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**ONE PANDEMIC, MANY CONTROVERSIES.
MAPPING THE COVID-19 “INFODEMIC” VIA
DIGITAL METHODS.**

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*Ai miei genitori che mi hanno sempre supportato,
e che leggeranno quest'ultima parola con una 'o' di troppo.*

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PREFACE

Since my first year as a sociology undergraduate, I have been intrigued by the profound influence of media on public knowledge. Whether it's the most frivolous tabloid gossip or the most crucial report about scientific discoveries, the media profoundly influences what we think, how we think, and what we deem central or peripheral in our society. Navigating this expansive and intricate landscape of communications feels like every ripple contributes to molding societal awareness.

In November 2020, when I commenced my doctoral studies at IULM, I consciously opted to delve into the nuanced domain of controversy mapping for my research endeavors. This field not only seized my academic curiosity, but also proved to be a source of profound fascination, one characterized by an interdisciplinary ethos that aligned seamlessly with my belief in the enriching synergy of contamination and interdisciplinarity as essential components of scientific inquiry.

Against the backdrop of the ongoing global pandemic, it felt not only pertinent but also imperative to channel my research efforts towards a subject of significant contemporary relevance. Therefore, I chose to focus my investigative lens on the public discourse surrounding the COVID-19 contagion and related health policies. The unprecedented challenges posed by the pandemic underscored the urgency of understanding how technoscientific controversies unfolded in real-time, impacting public perception, policy decisions, and societal responses.

In making this decision, I envisioned not only contributing to the academic discourse on controversy mapping but also actively engaging with a real-world issue that demanded thoughtful examination. The nexus between my academic interests, the interdisciplinary nature of controversy mapping, and the exigencies

of the pandemic formed a compelling backdrop, creating a meaningful trajectory for my doctoral research.

In line with this conceptual framework, my research proposal and plan unfolded along two distinct trajectories. The first path delved into the investigation of whether a global “infodemic” corresponded with the concurrent pandemic, employing computational social science techniques to study the dissemination of mis- and disinformation online. This entailed scrutinizing vast datasets and employing analytical tools to discern patterns and correlations, contributing to a structural understanding of the intricate interplay between information dissemination and the hybrid media ecosystem.

Simultaneously, the second avenue of my research journey focused on a closed exploration of the cultural, social, and political roots underpinning the public discourse in Italy. This served as a sort of laboratory setting, allowing for a fine-grained examination of the multifaceted dynamics involved in navigating and resolving socio-technical controversies. By adopting a sociological lens and employing quali-quantitative research methodologies, I sought to unravel the complex tapestry of Italy's public debate, shedding light on how our society grapples with and resolves unfolding challenges in this turbulent era characterized by a post-truth narrative.

Through this twofold approach, my research aimed to contribute not only to the academic understanding of information dynamics but also to the broader discourse on how societies can effectively confront and navigate the complexities of socio-technical controversies in the contemporary landscape.

While both research paths were meticulously undertaken as part of my doctorate, it is essential to note that only the latter investigation finds its place within the confines of this dissertation. The exclusion of the former warrants clarification, prompting me to offer an insight into the rationale behind my choices. This preface serves not only as a justification for the selection made, but also as a comprehensive account of the broader spectrum of my research endeavors. It

aims to provide a contextual backdrop, shedding light on the multifaceted nature of the academic journey that culminated in this dissertation. In essence, this preface stands as an overarching overview, elucidating the interplay between various elements that have contributed to the research and dissemination activities that form the backbone of this dissertation.

During the inaugural year of my doctoral research, I devoted my efforts into the investigation of the overabundance of information production and dissemination related to the pandemic at a global scale. This endeavor primarily focused on collecting and analyzing big data that could serve as a proxy for the study of the so-called COVID-19 infodemic. To achieve this goal, I initiated a collaboration¹ with the Infodemic Observatory² at Fondazione Bruno Kessler (FBK). Through the selection of key terms such as "COVID-19", "SARS-CoV-2", and "Wuhan" we amassed a dataset comprising over 200 million tweets published during the initial phase of the pandemic. In collaboration with my supervisor Prof. Pier Luigi Sacco and fellow researchers at FBK, we reconstructed the emergence of online knowledge communities surrounding COVID-19. Utilizing computational techniques, we calculated the centralization of discussions concerning various (dis)information sources, including journalists and scientists on one side and trolls and bots on the other. Our findings culminated in a publication in the scientific journal *Social Science and Medicine*³, and the research was presented at the annual *Complex Systems Society Conference*.

Simultaneously, in tandem with the same research group, we delved into the relationship between the Infodemic Risk Index (IRI) developed in a previous paper by the FBK team and the progression of global COVID-19 infections. Correlating these two measures, we uncovered an intriguing trend: as the number of infections rose, the IRI decreased. This idea was further developed, and, in

¹ https://covid19obs.fbk.eu/assets/reports/IDN_report.pdf

² <https://covid19obs.fbk.eu/>

³ Sacco, P. L., Gallotti, R., **Pilati F.**, Castaldo, N., De Domenico, M. (2021). Emergence of knowledge communities and information centralization during the COVID-19 pandemic. *Social Science & Medicine*, 285, 114215. <https://doi.org/10.1016/j.socscimed.2021.114215>

collaboration with the head of FBK's Complex Human Behavior Lab, Dr. Riccardo Gallotti, we successfully published the work in *Frontiers in Sociology*⁴. This paper tracked the evolution of the COVID-19 Infodemic Risk Index throughout 2020 and elucidated its interconnectedness with epidemic waves, with a specific focus on Europe, South America, and Southeastern Asia. Our analysis, based on 640 million tweets collected by the Infodemic Observatory and the open-access dataset on COVID-19 reported cases from Our World in Data, demonstrated a characteristic global pattern: a decline in misinformation on Twitter as the number of confirmed COVID-19 cases increased. Local variations underscored the impact of Twitter's robust content moderation policies and the selective trust process guiding users toward the most visible and reliable news sources available.

Concurrently with my exploration of global patterns within the COVID-19 infodemic, I embarked on a parallel investigation into the unique case of Italy. This particular inquiry delved into the multifaceted landscape of controversies surrounding scientific knowledge and public health measures related to the virus. However, as the research progressed, I found myself increasingly cognizant of the intricate granularity and expansive scope inherent in both phenomena, as well as the voluminous research material amassed during this investigative journey. Faced with this broad landscape, the decision was made within the context of this dissertation to concentrate specifically on the second research path conducted during my doctorate, namely the one focused on the Italian case. Therefore, this dissertation meticulously scrutinizes the unfolding of three sociotechnical controversies within the context of Italy, employing a digital controversy mapping approach.

The first essay within this exploration dissects the transformation in Italian Twitter discourse, tracing the trajectory from widespread support for “lockdown”

⁴ Pilati, F., Gallotti, R., Sacco, P. L. (2022). The link between reported cases of covid-19 and the Infodemic Risk Index: a worldwide perspective. *Frontiers in Sociology*, 7, 250. <https://doi.org/10.3389/fsoc.2022.1093354>

measures to the emergence of dissent and anti-lockdown sentiment. This evolution is traced across the timeframe spanning early 2020 to the culmination at the close of 2022.

The second essay probes into the controversy surrounding the rare side effects associated with the AstraZeneca vaccine. This investigation spans a six-month period in 2021, scrutinizing Italian tweets and news articles to unravel the complexities of public discourse surrounding this contentious issue.

The third essay undertakes an exploration of the digital public debate surrounding the introduction of Italy's "Green Pass" certificate in mid-2021. Unlike the organic lockdown backlash, this controversy crystallized around a specific techno-bureaucratic governance intervention rather than its unintended effects. However, positions both supporting and opposing the Green Pass's rollout appeared to align with pre-existing partisan and ideological identities.

Collectively, these case studies serve as a testament to the versatility and efficacy of digital controversy mapping in elucidating the connections, meanings, and temporal patterns inherent in debates surrounding sociotechnical issues. By immersing ourselves in the nuanced landscapes of these controversies, this dissertation aims not only to contribute to the existing body of knowledge but also to provide a nuanced understanding of the complex interplay between technology, society, and public discourse within the Italian context.

It should be noted that the three essays composing the empirical part of my Ph.D. dissertation already resulted in different published contributions.

The first essay, focusing on the shifting dynamics of Italian Twitter discourse from widespread support for lockdowns to growing dissent and anti-lockdown sentiment, and the third essay, that delve into the ideological polarization on the Green Pass, were presented at the 2022⁵ and 2023⁶ *AssoComPol Conference*.

⁵ **Pilati, F.** (2022) Mapping affective polarization around the "Green Pass" controversy: a digital methods approach. In: *Convegno AssoComPol*. <https://www.compol.it/eventi/convegno/convegno-2022/>

⁶ **Pilati, F., Anselmi, G.** (2023) From the "rally 'round the flag" to "backfire" effect: a longitudinal computational analysis of the Twitter debate on COVID-19 restrictions in Italy. In: *Convegno AssoComPol*. <https://www.compol.it/eventi/convegno/convegno-2023/>

This conference, held every year, focuses on political communication, serving as a venue to delve into the evolution of the Italian public debate from a political science perspective.

Furthermore, the second essay, investigating the controversy surrounding the AstraZeneca vaccine's rare side effects through Italian tweets and news articles in 2021, was selected for presentation at the 2021 *ILIS International Conference*⁷. This international conference, dedicated to innovative social research practices such as digital and computational methods, provided a platform for disseminating insights into the intricate status of the digital society during the challenging times of the COVID-19 epidemic.

In addition to conference presentations, the empirical research has yielded publications also in peer-reviewed open access journals recognized as both scientific and ‘A-class’ by the Italian National Agency for the Evaluation of the University and Research System. The study on the “Green Pass” controversy, co-authored with Prof. Andrea Miconi, is published in *Partecipazione e Conflitto – The Open Journal of Sociopolitical Studies*⁸. While the investigation into the AstraZeneca affair, co-authored with Dr. Guido Anselmi, resulted in a publication in *Tecnoscienza – Italian Journal of Science & Technology Studies*⁹.

⁷Pilati, F., Anselmi G. (2021). The "Astrazeneca affair": a litmus test of public arena formation in a hybrid media ecosystem setting? In: *ILIS Research Methods in the Digital Society – Areas and Practices*. <https://www.iris.unina.it/retrieve/handle/11588/863127/453744/ILIS-ABSTRACT-A4-1.pdf>

⁸ Pilati, F., Miconi, A. (2022). The "Green Pass" Controversy in the Italian Twittersphere: a Digital Methods Mapping. *Partecipazione e Conflitto – The Open Journal of Sociopolitical Studies*, 15(3), 549-566. <https://doi.org/10.1285/i20356609v15i3p549>

⁹ Pilati, F., Anselmi, G. (2023). The AstraZeneca affair. How the junk news regime affected the public debate on the COVID-19 vaccination controversy in Italy. *Tecnoscienza – Italian Journal of Science & Technology Studies*, 14(1), 105-122. <https://doi.org/10.6092/issn.2038-3460/17609>

INTRODUCTION

The COVID-19 pandemic has unleashed an unprecedented “infodemic” - defined by the World Health Organization as an overabundance of information, much of it misleading or false, surrounding the virus and public health measures (Zarocostas 2020). However, an overreliance on this framing tends to obfuscate the underlying dynamics and determinants of such a situation of communication crises (La Rocca, Carignan and Boccia Artieri 2023).

While the metaphor may seem intuitively appealing, information does not spread contagiously like a virus. The diversity of circulating information stems from myriad sources, not a single pathogen. As Simon and Camargo (2021) contend, the figurative notion of virality mischaracterizes multifaceted social processes driven by technological, political, economic, and cultural factors beyond contagious transmission. Rather than loosely conceptualizing an infodemic, sociological inquiry into communication issues during the COVID-19 pandemic should directly interrogate the context of ambiguity and uncertainty surrounding this novel sociotechnical controversy (Callon et al. 2009).

As Couldry (2022) notes, the pandemic laid bare deep structural inequalities that position people very differently in terms of ‘getting by’. Therefore, we should shift focus away from problematizing the volume of information to interrogating the lack of authoritative knowledge about the novel coronavirus, particularly in the pandemic's early stages. Hence, the communication crisis was undergirded more fundamentally by the ‘absence of shared interpretive resources’ amidst uncertainty. Research must foreground how this lack of knowledge was negotiated publicly, given the deep divides in society.

Mainstream scientific perspectives on issues like the virus's origins and prevention strategies were contested by legitimate alternative views. Such ‘unresolved controversies’ are characteristic of the collective production of knowledge, rather than anomalies (Saltelli et al. 2023). In conditions of limited

scientific knowledge and intense public concern, newly salient policy debates essentially serve as flashpoints illuminating the social construction of knowledge claims and evidence (Jasanoff 2005). The pandemic represents an opportunity to examine empirically how ‘unknown unknowns’ become ‘known unknowns’ and finally ‘knowns’, and to trace how this tentative stabilization process unfolds through complex discursive dynamics between media, elites, experts, and publics when existing sociotechnical imaginaries are disrupted (Jasanoff and Kim 2015). While the overabundance of information related to the virus posed a great challenge for the society, the pandemic also represented an unprecedented test on how public debate takes shape in contemporary hybrid media ecosystems (Chadwick 2013). Digital media have reshaped flows of communication, enabling more diverse actors to participate (Vaccari and Valeriani 2021), but also facilitating greater manipulation (Giglietto et al. 2020). Therefore a deeper examination of the overabundance of COVID-19 related information through these lenses could illuminate the complex dynamics between infrastructures, media practices, and collective sense-making that defined public discourse throughout the pandemic's uncertain early stages. The multifaceted notion of an infodemic obscures these intricacies. Shedding such a reductive metaphor instead opens possibilities for more nuanced understandings of how citizens navigated this unprecedented time of crisis.

In this sense, examining specific controversies around socio-technical issues offers valuable insights into how public debates emerge and evolve in turbulent times (Venturini and Munk 2021). This thesis investigates three such controversies that took prominence in the Italian public debate, utilizing digital methods and computational techniques to map how they unfolded on social media during the pandemic. The first essay analyzes the shift in Italian Twitter discourse from widespread support for lockdowns to growing dissent and anti-lockdown sentiment between early 2020 to the end of 2022. The second essay examines the controversy surrounding the AstraZeneca vaccine's rare side

effects through Italian tweets and news articles over a six-month period in 2021. The third essay explores the unfolding of digital public debate around the introduction of Italy's "Green Pass" certificate in mid-2021. Together, these case studies demonstrate the versatility of digital controversy mapping for elucidating connections, meanings, and temporal patterns of debate around socio-technical controversies.

Beyond the specifics of each case, several overarching themes emerge from this body of research. Firstly, they expose the reactive volatility of online discussions, which spike around events but rapidly fade. Secondly, the analyses reveal how social media debates readily become disconnected from scientific nuance, instead amplifying sensationalist frames, misinformation, and partisan posturing. Thirdly, they spotlight how savvy political actors leverage controversies to attract followers and consolidate their agendas.

These insights are pertinent both for understanding information disorder and nurturing higher-quality public deliberation. Examining controversies as situated processes, entangled with identities and power structures, brings texture to prevailing notions of the infodemic as an undifferentiated problem.

Several cross-cutting dimensions emerge across the three controversies: the role of influencers as gatekeepers, news media hype, and superficial public engagement. Firstly, the cases spotlight the outsized influence of prominent accounts in shaping narratives. Politicians, journalists, social media influencers, and legacy media pundits drove discussion spikes and polarized clusters. Their dominance illustrates the power asymmetries permeating hybrid media systems, belying promises of decentralized participation. Secondly, the research reveals the double-edged role of legacy and social media. Mainstream outlets focused on sensational pieces of information rather than communicating risks, uncertainties, and trade-offs. Meanwhile, misinformation circulated rapidly through social media and partisan blogs. This toxic media dynamic catalyzed polarizing spikes in attention. Thirdly, the studies showcase a superficial engagement of the digital

public. Beyond influencers, the wider public exhibited bandwagoning behaviors, ideological biases, and confirmatory thinking. However, glimpses of earnest inquiry also emerged. This complexity cautions against total dismissal of skepticism as just ideological sharing of misinformation.

Finally, a significant finding across all three cases is the networked polarization observed on the Italian Twittersphere, with distinct pro/anti clusters evident around each controversy. Users congregated in homogenous, ideologically aligned communities, exhibiting confirmation bias. This tendency towards echo-chambers is an important characteristic of COVID-19's digital discourse. Several factors drive such polarization, including historical elite divides, social media algorithms, and cognitive biases. However, the cases showcase how even temporary issues can become subsumed into partisan identity struggles. Single-issue deliberation is crowded out by efforts to integrate each controversy into pre-existing narratives. This trend exhibits what Hamilton and Safford (2021) called 'elite cues', where prominent voices signal identity-confirming positions on issues, subsequently amplified through media and online networks. In this model, polarization seems to stem not from isolated technical debates but broader ideological contestation.

Lastly, this thesis demonstrated the potential of digital methods for elucidating techno-scientific controversy emergence and evolution in the contemporary hybrid media ecosystem (Venturini and Latour 2010; Marres 2015). However, while digital traces affords windows into public debates, they are incapable of fully capturing collective life (Venturini and Munk 2021). Social media platforms like Twitter, though increasingly far-reaching, do not represent the entire Web. Daily, most pages evade algorithms and crawlers. Further, much information circulates outside Web protocols, via email, chats, transfers. And not all digital inscriptions circulate online. Most social interactions remain unmediated. Beyond partial coverage, digital records contain biases distorting the phenomena they purportedly represent (Venturini and Rogers 2019).

So while digital controversy analysis offers instruments, it requires circumspection. Digital traces provide limited proxies for realities on the ground. Our three case studies illuminated some fracture points but overlooked others. Each one glimpses partial vistas, needing further integration. Still, thoughtfully repurposing digital inscriptions offers opportunities to elucidate the processes that are limiting inclusive collective reasoning (Venturini and Munk 2021).

Nevertheless, examining information flows, media practices, and digital public engagement via digital methods still enriches single-focus analyses. It surfaces interdependencies and power dynamics that shape how controversies unfold.

In the upcoming chapter, we will embark on a comprehensive exploration of theories within the field of media studies. This endeavor aims to provide nuanced insights that will serve to clarify and contextualize the widely discussed concept of the infodemic. This theoretical excursion is designed to lay a robust foundation for the subsequent empirical analyses, offering a lens through which to interpret the intricate dynamics of information dissemination and public discourse in the context of the COVID-19 pandemic.

Following this theoretical groundwork, the second chapter will undertake an in-depth examination of the initial case study, delving into the multifaceted reactions and responses to the implementation of “lockdown” measures. This case study will serve as a lens through which to scrutinize the evolving narratives and the role of political actors in shaping the discourse around restrictive measures aimed at mitigating the impact of the pandemic.

Subsequently, the third chapter will shift its analytical focus to the investigation of the AstraZeneca vaccine campaign in Italy. In light of the rare but serious side effects that garnered significant attention, this essay will shed light on how scientific information is disseminated and interpreted within a digital public arena by scrutinizing tweets and online news articles.

The fourth and final chapter will explore the digital certificate known as the “Green Pass”. This chapter will unravel the ideological fractures surrounding the

adoption and public reception of this certification, which serves as a pivotal tool in incentivizing vaccination and facilitating public activities during the ongoing waves of the pandemic. By closely examining the debate surrounding the Green Pass, we aim to uncover the polarized perspectives that have emerged in response to this governance intervention.

The overarching goal of this thesis is to engage thoughtfully and respectfully with a topic that has significantly shaped our daily lives in recent years. This endeavor involves concentrating on specific case studies that hold centrality within the Italian debate on COVID-19's controversies seen as the aggregation of a myriad of socio-technical issues. Additionally, the interpretative framework will be broadened by incorporating insights from the latest contributions to public debate in hybrid media ecosystems. Through these efforts, the thesis aspires to provide a thorough, comprehensive, and intriguing analysis of the multifaceted issue of the COVID-19 infodemic.

CHAPTER I

The Infodemic as a feature of hybrid media ecosystems

The global crisis stemming from the COVID-19 pandemic has witnessed an unprecedented surge in information dissemination, both accurate and misleading, pertaining to the virus and the countermeasures implemented for public health. While the exceptional nature of the ongoing situation has brought attention to the sheer volume of information circulating both online and offline, it's crucial to view the so-called infodemic not merely as a transient anomaly but as an ingrained and recurring facet of the hybrid media ecosystems that define contemporary digital society. This chapter aims to delve into a literature review on the transformative processes that took place in the communication landscape and that underlie the emergence of the COVID-19 infodemic.

Commencing with a brief exploration of the concept of intermediality, we aim to elucidate the alterations in agenda-setting processes driven by the intricate interactions between traditional and emerging media. These shifts in agenda setting lay the foundation for the multifaceted challenges posed by the infodemic. Beyond the sheer abundance of information, it is crucial to recognize the socio-technical controversies embedded within this process. The infodemic is not merely a byproduct of the pandemic but reflects deeper changes in the way information is disseminated, consumed, and contested in our digital age.

Within this context, misinformation takes center stage as a critical facet of the information disorder precipitated by what can be termed as the junk news regime. This conceptualization transcends the binary lens of truth or falsehood, unveiling a more complex and insidious aspect of information dissemination. The transient nature of junk news emerges as a key consideration, acknowledging that its purpose extends beyond disseminating accurate or inaccurate information.

Instead, it functions as a form of content that not only distracts the public but may actively detract from meaningful democratic deliberation.

As we navigate the intricate dynamics of the infodemic, it becomes evident that the crisis facing traditional journalism is exacerbated in an environment characterized by an excess of information. The overabundance of content, coupled with the challenges of distinguishing credible sources from misinformation, contributes to a communication short-circuit observed particularly during the initial phases of the COVID-19 epidemic. This confluence of factors underscores the urgency of addressing the socio-technical controversies inherent in the infodemic, recognizing it as a systemic issue that requires comprehensive solutions to safeguard the integrity of information in our digital society.

Intermediality and transmediality

Before delving into the significant changes that have impacted the media world over the past decade, it's essential to clarify some foundational theoretical concepts that continue to possess substantial explanatory power in our contemporary society. When exploring the dynamics between different media, the prevailing and comprehensive theory is that of intermediality. This concept encompasses forms of contamination and contact among media (McLuhan 1964), interplayness between various types of texts (Cluver 1996), and competitive, adaptive, and interactive communication practices (Bolter and Grusin 1999).

Thinking about media in terms of intermediality we are taking the perspective of the public, who navigates a vast array of choices regarding both the media to consume and the content to enjoy (Jenkins 2006). Additionally, with this optics we consider the offerings provided by producers and their positioning concerning audiences within the media system (Giglietto 2000). Changes in the media

landscape highlight the central role of convergence, that connects producers and the public in a network that potentially brings everyone into contact, and divergence, that the other way around creates specific audiences and tailored offerings (Jenkins 2006). Citizens craft their personalized media diet based on individual preferences influenced by factors such as age, abilities, access to communication tools, and political inclinations (Boccia Artieri et al. 2018).

As the media landscape evolves, the concepts of convergence and divergence play a pivotal role (Jenkins 2006). With the proliferation of options, individuals can become dedicated consumers of specific content genres through the use of thematic media. Tracking the frequency and relevance of various categories in the media diet becomes more intricate due to the continuous interaction and intersection of cross and transmedia contents. Users can swiftly alter their consumption habits, both in terms of content and genres, as well as the types of tools employed, responding to evolving interests and attractions within the media landscape (Jenkins 2006).

While the concept of intermediality conveniently encompasses the aforementioned processes, it falls short of describing the complexity and specificity inherent in its various components. Rajewsky (2002) identifies three categories of intermediality applicable with some precautions to the specificity of journalistic content: media transposition, media combination, and intermedial reference. Media transposition involves adapting content into a different medium, leading to changes in representation and reception methods. Media combination refers to the merging of different media elements to create a new, integrated product (e.g., interactive infographics, podcasts with visual components, live streaming with chat interaction, etc.). Intermedial reference, akin to intertextuality, includes quotations, metatexts, and mash-ups, highlighting the interconnectedness of various texts. In this sense the concept of remediation proposed by Bolter and Grusin (1999) is instrumental. Re-mediation involves re-presenting content in a different medium and discursive context, leading to an

appropriation of techniques and social meanings associated with communication tools. This concept bridges the gap between medial transposition and medial combination, where different media are combined to create a new product.

Finally, trans- and cross-mediality are integral aspects of intermediality, denoting ways of disseminating content across different, related media (Jenkins 2006). Transmedia storytelling involves constructing a narrative through the recomposition of content in various media formats, offering unique perspectives and interpretations. Kraidy's studies (2006) introduce the concept of hypermedia space, emphasizing the intertextual nature of ecosystemic intermediality, where connections between new media and old media create a dynamic flow of content and information.

These definitions encapsulate the entire media ecosystem, portraying it as an emergent structure influenced by both individual agency and media influence. In this light, the communicative space can be seen as shaped by the flows passing through it, adapting to different configurations based on the situation and circulating content.

Agenda setting between legacy and new media

The term 'ecosystem' in media studies refers to a conceptualization where various media coexist and interact within an environment. This interaction involves competition for public attention, mutual recall, adaptation to context, and experimentation with hybridization. Such a holistic perspective allows for the exploration of the intricate relationships within the public communication space, where society and communication technologies intersect. Hybridization, as emphasized by Chadwick (2013), enables the co-presence and connection

Visualizing media ecosystems as complex, branched systems, akin to networks, illuminates the dynamic interplay among subjects and the communication flows

established between them (Giglietto, 2000). Departing from traditional models that dichotomize production into top-down and grassroots perspectives, the concept of hybrid ecosystems embraces continuous co-creation and re-mediation of content at each step of its intermedial path (Chadwick 2013). A noteworthy transformation in the shift to a hybrid media ecosystem is the evolution of the public from passive spectators to active participants who engage with the system. This transformation is exemplified by the inclination of individuals to “become the media” empowered by new digital tools that enable the production and reproduction of media content using established codes, languages, aesthetics, and rhetoric (Papacharissi 2015b).

Within this paradigm, the emergence of a truly new form of connected public (boyd 2010) highlights the pivotal role individuals play in shaping and disseminating media content. Departing from an isolated examination of individual media, the focus shifts to questions concerning the co-production of meaning within the ecosystem. Key inquiries include exploring the structure of the network, the flows it carries, their origins and destinations, and identifying its central nodes (Papacharissi 2015a).

Among the theories aiding in understanding these dynamics, agenda setting stands out for its ability to elucidate the relationship between media configurations and their societal impact. However, a simplistic hypodermic interpretation of agenda setting falls short in capturing the complexities of the evolved hybrid media landscape (Chadwick 2013). To address this, the concept of agenda building, rooted in a constructionist approach, becomes crucial. Unlike agenda setting, agenda building investigates how the media agenda is constructed, considering the nuanced relationships between media, political and economic power, and their audiences (Cobb, Ross, and Ross 1976).

The contemporary understanding of agenda building recognizes three interrelated agendas: that of connected publics, media, and politics (Bentivegna and Boccia Artieri 2020). The intricate interplay between these spheres determines the

presence and salience of a theme within public discourse. Agenda building posits a competitive context where the prominence of an issue is relative, shaped by the limited and contested space available. This competition extends to an individual level, with different actors vying for attention—media competing for diverse audiences, politicians striving for visibility, and audiences themselves advocating for specific themes in both media and political agendas (Chadwick 2013).

To understand the influences contributing to the affirmation of themes on the media agenda, McCombs' (1972) onion scheme proves insightful. Focusing on the outer layers that encompass sources, intermedia agenda setting, and norms of journalistic traditions, the second ring of the scheme draws attention to the relationships within the media ecosystem. Intermedia agenda setting captures changes in the agenda of one medium influenced by changes in another, involving considerations of importance, type, production structure, and proximity to the news (Weaver and Choi 2014). The influence of the public on the media agenda is both direct and indirect, encompassing attempts to achieve visibility through demonstrations and initiatives, as well as passively incorporating their footprint traces from social media and search engines that contributes to intermediary flows within the ecosystem, altering the salience and trajectory of themes between traditional media and connected audiences (Chadwick 2013).

Virality and the Internet

Before delving into the more recent origins of the COVID-19 infodemic, it is crucial to establish a fundamental premise: the propagation of information across digital networks does not typically follow a viral model resembling the exponential transmission of a disease. A comprehensive analysis of a billion online diffusion events revealed that the primary driver for message dissemination lies in the sharing by users with substantial audiences, making the

viral model, characterized by an exponential increase in person-to-person transmissions, a rarity (Goel et al., 2016).

Furthermore, research conducted by Rojecki and Meraz (2016) highlighted that the online environment alone may not always be sufficient to propagate disinformation on a large scale. Instead, widespread dissemination often occurs when traditional mass media pick up and amplify messages originating from online sources. Online platforms can play a crucial role in disseminating false stories, but their transformation into virality frequently hinges on integration into mainstream media narratives. The ease with which a message achieves virality is particularly pronounced at the onset of high-profile events or crises when public attention is heightened, and authoritative figures such as police, scientists, and journalists have not yet provided a definitive narrative or recommended specific actions. In the absence of comprehensive information, independent messages from the web swiftly occupy the informational void.

The concept of rumors further underscores the role of uncertainty in message diffusion. Defined as “unverified and instrumentally relevant information statements in circulation that arise in contexts of ambiguity, danger, or potential threat and that function to help people make sense and manage risk” (DiFonzo and Bordia, 2007), rumors thrive during the early stages of narrative formation around events. In these moments of ambiguity, individuals, seeking explanations for unfamiliar phenomena, are more prone to turning to alternative information channels, including social media and independent sites.

Emotional arousal has emerged as another significant factor influencing the social diffusion of information (Berger 2012). Messages with emotional resonance are more likely to go viral, as evidenced by repeated experiments and historical analyses (Brady et al. 2017). For instance, individuals are more inclined to share urban legends that elicit feelings of disgust due to the heightened emotional impact of such narratives (Heath et al. 2001).

Beyond individual predispositions, emotions contribute to the indirect diffusion of information. In a notable experiment by Chris Bail (2016), emotional posts on Facebook by autism spectrum disorder advocacy organizations triggered emotional comments from followers. These emotional comments, in turn, attracted views from other users who were friends or followers of the commenters, creating a ripple effect. This mechanism is significant as it explores the capacity of messages to spread beyond self-selection by social media users, a characteristic often associated with mis- and disinformation, as we will soon discuss.

Filter Bubbles and Echo-Chambers

A final topic before delving into the surge and propagation of misinformation and disinformation during the pandemic regards the characteristics pattern of users-content interaction in social media.

The concepts of filter bubbles and echo chambers have gained significant attention in contemporary discussions surrounding online information consumption. Both phenomena are intricately linked, yet they represent distinct aspects of the digital landscape. The interplay between filter bubbles and echo chambers shapes the way individuals perceive and interact with information, contributing to the evolving dynamics of online discourse.

Filter bubbles refer to the personalized information environments created by algorithms, tailoring content to individual preferences and past behaviors (Pariser 2011). This customization, while enhancing user experience, raises concerns about the limited exposure to diverse perspectives. Users often find themselves in a curated online space where their existing beliefs are reinforced, potentially isolating them from alternative viewpoints.

Echo chambers, on the other hand, delve into the social dynamics within homogeneous communities where individuals are predominantly exposed to like-minded opinions (Colleoni et al. 2014). These chambers of resonance serve as virtual spaces where ideas reverberate and amplify within closed networks. While filter bubbles are algorithm-driven, echo chambers are socially constructed, resulting from self-selection and affinity clustering.

Both filter bubbles and echo chambers share the consequence of fostering confirmation bias, reinforcing pre-existing beliefs and limiting exposure to diverse information. In filter bubbles, algorithms predict user preferences, presenting content that aligns with their existing worldview. Echo chambers, meanwhile, thrive on social interactions, as individuals engage primarily with like-minded peers, reinforcing shared beliefs and stifling dissent. The former is an outcome of technological design, while the latter is a manifestation of human behavior in social spaces. Nevertheless, recent studies argue that both filter bubbles and echo chambers may contribute to the polarization of public discourse (Valensise et al. 2023). By limiting exposure to diverse perspectives, individuals may become entrenched in their beliefs, leading to a fragmented and polarized information landscape. The reinforcement of one's worldview can contribute to the entrenchment of extreme ideologies and the erosion of a shared reality.

However, contrary to widespread belief, politically partisan online news echo chambers are not sprawling monoliths but rather compact enclaves (Fletcher et al. 2021). Academic research suggests that these echo chambers are smaller than commonly assumed, challenging the notion of a vast and impenetrable digital landscape where individuals exclusively encounter like-minded perspectives. The size of these echo chambers is dwarfed by the influence of automated serendipity and incidental exposure facilitated by search engines, social media, and other digital platforms (Fletcher and Nielsen 2018a; 2018b). Algorithmic rankings, rather than perpetuating homogeneity, often lead users to a slightly more diverse array of news, countering the filter bubble hypothesis (Fletcher et al. 2023). Also

self-selection emerges as a potent force shaping news consumption. This emphasizes that individuals actively choose their media diet, contributing significantly to the content encountered online (Vaccari and Valeriani 2021).

Even if the extensive body of empirical studies challenging the prevailing narrative of expansive echo chambers, it does not negate the existence of serious societal challenges. Inequality in news and information use, online harassment, and misinformation persist. While the risks associated with filter bubbles might be smaller than presumed, the possibility of individuals holding polarized views without residing in online echo chambers remains (Fletcher et al. 2020).

Fake News or Junk News?

The exploration of virality and filter bubbles in the preceding section naturally prompts us to examine another prevalent theme in public discourse ex-post the 2016 US presidential elections, the so-called fake news phenomenon. Indeed, during the Clinton vs. Trump campaign in the USA, a plethora of fake news and hyper-partisan stories gained wide circulation on social media, reaching millions of people (Allcott and Gentzkow 2017).

Initially, the prevailing narrative linked online misinformation to the echo-chamber effect within social media platforms (Colleoni et al. 2014). This perspective posited also that digital platforms' classification algorithms filtered out dissenting voices, leading to an increase in the consumption of partisan and ideologically aligned content (Pariser 2011). Simultaneously, discussions on the emerging digital economy underscored the pivotal role of attention commercialization in shaping a new web content market (Graham 2017). Social media platforms, with their vast user base and the ability to rapidly popularize content, played a crucial role in determining the economic value of certain contents over others (Gerlitz and Helmond 2013; Helmond 2015).

The intersection of online disinformation studies and platform economy analysis gave rise to the concept of junk news (Gray, Bounegru, and Venturini 2020). This term encompasses any news consumed primarily due to its acquired virality rather than genuine cognitive adherence on the part of the reader (Venturini 2019). While some fake news may fall into this category, the study of junk news shifts the focus from content to the methods of production, circulation, and consumption that characterize this new information regime (Bounegru, Gray, Venturini and Mauri 2018).

To comprehend how this information regime, centered around content virality and accelerated discussion, unfolded, we must backtrack and elucidate how the web 2.0 infrastructure led to the commercialization of online users' attention (Çalışkan and Callon 2010). Despite easy access to vast amounts of information without direct monetary costs, attention is not free; users pay attention to receive information (Simon 1971). The abundance of information has transformed attention into a valuable resource for economic gain, forming the basis of the attention economy (Webster 2014). This economic shift emerged in the early 2000s when digital native media transitioned from selling content to maximizing revenues from advertising (Goldhaber 1997;). Information's increase led to attention's scarcity, making attention a commodity. Google, with services like AdSense and AdWords, became a key player in this attention market, standardizing and quantifying attention through automated buying and selling flows (Rieder 2012; Cardon 2013).

Two major players in the attention market are social media and traditional information channels. Social media platforms prioritize increasing clicks, views, and scrolling to boost advertising revenue (Gerlitz and Helmond 2013; Helmond 2015), while traditional media outlets, grappling with declining readership and viewership, entered the digital realm in pursuit of new income through online advertising spaces (Giles 2010; Kaye and Quinn 2010). The importance of viral news in the hybrid media ecosystem lies in its ability to attract a large audience,

generating substantial views and, consequently, significant monetary earnings through advertising space sales (Rogers 2002).

The socio-technical system of attention underscores the ultimate goal of those producing junk news: capturing the attention of online users (Venturini 2019).

Junk news often circulates without requiring cognitive adherence, serving various purposes such as clickbaiting for viral content pages, supporting grassroots activist groups, campaigning for political loyalists, or providing humor for entertainment groups (Bounegru, Gray, Venturini and Mauri 2018).

Junk news becomes a tool for different actors once it captures the attention of a sufficiently large audience. Social users may leverage junk news to increase their visibility, redirecting the flow of attention from the initial source to their page. Traditional media outlets might publish successful junk news from social media to attract users to their sites. The role of junk news readers is pivotal, with studies indicating that users interested in exploring junk news content often belong to the opposite ideological camp, demonstrating that cognitive adherence is not the sole explanation for news consumption choices (boyd 2017).

This shift in news consumption patterns indicates a reliance on social contagion rather than cognitive adherence. The emphasis on virality in the information production regime has accelerated the issuance and consumption of news, leading to a decline in content quality, as evident in the proliferation of sensationalist news. Furthermore, this pursuit of virality has shortened the duration of news discussions in the public arena, creating ephemeral information bubbles (Castaldo et al. 2022).

Conclusion

The COVID-19 infodemic has been a focal point of both scientific discourse and public concern since the onset of the global health crisis. The sheer volume of

information became so overwhelming and pervasive that it prompted a response from the World Health Organization in February 2020 (Zarocostas 2020). The organization appealed to governments, public institutions, and digital platforms to actively combat the dissemination of false information both online and offline. Luckily, these efforts - combined with an augmented awareness in the population of the risks of contagion - slowed the dissemination of rumors and scientific hoaxes (Pilati et al. 2022).

However, examining the structural elements discussed earlier provides insights also into why the COVID-19 communication crisis was far from unforeseen. The combination of agenda setting challenges and the prevalence of a junk news regime elucidates that the infodemic is a consequence of structural components within the hybrid media ecosystem. The constant acceleration of debates leads to information overload, akin to a bulimic affliction of the media system, unable to select healthy content for public discussion (Gnatyshak et al. 2022). Simultaneously, the crisis of agenda setting exacerbates the difficulty of creating a common space for discussion. The formation of niches around specific sources results in the centralization of information around a few leaders, hindering the emergence of a common discourse due to the lack of coordination between mass media, online niches, and connected audiences. This process was evident in the case of the COVID-19 pandemic, where the analysis of over 200 million tweets between January and April 2020 revealed a fragmented debate, preventing the formation of a shared public space (Sacco et al. 2021).

In light of these observations, the COVID-19 infodemic is not an isolated event but rather a peak manifestation of the information disorder affecting digital society (La Rocca, Carignan and Boccia Artieri 2023). The metaphorical lens of medical terms, employed to describe these systemic disorders as information bulimia, may facilitate a better understanding of their causes and effects. However, an overreliance on this framing tends to obfuscate the underlying societal dynamics and determinants of the “infodemic” communication crisis.

Throughout this chapter, we have embarked on a journey to unravel the intricate layers of the so-called “infodemic”, drawing upon both classical and contemporary contributions within the expansive field of media studies. Our exploration has revealed that the infodemic is not a transient anomaly but rather a manifestation of profound structural shifts within the evolving hybrid media ecosystem. By delving into the core of the issue, we have underscored how agenda-setting processes play a pivotal role in source selection, while the accelerated regime of junk news perpetuates a constant deluge of news and information.

The infodemic, far from being a passing disturbance, emerges as an inherent and central feature of digital society. Building on this understanding, our endeavor has been to sketch the contours of the infodemic from a perspective based on communication and sociological studies. The intricate dance between information, media, and societal dynamics we have unraveled in this discourse serves not only to dissect the current infodemic but also as a guide for navigating the intricate landscape of socio-technical controversies in the digital age. As we look ahead, these insights lay the foundation for a research strategy that can elucidate the nuances of COVID-19 public debate through a fine-grained digital mapping.

CHAPTER II

Lockdown Unleashed. From the Rally ‘round the Flag to the emergence of a (counter) Digital Movement of Opinion.

The outbreak of the COVID-19 crisis in early 2020 prompted governments worldwide to implement a range of restrictive measures aimed at containing the spread of the virus. These measures, commonly referred to as ‘lockdown’, involved the closure of non-essential businesses, restrictions on movement, and various social distancing guidelines. Initially, there seemed to be a broad consensus regarding the necessity and efficacy of these measures in mitigating the impact of the epidemic. However, shortly after, the very same measures started to be criticized. This chapter delves into the quali-quantitative analysis of the Twitter debate surrounding the lockdown in Italy, seeking to understand the transition from the support of this health policy to a more contentious and polarized debate to a final hegemony of anti-lockdown's positions. In doing so, we aim to examine the presence of political actors able to fuel and exploit the growing dissensus against COVID-19 restrictive measures.

Keywords: COVID-19; Lockdown; Rally ‘round the Flag; Digital Movements of Opinion; Political manipulation;

Introduction

The early stages of the epidemic witnessed an overwhelming wave of support for COVID-19 restrictive measures on social media at a global scale. Hashtags such as #StayHome, #StaySafe, and #FlattenTheCurve dominated Twitter and also in Italy a similar wave of support took part (Boccia Artieri, Greco and La Rocca 2021). As time passed, however, the initial consensus began to wane. The length and intensity of the so-called ‘lockdowns’ tested the patience and resilience of individuals, leading to growing frustrations and challenges (Boccia Artieri and La Rocca 2021). People expressed concerns about the economic repercussions of extended closures, mental health issues arising from isolation, and the infringement upon personal freedoms. These dissenting voices gradually gained prominence also on social media, creating a digital environment of contention and giving rise to protests such as #IoApr15/01 (La Rocca, Boccia Artieri and Greco 2023).

One key aspect of our analysis involves understanding the pivotal moments and factors that contributed to this shift in the public debate. Leveraging on a time series analysis and examining tweets patterns, we can pinpoint critical events or influential voices that catalyzed the transformation of the discourse. Was it the emergence of scientific studies questioning the effectiveness of lockdowns? Or did political communication strategies play a role in shaping the digital public response? By implementing a quali-quantitative research design, this study aims to shed light on the triggers and catalysts behind the changing narrative on Twitter.

Our research is driven by the recognition of the multifaceted nature of digital public discourse, and the critical need to understand how this discourse is shaped and manipulated in the Italian context (Morlino 2021; Morlino and Sorice 2021). By analyzing the case of COVID-19 lockdown measures in Italy, we seek to

provide a comprehensive exploration of the digital narrative's evolution, highlighting the pivotal events and influential voices that contributed to the shifting public sentiment.

From an empirical perspective, our investigation aims to uncover the mechanisms that drove the transition from initial consensus to digital dissent, emphasizing the role of political actors and strategic messaging in shaping digital public opinion. By delving into the nuances of the Twitter debate, we aim to illuminate the dynamics and triggers that steered the trajectory of the online conversation, taking into account the positions of all the actors involved in it.

Theoretical insights from our study will contribute instead to the broader discourse on Digital Movements of Opinion (DMOs), while also highlighting the complexities of navigating socio-technical controversies in the digital age. In doing so, we seek to offer a nuanced understanding of the interplay between social media, political agendas, and the digital public, shedding light on the transformative power of strategic framing and its impact on the dynamics of online discourse.

Literature Review

In the pursuit of analyzing the dynamics at play in our investigation into the transition from an initial approval of COVID-19's restrictive measures to forms of digital dissent, it is imperative to delve into the relevant theoretical concepts that underpin their changing interplay. The literature review for our investigation draws upon two different concepts that provide a foundation for understanding the dynamics of public opinion during crises: the “Rally ‘round the Flag” effect and the emergence of “Digital Movements of Opinion”.

The “Rally ‘round the Flag” effect, as articulated by scholars such as Mueller (1970) and Brody (1991), examines the tendency of individuals and communities

to unite in support of their leaders when facing crises, whether it be a war, terrorist attack, or a pandemic like COVID-19. This concept underscores the initial surge in public approval and cohesion, emphasizing the role of perceived leadership in crisis management.

However, as our investigation will delve into, this unity is often temporary and can give way to dissent, which is where the work on so-called “Digital Movements of Opinion” (DMOs) becomes particularly relevant (Barisione 2022). This concept offers insights into how opposing narratives develop and gain momentum in response to crises. Previous works on DMOs emphasize the role of social media platforms, such as Twitter (Barisione and Ceron 2017), in amplifying dissenting voices and enabling the formation of organized counter-narratives (Anselmi, Maneri and Quassoli 2023). These counter movements often challenge the prevailing mainstream discourse, illustrating the fluid nature of public opinion in the digital age and the potential for shifts from unity to dissent during prolonged crises (Barisione, Michailidou and Airoidi 2019).

These concepts, which have been extensively utilized in the fields of political science, sociology, and digital communication, shed light on how societies respond to external threats and how these responses evolve over time. By integrating these concepts into our investigation, we aim to also provide a theoretical understanding of how the “Rally ‘round the Flag” effect and the subsequent emergence of a counter Digital Movement of Opinion shape the discourse surrounding COVID-19 lockdown, with a specific focus on the Italian context.

The “Rally ‘round the Flag” effect

The “Rally ‘round the Flag” is a concept that describes the tendency of individuals, communities, or even entire nations to unite and support their leaders during times of crisis or external threats (Muller 1970). This rallying effect often

results in a temporary increase in public approval, trust, and cohesion towards the government or authority figures in charge (Brody 1991). It's a psychological and sociopolitical response where people set aside political differences and prioritize the collective interest or national security (Lambert, Schott and Scherer 2011).

This phenomenon can be observed in various situations, such as during wars, natural disasters, terrorist attacks, and, as particularly relevant for our case, pandemics (Yam et al. 2020; Devine et al. 2021). In the context of a pandemic like COVID-19, for instance, citizens might initially come together to support the government's response efforts, embracing measures like lockdowns, social distancing, and mask mandates in a bid to safeguard public health (Baekgaard et al. 2021) and cope with the individual anxiety provoked by uncertainty (Roccatò et al. 2021).

Several factors contribute to the “Rally ‘round the Flag” effect. Firstly, a sense of shared threat fosters a sense of unity and common purpose (Schraff 2021). Secondly, leaders are often seen as the authority figures with access to information and resources to manage the crisis (Kritzinger et al. 2021). Lastly, in times of uncertainty and fear, people tend to gravitate towards perceived stability and cohesion (Erhardt et al. 2021). However, it's essential to recognize that the “Rally 'round the Flag” effect is often temporary (Johansson, Hopmann and Shehata 2021). As the crisis endures, public opinion might shift due to various factors, including the perceived effectiveness of the leadership's response, the economic and social toll of crisis management measures, and the development of differing perspectives over time (van der Meer, Steenvoorden and Ouattara 2023).

In the context of COVID-19, for instance, the initial rallying of public support for strict lockdowns seems to disappear and could evolve into dissent as people experience the prolonged impacts of these measures (Johansson, Hopmann and Shehata 2021). Economic hardships, mental health concerns, and doubts about the efficacy of restrictions can erode the initial unity, leading to the emergence of

counter-narratives that challenge the initial approval of public health restrictive measures.

Digital Movement of Opinion (DMO)

A Digital Movement of Opinion (DMO) can be conceptualized as a distinct form of collective action that arises on social media platforms (Barisione 2022), characterized by its ability to mobilize a multitude of users who respond collectively, often through hashtags, to emotionally charged and highly publicized events (Barisione and Ceron 2017). DMOs are characterized by their one-sided perspective, where a majority of participants share a common sentiment, such as empathy or indignation, in response to a specific event (Papacharissi 2015a). These movements have a unique feature of temporarily monopolizing the digital discourse on a particular topic, often overshadowing dissenting voices and even leading to self-censorship among those who hold opposing views (Barisione, Michailidou and Airoidi 2019).

The emergence of a DMO typically follows a prominent triggering event that captures immediate attention within the hybrid media landscape, involving issues of public interest and political relevance (Barisione 2022). A DMO typically originates in response to an emotionally charged and highly publicized event, often utilizing normative hashtags (e.g., #RefugeesWelcome, #MeToo) to symbolically frame the conversation around a shared social norm or cultural value (Barisione and Ceron 2017). Unlike traditional social movements, DMOs lack a prior unifying activist network and instead involve a multitude of users who react simultaneously with unanimous positions (Bennett and Segerberg, 2013). This unified response can reflect sentiments of empathy or indignation related to the focal event (Papacharissi 2015a). This wave of support or opposition reflects a collective emotional response among the general digital public, which temporarily transforms into online activists (Barisione and Ceron 2017). At its peak, a DMO becomes a unified collective force that marginalizes contrary

perspectives, making it the sole position with social legitimacy at that moment (Barisione, Michailidou and Airoidi 2019). Unlike traditional social movements, which tend to be sustained over extended periods, DMOs are inherently short-lived, reflecting the intense emotions of the general public for a limited time. The duration of a DMO often correlates with the intensity of media coverage surrounding the focal event (Barisione 2022).

To sum up, the DMO concept represents a unique fusion of public opinion and collective action within the digital realm, showcasing the transformative power of social media in unifying diverse voices around a shared cause, but also, in the opposite way around, their power to obstacle the emergence of a common public ground in which different users with different views may discuss.

Research Design

In this study we employed a quali-quantitative research design to understand the unfolding of Twitter debate surrounding COVID-19 restriction measures in Italy (Venturini 2024). In this light, we focused over a significant time, namely from January 2020 to January 2023. To gather relevant data for our analysis, we utilized Twitter's Application Programming Interface (i.e., v2 API for academic research) to collect all the tweets in the Italian language that contained the keyword 'lockdown(s)'. This resulted in a dataset of 2,923,641 tweets published between 01/01/2020 and 01/01/2023, which provided a full sample of the Italian Twittersphere on this topic.

Our analysis began with a quantitative and descriptive examination of the conversation. We firstly tracked the number of tweets over time to observe any trends or patterns in the volume of discussion. Additionally, we calculated the Gini index, a commonly used measure of inequality, to assess the concentration of retweets among a select group of influential users (Bracciale, Martella and

Visentin 2018). This allowed us to determine the degree of verticality and centralization in the Twitter debate on lockdown measures (Sacco et al. 2021). Next, to gain further insights into the dynamics of the discourse and given the vertical and centralized nature of the conversation (Gini on retweets equal to 0.77), we focused directly on the role of the most influential users in shaping the debate on Twitter.

First, we selected the most retweeted authors, comprising 150 users that were retweeted 836,420 times, meaning that they collectively accounted for approximately 30% of the total volume of tweets present in our dataset. Then, for each one of the top retweeted users we carried out a qualitative manual categorization of the pro- or anti-lockdown predisposition of each author—meaning that we closely read the users tweets regarding COVID-19's lockdowns to grasp the position of each author on this specific subject. This netnographic process allowed us to tag the most retweeted authors in 43 pro-lockdown and 107 anti-lockdown users. Using this new variable as a proxy for detecting the wider narrative in Twitter (Rogers 2019), we calculate the percentage of retweets coming from the most influential users to assess the distribution of pro- vs. anti-lockdown positions over the three years of debate.

Finally, to deepen our analysis, we delved into the network structures of the conversation during topical discussion periods. We extracted retweet networks for three specific time points: from the 9th to the 22nd of March 2020, from the 25th to the 31st of October 2020, from the 14th to the 20th of February 2021. These time points were selected based on significant events, namely: the two weeks in-between the installation and propagation over Italy of the first lockdown in spring 2020; the week preceding the beginning of the second lockdown during fall 2020; and the week ahead of the change in the government of Italy from the executive lead by Conte to the one lead by Draghi in winter 2021—when a rumor about the reinstallation of a third lockdown spread over the Italian media system. For each one of these three periods we combined visual

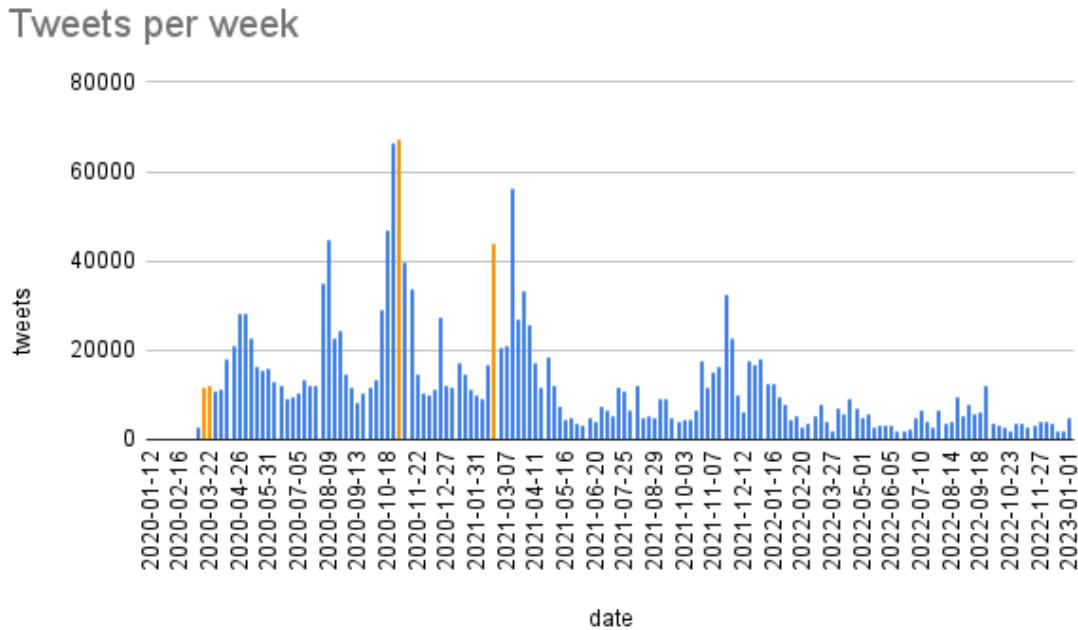
network and content analysis techniques to identify the main community of users and to understand how their internal narratives were framed. For each cluster, we read all original tweets and additional content present in the retweets. This process ensured that the topologically emerging communities were also cohesive in terms of textual content, shedding light on the specific topics around which these conversations unfolded.

Results

The rising and falling waves of Twitter activity closely mirrored the timeline of lockdown policy introductions and liftings, serving as a barometer of a changing public debate. A first wave occurred in Spring 2020, with a relatively broad peak of approximately 30,000 tweets per week corresponding to Italy's initial nationwide lockdown implementation. This was followed by a more acute but short-lived second wave in mid-Summer 2020, spiking to over 45,000 tweets per week in response to the reinstatement of some public restrictions, such as the closure of dancefloors. The third wave marked the height of Twitter engagement on this issue, with peaks of around 70,000 tweets per week in Autumn 2020 as national and regional lockdown measures ramped up again. A final burst of attention in Winter 2021 temporarily pushed tweet volumes back to 60,000 per week before activity steadily declined over the course of the year. By Spring 2021, a consistent ongoing trend composed by a baseline of around 7,000 tweets per week stabilized, indicating fading public attention. One exception was a temporary spike in Autumn 2021 triggered by debates around the so-called “Green Pass” (see Chapter 4), which reignited lockdown's references by raising similar issues of restricting personal freedoms. In total, the data shows three rising waves of Twitter activity in 2020 corresponding to periods of change in the lockdown measures, followed by two decreasing waves in early and late 2021.

Tweet volumes then faded over the course of 2022 despite periodic policy changes, indicating much of the public had moved on from directly debating lockdowns themselves to a looming presence of the topic within the broader COVID-19 debate.

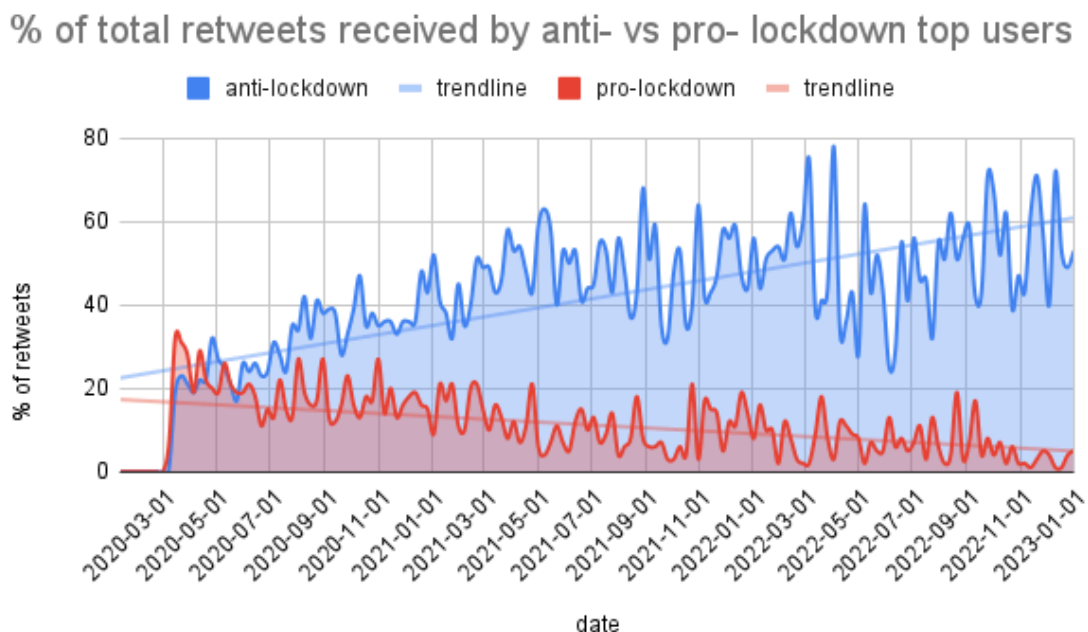
Figure 1: volume of tweets per week from January 2020 to January 2023



Looking at the longitudinal data regarding pro- and anti-lockdown influencers on Twitter it is moreover possible to observe an early and significant shift of narrative. In this sense the Italian Twitter's debate could be splitted into three phases. A first ‘pro-lockdown’ phase, that is comparatively much shorter, starts in March 2020, lasting up to the end of April 2020; a second phase that goes from May 2020 to November 2020, in which a contentious environment between pro- and anti-lockdown views took place in Twitter; and, finally, a last phase starting from December 2020 going on to the very end of our investigated period in which the retweets of anti-lockdowns influencers dominated the discussion. The first two phases are the only periods in which a pro-lockdown narrative (as measured by the top influencers RTs) has been in competition with the

anti-lockdown discourse. The third and longer phase, conversely, sees the predominance of a hegemonic anti-lockdown narrative. Figure 2 visually identifies these trends, clearly indicating that over time the influence of anti-lockdown influencers became increasingly prominent and solidified. Obviously, tweet volumes decrease with time (see again Figure 1), essentially meaning that an anti-lockdown narrative consolidated as hegemonic within a smaller audience of Twitter's users. In this last phase the debate on Twitter was essentially led by a mix of anonymous users and public figures, namely: talk-shows' politicians -such as Claudio Borghi (Lega) and Vittorio Sgarbi (Forza Italia)-, political leaders of small populist parties that propagated conspiracy theories -as Francesca Donato (Eurexit) and Alessandro Meluzzi (PAI)-, and a set of pundits who sporadically focus their attention on the issue -for example Francesca Totolo and Nicola Porro.

Figure 2: percentage of retweets (on a scale from 0% to 100%) coming from the 150 most retweeted users (classified as anti- or pro-lockdown)



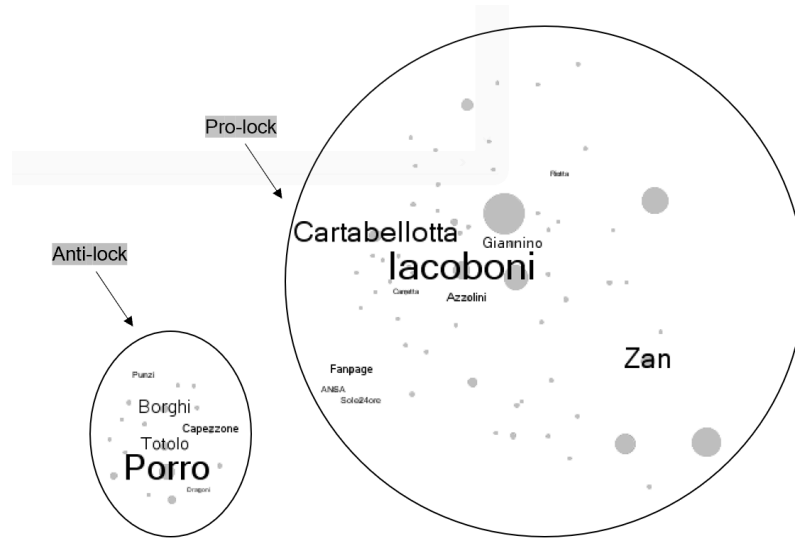
Examining the network visualizations presented in Figures 3, 4, and 5, we can gain more insights on the turning points of the transition from a support for

lockdown measures to opposition towards the very same policy. In the retweets network, each node represents a user and the links between two nodes indicate a retweet of a specific tweet by the user to whom the link is directed. To enhance the visibility of the influential users in the networks we filtered out the nodes that received less than 20 retweets. The size of the nodes and the labels are proportional to the number of retweets received. Node labels are displayed only for public figures (i.e., politicians, journalists, pundits, etc.). The visual clustering was generated by the ‘Force Atlas 2’ force-directed algorithm (Jacomy et al. 2014; see Venturini et al. 2021 for an explanation of its recommended usage).

Figure 3 illustrates the network of retweets related to lockdown measures during the two weeks following the implementation and dissemination of the initial lockdown in Italy in spring 2020. In this network, two distinct groups of users become apparent, each reflecting either a pro-lockdown or anti-lockdown perspective. The pro-lockdown group consists of journalists, politicians and medical professionals who garnered attention through references to official scientific and policy reports, as well as mainstream news articles. In contrast, the anti-lockdown group primarily comprises a small number of right-wing affiliated politicians and pundits. These individuals utilize Twitter to promote their private blog articles and social media posts, advocating against lockdown measures.

It's noteworthy to observe distinct framing strategies employed by both the pro- and anti-lockdown narratives during this early period. Proponents of lockdowns directly report their effects and also acknowledge potential limitations. Conversely, among the smaller and homogenous group critical of lockdowns, these points are not addressed directly. Instead, they are approached indirectly through economic arguments. This indirect approach not only emphasizes the economic unsustainability of lockdown measures in the long term, but also insinuates doubts about the collusion of the Italian and Chinese governments in trying to limit the freedom of citizens and uses the slogan “harbors open to migrants, while italian citizens close at home” to attack the government.

Figure 3: retweet network visualization (9-22 March 2020)



Delving deeper into the content of these tweets, we can discern various evaluations and discussions about lockdown measures within each group. The pro-lockdown group predominantly emphasizes the urgency and necessity of lockdown measures as a crucial means to combat the epidemic:

“These days we have become such a model of virtuous behavior that even the French are calling the total lockdown “Italian-style” lockdown, where for the first time in history “Italian-style” does not mean “bullshitting” but “strict”. Can’t believe it.” (1236 retweets)

“In the province of Lodi, the lockdown began on February 23. In Bergamo on March 8. Look at the difference in the trend of new infections. The lockdown is starting to bear fruit. We need to hang in there and use the time gained to plan complementary strategies.” (744 retweets)

However, concurrently, some users introduce the point of using contact tracing strategies to complement the lockdown. While these users still support the

installation of the lockdown, they engage in an internal debate about the effectiveness of restrictive measures alone:

“Economists, mathematicians, computer scientists, international studies scholars: Italy's lockdown is not enough, we also need targeted tracking, smart data and study South Korea. Here's why the government would do well to listen to them. My article in @LaStampa” (403 retweets)

“Lockdown is not enough, WHO denounces today. Without applying the "3Ts" (trace, test, treat) with appropriate technologies and processes, the Beast will be back to spread as soon as we leave home. An essential, must-read thread, for everyone.” (821 retweets)

In contrast, the anti-lockdown group adopts a different approach, not directly addressing the lockdown itself as a health policy. Instead, they tend to highlight peripheral issues related to the primary debate. Within the anti-lockdown cohort, the main allegation levied is that China deliberately engineered the pandemic in order to economically hobble Western nations through mandatory lockdowns. However, a close reading of the web pages linked to tweets reveals these accusations are fundamentally centered on apprehensions over the limitation of personal freedoms rather than genuine suspicion of a financial collapse. Despite superficial focus on China, the underlying sentiment stems from anxieties related to the control of citizens by the state, with China providing a convenient external entity on which to build these fears. However, while China is explicitly called out within influential anti-lockdown tweets, the core arguments remain intrinsically tied to worries over the lockdown limitation, rather than sincere belief in a coordinated Chinese conspiracy:

“Here is #LaVeritaAlleSette, unfair review with @capezzone. Italy and the risk of handing itself over to China. Mattarella's strategy and opposition warnings.

Conte tries again with the European Stability Mechanism? The Wsj: we need a vision beyond lockdown, you can't kill the economy” (57 retweets)

“From the origin of #contagium to the "gift" of masks: here are the omissions and lies of the Chinese regime that we pretend not to see. Commentary by @Formicola_lo #Covid #lockdown #healthcare.” (322 retweets)

While some elements of the anti-lockdown discourse veer toward discussing China's involvement in a conspiracy without explicitly framing it as such, others take a markedly different approach. In this variant, the narrative implies a distinct frame, one where the lockdown measures are portrayed as a deliberate ploy to curtail personal freedoms while migrants continue to arrive without adequate COVID-19-related scrutiny (Caliandro et al. 2020). This perspective delves deeper into the issue of personal freedoms and does so with pronounced conspiratorial undertones:

“#lockdown #pandemic Italians locked in but harbors still open: ferried boat of Tunisians migrants arrived today in Lampedusa” (156 retweets)

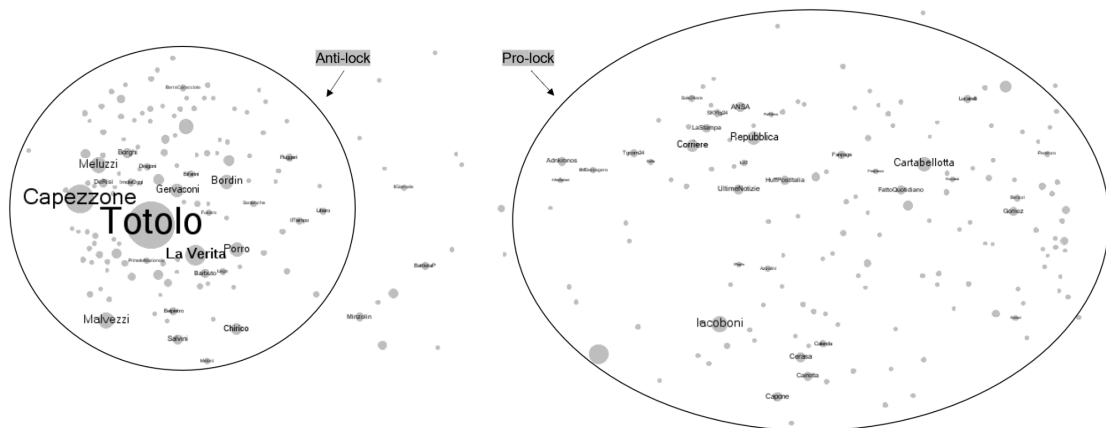
“First landing from #lockdown. Boat from #Tunisia arrived in #Lampedusa today. On board 27 #migrants of Tunisian nationality. <https://t.co/5RHhXuMitC>” (228 retweets)

“#Covid_19 #coronavirus #italiawe #lockdown ITALY, WAKE UP! Lack of respirators to save infected: hobby room and pilates classes for refugees - VIDEO <https://t.co/mImrrOgSPX>” (114 retweets)

Moving to autumn 2020, the visual representation of Figure 4 captures the evolving retweeting dynamics during the week leading up to the implementation of a second nationwide lockdown. This decision was made in response to the exponential increase in COVID-19 infections that followed the summer vacations and the reopening of schools and offices. It's worth noting that these reopenings adhered to strict protocols involving temperature measurements and mask usage.

In this period, the anti-lockdown group began to take on more defined shapes, reflecting the intensifying disagreements regarding lockdown measures. Figure 4 presents a visual representation of the network of retweets in this specific timeframe.

Figure 4: retweet network visualization (25-31 October 2020)



The visual network analysis of retweets during this period reveals a divergence from the earlier structure observed in the Twitter debate. Notably, the group of users opposed to lockdown grows centering around the same influencers affiliated with the right-wing political sphere observed previously. Additionally, while in March the most retweeted users were predominantly aligned with the pro-lockdown stance, during this period it is the group advocating against COVID-19 restrictive measures that attracts the most influential voices and garners the largest following. On the other hand, the previously cohesive pro-lockdown counterpart gave rise to a more nuanced landscape. This new configuration includes some users that are still strongly supportive of the continued implementation of restrictive measures, alongside another set of users that, while stating their support to restrictive measures, questions the scientific validity and empirical outcomes of another lockdown.

Content analysis of the most widely shared tweets within the identified groups indicates that, from a framing perspective, there is continuity between the current discussion and previous debate in March regarding lockdown policies.

Specifically, within the anti-lockdown group, the predominant criticism continues to be focused on personal freedoms and economic repercussions of such restrictive measures. The tweets garnering the highest retweet volumes emphasize predictions that an additional lockdown would be financially ruinous. Moreover, these influential tweets repeatedly couple such economic warnings with demands for financial reimbursement from the state, which is portrayed as inept in managing the epidemic while unfairly burdening small businesses and merchants—described as the backbone of the Italian economy. Contrastingly, the anti-lockdown discourse argues, big firms and state employees are protected through remote working arrangements, evading the hardships inflicted upon private small businesses by government-mandated closures.

“#Conte (i.e., the Italian prime minister) press conference challenges even the patience of the meek. While sending hundreds of thousands of businesses to bankruptcy, he says he's protecting the economy, but doesn't give precise figures on relief and to whom. He imposes a lockdown, but denies doing so. The first thing to do is to kick out these incompetents.” (1005 retweets)

“Anyone who talks about lockdown on the other hand must have a paycheck ready. Ah, the check is needed even without talking about lockdown because the damage is already there anyway.” (656 retweets)

“I finally understood what semi-lockdown English means in Italy: that if you are an employee you stay at home and stick to your PC for smart working, if you are an entrepreneur or self-employed or professional you stay at home and stick to bullshit.” (556 retweets)

“Italy is splitting in two. Those who have a fixed salary wish for smart working and lockdown. Those who have to provide bread for their families with their jobs do not. Homo homini lupus. For all.” (417 retweets)

Exacerbating the conspiratorial traits already developed during the March lockdown, during the period leading up to the second national lockdown in October 2020, the anti-lockdown group contained an even more assertive narrative. This narrative suggested that the Italian state was, in fact, acting against its own citizens, infringing upon their freedoms and trying to perpetuate the ‘Great Reset’—a recurring transnational conspiracy theory which alleges that the pandemic is being exploited to reset the global economy and societal structures (Tuters and Willaert 2022):

“The Great Reset slogan is 'never again anything like before'. Without a new planetary lockdown that resets everything there is a risk that the old world of peoples and nations will try to resist! Therefore everything will be locked down. Historical changes used to be done with wars today with psycho-info-pandemics.” (266 retweets)

“Former apostolic nuncio of the United States writes to the U.S. president: "There is a global plan, the 'Great reset,' to subdue humanity. Voting for the Republican leader is the only way to stop those who would like to wipe out the world by lockdown." <https://t.co/DrdzJjL9aD>” (237 retweets)

“I have a vague feeling that the government, in order to enact more drastic measures and kick off the Great Reset directives, is waiting for the US elections. If Biden wins it will be lockdown, army on the streets, repression etc; if Trump wins there will be a softening of the situation.” (239 retweets)

“The curious phenomenon that if contagions increase in the US it's #Trump's fault, if they increase in the UK it's Johnson's fault, if they increase in France and Germany it's the virus's fault while if they increase in Italy it is the Italians' fault. #curfew #lockdown” (669 retweets)

Within this conspiratorial narrative, the mentions of street protests are framed as moments of rebellion against these perceived injustices, with suggestions that

these protests could serve as opportunities to overturn the situation with the assistance of the police:

“#Trieste: policemen strip off riot gear and stand with protesters. #UprisingItaly #lockdown” (672 retweets)

“#Bari, hundreds of protesters in square against #Dpcm: 'Government we come for you in Rome' #UprisingItaly #Lockdown #Conte” (268 retweets)

“#Vicenza, #Treviso, #Padova and #Torino, these are the real squares, the ones crowded by thousands of civilized citizens and censored by TV and newspapers. #UprisingItaly #lockdown #Dpcm” (264 retweets)

The analysis of the most influential tweets within lockdown supporters indicates as well a general framing consistency from prior periods, yet also reveals a growing division on using the lockdown as the only curbing strategy. While in March no tweets directly challenged lockdowns, this time voices emerge both defending and opposing such measures on medical grounds. On one side, the most amplified tweets argue from an epidemiological perspective that renewed lockdowns are inevitable to control surging caseloads. However, a split emerges as other influential tweets aim to demonstrate lockdowns' ineffectiveness in positively impacting either COVID-19 containment or citizen mental health. This zone of debate centers on the medical merits and public health impacts of mandated restrictions. Whereas before lockdowns were implicitly accepted as a necessary medical response, this schism represents the crystallization of skeptical perspectives grounded in health data, disputing the medical rationale and benefits relative to societal side effects. The increasingly contentious discourse suggests potential fracturing of public consensus as the costs of lockdowns compound over time.

“To prevent the situation from getting out of hand, it is necessary to take significant measures. It should be remembered that lockdowns are already being

implemented in France, Spain and the UK. Minimizing by saying that the sick are few and less serious does not help, but causes confusion about the goals, creating false illusions.” (690 retweets)

“Coming down from a hellish night. Outside every hospital are dozens of STOPPED ambulances with #Covid_19 patients that hospitals won't accept. Every patient has family doctors who won't help them. Shut it all down. It can't be done like this. I call for #lockdown . I am shocked” (368 retweets)

“After 215 days of lockdown (a world record) Argentina is the most infected country. Not only that, the undernourished and starving are also increasing.” (616 retweets)

“Covid, in UKs treatments suspended due to lockdown: boom in people dying at home from other diseases <https://t.co/ZiRiHog8t7>” (530 retweets)

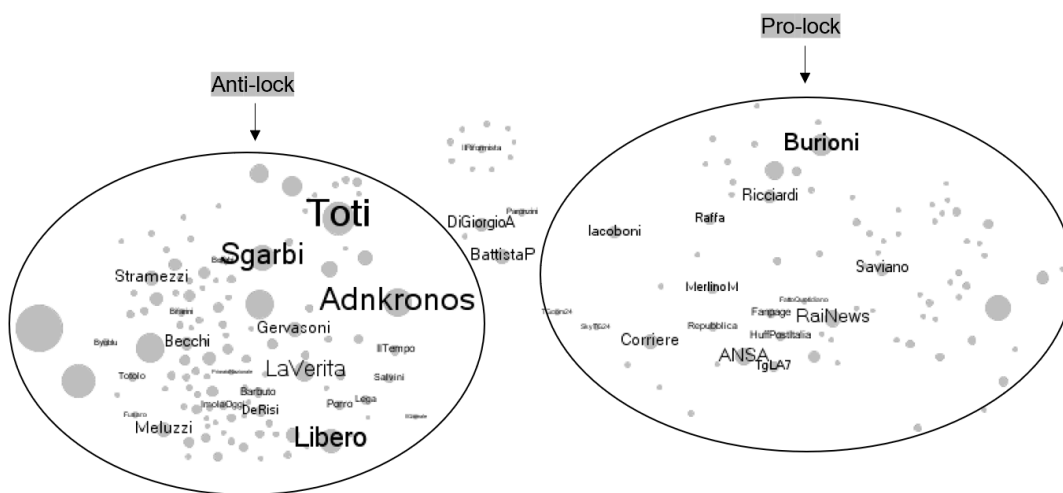
“I am thinking about those people who suffer (and will begin to suffer) from anxiety problems, depression and other mental disorders with all this alarmism and threats of a new lockdown. Health also includes psychological well-being and not just physical well-being.” (744 retweets)

Transitioning to winter 2021, the visual representation of the retweeting network in Figure 5 captures the heightened dynamics during the week before the rumored third lockdown, a rumor that swiftly spread across the Italian media landscape. Despite the speculation later being proven false, the period saw an eruption of intense debate on Twitter within pro and anti-lockdown groups.

Indeed, in the lead-up to February 2021, ahead of the formation of Mario Draghi's government, a climate of uncertainty prevailed regarding the possibility of a third nationwide lockdown. While the rumor, as later confirmed, had no factual basis, it ignited a fiery debate on Twitter between proponents and opponents of lockdowns. This period witnessed a resurgence in disagreements, akin to previous phases, with anti-lockdown voices becoming even more adverse to the Italian government and its health policy. On the other hand, a more cohesive pro-lockdown set of users reemerged to urge the need of restrictive

measures. The consequence of these two opposing stances, each leveraging the unverified rumor to reinforce their respective echo chambers, was the avoidance of any meaningful dialogue between the two factions. The debate regressed to a state of standoff, resembling the one observed in March 2020, albeit with the majority now consolidating around the anti-lockdown group, while a dispersed minority remained associated with the pro-lockdown group.

Figure 5: retweet network visualization (14-20 February 2021)



The discussion surrounding a third lockdown in Italy was notably initiated by a statement from Walter Ricciardi, a prominent figure in the country's response to the COVID-19 crisis. With the installation of the new government, he proposed the implementation of a fresh nationwide lockdown as a measure to curb the rising number of COVID-19 cases. Even if this statement was quickly discarded as a personal one by the very same Ricciardi, the rumor about the reinstatement of a lockdown was quickly seized upon as a pretext to launch an offensive against the newly formed government. The criticisms of this homogeneous group of anti-lockdown users -centered once more around the right-wing area of politicians and pundits- echoed the familiar narratives involving economic harm and threats to personal freedoms resulting from lockdown measures.

Furthermore, this discourse incorporated over again conspiratorial traits such as the collusion of the Italian and Chinese governments in trying to limit the freedom of citizens and the ‘Great Reset’ conspiracy:

“I make a few tweets critical of the #orangezone. I go to read the comments: all trolls with zero or at most two followers responding that TI bursts and it takes #lockdown (TI free, to date, 80%). They are using the services to run the SME genocide, it's obvious.” (109 retweets)

“The salaries and pensions of those people who advocate lockdowns and closures should be reduced to zero by decree. Then, perhaps, they will understand the meaning of what they advocate.” (170 retweets)

“Speech by #draghi: surrender of sovereignty, sanctification of external constraint (irreversible euro buzzword as signal), lockdown. Worse than that we didn't think even we who have lined up against the government at the first second #NoToDraghiGovernment” (101 retweets)

“Evident is the Chinese hand behind the infiltrators in the technical-political structures managing the false emergency. There is a will to #lockdown clearly independent of the pandemic curve, thus linked to a trade war. Either we arrest the traitors or they arrest us.” (136 retweets)

“But call a spade a spade! The #lockdown in Italian is called #SEGREGATION. Never before Chinese communism, not even the worst criminal tyrants, had anyone thought that because of a disease you could segregate a people and take away their jobs. To jail, you must go.” (279 retweets)

“Let's rest assured that until the last vial of vaccine is administered after variant lockdown swabs and waves essentially nothing will reopen! Let everyone draw whatever conclusions they wish. After that finally there will be the Great Reset and the New World ruled by the NWO.” (309 retweets)

“Since the beginning of the pandemic, the #variants are thousands. They never talked about them. Now that the numbers are dropping and there is no third wave, they use them to justify a #lockdown wanted by foreign forces to wipe out

local production. They are making war on us, they want to kill us like dogs.”
(360 retweets)

On the other side of the spectrum, pro-lockdown users displayed a somewhat similar reaction to Ricciardi's statement. Rather than questioning the rumor of an impending lockdown, they seized this opportunity to reaffirm their positions. For them, this was an occasion to regroup and emphasize the need for continued restrictive measures. They urge the reinstatement of restrictive measures with data and comparisons with the situation in the rest of Europe, emphasizing their perspective on the scientific validity of lockdowns. However, this unilateral response to the rumor, like that of the anti-lockdown group, reflected a certain degree of echo-chambered dynamic:

“Did you really think that the closures, the yellow, orange and red zones and the #lockdown were #Conte's whims? Have you still not realized that as long as this virus is circulating you only have to stick to the bleep and hope the vaccine is effective?” (195 retweets)

“Half of Europe goes back into lockdown, here they're pissed off because the ski lifts won't reopen. What didn't they understand about the spread of Covid and its variants?” (204 retweets)

“That lockdowns only serve to gain time seems obvious to me; the important thing is to use the gained time well. In the spring we were forced to use it to build intensive care units; now fortunately we can use it to vaccinate as much as we can. Let's get moving“ (247 retweets)

“Germany continues the lockdown, France as well, England as well, only we Italians think about skiing and eating out.” (403 retweets)

“Germany - Lockdown; United Kingdom - Lockdown; France - Curfew at 6 p.m., bars and restaurants are always closed; Italy: "Let's reopen everything! Ricciardi, Galli and Crisanti spread terror"; Doesn't the slight suspicion arise that perhaps we are underestimating the variants?” (575 retweets)

To sum up, our results reveal a significant transition from an initial support of lockdown measures to a more polarized and contentious environment to a final hegemonic anti-lockdown narrative inside the Twittersphere. This shift was fuelled and exploited primarily by right-wing political actors in Italy, who strategically positioned themselves as anti-lockdown influencers, capitalizing on the growing dissent and frustrations expressed by the public.

Initially, the conversation revolved around the severity of the virus, the importance of social distancing, and the need to flatten the curve. However, as the lockdown measures persisted, concerns regarding economic repercussions, mental health issues, and infringements upon personal freedoms gained prominence. These concerns were amplified and exploited by right-wing political actors, who framed them as issues of individual liberty and government overreach. Despite the dissipation of the broader public debate on lockdown measures, anti-lockdown influencers (i.e., mainly a small vocal group of right-wing political actors) remained persistent in their opposition, utilizing Twitter to propagate their messages and foster their followers' grievance.

The exploitation of the anti-lockdown narrative by right-wing actors showcases their strategic maneuvering and opportunistic tendencies, at the point of relaunching elements from the 'Great Reset' conspiracy theory. By aligning themselves with the growing dissent, these actors sought to position themselves as champions of individual liberties, appealing to a specific portion of the population: on one hand small businesses and merchants -described as the backbone of the Italian economy- while, on the other hand, those citizens that felt an infringement upon their personal freedoms.

Discussion

The results of our study illuminate a somewhat expected transformation that occurred within the Italian Twittersphere during the COVID-19 pandemic. Our analysis reveals a significant transition from an initial support of lockdown measures to a more polarized and contentious environment to a final hegemonic anti-lockdown narrative inside the Twittersphere. This shift was fuelled and exploited primarily by right-wing political actors in Italy, who strategically positioned themselves as anti-lockdown influencers, capitalizing on the growing dissent expressed by the digital public.

Given this situation, the crucial point to consider is the extent to which political actors can influence digital discourse. Their ability to exploit the reaction of a digital public that is highly susceptible to emotional framing to advance their agendas is a testament to the strong influence they wield in the digital age (Donovan, Dreyfuss and Freidberg 2022; La Rocca, Carignan and Boccia Artieri 2023). This influence challenges the notion of the DMO as solely a grassroots movement and emphasizes the intricate power dynamics that underlie online spaces.

Indeed, in the final hegemonic anti-lockdown stage the extractivist exploitation of digital dissent by right-wing actors showcases their strategic maneuvering and opportunistic tendencies, at the point of relaunching conspiratorial elements linked to the ‘Great Reset’ narrative instead of giving voice to similar, but more accurate, critics on the pervasiveness of philanthrocapitalism and surveillance capitalism within the decisions that shaped the pandemic’s management.

This right-wing hegemony in the anti-lockdown’s DMO not only oversimplified all the potential restrictive measures as just ‘lockdowns’, but also ‘muted’ the voices from the left wing that criticized the same controversial health policies. Capturing the growing dissent, right-wing digital opinion leaders sought to

position themselves as champions of individual freedoms, while appealing only to a very specific part of the population: the small businesses and traders who were described as the backbone of the Italian economy. This fact raises questions about the visibility of structured local initiatives and grassroots movements not only in legacy media, but also on social media. In the case of Twitter, for example, an appropriation of the anti-lockdown protest from the peculiar and singular conservative-libertarian stance shaped the DMO's narratives and selected topics. Moreover, it is plausible and likely that the turn towards sensationalistic, simplified, and conspiratorial tones was rewarded by the attention economy model governing Twitter's recommendation algorithm.

In tracing this trajectory we uncover a profound challenge: the hindrance of genuine and informed debate on socio-technical issues (Venturini and Munk 2021). At its core, the real controversy revolves around the efficacy and ethics of lockdowns. Do they work? Are they the most appropriate response to a global health crisis? What does the evolving scientific discourse reveal? What are the implications of choosing lockdowns over alternative strategies? The framing of all the potential restrictive measures and public health interventions as simply 'lockdowns' -and their association with a contentious political agenda- has obscured the opportunity for a comprehensive and rational exploration of these vital questions. In this sense, the use of ideological and conspiratorial frames has, in many ways, hijacked the DMO's discourse, steering it away from a rational consideration of scientific evidence and pragmatic ethical dilemmas (Tuters, Willaert and Meyer 2023).

This dynamic raises concerns about the state of an informed public debate in our digitally mediated society (Morlino 2021; Masullo, Wilner and Stroud 2022). Critical questions about public health measures, grounded in scientific evidence and ethical considerations, deserve robust information and thoughtful exploration. Yet, the simplification and ideological appropriation of critics we've observed may deter open discourse. It may discourage experts and policymakers

from engaging in the kind of thoughtful, evidence-based discussions necessary to debate effective public health strategies.

The lesson here is clear: democratic systems must safeguard the integrity of public debate and ensure that controversies are discussed openly, honestly, and rigorously (Saltelli et al. 2023). The broader implications of these topics extend beyond the realm of COVID-19. They touch upon the broader landscape of socio-technical controversies in our digital age. In this scenario, the emergence and debate of actual controversies (i.e., the ones informed by science, ethics, and reasoned dialogue) should remain the compass guiding collective responses to the complex challenges of our times.

Conclusion

Our case study offered a comprehensive examination of the evolving discourse surrounding COVID-19 lockdown measures on Twitter in Italy, spanning from January 2020 to January 2023. By collecting a dataset of 2,923,641 Italian tweets and employing a quali-quantitative research design, we have gained valuable insights into the shifting narrative, the emergence of a counter DMO, and the role of political actors within the digital landscape of Twitter. The findings reveal a significant evolution from an initial support of lockdown measures to a more contentious and polarized debate and finally to a last and longer period where the anti-lockdown narrative was hegemonic. In the Italian context, right-wing political actors strategically capitalized the dissent. This exploitation continued even after the broader public debate had subsided, indicating the enduring presence and amplification of right-wing figures.

Moreover, the alignment of right-wing political actors with the growing dissent against lockdown measures may have allowed to consolidate the libertarian position of the right-wing coalition on this issue. The ability of right-wing

affiliated influencers to tap into the dissent of small businesses and merchants - positioning themselves as defenders of individual liberties and amplifying their messages through a huge volume of retweets - could have played a significant role in mobilizing a specific population target for the post-pandemic election.

Our study also has some implications related to the literature regarding the “Digital Movements of Opinion” (DMOs). Indeed, the analysis of COVID-19 lockdown measures in the Italian Twittersphere reveals overlapping dynamics that underscore the fluidity of digital public debates and the potential for shifts from unity to dissent during prolonged crises. In this light, the rise of a counter DMO underscores the need for critical scrutiny to better understand the mechanisms at play in shaping public debate on socio-technical controversies and their implications for democratic processes.

The “Rally ‘round the Flag” effect initially finely described the propensity of Twitter's users to unify and support the national government's health policies during early stages of the COVID-19. This initial surge in unity confirmed the hinges on shared perceptions of a common threat and a desire for stability. In the context of the COVID-19 crises, this phenomenon manifested as initial support for lockdown measures. However, our investigation highlights the temporality of this effect. The transition from unity to a polarized environment happened fastly and seems to be a consequence of the rising of a counter Digital Movement of Opinion. In our case the concept of DMO, as elucidated by Barisione (2022), illuminates how a dissenting narrative gained momentum on Twitter. The initial unity in support of restrictive measures eventually backfired and gave way to dissent, as concerns about the economy and personal freedoms gained prominence. This dissent was amplified by right-wing politicians, leading to the consolidation of an anti-lockdown DMO. In this light, from a theoretical point of view, our case study highlights the need to differentiate between genuine bottom-up DMOs and those that are top-down manipulated for political purposes.

CHAPTER III

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

In this chapter we seek 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 do so, we collected 798,954 tweets and 31,169 news articles related to the adoption of AstraZeneca Covid-19 vaccine in Italy for a period of six months (1st January 2021 - 30th June 2021). Initially, using timestamps of news and tweets, we tracked the pace of public debate. Then, using a quali-quantitative approach, we investigated the discussion on Twitter during the climax of attention toward AstraZeneca. Our study reveals three different but intertwined information disorders: first, the vaccine debate exhibit a flat progression with few condensed spikes of attention (acceleration); second, the two main peaks of the debate generate from news and social media's hypes of the suspect deaths related to AstraZeneca (sensationalization); finally, the report of suspect deaths by the legacy media accounts on Twitter correlates with an increasing ideological and partisan reaction of the social media's users overtime (polarization). These results highlight how a direct implication of the Italian hybrid media ecosystem's configuration is the incapacity to sustain a prolonged and open debate with respect to controversial societal issues such as those related to the COVID-19 vaccination campaign.

Keywords: COVID-19; AstraZeneca; Information disorder; Public arena model; Junk news regime;

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). Indeed, influenced by the pervasive attention economy, the actors of hybrid media ecosystems (Chadwick 2013) 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). 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 media 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 prioritize content that generates the most engagement and sharing. As a result, a lot of news organizations have been forced to adapt their business models to compete in this new attention-driven landscape.

Drawing on these considerations, we seek to understand how the junk news regime (Venturini 2019) influences public debate concerning socio-technical controversies. 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.

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 signaled 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 prioritizing the over-60s, but left unaffected the possibility of using AstraZeneca, previously renamed Vaxzevria, 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.

In order to study whether and how such a junk news regime may have influenced the public debate on the AstraZeneca vaccine, we have chosen to study three different processes of information disorder that may arise from this regime.

The first process of information disorder that we want to analyze 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 sensationalization 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 dramatization 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 polarization 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 maximize newsworthiness or visibility, but these strategies may lead to the polarization of public opinion.

Starting from the above discussed processes of 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.

Literature Review

Within the studies on information disorder (Wardle et al. 2017), reflections on the digital economy highlighted the effect that the commodification of attention (Çalışkan and Callon 2010) had on the information market (Webster 2014). Indeed, it is through standardized metrics that measure the attention devoted to a content that news is evaluated (Cardon 2013).

This new form of value regulation, also called hit economy (Rogers 2002), created the conditions for the birth of click-baiting. For diametrically opposed reasons, two of the main economic players that fuelled this phenomenon are social media and digital channels of traditional journalism. While the former have always been committed to making profits from the sale of ads and sponsorships (Gerlitz and Helmond 2013), the latter, due to the serious and continuous loss of readers and viewers, entered the web market with the aim of obtaining new revenues (Kaye and Quinn 2010).

The importance of these sources of revenue may explain the growing importance of viral news (Lucchesi 2018). Thanks to their ability to attract the attention of many people, this news produces thousands of views which are a source of huge monetary gains through the sale of online advertising space. However, the importance given to the virality of content (Bakir et al. 2018) and the mechanism

of buying and selling digital spaces (Graham 2017) seem to have stimulated the production and circulation of low quality information content able to attract the attention of online users, the so-called ‘junk news’ (Venturini 2019).

Data collected so far show that this type of news is increasingly being shared on social media (Burger et al. 2019). In fact, junk news spread rapidly on these platforms thanks to sharing within ideologically aligned user groups (Conover et al. 2011) and classification algorithms that, by creating information bubbles (Pariser 2011), amplify their salience (Flaxman et al. 2016). Despite this, it has been found that the largest producers of junk news are small websites with little relevance to the media diet of citizens (Fletcher et al. 2018) and their contents rarely reach a wide and heterogeneous audience (Nelson et al. 2018).

This difficulty seems to confirm the recent discoveries regarding the viral diffusion of content on the web. It has been shown that a contagion based on peer-to-peer contacts is uncommon (Goel et al. 2016), especially for news that have divisive characteristics (Dwyer 2019). In fact, these contents reduce the possible audience of interest to people closely related to each other within ideological groups (Del Vicario et al. 2015). Junk news are therefore more likely to cross the boundaries of online communities thanks to the sharing by central actors within heterogeneous networks (Barbera 2018).

From this point of view, a possible research strategy to identify the actors that make junk news go viral is to investigate the role of professional digital journalism (Tsfati et al. 2020). Indeed, the visibility that the wide audience of newspapers and newscast websites guarantees to a news (Newman et al. 2019), the centrality that they cover with respect to heterogeneous networks of pages and online users (Buhl et al. 2018) and the process of emulation of smaller information sites compared to the most popular pages (Quattrociochi et al. 2014) suggests that junk news issued by these channels can cross the boundaries of different digital audiences and hegemonize public debate, creating the condition for pointless or misleading debates. This condition is also due to the

potential backfire effect that would increase the polarization of social media users involved in the debate (Bail et al. 2018). In fact, although the interaction between users belonging to different online communities could be positive to reconcile different positions, when such interaction takes place on the basis of news that accentuate the emotional component of a piece of information the result could be an increased affective polarization between different social groups (Wood and Porter 2018).

The strategy of analyzing mainstream media digital channels can be even more fruitful if applied to times when there has been a greater circulation of mis- and disinformation content like the 2020 Covid-19 related infodemic (Cinelli et al. 2021; Gallotti et al. 2020). Indeed, during ambiguous circumstances the role of mainstream media websites is central both to citizens' media diet (Rojecki and Meraz 2016) and to agenda setting processes (Ceron et al. 2016; Harder et al. 2017). Consequently, release of junk news by professional digital journalists could prove extremely harmful.

Unfortunately, due to the amount of news circulating online and the outsourced or automated ways adopted to identify misinformation content (Reis et al. 2019), most of the research conducted so far focused on disinformation contents produced and disseminated by independent hyper-partisan websites and social media pages (Tucker et al. 2018) that, as shown before, are irrelevant to the media diet of most citizens (Fletcher et al. 2018; Nelson et al. 2018). Considering the functioning of the hybrid media ecosystem with respect to mis- and disinformation phenomena (Marwick 2018; Giglietto et al. 2019), the role of professional journalism is instead extremely relevant either for setting the public agenda and for making a news go viral (Tsfati et al. 2020).

The importance of professional journalism in creating opportunities for a broad and heterogeneous debate around a story seems to have been understood also by those who intend to manipulate public opinion. For example, within computational propaganda (Benkler et al. 2018; Wooley and Howard 2018) it

would seem that one of the objectives of coordinated inauthentic behavior techniques (Giglietto et al. 2020) could be that of letting certain news reach such visibility that major newspapers and newscasts websites are induced to relaunch their content (Philips 2018) for reasons ranging from debunking information to click-baiting (Bounegru et al. 2018). This strategy shows how professional journalists are becoming specific targets through which political actors try to manipulate information cascades and public opinion (Marwick and Lewis 2017), but also how these latter could be relevant hubs for viral dissemination of misinformation content (Rojecki and Meraz 2016).

Research Design

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 extensive 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 utilized 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 analyzed the flow of information overtime. We determined the temporal distribution of both tweets and news, which enabled us to identify the peaks of attention. To identify these peaks, we utilized 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 sensationalization 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”), 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”), to pure click-baiting news (“Died after Astrazeneca vaccine, her life worth 70K”). 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 if the bursts of attention in Twitter correlated more with total news or with the sensationalization news subsample we calculated a Pearson correlation test. In addition, we also performed a Granger causality test, 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 polarization of the public arena. To operationalize this concept, we relied on the networked reaction of Twitter's users as a proxy. 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

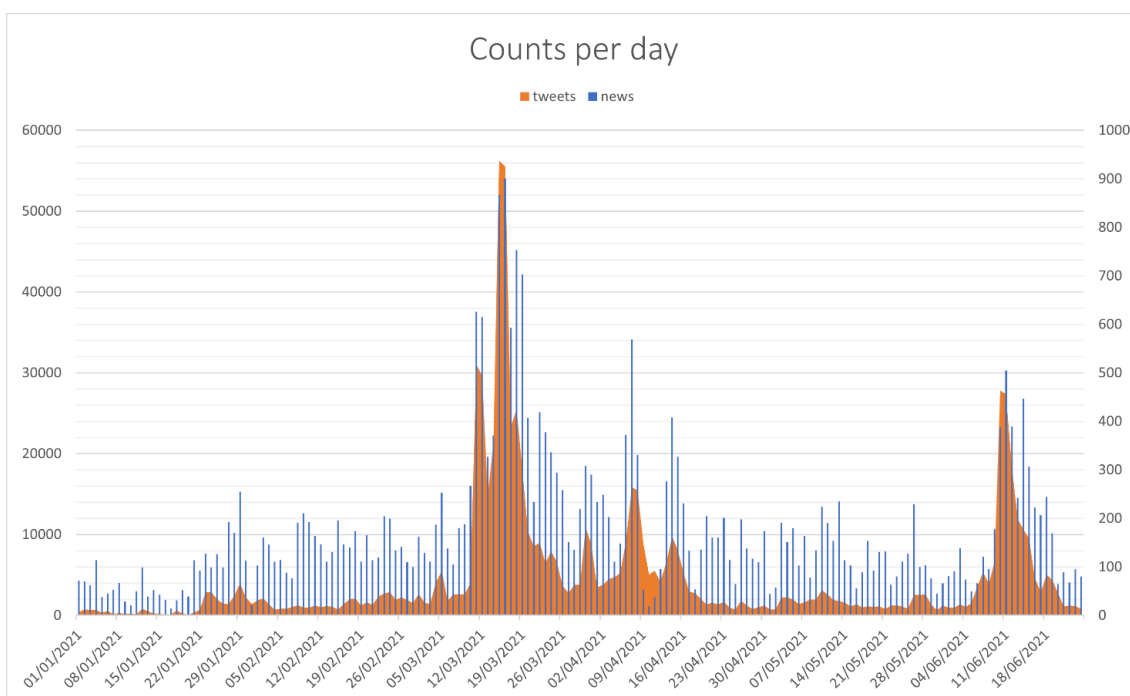
algorithms. Centrality, betweenness, diameter, density, structural separation, and many other concepts recover their graphical meaning. They cannot only be calculated, but graphically visualized (Venturini, Jacomy and Jansen 2021).

Finally, the 500 most shared tweets were selected and manually analyzed 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 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 legitimize the choice of a close reading of the top messages instead of using computational techniques to model or classify all tweets.

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 normalized volumes in rank order to compare the time series on a common scale. Comparing Twitter and Media Cloud time series it is possible to distinguish different patterns on the attention paid to AstraZeneca vaccine. As elucidated in Figure 1 the debate on AstraZeneca shows a fluctuating progression all over the six months we considered.

Figure 1: tweets (left axis) vs news (right axis)



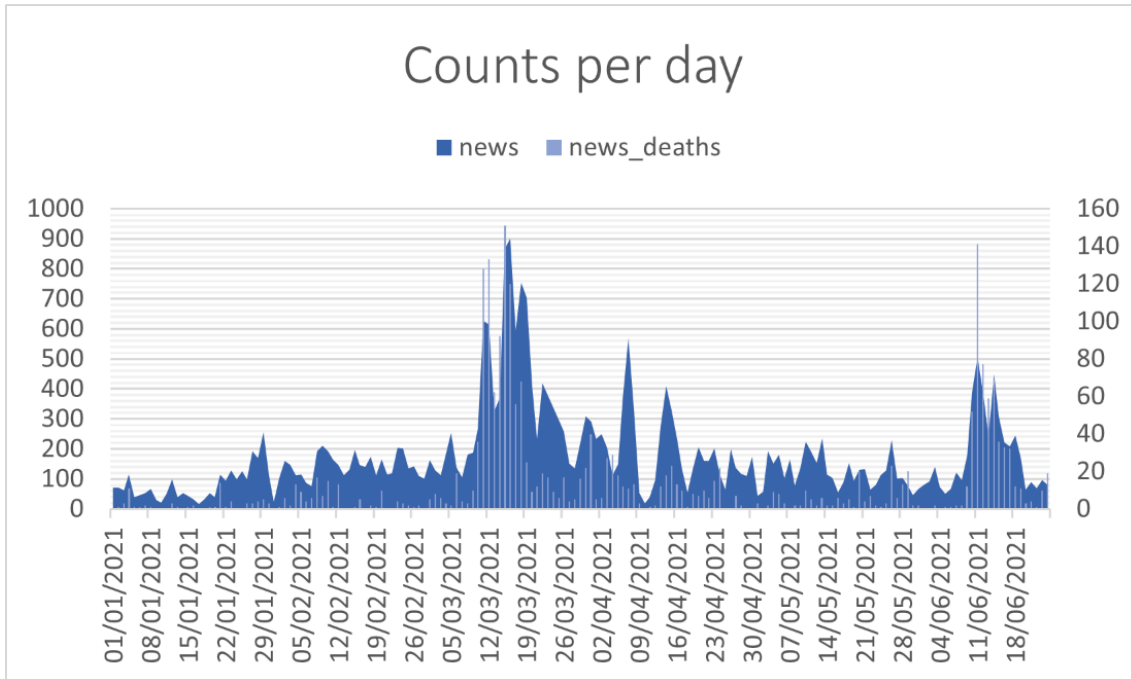
A first relevant finding when comparing news and tweets is that legacy media coverage of AstraZeneca is more evenly distributed than Twitter discussions. Indeed, on average, we can count about 150 news articles per day (roughly 0.5% of the total) with a maximum coverage of 901 items in a day (around 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 sensationalization of the controversy

surrounding the debate about vaccine safety. Figure 2 compares press coverage for the totality of AstraZeneca news and for the subset of news about the death links.

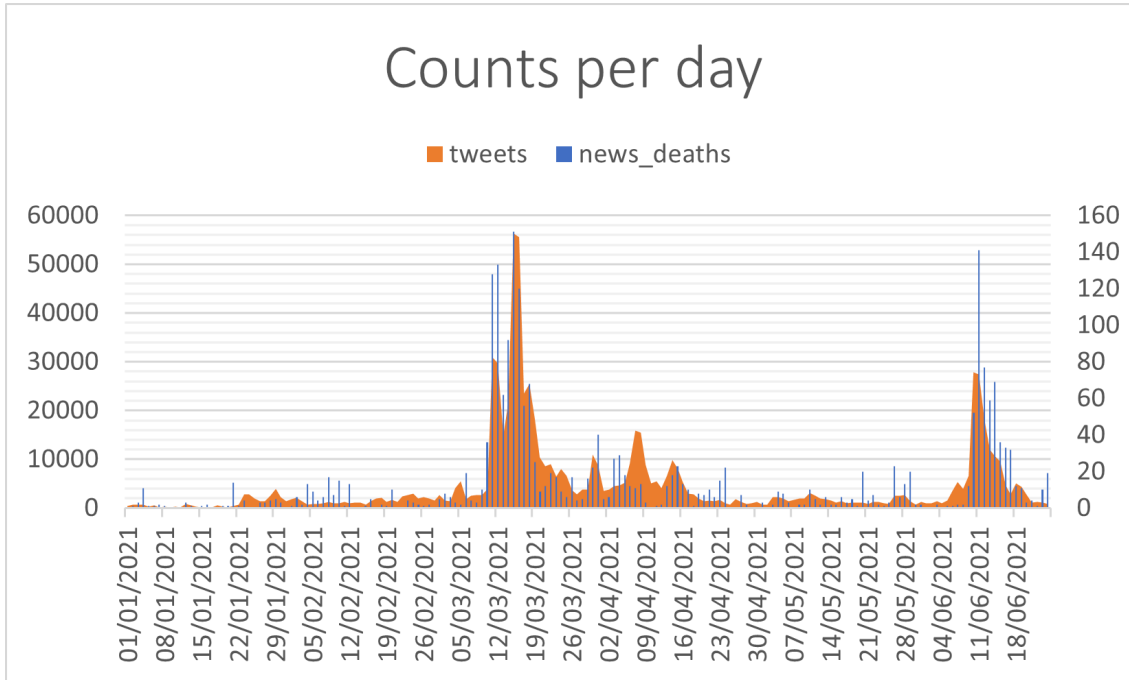
Figure 2: news about AstraZeneca (left axis) vs. news about suspect deaths (right axis)



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 rumor on the possibility of administering AstraZeneca only to people over 60 years and then it was reported in the official EMA communication about the correlation between rare thrombosis and the vaccine.

Figure 3 shows instead 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.

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



To find which one of the two aforementioned 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).

A last point of interest for our analysis concerns the potential polarization of the digital arena. By looking at the forced-directed network visualization 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.

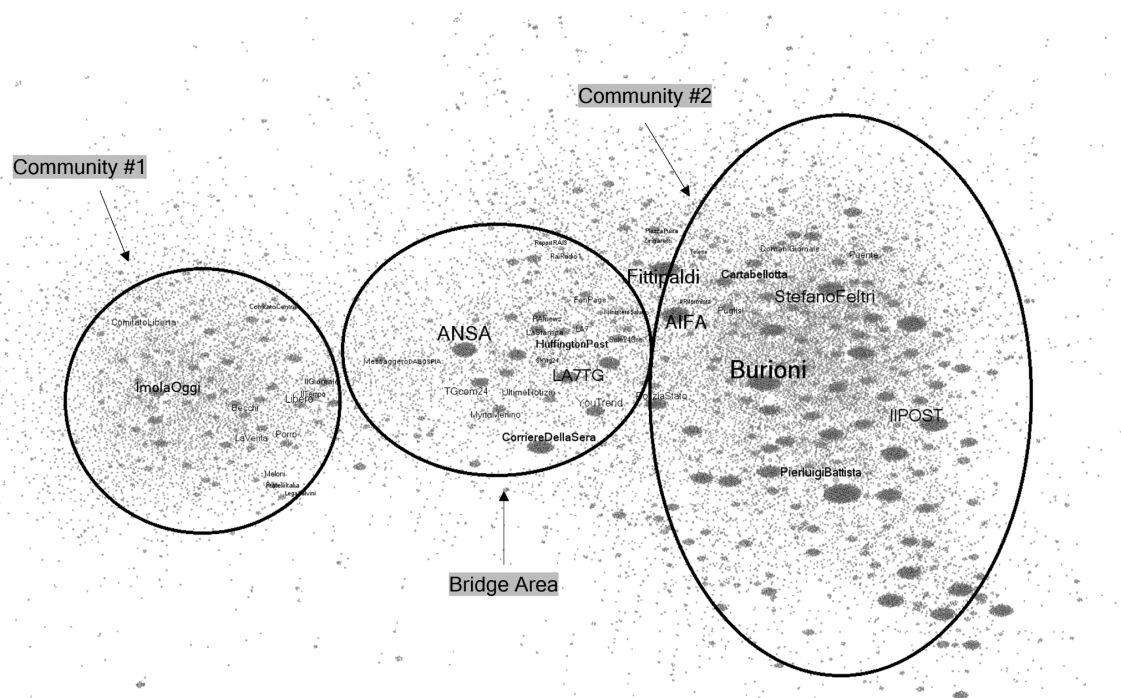
The first community is located on the left of Figure 4 and is composed of both a few newspapers and politicians belonging to the Italian right-wing parties, as well as openly no-vax users.

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 center-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.

Figure 4: 11th-19th March retweets network visualization



Digging deeper into more details, the discourse that can be traced through the analysis of the most shared tweets confirms a polarization 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."

"The #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 rationalizing 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.

"#fake news 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 math? Remember it's to not become like them."

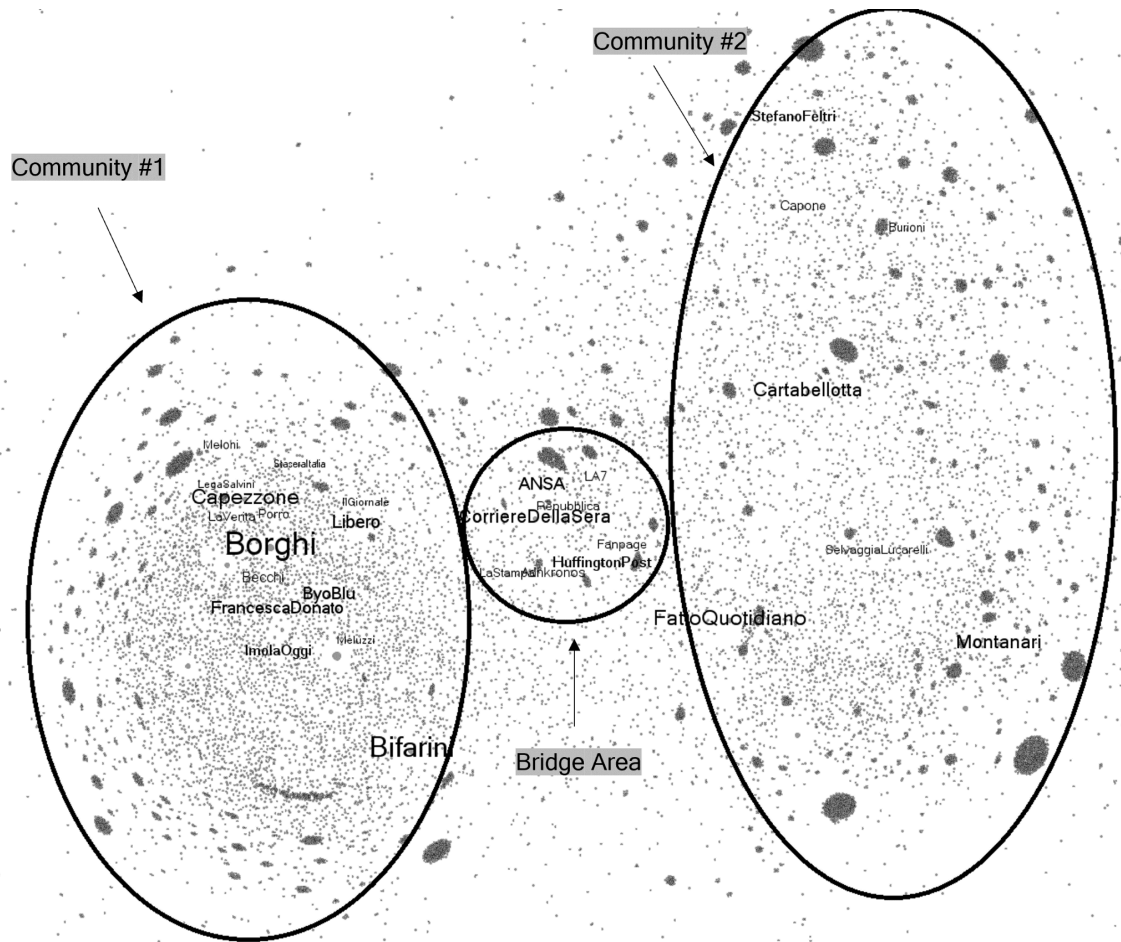
Moving to the next spikes of attention, the discussion peak of June presents characteristics that are very similar to the March one. It is indeed composed of two distinguished communities and a smaller bridge area in the center of the network.

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 (e.g., ImolaOggi and ByoBlu).

The small bridge-area in the middle of the visualization 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.

Figure 5: 10th-18th June retweets network visualization



Content analysis of the most retweeted contents shows that many 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 for 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 Marco Travaglio statements concerning 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”, 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 favorite 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. These users claim that the state should defend the freedom of taking or not the vaccine.

"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."

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 skeptical views using a seemingly balanced statement as a way to avoid taking a clear position.

Discussion

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 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 polarization 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 sensationalization 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 attention 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 dramatization, which in turn activates the confirmation biases already embedded in the technical affordances that structure Twitter discussion.

While significant progress has been made in analyzing 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 prioritize 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, which can further complicate public debates related to the COVID-19.

Our research has shown that the politicization of COVID-19 news and the celebrity status of experts in Italy align with our findings on the AstraZeneca affair. The Italian press has been found to prioritize 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 sensationalized news related to suspicious deaths can be viewed through the lens of an increased politicization 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 polarized 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 is relevant in itself, 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 analyzing 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.

Conclusion

This chapter set out to examine how the junk news regime affects public debate surrounding controversial socio-technical issues, using the illustrative case study of the AstraZeneca Covid-19 vaccine controversy in Italy. Our analysis reveals concerning implications of current media dynamics for the emergence of constructive public deliberation on crucial science-related controversies.

The AstraZeneca vaccine case highlights how an issue can become rapidly sensationalized, polarized along partisan lines, and exhausted of public attention under the junk news regime dominating contemporary hybrid media ecosystems. Both legacy and social media coverage of concerns over vaccine side effects exhibited pronounced “hype cycles” driven by dramatic events like isolated reports of deaths tentatively linked to the vaccine. During the resulting spikes of attention on Twitter, discussion fractured between mainly ideological anti- or pro-vaccine narratives.

Moreover, between these bursts of activity, public attention and debate remained minimal, suggesting the controversy was not consolidating into an ongoing public debate for deliberation. These findings align with previous research arguing the attention economy incentivizes partisan, emotional and dramatic

frames in order to capture interest, at the expense of nuanced consideration of complex issues (Schmidt et al. 2018; Venturini and Munk 2021).

In the Italian context specifically, our analysis suggests traditional media's focus on political conflict over expert evidence (Crabu et al. 2021), and reliance on celebrity scientists (Campus and Saracino 2022), shaped social media discussions in line with dynamics of hype and polarization. For instance, peaks of attention were driven by widespread reporting on alleged suspicious deaths before clear evidence of any fatal risks, while partisan narratives framed the issue as government incompetence versus irresponsible no-vax misinformation.

Our analysis of the AstraZeneca vaccine controversy in Italy also reveals tensions between current media dynamics and the idealized model of public arenas proposed by Hilgartner and Bosk (1988). Their model aims to explain how scientific controversies become visible and unfold over time through stakeholder interactions mediated by the media system. However, our analysis of the AstraZeneca case suggests that conditions today diverge drastically from an ideal public arena model.

According to the public arena model, controversial science-related issues can generate productive public deliberation through open-ended debate involving diverse stakeholders like scientists, policymakers, journalists, interest groups and citizens (Hilgartner and Bosk 1988). This assumes public attention and participation will be sustained over time, allowing careful evidence review, perspective sharing, and collective learning. Our findings highlight how junk news regime pressures towards drama, speed of discussion and partisan conflict tend to fracture and exhaust public attention on controversies like AstraZeneca. The brief spikes of Twitter activity driven by sensationalized legacy media coverage revealed minimal substantive discussion of vaccine evidence. Instead, debate followed polarized scripts blaming no-vax misinformation or government incompetence.

This aligns with the “fragility” of contemporary collective attention, which rapidly shifts between emotional triggers rather than consolidating around issues (Venturini 2019). The public arena for deliberating AstraZeneca risks failed to fully materialize, undermining inclusive policy debate.

These findings have implications for theorizing the possibilities of stable public arenas in current media environments. High-choice digital infrastructures may reduce capacities for shared attention on complex issues outside dramatic hype cycles (Venturini and Munk 2021).

Acceleration of legacy news production also limits time for investigating nuances before issues expire from focus (Lorenz-Spreen et al. 2019; Castaldo et al. 2022).

The public arena model’s expectation of sustained pluralistic deliberation now seems questionable given the ephemeral and fractured attention characteristic of the junk news regime. The lack of a stable public arena emerging around the AstraZeneca controversy indicates the junk news bubbles may be eroding capacities for democratic deliberation on emerging techno-scientific issues. This raises concerns regarding both the legitimacy of policy-making in areas like vaccine regulation, and in the publics’ ability to develop well-informed perspectives on science-related controversies.

Finally, from a methodological point of view, this study demonstrates the value of mapping issue emergence and public debate using digital methods that combine computational analysis of attention flows with a quali-quantitative online discourse analysis (Marres 2015; Venturini and Munk 2021).

Tracking the temporal dynamics and networked reactions surrounding the AstraZeneca controversy provided insight into how acceleration, sensationalization and polarization manifest at the intersection of legacy and social media under conditions of information disorder. Integrating computational techniques with close reading of resonant voices and narratives offers a productive approach to monitoring junk news impacts on techno-scientific controversies.

CHAPTER IV

Eluding the “Green Pass” controversy. From Ideological Reframing to the yes vs. no pass Flame War.

In this chapter we developed a digital methods mapping of the controversy arising from the adoption of the so-called “Green Pass” in Italy. Adopting an "agnostic" approach to our object of study, we used a well-established research design: namely, to collect all the tweets that contain words related to conversations about the Green Pass in Italy (e.g.: Green Pass, #greenpass). In this way, the sample collected amounts to 4.307.487 tweets, published between June 15, 2021 and December 15, 2021. To bring out the “voices” of the different actors involved in the controversy we adopted a quali-quantitative approach: on the one hand, by means of computational techniques, we reconstructed the structural relations in which the actors are involved and its evolution over time; on the other hand, by means of content analysis we enriched our map with an interpretation of the discourse surrounding the controversy. Finally, these cartographic results are discussed in light of the Italian media system functioning, in order to understand how its conformation may have influenced the public debate concerning the Green Pass.

Keywords: COVID-19; Green Pass; Information centralization; Ideological polarization;

Introduction

The rapid and in some ways unexpected Covid-19 pandemic caught most countries around the world unprepared, prompting several governments to adopt as precautionary and exceptional measures a set of restrictions designed to contain the risks of citizens at a time of extreme uncertainty related to the absence of knowledge about the virus. As pointed out from the very beginning of the pandemic by several STS scholars, policy decisions such as the one related to the closure of activities and personal restrictions are intrinsically linked to the role that science has assumed in our societies (Anderson 2021). On the one hand, experts assist the technical choices made by governments and policymakers, while on the other hand, the same choices made by governments are evaluated by scientifically grounded explanations (Weingart 1999). In both cases, the scientific knowledge accumulated at a given time thus plays a crucial role in both guiding strategies and justifying or disproving the decisions made (Saltelli et al. 2020; Brusselaers et al. 2022). Consequently, the Covid-19 outbreak offered a unique opportunity to momentarily place at the center of the public debate not only the issues surrounding the virus discoveries, but also the very process of scientific knowledge development, dissemination, and governance.

It is indeed arguable that one of the unintended effects of the choices made to embank contagions and deaths during the Covid-19 epidemic was to make salient the science-and-society's nexus potentially for everyone. However, a grounded discussion on the role of science in society on such a large scale has proven to be very difficult, and there are several upstream motives that we can identify. A first reason is surely the rapidity with which the global pandemic crisis unfolded, which caught much of the scientific world itself unprepared at a time when all social actors (from institutions to policy makers or simple citizens) were looking for clear information with which to act (Gallotti et al. 2020); the second concerns

the emergence of differing scientific viewpoints, which, however, at a time of great stress and needed uncertainty's reduction, prompted individuals to maintain a strong positioning with respect to the proposal closest to their own experience as to diminish cognitive dissonances (Sacco et al. 2021); finally, the most important point in our opinion concerns the very structure in which these discussions' processes were embedded, namely that of a public space that increasingly links the media system and the scientific field (Miconi and Risi 2022).

Starting from the above assumptions, in this chapter we developed a mapping of a peculiar socio-technical controversy: namely, the adoption of the so-called "Green Pass" in Italy during the Covid-19 epidemic (in simplistic words, a pass that certifies the absence of Covid-19 infection via a test or via the fact that a person is vaccinated). The controversy surrounding the green pass is indeed an exemplar case of how the adoption of new scientific norms in social life is a process "in fieri" that results from a negotiation between the technical object itself, the field's experts, and the broadly conceived public sphere (i.e., politicians, media and citizens). In Italy the controversy over Green Pass takes on a particular significance as it has been used as a radical nudging measure to incentivize the vaccinations (Moccia et al. 2022), but also to exclude a part of the population from work, schools, public venues and public transportation. As a result of this, a thorough political examination and a serious public debate would be expected to take place. From this point of view, an increasing amount of literature has shown how people express their personal viewpoints, including their feelings and opinion about social facts, in an increasingly common way through social media and that Twitter can be considered as a reliable tool to monitor public opinion dynamics (Boccia Artieri et al. 2021).

Therefore, the purpose of this essay is twofold. First, using Twitter as our digital field, we mapped the evolution of the controversy overtime, and we described the roles and positions of involved actors. Secondly, the same cartographic results

are discussed considering the Italian media system functioning, in order to understand how its conformation may have influenced the debate and the broader controversy concerning the green pass.

Literature Review

Since the 2000s and even more so during the Covid-19 pandemic, several scholars have pointed out an increasing proliferation of issues related to science and technology in public debates, particularly referring to issues linked to the role and use of expert and scientific knowledge in society (Venturini and Munk 2021). For these authors, this change is mainly due to two different and parallel developments taking place in our societies: on the one hand, as mentioned earlier, the role of technoscience is increasingly central to a myriad of daily activities and public choices, thus also becoming a recurring theme for news and debates (Marres 2005); on the other hand, the emergence of the web 2.0 and the expansion of social networking sites has in fact changed the old logic of operation of the media systems themselves by making hegemonic a business model based on the digital attention economy (Goldhaber 1997; Venturini 2019). In this context, in which different actors are constantly and incessantly searching for issues that can attract public attention, the so-called socio-technical controversies can promote high-activation feelings, such as outrage and rivalry, which are very effective in capturing attention. Therefore, in the so-called hybrid media ecosystem controversies tend to be pushed at the center of public debates (Venturini and Munk 2021). Nevertheless, the regulatory mechanisms based on the attention economy at the same time obstacles the controversies' societal-changing capability. Indeed, one of the lateral consequences of the digital economy is to accelerate both the news cycle and the related attention devoted to the topics covered by journalism (Castaldo et al. 2022). This

accelerated formation of a debate can push audiences towards confirmatory bias and, as consequence, creates the basis for the polarization of public opinion (Cinelli et al. 2021). Therefore, even if controversies spread broader and faster than before, it seems more and more difficult to effectively address the same controversies in a democratic sense and find a way for their resolution.

To address whether a controversy unfolds and how it ends, the most consolidated approach is certainly the one coming from actor-network theory (Latour 1987). Controversy mapping is a methodology developed by Bruno Latour in the 90's to help students of MINES's school in engineering engage with the different ways in which society enters scientific processes (Latour 2007; Venturini 2010). Soon after its invention, due to the birth of web 2.0 studies, controversy mapping resurfaced thanks to the development of open-source tools pertaining to digital methods (Venturini 2012). Consequently, in the last ten years an explosion of empirical research that used digital media to trace controversy took place (Venturini and Munk 2021). Indeed, using a digital methods approach could be useful in many different ways (Venturini and Latour 2010): first, thanks to the temporality of digital traces it's possible to follow the evolution of a controversy over time (Venturini et al. 2014); second, relying on the concept of actor-network (Venturini et al. 2019) it is feasible to depict the broader context in which the interaction between single actors and media ecosystems take place; finally, thanks to the affordances of specific platforms (as Wikipedia or Twitter), a relevant part of the bottom-up and public dimension of a controversy can be taken into account (Venturini et al. 2015).

Research Design

In the vein of Actor-Network Theory (ANT), we choose a quanti-quali research design to empirically map the Twitter discussion related to the green pass

controversy in Italy (Munk 2019). Starting from the encounter between ANT tradition and the discovery of digital methods, controversy mapping has in fact made use of the digital traces and computational tools at its disposal in an innovative way: distancing itself from a prescriptive model in the use of data science techniques, controversy mapping seeks to use big data to recreate the complexity of interactional micro-processes among the involved actors, while at the same time it relies on the richness of ethnographic material left behind to interpret emerging phenomena (Venturini and Latour 2010).

Adopting an agnostic approach to our object of study, we used an established data collection in controversy mapping via digital methods (Marres and Weltevrede 2013; Marres and Moats 2015; Marres 2015): namely, to collect all the tweets that contain words or hashtags related to conversations about the adoption of the “green pass” policy in Italy (i.e., green pass, #greenpass) and use Italian as their primary language. This way, the dataset collected through the official Twitter V2 search API amounts to 4.307.487 tweets, published between June 15, 2021, and December 15, 2021.

The choice of Twitter as the data resource for our mapping stems from three different motivations.

The first reason is preemptively methodological and concerns the possibility of finding all the content circulated on the platform related to the topic of our interest. The second, on the other hand, concerns the desire to capture both top-down and bottom-up discussion, thus consequently we need to rely on social media in which interactions are based on public logic. Finally, we decided to capture tweets as opposed to Facebook posts because Twitter had grown considerably during the initial phase of the pandemic (e.g., +34% as for 2020 official report), mainly due to the influx of new users seeking an online arena where to discuss Covid-related topics (see Kwak et al. 2010 for an insightful description of Twitter as a ‘news driven’ social media).

Mapping part1: macro-structure

Initially to get a first glimpse on the general trends that the controversy has taken in Twitter, we focused on its temporal evolution. To do this, we counted and plotted the number of tweets issued daily: in this way, on the one hand it was possible to observe the general pace of the debate (e.g., did the debate develop consistently over-time or did it advance by means of extemporal peaks?) while on the other hand it was possible to understand its interaction with the advancement of the green pass legislation (e.g., did the introduction of new rules trigger the debate or not?).

The second step in our research was related to a wide reconnaissance of the debate structure, to do this we decided to rely on two different strategies. A first metric concerns the average daily percentage of retweets and replies out of the total number of tweets: in this way we had a rough measure on how much the conversation was based on the general production of original content or was instead driven by a few tweets. Secondly, we calculated the Gini coefficient on the concentration of retweets in order to understand the verticality or horizontality of the debate with respect to prominent influencers (Bracciale, Martella and Visentin 2018). Indeed, in our case the Gini coefficient measures the extent to which the distribution of retweets within our dataset deviates from a perfectly equal distribution. A coefficient of 0 expresses perfect equality where everyone has the same retweets, while a coefficient of 1 expresses full inequality where only one person has all the retweets.

Mapping part2: meso-structure

Starting from the insights gained through the time series analysis we then moved our focus to a more detailed cartography of the controversy. In order to map the communities of actors and users involved we have employed a pure retweet network (i.e., excluding mentions and comments): this entails an assumption, namely it presumes that retweeting something means, most of the times, an

endorsement of the original tweet; while some Twitter users routinely state that ‘RT is not endorsement’ we do have substantial empirical evidence of the contrary, at least when it comes to extrapolate wider user communities (Metaxas et al. 2015).

Since a mapping of meaningful interactions requires narrow time windows (Venturini et al. 2019), we decided to consider three moments of greatest activity in the Twitter debate. The first corresponds to the days following the official introduction by law of the green pass for closed spaces regulation (i.e., July 22 and 23 equivalent to ~150k tweets), the second moment is the one straddling the decree introducing the green pass obligation also for private and public workers (i.e., October 14 and 15 equivalent to ~160k tweets), and the last one refers to the twitter discussion following the introduction of the so-called super-green pass obtainable only through vaccination (which occurred on the 24 and 25 of November and amounted to ~110k tweets). This selection of cases thus allowed us both to have three photographs of different crucial moments in the evolution of the controversy, and at the same time to follow in a balanced way its development over the six-month period we considered.

For each of the selected time periods we extrapolated from our datasets all the retweets and we built three different directed networks. In these retweets’ network, each node represents a user while an arc between two nodes, whose value is unitary, indicates a retweet of a specific tweet made by the user to whom the arc is directed. To identify the communities within the retweet networks we used the community detection algorithm called 'Louvain' (Blondel et al. 2008). This algorithm optimizes the modularity function, which measures the density of internal arcs of a single community compared to that of external arcs. To measure the permeability between each cluster of users identified, we relied instead on a similar parameter called 'E-I Index' (Krackhardt and Stern 1988). While in fact through the study of modularity it is possible to have a general measure of how fragmented a network is, when applied to the same modules identified by the

Louvain's algorithm the E-I index allows to measure the openness or closure of each most prominent cluster. Indeed, the E-I parameter measures the portion of internal arcs, i.e., directed from one member to another of the same community, compared to the number of external arcs, i.e., directed from a member of a community to an external member. Using this measure, a node whose arcs connect only to nodes outside the community will have an E-I equal to +1 while, for a node whose arcs connect only to nodes inside the community, the E-I will be equal to -1. Since these extreme values are very rare in a real-world context, within the spectrum of values between -1 and +1, the E-I becomes a reliable measure of a node's tendency to connect to nodes within its community. From these measures, it is possible to convert the total number of internal and external arcs into a normalized index which, defined in this way, can represent a good estimate of how closed the communities are, i.e., how their structure is similar to an echo-chamber.

Mapping part3: micro-structure

The operations described so far allowed us to map the macro and meso-structures of the interactions among the actors and users involved in the controversy on Twitter, but at the same time they still cannot describe in detail the opinions and positions of the very same. To make up for this lack, the last two choices made in our research design are focused on visual network analysis and qualitative content analysis. Let us anticipate that both choices are consequential again from the previous research outcomes: indeed, as we will illustrate in more detail in the results section, the green pass debate developed in an extremely hierarchical way, with only a few and very influential accounts that centralize the information flow and consequently also few tweets able to dictate the overall agenda.

Firstly, to have a more ethnographic kind of information related to the actors' positioning, we decided to filter our retweets networks by keeping only the most influential accounts. To visualize the reduced retweet networks, we used the

open-source software Gephi (Bastian 2009). The images shown below were obtained by applying firstly the visualization algorithm 'Force Atlas 2' at the entire retweet network (Jacomy et al. 2014) and then by removing the nodes whose sum of outgoing arc weights is less than 20 (that is Gephi's automatic calculated and suggested threshold to maximize the reading of our network maps without losing relevant nodes spatialization). By means of these reduced samples, and by keeping node labels only for public Twitter accounts, we were therefore able to navigate and describe in detail the role and relation of politicians, journalists, health experts and legacy media during the controversy.

Finally, to gain a deeper insight into the viral contents that drove the debate, we extrapolated and closed-read the 50 most retweeted tweets for each time windows considered. Indeed, the retweeting of these top-50 tweets hegemonize respectively ~35%, ~30% and ~45% of total content production for July, October and November peaks, thus making it possible to avoid sophisticated computation techniques in place of a traditional qualitative analysis.

Results

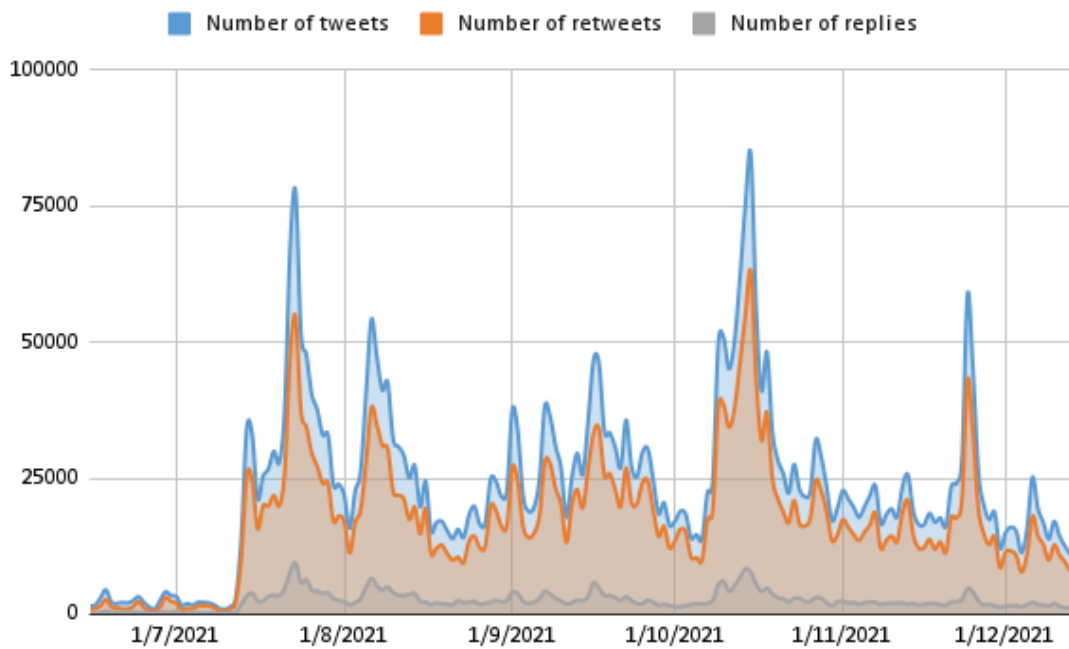
Attention spikes and information centralization

The stickiness and consistency of an issue is an indicator of whether or not the discussion of the topic itself is driven by prolonged or ephemeral cycles of attention (Boydston et al. 2014a) and can be therefore conceived as a proxy for the emergence of a stable public arena (Hilgartner and Bosk 1988). Though originally conceived for a mass media environment (Downs 1972), these concepts can also find application in today's digital context, if properly repurposed for analyzing social media's debates.

In the case of the Green Pass debate on Twitter, we can see how after an initial period of low interest from July 13, 2021 (date of the "Pass Sanitaire"

introduction in France), the awareness of this issue grew immediately. Indeed, the average number of daily tweets from this point in time onward is 27k tweets per day, with a minimum value of ~11k tweets and a maximum value of ~85k tweets. The fluctuating trend can be intercepted visually in Figure 1.

Figure 1: Tweets, retweets and replies per day



By looking at the development over time of the debate regarding the green pass controversy, we can thus describe two different dynamics. The first concerns the advancement by initially increasing and then decreasing spikes, thus showing how the green pass discussion has grown very rapidly and then wanes over time (particularly after the mandatory introduction of the pass at work). Another result concerns instead the causes of peaks' triggering: these latter in fact are springing at the same time of legislative moments, thus suggesting that the debate rather than following a grassroots logic is conversely a reaction to the agenda setting of the political and media system in which it is embedded. A second observation that is immediately apparent from the figure is the disproportion of the number of retweets to the total number of tweets produced during the period we considered. In fact, as many as 75% of the total content consists of retweets while another

10% consists of replies. This means that the number of original contents in the discussion is only 15% out of the total number of tweets produced.

The very same disproportion is also evident by looking at the top-50 most retweeted contents per day, that on average hegemonize as much as 35% of the daily total content production. Taking a close look at the underlying interactional dynamics of this result, we can see how there is also a huge inequality in the source of the original tweets. In fact, the Gini index calculated on retweets is equal to 0.79, showing a large inequality in the centralization of debate with respect to few and very influential users. The huge amount of non-original content and the resulting centralization of information, while not new in the Twitter debate related to Covid-19 (Sacco et al. 2021), is thus a sign of a strong hierarchy of sources and of a top-down communication flow related to the green pass controversy.

The emergence of closed and polarized communities

Collective phenomena are made of opposition as much as of alliances and in Actor-Network theory perhaps social relations are defined by their “enemies” as much as by their “friends” (Latour 2007). The affinity between ANT and SNA has therefore been successfully used to exploit network analysis for controversy mapping as it produced particularly interesting results when applied to digital traces (Venturini 2010; Venturini 2012). In our specific case mapping the emergence of communities and their openness or closure in Twitter is thus an important first step in understanding the positions of actors within the green pass controversy, therefore here we will resume the highlights from the quantitative network analysis carried out.

The first retweets network we considered is that of July. This network is composed of 28.570 nodes. The Louvain community finding algorithm identified more than 500 communities. However, amongst these, the first five clusters gather as much as 90% of all nodes. Of these five leading communities only one

presents a positive E-I index, while the other four have strongly negative results in the External-Internal links ratio (see table 1).

Table 1 - 22-23 July retweets network statistics

<i>Communities (Louvain)</i>	<i>Nodes (%)</i>	<i>E-I index (-I/+I)</i>
Cluster 1	~30	-0.39
Cluster 2	~20	-0.35
Cluster 3	~20	-0.57
Cluster 4	~10	-0.68
Cluster 5	~10	+0.41

The second retweets network we took into account is that of October. This network is composed of 24.650 nodes. The Louvain algorithm identified approximately 120 communities. Amongst these, the first five clusters are equal to around 90% of all nodes. Also in this case, of the leading communities only one presents a positive E-I index, while the other four have strongly negative scores (see table 2).

Table 2 - 14-15 October retweets network statistics

<i>Communities (Louvain)</i>	<i>Nodes (%)</i>	<i>E-I index (-I/+I)</i>
Cluster 1	~35	-0.65
Cluster 2	~25	-0.42
Cluster 3	~10	-0.24
Cluster 4	~10	-0.41
Cluster 5	~10	+0.33

The third retweets network we considered is the November one. This network is composed of 14.578 nodes. The community finding algorithm identified approximately 350 communities. Amongst these, the first seven clusters gather approximately 90% of all nodes. Of all the main communities only one presents a positive E-I index, while the other six have strongly negative scores (see table 3).

Table 3 - 24-25 November retweets network statistics

<i>Communities (Louvain)</i>	<i>Nodes (%)</i>	<i>E-I index (-1/+1)</i>
Cluster 1	~30	-0.63
Cluster 2	~15	-0.22
Cluster 3	~10	-0.67
Cluster 4	~10	-0.43
Cluster 5	~10	-0.37
Cluster 6	~10	-0.59
Cluster 7	~5	+0.21

Pulling together all the statistics, the most important result for our controversy mapping purpose pertains to the emergence of stable-in-time, close-influenced and polarized communities. Combining the E-I index finding with the Gini index result we can in fact realize how the former is due to a partisan selection of sources, based on super-influencers who are closest to one' s own positioning regarding the green pass controversy. Nevertheless, at each of the three time points considered it is possible to see a remaining cluster always having a positive E-I index, which is why it is possible to identify these kinds of clusters as bridges between the otherwise hyper-polarized communities.

From ideological reframing to a yes/no-pass “flame war”

Although there are several techniques for network visualization, one family of algorithms has gradually established itself as the standard for visualizing graphs: the so-called "force-directed" spatialization or "force vectors" (Venturini, Munk and Jacomy 2019).

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. Once launched, the algorithm changes the layout of the nodes until an equilibrium is reached. This balance minimizes the number of line crossings and thus maximizes the readability of the graph. Not only do force vectors minimize line crossings, but they also make sense of the arrangement of nodes in space. In a network spatialized by forces spatial distance acquires

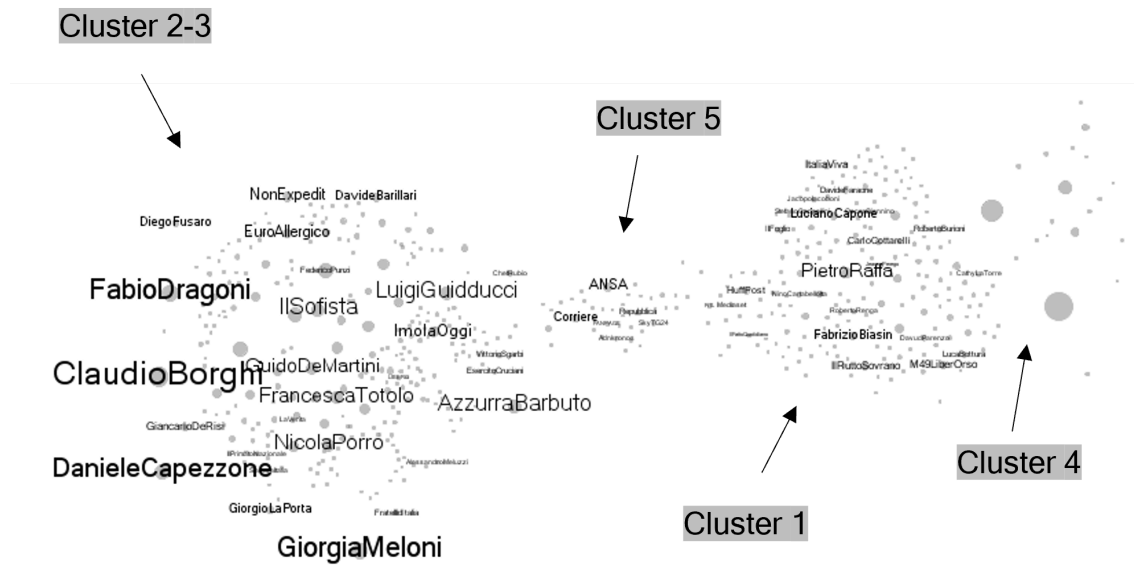
meaning: two nodes are closer the more directly or indirectly connected they are (Jacomy et al. 2014). This way, spatialization can effectively re-materialize notions of graph mathematics. It was shown that visual clustering in networks spatialized by forces is directly equivalent to clustering with modularity algorithms (Noack 2009). Centrality, betweenness, diameter, density, structural separation, all these concepts (and many others) recover their graphical meaning (Venturini, Jacomy and Jansen 2021). They cannot only be calculated, but also seen. This is where the figurative power of networks takes place: it is here that the deepest link between SNA and ANT can be found.

Therefore, for our purposes, the results that we previously showed served in essence to prepare the field for a more minute and qualitative mapping. This latter is thus composed of two parts: as suggested by Venturini and colleagues (2019) we will illustrate the interactional positioning among actors precisely using the visualization of retweet networks, while contemporarily we will explore what typology of content triggered the debate. The images reported were obtained using the 'Force Atlas 2' visualization algorithm in Gephi (Bastian et al. 2009; Jacomy et al. 2014). This visualization algorithm builds visual clusters from the proximity between two nodes in the graph, considering this proximity as both a direct and indirect (i.e., mediated by a third node) exchange of information. Applying such a tool to visualize digital networks (as in our case for Twitter) is therefore particularly useful to explore communities that are homogeneous in practices or opinions (Venturini et al. 2021). Finally, the size of nodes and labels are proportional to the number of retweets received.

22-23 July: the “green pass” is made mandatory in public spaces

By looking at the forced-directed network visualization in Figure 1, it is possible to notice how, during the first peak of July, the discussion on Twitter started immediately under a strong division, thus being cut into two clearly distinguishable macro-areas.

Figure 1: 22-23 July retweets network visualization



The first area is located on the left of the network visualization and is formed by cluster 2 and 3. This community is composed of both newspapers, journalists and politicians belonging to the Italian right-wing parties and nationalist movements. The second area, on the right, is instead composed of members belonging to clusters 1 and 4. Of these members, the most retweeted are satire web pages accounts and users made up of both physicians and scientists as well as journalists and pundits referring to center-left political parties. Finally, at the center we find an area composed of legacy media that works as a bridge. It is to remember that cluster 5 is also the only one with a positive value assumed by the E-I index, remarking the fact that the discussion generated through mainstream media accounts and then took the roots of polarization following mainly ideological and political drivers.

Digging deeper into the texts of the tweets, the discourses that can be traced through the content analysis of the most shared tweets in the different clusters confirm a polarization not only at network level but also regarding narratives.

Within the clusters on the left of the network, it is possible to trace two different discursive matrices. The first and most evident is what we could define as a skeptical narrative related to the vaccine efficacy and to the very existence of the virus. This narrative is also defined by an open accusation against the “powers that be” (as the Italian government, Europe or drug firms) who, aware of the inutility and of the damage, still want people to be vaccinated anyway.

"Until yesterday: zero contagions in Britain, Thanks to vaccines!!! today: record number of contagions a Britain, It takes the Greenpass!!! Will you stop it!?! Meanwhile in Sweden where they have never done neither lockdown, nor hysteria, nor masks the contagions are at zero and the deaths as well." (1259 retweets)

"IN THE FRONT OF ZERO COVID RISK FOR YOUNG PEOPLE THE ADVERSE REACTIONS HIT ESPECIALLY THEM Why should we put them at risk? Hands off the kids!!! In Germany, vaccinations to young people are discouraged (and no greenpass). Let's do as they do" (775 retweets)

A second narrative within this area on the left of the network is carried out by right-wing politicians and is based on an invective against the government and the leftists, guilty of trying to take control over the individual freedom of Italian citizens.

"The idea of using the green pass to be able to participate in social life is chilling; it is the latest step toward the realization of an Orwellian society. An unconstitutional folly that Fratelli d'Italia strongly rejects. For us, individual freedom is sacred and inviolable" (1531 retweets)

"You were the ones whose ass it weighed to pull out your passport to go to France; you were the ones of open ports for a world without borders. Today you are the ones who invoke the #greenpass even to buy bread. You are and always will be SHEEP." (572 retweets)

Regarding the clusters 1 and 4 on the right of the network the narratives are more jagged, but at the same time found as common denominator the use of irony or caustic tones. On the one hand some users rely on tweets that point out how the green pass is comparable to precedent vaccine obligation or with other typologies of regulated social norms. On the other hand, collectivists' style of arguments is carried out in a more critical way by also directly attacking the "no-pass" area's exponents.

"Do you know why the GreenPass had to be done? Because it's 9 o'clock and we're already on the third convince novax person calling to move the appointment because he has to go to the vaccination center today to see how to get put back on the list. Because they weren't idealists, just selfish." (1774 retweets)

"They write to me that the right position for a liberal would be: freedom from vaccines, no green passes, no closures, and no obligations in general. There is some confusion between being a liberal and being a jerk" (1062 retweets)

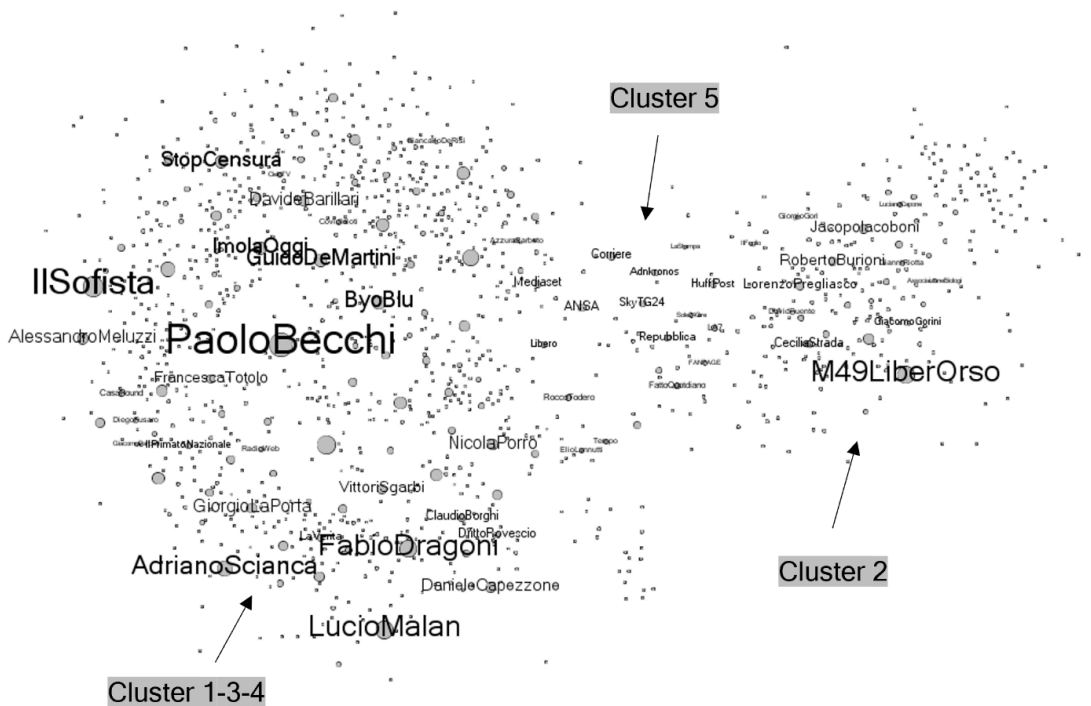
Putting the dots together, the analysis of this first Twitter spike highlights how during the introduction by law of the green pass the Twittersphere instantly split into opposite factions. This immediate polarization is made even more evident by the discourses present in the different clusters: the rhetoric used is in fact simple and is based on ideological divisions that were already evident in the general debate on the Covid-19 and preceded the Green Pass controversy (see for example Caliandro et al. 2020). As we have seen, there is a strong rift both at the level of opinion leaders driving the communities and at the level of internal narratives. Following that, the most retweeted content itself exhibits characteristics that are often offensive to the opposing faction and invoke frictions between political sides. Therefore, the debate on the role of science in

society seems to be widely underrepresented and relegated only to its declination into ideological and moral formats rather than reflexive and analytical ones.

14-15 October: “green pass” starts to be mandatory also at workplaces

The discussion peak of October presents characteristics that are very similar to the July one (such as the bridging role of legacy media or the yes-no pass clusters alignment), but it accentuates several features.

Figure 2: 14-15 October retweets network visualization



Above all, ongoing radicalization is evident. This is due to a strong self-selection of opinion leaders taking part in the controversy and by accepting or not accepting the green pass as a zero-sum game between the two factions. Indeed, if in July the cleavage was mainly played out on established political lines (libertarians/collectivists; right/left) this differentiation in October is no longer present or at least is very weakened. For on the one hand, in the no-pass area on the left side of the network visualized in Figure 2, the actors involved are mainly

influencers and opinion makers linked to tabloid journalism who spectacularize issues related to the green pass. On the other hand, in the yes-pass area on the right of the network, the remaining relevant actors are composed of physicians and satirical web pages that, in different ways, present their cause as a mission of debunking the “fake news” and unscientific information that in their opinion drives the no-pass area.

The content analysis of the most shared tweets also confirms a radicalization of clusters positions, to the expense of a possible common ground for discussing the motivations and limitations of having adopted a divisive and controversial measure as the green pass. Within the “no-pass” clusters 1, 3 and 4 the narrative regarding the constitutionality of the green pass or its actual effectiveness seems to fade. Its substitution instead gave way to a stream of outbursts and to strikes coverage.

"If there had been Salvini premier and he had put the green pass for labor do you think the #CGIL would have applauded or would be in the streets shouting against the fascist attack on workers' rights?" (1266 retweets)

"Of photos like these you will not find news. And that is of free citizens, who with fascism violence have nothing to do, who went to Rome to demonstrate their dissent on the obligation of the "Green Pass" but were brutally truncheoned by the State Police." (1144 retweets)

"Strike of #PortualsOfTrieste declared illegitimate by the regime. The #Portuals will stop the port anyway. Then #Draghi will explain to Germany why his stocks are blocked because of a #greenpass on labor that exists only in Italy. Do you like being tough? So do we." (1179 retweets)

At the same time also the yes-pass area points towards the street demonstrations. Indeed, on the one hand some users underlie the discrepancy between “real-life” issues and the “nonsense” problematization around the green pass, while on the other hand a blaming argument against the no-pass demonstrators is reiterated.

"These are the thugs the moment they storm the #Cgil headquarters. Those who gave ideological, philosophical, moral and political cover to this no green pass madness in good faith, know that after today the presumption of good faith no longer applies." (1671 retweets)

"Deaths at work ALL SHUT UP Layoffs ALL SHUT UP Tax evasion ALL SHUT UP Femicides ALL SHUT UP Green Pass REVOLUTION" (1201 retweets)

"What if the 43.5 million Italians who have vaccinated for everyone's freedom took to the streets? #greenpass #portualiditrieste #mandatoryvaccine" (771 retweets)

Considering the radicalization of opinion influencers embroiled in the debate and the parallel entrenchment in oppositional confrontation rather than dialogue, also in the October surge it is thus clear how the green pass controversy is struggling to develop. In fact, if already in July a reasoned and reflexive questioning seemed decidedly minoritarian, with the introduction of the green pass obligation for the workplace the debate shifts even more to the clashing locus of "knowledge/ignorance," thus seriously undermining the demands of those who would like instead to talk about the government's choices as a negotiation of the role of scientific-driven policies itself. This situation seems inevitably to lead to a simplistic reduction of the issue by describing the green pass as a scientific "right or wrong" application rather than a tool for regulation and power within society.

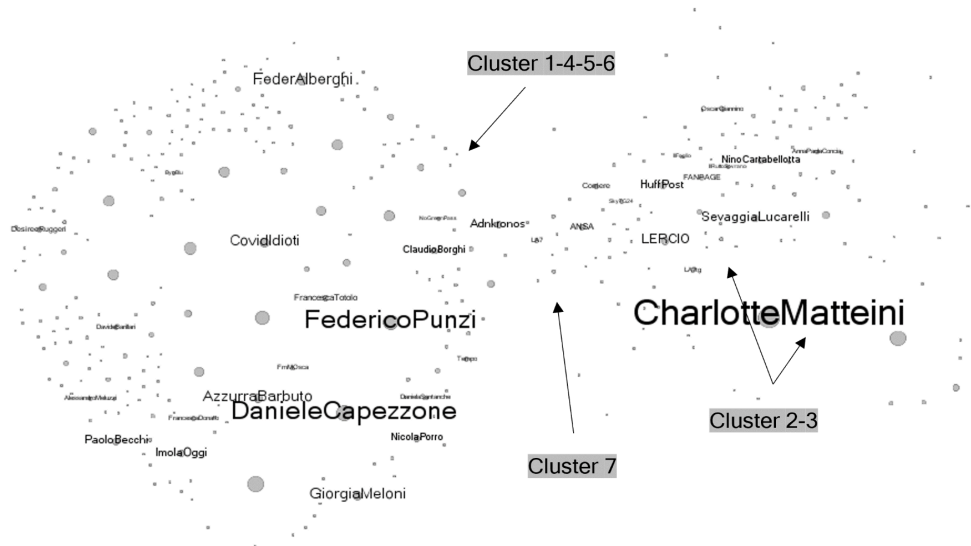
24-25 November: "green pass" is obtainable only via vaccination

The last attention spike we considered is the November one, triggered by the introduction of vaccination to access certain places.

The ongoing division between the no-pass and yes-pass front is clearly visible; nevertheless, Figure 3 shows also how the role of the media system (understood as news outlets, journalists, pundits, and experts) has definitely declined, giving way to several small clusters led mostly by internal Twitter leaders who have

consolidated on the Covid-19 front: in proportion to the nodes the labels have decreased, a sign that there are fewer public figures in the debate while at the same time "ordinary" users increased.

Figure 3: 24-25 November retweets network visualization



Looking more in detail at the most retweeted content of the conversation, what emerges from the network analysis is confirmed. First, we can see how the moral divide between those who are for and those who are against the pass continues unchanged through pre-positioning-like arguments.

"Deaths every two years from hospital infections: 100,000. For cancer: 360,000. For heart problems: 460,000. For #Covid: 3,783 (today's #ISS data). Those guilty of forgery, illegal arrests, violence and #greenpass vaccination discrimination, be brought to trials. #3783" (982 retweets)

"In Austria, a 55-year-old man died of covid after attending a coronaparty organized to get infected and obtain a green pass without having to be vaccinated. Darwin Award given by acclamation." (879 retweets)

"For me, you can also introduce the fifth-level super saiyan green pass as long as you ask for it at the entrance or put up hefty fines for those who don't ask for it you swine of a swine-judge" (837 retweets)

On the other hand, compared to previous peaks where media pressure was evident, however, dialogue and critical questioning from ordinary users seems to come out. This category is divided mainly on two fronts: on the one hand the very scientific reason for the measure is questioned, while on the other hand content related to the green pass legal controversy manages to emerge more consistently.

"The method however is always the same: Is there a problem? You offer wrong solution, the problem gets worse, you propose more wrong solution. Is there public debt? Austerity! Not working? More austerity is needed! Is there covid? Green pass! Not working? We need more green pass!" (827 retweets)

"SPAIN COVID-FREE? NO covid circulates but the Spanish government has decided to live with the virus without harassing citizens with unnecessary and DAMAGING impositions and limitations such as the #greenpass deemed unconstitutional. In Spain no hatred between citizens, no segregation. WE LIVE" (560 retweets)

"The amendment to DL 127/21 is contrary to the EU Regulation on the #GreenPass, which provides for the non-retention of data, and is not compatible with @coe resolution 2361 on possible discrimination for vaccination choice, and with the #GarantePrivacy jurisprudence" (1116 retweets)

"UPDATE: A group of parliamentarians has filed two appeals - one to the Constitutional Court and one to the House courts - against the #greenPass in Montecitorio." (471 retweets)

The November results thus suggest on the one hand that the primarily oppositional and polarized dynamic of debate continues to prevail on Twitter, but at the same time a new trend concerns tweets directly related to the technoscientific controversy. Despite this opening towards a more focused discussion about the green pass policy as such, however, this change seems too

little and too late to change the fortunes of a controversy that never really unfold in the Twitter debate, and instead, as we had seen, could have exacerbated even more the societal laceration linked to Covid-19 issues.

Discussion

Wrapping up the overall results of our research, the analysis carried out only partially overlaps with the findings of existing studies. What seems to be confirmed, is the succession of peaks in online public debate, which has been already referred to as “Twitter storm” (Boydston et al. 2014b). The alternance between high and low-intensity periods has been detected in the Twitter discussion about COVID-19 as well (Leng et al. 2021), with synoptic analyses of dozens of countries – 87, to be precise – revealing the same pattern (Islam et al. 2020).

Another feature typical of hybrid media systems that is confirmed by our analysis is the relevance of disintermediation in the polarization processes. Indeed, in the clusters of polarized communities there’s a preponderant presence of satirical pages (e.g., Lercio), blogs (e.g., Il Sofista) and pages of non-traditional newspapers that are somewhat emblematic of disintermediate journalism that takes place on social media (e.g., Imola Oggi, ByoBlu, StopCensura). Polarization also seems to be linked to the role played by the accounts of politicians (and not, for example, by those of the parties) and of para-journalists that are difficult to identify with a single media outlet and more easily identifiable as social media influencers and opinion leaders.

Finally, also the accounts of scientists who became famous during the pandemic are prominent in the polarized clusters, thus reinforcing the idea that the phenomena of social media’s disintermediation and personalization played a central role in both political and scientific online communication. On the other

hand, the role played by traditional gatekeepers in shaping online discussion is a result which will require deeper attention. Legacy media regularly take the center of the diagram in all three cases, therefore providing a bridge between otherwise separated clusters of users. To some extent, though, the technical function of these bridges is not totally aligned with their social function, as mainstream journalists also appear to be frequent igniters of polarization tendencies.

With this respect, traditional outlets incorporate the peaks which are typical of social media debate, with this tendency arguably having its roots in the highly polarized nature of the Italian media system (Hallin and Mancini 2004, p. 98-109). Our findings are somehow in line with partial assessment of the US debate, where both newspapers and Tv news have been producing polarization consequences and framing effects (Sol Hahn, Chinn and Soroka 2020) – to the point that the compliance with Covid-related restrictions was higher in the areas with strong Tv watching, rather than in those more violently affected by the epidemic itself (Kim, Shepherd and Clinton 2020).

In the Italian case, we detected a sort of top-down polarization, with influential people – journalists, opinion-makers, or politicians – being responsible for the three storms in Twitter debate. In all cases, regardless of the decreasing magnitude of the peaks, the (alleged) digital public arenas split into opposite fields, either totally accepting or totally refusing the Green Pass.

The limited sharing of information and views among the different clusters is a main facet of the problem, as it is likely – as for example confirmed by an experiment realized in the US with a sample of 3,200 citizens – that providing people with better information is key to “de-polarize the policy discourse at least around an easily identified set of issues” (Guidi, Romano and Sotis 2021).

As to the above-mentioned polarization of public debate, it has come with a serious blaming of political oppositions of any kind, put in place by many media outlets (Miconi and Risi 2022). The association of “no-GreenPass” people with no-Vax, COVID-19 deniers and conspiracy believers can well be defined as a

form of scapegoating, similar to that detected by Matthew Flinders in the English case (Flinders 2020; 2021). Even though most individuals opposing the Green Pass share anti-vaccine views, the main argument behind the protests – as it emerged from an analysis of Telegram conversations – has rather to do with the political and legal definition of individual freedom (Spitale, Biller Andorno and Germani 2022).

In this respect, the opposition to the Green Pass is probably resulting from the long-term legacy of critical positions, rather than from the understanding of the pandemic as such: as a matter of fact, the online discussion about “vaccine passports” has started at the beginning of 2021, well before its actual release (Crupi et al. 2022). According to some surveys, for instance, the percentage of citizens in favor of mandatory COVID-19 vaccination is significantly higher (45.5%) than the percentage of those favorable to the adoption of the Green Pass (33.3%) (Gallé et al. 2021).

It is no surprise, therefore, that the debate around the Green Pass has taken the polarization tendencies to the next level, though the support or opposition to the measure does not properly overlap with classical political positions, in terms of voting preferences (Russo and Valbruzzi 2022).

Conclusion

Our study provided a digital mapping of the controversy surrounding the adoption of the Green Pass in Italy during the COVID-19 pandemic. Analyzing over 4 million Twitter tweets from June to December 2021 we revealed important insights into how this complex issue unfolded in the digital public debate.

Several key findings align with prior research on social media controversies and public debates on science and technology. The temporal pattern of spikes in attention correlating with legislative actions mirrors the “Twitter storms”

observed around other societal issues (Boydston et al. 2014). This reactivity contrasts notions of organic, grassroots debate, instead suggesting an agenda-setting role of political and media institutions in driving Twitter discussions (Hallin and Mancini, 2004), even if the effects manifest in a decentralized way. Each legislative action triggering the Green Pass proved an ignition point for Twitter storms, suggesting top-down agenda setting by political and media institutions rather than organic grassroots discussion, consistent with the issue-attention cycle model (Downs 1972).

The massive imbalance between original tweets and retweets also confirms the unequal “attention economy” of social media, where few viral posts command outsized visibility (Venturini 2019). Combined with the high concentration of retweets around a handful of influential accounts, this indicates a pronounced top-down, centralized flow of information. According to Venturini and Munk (2021), such vertical communication flows are not conducive to democratic, multi-vocal deliberation.

These dynamics contributed to the rapid formation of polarized communities divided along ideological lines, contrary to notions of Twitter facilitating exposure to diverse viewpoints (Brugnoli et al. 2016). The insularity increased over time as influential accounts solidified positions, reducing opportunities for information sharing, as observed in previous network analyses of online polarization (Cinelli et al. 2021). This echoes the tendency toward echo chambers on social media around scientific issues (Bessi et al. 2014). Within these polarized clusters, viral tweets frequently blamed opponents or mocked their views rather than engaging arguments, similar to the scapegoating reaction noted in other controversies (Flinders 2020). This fragmentation contradicts the public sphere ideal of shared discourse and suggests collective sensemaking around complex issues like the Green Pass is impaired (Miconi and Risi 2022). Moreover, the moralistic, oppositional tone of viral content indicates online debate antagonized differences rather than encouraging pluralism or compromise

(Del Vicario et al. 2016). Blame and outrage incite participation, but make nuanced deliberation unlikely. This divergence from rational-critical assessment toward dramatized conflict follows the logic of the attention economy (Venturini 2019).

The confluence of these forces - unequal attention distribution, influencer dominance, moral outrage for engagement, and identity-based polarization - constrained the Green Pass debate within established divides instead of fostering novel public discussion of challenges at the intersection of health, science, and politics. This likely stems from pre-existing sociopolitical fragmentation exacerbated by Italian media ecosystem features like disintermediation and partisan press (Hallin and Mancini 2004; Iannelli et al. 2020)

Situating these findings in a science, technology, and society perspective reveals the deeper challenges at play. While digital media provides infrastructure for mass deliberation, realizing its democratic potential requires addressing complex dynamics shaping how controversies manifest online. From an ANT perspective, collective negotiation of socio-technical issues involves reassembling relations between actors, ideas, and artifacts (Latour 2007). The fragmented and polarized nature of this reassembly on social media highlights the difficulty of translating scientific matters into broadly accessible public issues (Marres 2005). The immediacy of social media may inadequately serve society's need for reflective examination of how scientific expertise gets operationalized into contested policies like the Green Pass. The complex trade-offs between public health, economic impacts, civil liberties, and privacy got reduced to black-and-white positions, as the rapid pace of online debate likely impeded a reflexive "critical promiscuity" (Anderson 2021).

CONCLUSION

The COVID-19 pandemic has unleashed an unprecedented overabundance of information, inundating our media ecosystems with a torrent of news and opinions concerning the virus (Gallotti et al. 2020). This overload crisis of public and scientific communications poses profound dangers to democratic societies, yet examining it only at the broad level of the “infodemic” risks obscuring deeper complexities (Simon and Camargo 2021). By closely investigating specific controversies around controversial socio-technical issues arising during the pandemic, we can gain finer-grained and more grounded perspectives into the challenges impeding inclusive and evidence-based public deliberation on a diverse range of relevant topics (Venturini and Munk 2021).

This thesis consisted of three essays analyzing such controversies as they unfolded on social media in Italy, utilizing computational methods techniques and sociological hermeneutics to map their evolution. The three case studies presented focused on public debates regarding restrictive “lockdown” measures, the so-called “Green Pass” certificate, and the AstraZeneca vaccination campaign. Together they demonstrate how detailed digital controversy mapping can elucidate flows of influence, meaning, and power that shape the trajectory of socio-technical debates online.

Investigating key themes across three essays, this thesis aimed at considering overarching challenges for democracy on complex science and technology issues in the turbulent, polarized, and sensationalistic communication environment of the 21st century. How and why do contemporary public debates surrounding controversies often fail to properly unfold in the direction of democratic deliberation, inclusion, and nuance? In our opinion, this thesis offered grounded perspectives into impediments and fractures in need of redress.

This conclusion synthesizes ‘take-home’ learnings presented across five sections. The first summarizes the contours of each specific socio-technical controversy

analyzed. The second examines cross-cutting dimensions of the Italian Twitter debate. The third discusses how the empirical research elucidates also the main theoretical implications of our study. The fourth reflects on the polarization observed across our three case studies. Finally, the conclusion considers pathways to restore constructive public debate and deliberation in contemporary hybrid media ecosystems.

By illuminating recurring barriers and exclusions, this synthesis aims to further diagnose a hazardous infosphere so remedies may be better targeted. It demonstrates how controversy mapping uncovers socio-cultural logics that escape simplified notions of the “infodemic”. This approach may inform strategies aimed at restoring nuance and empathy to fraught digital public debate. With democratic deliberation under strain, mapping ruptures becomes the first step for finding solutions.

The contours of COVID-19 socio-technical controversies in Italy

The first controversy examined revolved around the imposition and duration of restrictive COVID-19 “lockdown” policies in Italy. Using a dataset of nearly 3 million tweets from 2020 to 2023, we traced an arc from initial widespread compliance and approval of lockdowns towards growing dissent and anti-lockdown sentiment over time as the costs of restrictive measures accumulated. The analysis suggests this shift was fuelled and exploited by Italian right-wing political actors to position themselves as defenders of individual personal freedom, targeting frustrations even as overall social media discussion of lockdown measures declined from initial peaks.

This organic lockdown backlash developed as an unintended consequence of the invasive public health response measures adopted rapidly by the Italian government in early 2020 seeking to contain the novel coronavirus and prevent healthcare system collapse. Sweeping decrees involved business closures, stay-at-home orders, school shutdowns, travel restrictions, and border controls.

Initially, public compliance was broad, aided by social media trends, like #StayHome, that reinforced solidarity around collective sacrifice. However, as debilitating lockdowns dragged on for months with fluctuating success, dissenting voices gradually amplified concerns regarding economic impacts, mental health issues, potential authoritarianism, and prolonged disruption of social activities and milestones. Our study demonstrates how Italian right-wing politicians strategically pivoted to capture this emerging lockdown fatigue using ideological and conspiratorial frames.

This case illuminates the political manipulation strategies that can arise as the societal costs of public health protections escalate over time, providing opportunities for political maneuvering. It traces how lockdown measures shifted from an accepted necessity to a partisan flashpoint as the elongated pandemic exacted its toll on weary populations.

The second case study focuses on the controversy related to the COVID-19 vaccine developed by AstraZeneca, which was found to have rare but serious side effects. Analyzing Italian tweets and news articles over six months in 2021, we identified interlocking breakdowns in the quality of public debate regarding the vaccine's risks and benefits. Rather than earnest collective reckoning with evidence, discussion was characterized by periodic spikes fixated on exaggerated reporting of alleged vaccine fatalities. Hyper-partisan social media posts further obfuscated balanced scientific interpretation.

Specifically, sensationalist coverage implying exaggerated or unproven vaccine risks activated partisan biases on social media, with both conspiratorial claims and defensive posture from pro-vaccine factions. Just as pre-existing identities colored debates around lockdowns, the AstraZeneca controversy followed entrenched scripts valorizing or vilifying vaccines. Amidst this noise, nuanced consideration of uncertainties and trade-offs faded from view. The case encapsulates how the junk news regime creates impediments to sound public

interpretation of the complex risk trade-offs inherent in health and scientific interventions.

The third essay focuses on the controversy surrounding Italy's COVID-19 “Green Pass”, a digital certificate requiring proof of vaccination, recovery from having contracted the virus or negative testing introduced in 2021 to incentivize inoculations and facilitate public activities during subsequent waves of the pandemic. Analyzing over 4 million tweets, we mapped the polarized debate regarding this vaccine related policy, in between advocates portraying it as a justified public health tool versus critics decrying it as an unacceptable imposition reflecting governmental overreach.

Unlike the organic lockdown backlash, this controversy crystallized around a specific techno-bureaucratic governance intervention rather than its unintended effects. However, positions both supporting and opposing the Green Pass’s rollout appeared to align with pre-existing partisan and ideological identities. Justifications framed in terms of public health benefits or civil liberties infringements mirrored familiar ideological divides. The tool itself became engulfed as a symbol within a bitterly contested political arena rather than an object of policy deliberation.

In our study we highlighted how attention spikes coincided with mainstream media coverage of suspected Pass-linked fatalities and social media hype amplifying remote risks. This sensationalism catalyzed polarization between opposing interpretative frames. The essay reveals the combustible dynamics when technologies designed for one purpose are abruptly thrust into a frenzied, polarized information environment dominated by selective exposure and partisan reasoning.

Together, these essays showcase how socio-technical controversies readily become entangled with moral meanings, exploitable by media and political actors (Venturini and Munk 2021). While the lockdown backlash emerged organically, the AstraZeneca controversy emerged under conditions of uncertainty in public

and scientific knowledge available at the time, and the Green Pass debate crystallized around a specific governance intervention. Synthesizing the contours of these controversies illuminates recurring limitations of contemporary digital discourse on complex socio-technical issues. Online debates readily decouple from scientific nuance, instead becoming dominated by partisan identities and sensationalistic narratives. Opportunities for inclusive, evidence-based public deliberation are frequently obstructed. Against this inauspicious backdrop, our investigations demonstrate possibilities for mapping otherwise opaque dynamics that derail from the auspicated deliberative function of public debate in democratic societies.

Recurring characteristic of the debate on COVID-19 in the Italian Twittersphere

While each case study highlights distinct themes, several concerning dimensions arise across our analyses: the outsized influence of prominent accounts, low ethical standards for media and political actors, and precariousness of the public engagement in between justified skepticism and the sharing of misinformation.

Firstly, the three essays spotlight an exaggerated influence of few select accounts in directing discussions and dominating attention over the Italian Twittersphere. A limited number of politicians, journalists and pundits succeeded in amplifying sensationalistic frames, driving spikes and polarization across all the case studies. Their dominance starkly illustrates the steep power asymmetries that permeate social media, belying ideals of decentralized democratic participation (Sacco et al. 2021).

For instance, Chapter 2 demonstrated how prominent right-wing figures and outlets sustained an anti-lockdown presence on Twitter even as overall volumes declined. Chapter 3 identified a minimal representation of scientists and a specular massive presence of ‘talk-shows’ pundits among vocal accounts discussing AstraZeneca. Chapter 4, finally, noted again how politicians and health experts fueled an ideological pro- and anti-pass flame war.

These examples demonstrate how motivated and popular actors can strategically exploit online networks to blast preferred narratives around complex issues to extensive audiences. Legacy prestige and large follower bases translate into exponentially amplified reach. In this sense, our analysis revealed that public engagement is shaped more by elite cues than by an open grassroots dialogue.

Secondly, our research spotlights sensationalistic information sharing practices from both legacy media and social media's users. Mainstream outlets prioritized sensational events over communicating nuance, uncertainty, or policy rationales (Chadwick et al. 2018). Meanwhile, misinformation flowed rapidly through partisan blogs and social media. This interplay between traditional and new media catalyzed spikes of polarized attention rather than scrutinized information. This way, inaccurate health claims gained traction widely on Twitter before fact-checking. Attention surges occurred around mainstream reporting of alleged vaccine related deaths and unvetted AstraZeneca concerns. While in the lockdown and green pass debates different rumors polluted the whole Italian media system. This illustrates the urgent imperative of raising both journalism and politics ethical standards.

Thirdly, the studies reveal multifaceted features of public engagement on social media around the issues. Beyond a visible minority of influential accounts, the broader citizenry exhibited bandwagoning behaviors, confirmation biases, and partisan reasoning alongside other motivations. However, while the ideological polarization process was pronounced, glimpses of earnest inquiry also emerged across all our cases.

For instance, Twitter users challenged the evidence behind prolonged lockdowns, priorities in vaccine allocation, and scientific sounding arguments against the Green Pass over the duration of the crisis. In the lockdown debate we saw how right-wing affiliation strongly drives anti-lockdown activity, but it also raises genuine concerns about restrictions. Similarly, openness on empirical proofs of the vaccine effectiveness remained a main point in the debate around

AstraZeneca, amidst some conspiracies. Finally, the last spike in the Green Pass debate highlighted how balanced voices on the pragmatic and ethical consequences of using the certificate gain traction. This complexity cautions against the total dismissal of skepticism as just misinformation sharing.

In summary, analyzing flows of influence alongside media practices and public participation brings interdependencies into focus. This systemic perspective elucidates exclusions that distort online controversies away from the formation of inclusive public deliberation.

Theoretical implications of public arenas emerged during the COVID-19 crisis

Stepping back, the three essays collectively enhance conceptual understanding of the processes shaping public debates around complex policy dilemmas in the digitally-networked media environment of the 21st century. The three essays present in this thesis provide grounded understandings of several salient dimensions of contemporary digital discourse on complex policy matters.

Firstly, the ephemeral spikes and fading of debates observed strongly resonate with an acceleration of the attention cycles, where public interest in issues fluctuates faster than ever before (Castaldo et al. 2022). Social media discussions reacted to events rather than sustain collective reckoning (Venturini and Munk 2021). This echoes the “trading up the chain” logic of technology companies competing for user minutes through maximally engaging content (Graham 2017). Meaningful assessment of uncertainties, risks and trade-offs gets lost amidst fractured, thin engagement, while collective attention becomes distorted from a scarce public good into a commodity to be exploited (Venturini 2019).

Furthermore, the enduring influence of traditional elite voices, cues and agendas in shaping digital debates is substantiated, despite decentralized mass publishing (Chadwick 2013). Politicians, journalists, pundits and news media strongly steered frame contests and attention spikes across our case studies. This underscores the hybridity of contemporary media where legacy and social media

logics intersect, defying simplistic narratives of disintermediation (Vaccari and Valeriani 2021). Power remains more centralized than disintermediated, and techno-scientific controversies readily morph into proxies for ideological struggles between camps rallying behind traditional elites. Additionally, the recurring sensationalism, exaggeration and affectivity observed strongly validates the ascent of partisan tabloidization documented in political economy scholarship (Gori et al. 2023). Across cases, both legacy and social media prioritized dramatic narratives over communicating nuance, probabilities, or rationale. This substantiates the commercial and technological pressures driving this trend toward dramatization and “infotainment” over substantive information.

Moreover, the sparse substantive discussion and policy nuance aligns with notions of a “post-truth” climate increasingly skeptical of facts and feasibility (Fuller 2018). The politically-correct sense that privilege “both sides” equivalency regardless of evidence bolster circulation of false claims. In this light, journalistic practices of balancing claims rather than verifying them likely enabled misinformation proliferation.

Finally, the cases provide nuanced perspectives to debates on “filter bubbles” and “echo-chambers” (Pariser 2011; Colleoni et al. 2014). They reveal both how digital debates reproduce societal identity divides but also how public heterogeneity persists amid algorithms and customization (Vaccari and Valeriani 2021). The roots of fragmentation implicate culture, societal norms and ideological positioning, not just algorithms (Venturini 2019). In this sense, while it is important to computationally model the dynamics of echo-chambers and filter bubbles (see Valensise et al. 2023), the scientific discourse on such hyped phenomena may require a more nuanced and contextualized perspective.

To sum up, integrating controversy mapping with scholarship on media studies and public debate yields mutually enriching synergies and insights. The analysis presented in our thesis offered practical demonstrations of the dynamics identified by theoretical work and large-scale studies. In turn, surrounding

literature helped contextualize our empirical observations. Further cross-pollination presents rich opportunities to advance understanding of the societal forces shaping digital public arenas.

Networked and ideological polarization

Another significant thread across all three essays is the pronounced degree of networked polarization observed in the Italian Twittersphere, with similar ideological clusters emerging around each controversy. Users converged into homogeneous groups, exhibiting confirmation biases that amplified chosen narratives while ignoring disconfirming information (Del Vicario et al. 2017). This social division mirrors wider tendencies toward “echo chambers” on digital platforms (Cinelli et al. 2021).

Several factors drive online polarization, including social homophily, algorithms personalizing content, and cognitive biases that pre-date the internet (Valensise et al. 2023). However, our case studies reveal even temporary controversies can become rapidly subsumed into identity-driven struggles as opposing camps coalesce. Opportunities for cross-partisan issue deliberation are frequently sidelined as controversies morph into proxies for deeper cultural conflicts. For instance, Chapter 2 demonstrates how Italian right-wing figures successfully captured emerging lockdown fatigue within their broader anti-establishment messaging. Chapter 4 instead outlines how the Green Pass debate split along familiar left-right lines rather than open deliberation of merits.

Furthermore all the three essays exhibit the power of “elite cues” - influential voices signaling identity-confirming positions which are then refracted and amplified through social media (Clayton et al. 2021). In this model, polarization follows more from who raises concerns than the substance of concerns themselves (Lasser et al. 2022). Techno-scientific controversies devolve into proxies for these deeper worldview collisions (Latour 2004).

Accordingly, our analysis substantiates scholarship arguing online echo chambers frequently magnify societal schisms rather than directly generate them. While social media enables selective exposure, similar cognitive biases limit exposure to disconfirming perspectives offline too. Techno-scientific controversies readily transform into blinkered culture war battlegrounds (Venturini and Munk 2021). Effective solutions must recognize polarized online networks frequently represent offline social divisions. Cultivating digital reflection and empathy requires grasping how science and technology debates become embedded within struggles over identity and prestige. The cases reveal micro-level dynamics driving this at scale. Techno-scientific controversies become more about who is perceived to be ‘right’ than constructive collective reasoning.

Cultivating inclusive and democratic deliberation on socio-technical issues

What guidance emerges from this research for restoring constructive, evidence-based public deliberation on complex sociotechnical controversies, given the prevalence of acceleration, sensationalism and ideological simplification observed across our case studies?

Firstly, journalism reforms, including public funding models, merit urgent consideration (Kaye and Quinn 2010). Systemic changes are needed to reverse declining quality and enable measured communication of uncertainty, risks and trade-offs rather than exaggeration of fringe sensationalistic pieces of information (Chadwick et al. 2018).

Relatedly, structured online deliberation spaces can potentially facilitate reflective cross-partisan exchange if thoughtfully designed to counteract selective exposure. Further research into interface features and norms that foster open dialogue across lines is warranted (Masullo, Wilner and Stroud 2022).

Thirdly, regulation of platforms to enhance transparency, reduce attention driven algorithmic governance, and discourage addictive design patterns may mitigate

polarization online (Valensise et al. 2023). However these sorts of interventions must be carefully balanced with free speech implications.

Finally, in liberal democracies, gradual cultural shifts towards valuing substance, empirical evidence, and feasibility assessment over identity appeals remain imperative (Saltelli et al. 2023). Strengthening civic education and public reason represent promising directions to develop citizens competences in navigating socio-technical debates (Venturini and Munk 2021).

The pollution of public discourse and erosion of shared knowledge is an intricate process that is enabled more by societal fragilities than technology alone. Renewing democracy requires solutions that empower publics, reform institutions, and nourish social cohesion. Digital controversy mapping brings nuance to this challenge by elucidating interactions between platforms, legacy media, politics and the public. With science itself under assault, illuminating potential societal fractures on public knowledge and deliberation is an essential first step to empower an effective active citizenship.

The significance and value of mapping controversies with digital methods

All in all, this thesis tried to demonstrate the vital role of layered controversy analysis in diagnosing the socio-cultural forces that derail inclusive collective reasoning and debate regarding complex societal challenges.

By elucidating patterns in public debate, mapping situated techno-scientific controversies brings nuance to the “infodemic” framework. It complicates reductive narratives that attribute crises of truth primarily to technology. Instead, granular empirical inquiry reveals layered socio-technical interdependencies. Mapping practices also uncover the cultural logics that escape simplified notions of ephemeral digital frenzy decoupled from reality. Controversies arise from and mirror deeper social rifts. Their exacerbation online implicates cultural, societal and political dimensions beyond purely technological effects.

Tracing controversies highlights fracture points and blind spots that should focus interventions—education to heighten critical faculties, structural media reforms to nourish substantive accountability journalism, platform changes to increase transparency, and cultural shifts towards empiricism and shared purpose.

Analysis of techno-scientific controversies remains vital as democracies confront escalating health, economic, and ecological crises that demand inclusive evidence-based understanding. Revitalizing collective sense making and deliberation requires recovering notions of shared purpose and interdependence that transcend partisan divisions over identity and power. In this light, a positive communication environment should convey nuance, trade-offs and doubt while safeguarding the goal of truth-seeking.

By tracing situated techno-scientific controversies as they unfold across media ecologies and networks of publics, we gain contextualized perspectives into the underlying dynamics shaping and constraining collective reasoning and debate. Elucidating recurring fractures and limitations is an essential first step toward envisioning remedies. Renewing democratic discourse requires multifaceted efforts to strengthen media systems, platform governance, civic competences and social cohesion. While certainly not a panacea, careful empirical analysis of situated communication breakdowns can inform targeted interventions to restore collective sense making. With democracies under strain, mapping otherwise opaque ruptures becomes a prerequisite for repair.

Controversy mapping provides grounded understandings to guide this renewal by tracing how techno-scientific debates embed within deeper societal struggles. Meticulous tracing of situated complexities resists reductive notions of an undifferentiated “infodemic” driven solely by the virus novelty. Instead it reveals interdependencies between media, politics, culture and the public.

Democratic public debate and deliberation are fragile achievements that require constant nurturing. This thesis demonstrates the potential of controversy mapping to bring nuance to this challenge.

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