealth or income among a population. It ranges from 0 to 1, where 0 represents perfect equality (everyone has an equal share) and 1 represents perfect inequality (one person has all the wealth or income). In the context of social media, the Gini index can be used to measure the concentration of retweets among users. By calculating the Gini index of retweets for a particular topic, researchers can determine how concentrated the retweets are among a small number of users, or if they are more evenly distributed among a larger number of users.

[7] By converting values to rank order, time series has been normalised on a common scale. The number of tweets about AstraZeneca is shown on the left and the amount of news on the right of the vertical axis.

[8] The excerpts in the article comply with AOIR's ethics guidelines and Twitter developer policies (https://aoir.org/ethics/; https://developer.twitter.com/en/developer-terms/policy).

[9] According to different users statements the "System" can include government agencies, corporations, financial institutions, and the media. In their view, the "System" operates in secret, outside of public scrutiny, and uses its power to manipulate information and events to maintain control over the population.

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