

ORIGINAL RESEARCH ARTICLE

Bringing Together Multiple and Diverse Forms of Resistance to Innovation: A Rhetorical Approach to the Anti-5G Movement

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Abstract

Numerous resistance or contestation movements exhibit a surprising ability to bring together individuals with very different sensibilities and arguments that may be contradictory. Rooted in a study of a resistance movement against 5G technology, this article helps to better understand the phenomenon whereby multiple and heterogeneous resistances come together within the same movement by showing the role played by rhetoric. We analyse the great diversity of arguments in 5G resistance, focussing on four main lines that structure the arguments, and we shed light on an 'argument decentring' phenomenon where, although they may not adopt the arguments advanced by other opponents, some actors leverage the resulting controversy to legitimate their own discourse and increase the credibility of their own lines of argumentation. By considering rhetoric as a mechanism that aggregates resistance movements, this study contributes to a better understanding of the mechanisms and effects of argument heterogeneity, in particular online or on social media.

Keywords: 5G; Rhetorical approach; Resistance to innovation; Argument decentring

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Studies on resistance to innovation have mainly highlighted the existence of opposing actors. Two distinct camps emerge, the *pro*-side and the *anti*-side, in various contexts such as electric vehicles (Noel et al., 2019), smart electricity meters such as Linky in France (Chamaret et al., 2020), and biotechnologies (Davies & Macnaghten, 2010; Halstead et al., 2021). Major current movements of resistance to innovation are also surprising because of their heterogeneity, blending various actors with diverse motivations and ways of taking action (Chamaret et al., 2020; Halstead et al., 2021; Huang et al., 2022; Kinefuchi, 2021). Within each camp, this heterogeneity is seen in the aggregation of opponents with diverse identities who, although they fight together, exhibit different motivations and arguments. Hietschold et al. (2020) note the importance of the medium-term success of a resistance-to-innovation movement of a certain type of leader, termed 'aggregators', who has the ability, once the resistance movement has begun, to aggregate different sub-movements into a common force. This phenomenon appears to be amplified by digital technologies, which can bring together socially and spatially diverse groups

of people (Allcott et al., 2019; Goel et al., 2016; Küçükali et al., 2022).

The literature appears to view this aggregation of several factions within a single camp as an explanatory dimension of contemporary resistance movements as well as an undertheorised dynamic (Hietschold et al., 2020). Adopting a rhetorical approach (Symon, 2000), we examine the following research question: How are several lines of argumentation articulated with each other within a given resistance-to-innovation movement?

To answer this question, we investigate an emblematic case of a particularly hybrid resistance movement in terms of actors, motivations, and practices: resistance to 5G technology. This movement gathered steam in 2019, to the point where it was seen as a real threat to the success of the technology; in particular, the expansion of its network (ITU, 2015; WEF-PwC, 2020). Working with a database of anti-5G arguments containing 214,848 words, which we analysed using algorithmic tools (topic modelling via latent Dirichlet allocation, or LDA, Blei et al., 2013), we examine the various lines of argumentation

espoused by the resisters and how 5G opponents refer to the arguments of other opponents.

What we found is a wide range of opponents with very different sensibilities (on political, religious, cultural, or ecological issues). This diversity naturally translates into a multiplicity of arguments which may be categorised into four main lines of argument: (1) the electromagnetic waves used in 5G are said to be harmful to health; (2) 5G disturbs the ecosystem, upsetting the natural balance; (3) 5G embodies the pro-technology and production-driven race to progress; and (4) 5G has been forced upon us, characteristic of the state's totalitarian inclinations or the groups that influence it.

Adopting a rhetorical approach (Symon, 2005), we are able to shed light on the intertwining of the different lines of argument as well as a rhetorical mechanism that we call 'argument decentring', which we define as the way some opponents, rather than using the arguments put forward by other opponents, seize upon the existence of the ensuing controversy to legitimate their discourse and strengthen the credibility of their own line of argument.

Analysing the opponents' arguments and their hybridisation in depth, we make a significant contribution to the empirical understanding of resistance movements. In addition, this study offers an original theoretical contribution to the literature on resistance to innovation by revealing the importance of argument decentring in aggregating opponents with different sensibilities. This mechanism appears to be facilitated by certain digital media such as YouTube algorithms (Arthurs et al., 2018; Bryant, 2020), and helps to show the role of digital media (Etter & Albu, 2021; Vaast et al., 2017) in the aggregation of resistance-to-innovation movements.

In the following sections, we present a literature review rooted in a rhetorical approach to studying resistance to innovation. Then we describe our methodology of topic modelling using LDA. In the third section, we present our results structured around the four main lines of argumentation and the argument decentring phenomenon that emerge from our analysis. We end with a discussion of these results, and conclude with the implications for practice.

Literature review

Rhetorical approach to resistance to innovation

The rhetorical approach to resistance, mainly advanced by Symon (2000), offers an analytical reading of the construction and maintenance of arguments between opposing sides (Suddaby & Greenwood, 2005; Symon, 2000, 2005, 2008; Symon & Clegg, 2005).

Rhetoric may be defined as an 'art of persuasion, a set of rules, or recipes which when applied will convince the listener of the discourse' (Barthes, 1970, p. 173, our translation).

Research contexts suited to a rhetorical approach are therefore those of controversy, that is, situations in which there is a clash of discourses that were initially intrinsically linked by forms of reciprocal oppositions ('dissensus-oriented discourses', Kock, 2009).¹ Studies on rhetoric date back to the philosophers of ancient Greece such as Aristotle or Pythagoras; but there was a revival of interest in the 1970s in the social sciences (Nelson et al., 1987), and more recently in management science (Nentwich & Hoyer, 2012; Symon, 2000, 2005, 2008). Rhetorical analysis is used to study the linguistic strategies of argument whereby individuals seek to convince an audience of a reality in keeping with their interests (through justification) or to deconstruct a contrary reality (through criticism or counter-arguments). For example, Symon (2005) examines how British public servants opposed to a technological change produced an argument to shape a certain interpretation of reality while resisting management's efforts to the contrary.

The classic theory of rhetoric, notably found in Aristotle, has historically accorded great significance to the performance of the orator and their ability to adjust their discourse to the audience (Jarzabkowski & Sillince, 2007). Modern theorists have extended this contextualisation of rhetoric, notably by integrating it into organisational theory, making rhetoric an important practice within organisational spaces (Browning & Hartelius, 2018; Jarzabkowski & Sillince, 2007; Symon, 2005, 2008; Symon & Clegg, 2005). In this view, organisations are social entities in which shared rhetorical constructs (vocabulary, metaphors, logical arguments, etc.) model the interactions between individuals and structure the way they refer to events or new practices. The study of argumentation is carried out within normative socio-cognitive environments, with the aim of understanding how rhetorical strategies are developed from these contexts, and vice versa (Suddaby & Greenwood, 2005).

Rhetorical analysis dissects the fabric of an argument in relation to the social and political space, and observes how the milieu reacts and adjusts accordingly. The dissemination of an argument depends on rhetorical performances in relation to the organisational environments through which it passes: 'Instead of an assumption that social structure is independent of and exists prior to rhetoric, social structure is seen as something that is shaped and constructed by discourse' (Green, 2004, p. 663). Inversely, the emergence and structuring of a resistance process also depends on the environment: the narrative, the way resistance is justified, and the nature of arguments which can be brought into play are all part of a context and are influenced by it as much as they may shape its codes and values in the future (Noel et al., 2019; Symon, 2005).

¹. Going beyond the principle of 'preferred study context', some scholars even see rhetoric as being epistemologically derived from the principle of controversy and vice versa (Kock, 2009).

Studying the rhetoric of heterogeneous resistance movements

Rhetorical analysis may be used to study different types of resistance such as the various phenomena of resistance to innovation (Garcia et al., 2007; Hietschold et al., 2020; Huang et al., 2020). There is renewed interest in studying resistance-to-innovation movements owing to their capacity to influence, slow down, or even impede certain innovations (Heidenreich & Kraemer, 2016).

Some scholars have analysed how the lack of democratic debates on subjects such as Genetically Modified Organism (GMO) crops or nuclear power have caused persistent fractures in western societies, whose consequences make it harder to manage resistance-to-innovation movements, both for industrial actors who wish to explain their approach and for activists who want to anchor their combat in a well-founded epistemic approach (Koopmans & Duyvendak, 1995; Wynne, 2001, 2006).

The academic and industrial worlds are worried about the increasing divergence between decisions regarding the pace and mode of technological and economic development and public opinion on these issues, as well as the difficulty of reconciling the two when trust between stakeholders has been lost (Wynne, 2001, 2006). In addition to this risk of rupture, there is a great deal of questioning in the academic community about the role of new technologies in the way opposition movements (and their arguments) are structured, evolve, and sometimes become radicalised (George & Leidner, 2019; Kelly Garrett, 2006; Sandoval-Almazan & Gil-Garcia, 2014). Understanding the specificities of new resistance movements is a major concern, especially given the emergence of new technologies such as artificial intelligence (AI) and ecological paradigm shifts, which may give rise to durable and radical resistance movements (Smith, 2021; Sovacool & Dunlap, 2022).

In this context, the rhetorical approach offers keys for examining the rhetorical ingenuity of an innovation's promoters (Cristofini, 2021; Ruebottom, 2013; Suddaby & Greenwood, 2005) and the difficulty for opponents to develop a counter-discourse, and vice versa. Some innovations may be managerial in nature or innovations introduced to change the production and administrative processes in an organisation. For example, Suddaby and Greenwood (2005) identify rhetorical strategies deployed in auditing firms and their role in the legitimisation of major organisational transformations, highlighting the influence of the institutional lexicon in crystallising dissenting discourses as well as standard arguments about change (teleological, historical, cosmological, ontological, and disagreements on values) which structure and segment the opposition. Similarly, Lepistö (2015) dissects the arguments advanced by the promoters of an Enterprise Resource Planning (ERP) system (software for managing and integrating business processes

within a company); Cattla (2005), the rhetoric on innovation introduced by new public management; and Arrington and Schweiker (1992), the rhetoric on innovation in the accounting profession. Other innovations are technological. Wilson et al. (2022), for example, study the rhetoric of 'smart city' promoters. Studying the opponents' side, Colombini (2019) analyses the anticapitalism discourse voiced by the 'tiny homes' movement. Noel et al. (2019) explain the arguments employed by some of the opposition to electric vehicles using Hirschman's (1991) 'reactionary rhetoric' framework and show how range anxiety (the fear of being unable to do long trips in an electric vehicle) has no technical or psychological basis, but is sustained by the resilience of the reactionary argument advanced by opponents to this technology.

Rhetorical analysis is a fundamentally dialogical exercise (Billig, 1996), in other words, it posits that arguments do not exist per se, but are constructed in response to the arguments (real or imagined) of the opposing camp:

Arguments are produced in the context of potential counter-arguments and so may be oriented to their undermining. [. . .] Thus, individuals may be seeking to convince an audience that a particular social construction is true (not a social construction) while simultaneously seeking to expose other accounts as social constructions (not true). (Symon, 2005, p. 1646, original emphasis)

The opposing camps not only seek to convince people, but also to reduce the influence of opposing arguments. According to the rhetorical approach to resistance phenomena, the opposition actually shapes the opposing camps, which cement their respective identities through their arguments and the divided representation of the world they are trying to construct (Symon, 2005; Symon & Clegg, 2005). Resistance to innovation thus sets the 'pros' against the 'antis', whether for electric cars (Noel et al., 2019), smart electric meters such as Linky (Chamaret et al., 2020), vaccines (Küçükali et al., 2022; McKinley et al., 2023), nuclear power (Kinefuchi, 2021), or biotechnologies (Davies & Macnaghten, 2010; Halstead et al., 2021).

Although the emphasis is placed on the headlong confrontation between opposing sides, very few studies have explored the way each camp structures itself by taking in and integrating several divergent factions. Yet, resistance is rarely monolithic; it combines numerous and very diverse actors, socio-cultural horizons, and politics. A certain number of recent movements of resistance to technology have been characterised by their ability to 'aggregate' actors with diverse profiles, motivations, and practices (Chamaret et al., 2020; Kinefuchi, 2021; Halstead et al., 2021; Huang et al., 2022). For example, Chamaret et al. (2020) show the diversity of profiles in French town councils who are opposed to the installation of Linky smart electric meters. The arguments of anti-Linky opponents are made at different levels, from the individual level to that of society as a whole (Chamaret et al., 2020; Sovacool et al., 2019). The

anti-5G movement is marked by its surprising ability to gather opponents with very diverse profiles and discourses (Jenal et al., 2021; Gerli, 2021). Given these observations, several scholars have called for this phenomenon to be a research priority in studies on resistance to innovation (Hietschold et al., 2020; Huang et al., 2022).

To explain the phenomenon of significant heterogeneity within resistance-to-innovation movements, several recent studies underscore the role of certain actors in this ability to bring together these initially divergent opponents. Hietschold et al. (2020) highlight the importance of a specific type of leader, known as *aggregators*, for the medium-term success of resistance movements against innovation. Once the resistance movement has begun, these leaders have the ability to unite various sub-movements into a common force. The literature also highlights the role of municipalities in this regard, whether in the opposition to smart electricity meters in France (Chamaret et al., 2020) or against 5G in Europe (Gerli, 2021; Jenal et al., 2021). Several authors emphasise the role of social media platforms in the construction and dissemination of arguments in opposition to innovations such as vaccines or 5G, through which socially and spatially diverse milieux come together (Allcott et al., 2019; Goel et al., 2016; Küçükali et al., 2022), but which also open the door to the interpenetration of opposition arguments with conspiracy theories (Bodner et al., 2020; Bruns et al., 2021; Flaherty et al., 2022; Küçükali et al., 2022).

Notwithstanding the identification of these 'aggregators' and the impact of digital technologies on how these movements are organised, relatively little is known about the way these movements produce arguments that manage to bring together opponents who in principle are highly heterogeneous or divergent. Consequently, this paper aims to fill a gap in the literature on the rhetoric of resistance movements by investigating the following research question: How are several different lines of argumentation integrated within a given resistance-to-innovation movement?

Methodology

Resistance to 5G

Our study focusses on resistance to 5G, which offers several interesting aspects for our research. The resistance to 5G is characterised by a diversity of actors and practices (Gerli, 2021; Jenal et al., 2021), largely organised and popularised online, in particular on social media (Ahmed et al., 2020; Bahja & Safdar, 2020; Bruns et al., 2020; Gerli, 2021; Jenal et al., 2021). It is marked by surprising radicality, with opponents taking direct action, including the sabotage of telecommunications infrastructure, in particular cell towers and antennas. This phenomenon has been observed in many western countries.

Moreover, this movement is interesting because it constitutes a threat for 5G promoters, owing to prolonged moratoria and potential sabotage, which may compromise its reliability and coverage (Oxford Analytica, 2020). This infrastructure is essential for technologies such as AI and the Internet of things (IoT), which require extended deployment with a minimal amount of incidents (Ballard, 2018; Gupta & Jha, 2015; ITU, 2015; WEF-PwC, 2020). The criticality of 5G for related technologies has engendered conflicts between telecom companies and between countries, sparking geopolitical tensions, in particular the Chinese-American rivalry (Danet & Desforges, 2020; Wang, 2020). Anti-5G movements are, therefore, linked to critical questions concerning industry and sovereignty² associated with other future technologies (Ballard, 2018; Oxford Analytica, 2020; WEF-PwC, 2020).

Analytical methods

The chart, depicted in Table 1, summarises the four stages in our research methodology: data collection, pre-processing of the corpus, computational processing using topic modelling, and analysis of lines of argumentation (Table 1).

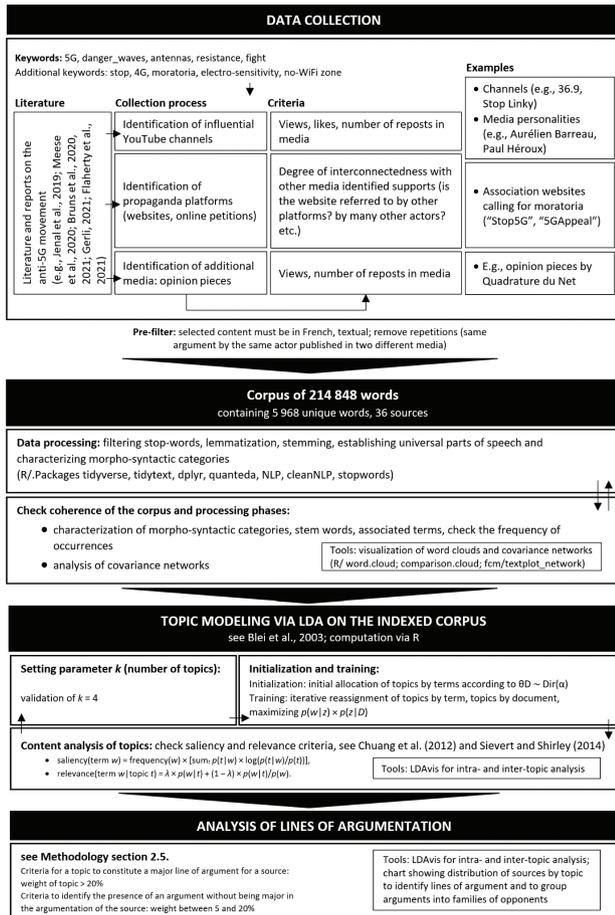
Supplementary information on each of these stages is provided in the appendices. For data collection, Appendix 1.1 outlines the data collection procedure on YouTube and Appendix 1.2 summarises the elements making up the corpus. Regarding the pre-processing of the corpus, Appendix 1.3 provides an example which illustrates the vectorisation of the texts in our corpus during the pre-processing stage. Appendix 1.4 contains charts showing word distribution in morphosyntactic categories and Appendix 1.5 is an illustration of word covariance graphs used during the pre-processing stage. Appendix 2.1 summarises the computational process by which topic modelling is done using LDA. Appendix 2.2 presents the different stages involved in setting parameter k . Appendix 2.3 is an extract of the principal words making up the topics at an intermediate stage of the process. Finally, for the analysis of lines of argumentation, Appendix 3 shows the distribution of topics by source in the corpus.

Data collection

The data collected, combining online opinion pieces, pamphlets, and videos, mainly on YouTube, produced a total corpus of 214,848 words in French of arguments made in opposition to 5G. This focus is relevant because French-speaking countries have been particularly affected by anti-5G mobilisations (Griessel, 2021; Jenal et al., 2021). In the literature, France has

² Attested by the promulgation in France of law no. 2019-810 on 1 August 2019, "aiming to preserve the national defence and security interests of France in the context of the operation of wireless mobile networks" (DILA, 2019, our translation).

Table 1. Overview of the methodological process, from data collection to analysis



Source: Own elaboration

been identified in particular as a crucible for polarisation regarding the official discourses on health dangers, ranging from the debate on glyphosate (Richet et al., 2024) to that on vaccination (McKinley et al., 2023). Finally, having a single language in the lexical corpus is essential to computational analysis methods. Our first steps were made with the help of the literature (e.g., Bruns et al., 2020; 2021; Flaherty et al., 2022; Gerli, 2021; Jenal et al., 2021; Meese et al., 2020), which points to a certain number of relevant actors (e.g., associations that promote moratoria at the municipal, national, and European levels). We listed these actors and collected the related material (videos, pamphlets, and opinion pieces; see the list in Appendix 1.2). We then conducted a more systematic data collection on Internet platforms, especially on YouTube. The collection procedure is detailed in Appendix 1.1.³ YouTube videos account

³ We ran the data collection and analysis process using a coefficient to gauge the explanatory power of lines of argumentation generated by our topic modelling method in relation to the content indexed in the sources. This coefficient is defined as the ratio of the sum of distances squared of

for a significant share (70%) of our corpus, as the medium is favoured by a wide variety of opponents to 5G, with a broad audience and arguments that are sometimes more cogent than those advanced in pamphlets and opinion pieces against 5G. Moreover, the important role played by the platform has already been underlined, owing to its contribution to the dissemination of viral controversies (Hess, 2009; Walther et al., 2010), most recently concerning the dissemination of disinformation propaganda about COVID-19 (Marchal & Au, 2020).

Computational procedure for textual analysis

Choice of computational analytical method using latent Dirichlet allocation

The decision to use an algorithmic processing method for our study was based on several factors, notably the size of the corpus studied, as well as the homogeneity and replicability of the analysis. First of all, language processing algorithms offer the opportunity to work uniformly on a large amount of data (Aranda et al., 2021; Goldenstein & Poschmann, 2019; Kherwa & Bansal, 2020), by performing the analysis 'instantaneously', handling the entire corpus at once rather than proceeding sequentially. These tools allow a uniform reading of the documents making up the corpus and can therefore reveal dimensions which may have remained invisible had the documents been studied sequentially or, worse still, studied by different analysts (Aranda et al., 2021; Hannigan et al., 2019; Kherwa & Bansal, 2020). Furthermore, these methods help to limit any projection bias in interpreting the data (Aranda et al., 2021; Kang et al., 2020). Indeed, automating the first phases of analysis minimises the risk of begging the question. Regarding the sensitive nature of the material in our study (with significant political, philosophical, and spiritual overtones, concerning sensitive areas such as the family, the meaning of life and attitudes to death, the moral obligations of the individual vis-à-vis society, and vice versa), it was necessary to adopt a method that would produce an interpretation as independent as possible of the researchers' interpretative sensibilities. The interpretative phase is still there, but it is better demarcated thanks to the upstream computational processing which contributes to making the analysis more objective (Aranda et al., 2021).

The principle of computational text analysis method is to determine associations between thematic elements identified in the corpus (Kherwa & Bansal, 2020). Once the texts have been converted into vectors, the closeness of these vectors allows us to identify thematic similarities or associations between texts or portions of texts, and possibly their authors (Aranda et al., 2021; Crain et al., 2012; Khan et al., 2010; Kherwa

the four main factors to the sum of the distances between points and factors in an n -dimensional space, where n is the number of points (see Appendix 2.2). Our target was a ratio greater than 80% (final ratio: 86%).

& Bansal, 2020). The final goal is to reduce and transform the text into variables, then to gradually reduce the dimensionality of the dataset thus codified to obtain a rather restricted and legible result that can be studied by the researcher (Crain et al., 2012). The analytical process is done in two steps: in the first phase, the data is shaped algorithmically by identifying statistical similarities, then there is a second phase of qualitative interpretation of the mathematical indicators.

Several algorithmic methods are possible.⁴ There are several reasons behind our choice of the LDA model, popularised by the work of Blei et al. (2003), which belongs to the family of unsupervised probabilistic algorithms. The significant performance of LDA has been demonstrated for topic modelling tasks (Kang et al., 2020; Kherwa & Bansal, 2020). In particular, LDA avoids certain pitfalls, such as the 'overfitting' of alternative probabilistic models, particularly the probabilistic latent semantic analysis (pLSA) model (Blei et al., 2003; Kang et al., 2020). The algorithmic process by which topic modelling is generated via LDA is explained in Appendix 2.1. The algorithmic pre-processing and processing phases were performed using R.

Pre-processing of the corpus and setting of topic modelling parameters

The first operation in pre-processing is checking the uniformity of language (French), then filtering out interference or noise, also known as stop words.⁵ The dataset is formatted by indexing the corpus through stemming, lemmatisation, and

⁴ There are supervised and unsupervised methods (Khan et al., 2010; Kherwa & Bansal, 2020; Aranda et al., 2021). Supervised methods, among which support vector machines (SVM) are the most popular (Khan et al., 2010), are based on a prior definition of the thematic structures making up the documents. On the other hand, non-supervised methods have the advantage of operating more autonomously, identifying relations between classes as they go through the statistical learning process (Kherwa & Bansal, 2020). Two categories coexist in non-supervised models: probabilistic and non-probabilistic models. Non-probabilistic models state that the distribution of words in texts or portions of text indicates belonging to a unit of meaning. One of the leading methods of non-probabilistic models is latent semantic analysis (LSA). It is based on the generation of matrices where rows represent terms, and columns are documents, to measure the frequency of terms in and between documents. A major limitation of these models lies in the process of creating a 'bag of words' in which the order of words does not matter (Hofmann, 2001; Kang et al., 2020). Probabilistic models aim to overcome these limitations stemming from the distribution assumption (Kherwa & Bansal, 2020).

This is the case of latent Dirichlet allocation (LDA), which belongs to the family of unsupervised probabilistic algorithms. LDAs for the computational analysis of text have been popularised in particular by the work of Blei et al. (2003), and are among the most widely used as they are generally considered to perform better than other algorithms (Kherwa & Bansal, 2020; Kang et al., 2020).

⁵ This second step is done with a dictionary of stop words using R-based software (language parameter = 'French' and source = 'stopwords-iso').

tokenisation.⁶ Appendix 1.3 illustrates this pre-processing phase with an example from the corpus.

The tables in Appendix 1.4 summarise the main word occurrences in our corpus according to morphosyntactic categories. Unsurprisingly, we find the marked presence of lexical fields associated with telecommunications, (radio)waves, health, 5G infrastructure (cell towers, antennas, operators), (over)consumption, and the scientific debate. Additionally, we find the vocabulary typical of online controversies.

As part of the pre-processing procedure, we also performed an analysis of covariance graphs. This stage (presented in detail in Appendix 1.5) offers an overview of the salient dimensions in the corpus after pre-processing, before conducting the LDA analysis. Combined with the study of lemmas indexed by morphosyntactic categories, this stage helps to correct pre-processing shortcomings, such as the poor indexing of words or the presence of terms that generate interference and should be added to the stop word list.

Topic modelling

Topic modelling requires us to specify the number of topics k (Blei et al., 2003), determined by gradually decreasing k to find an optimal value between interpretative potential and the statistical explanatory coefficient (Aranda et al., 2021; Blei et al., 2003). The extraction of topic composition is done in accordance with the methodology prescribed by Sievert and Shirley (2014) via the LDAvis application for inter- and intra-topic visualisation by extracting the salience and relevance of the semantic networks that make up each of the topics (Chuang et al., 2012). These values are estimated as follows: for each topic t , where λ denotes topic specificity:

$$\text{saliency}(\text{term } w) = \text{frequency}(w) \times \left(\sum_t p(t|w) \times \log \frac{p(t|w)}{p(t)} \right),$$

$$\text{relevance}(\text{term } w | \text{topic } t) = \lambda \times p(w|t) + (1 - \lambda) \times \frac{p(w|t)}{p(w)}.$$

Following Sievert and Shirley's (2014) recommendation, we set $\lambda = 0.6$, considered the optimal reference value for λ for examining topics using LDA.

⁶ The following steps were carried out with modules of the following packages: tidyverse, tidytext, dplyr, quanteda, NLP, and cleanNLP, whose purpose is to prepare a corpus for natural language processing (NLP) methods. Stemming identifies the stem or root of a word, so as to compare semantic units with each other (e.g., in French, *ils vont*, *nous sommes allés*, and *allant* are all inflections of the verb *aller*). Lemmatization is the process of grouping together occurrences of a text under lexical entries. Tokenisation is the process of breaking up the sequences in a text according to syntactic, pragmatic, and semantic dimensions (Palmer, 2000). The corpus is annotated by indexing the corresponding morphosyntactic categories (noun, adjective, adverb, verb).

We progressively refined the number of topics (cf. Aranda et al., 2021; DiMaggio et al., 2013; Roque et al., 2019; Sievert & Shirley, 2014) from around 30 down to 4 (see Appendix 2.2 on specifying the k parameter) by examining the criteria of saliency and relevance. For example, Appendix 2.3 illustrates the intermediary stage where $k=10$. Appendix 2.4 shows the distribution of sources in the last stage on Principal Component Analysis (PCA) biplots, which allows us to index the explanatory power of topics for a given k value.⁷

Analytical procedure following the computational process

The analytical procedure was done in two stages. First, the four topics obtained through LDA revealed the four main stable lines of argumentation in our corpus. We studied them one by one. Then, using the distribution of sources by topic, we were able to identify which line of argument each source built an argument on.⁸ We characterise the scale and the ontology of these lines of argumentation (Wynne, 2001, 2006).

We then examined how opponents referred to the arguments of other activist groups. For this, we used a combination of LDAvis and the sources/topics chart, which allowed us to detect the presence of one or more topics within an argument that are not among the major topics characterising those opponents.⁹ Appendix 3 presents the distribution of topics by source.

The results section summarises the main contributions of this analysis, step by step. Quotations are provided to illustrate the analysis. Our selection criteria for quotations were twofold: the exemplariness of the line of argumentation discussed,¹⁰ and the media influence of the actors (as evidenced by the number of views and the sharing of their positions and videos in anti-5G spheres), which qualifies them as key actors on social media (see, Benabdelkrim et al., 2020).

Results

The four major lines of argumentation

The topic modelling method using LDA revealed four stable lines of argumentation in our corpus: (1) the electromagnetic waves used in 5G are said to be harmful to health; (2) 5G

⁷ Principal Component Analysis biplots allow us to visualise the explanatory coefficient obtained by summing two-variable coefficients of determination (R^2). See DiMaggio et al. (2013) or Roque et al. (2019) for the various methods of gauging the explanatory power of topics when setting k .

⁸ The threshold for a topic to be considered major in a source's arguments is set at 20% (i.e., the contribution of the topic is greater than 20% of the sum of the contributions of topics for this source). See Appendix 3.

⁹ A topic is considered present but not major if it represents between 2% and 20% for a given source. See Appendix 3.

¹⁰ It is calculated mathematically based on the topic-specific relevance of the source that the quotation comes from in the LDA and materialised by the distance of the arrow (Appendix 2.4).

disturbs the ecosystem, upsetting the natural balance; (3) 5G is pro-technology, production-driven, and energy consuming; and (4) 5G has been forced upon us, characteristic of the state's totalitarian inclinations or the groups that influence it.

In our corpus, 42% of opponents support a single line of argument, and 58% support two lines.¹¹ First we present the four lines of argument. The quotations used to illustrate these arguments were selected mainly on the basis of the relevance criterion (see methodology section 2.5).

Electromagnetic waves are harmful to health

Opponents claim that 5G is carcinogenic and has various adverse effects on human health.

The criticism that non-ionising waves are 'probably carcinogenic' is not specific to 5G. Present for decades in movements that opposed satellite networks and then the large-scale deployment of Wi-Fi, these arguments have been popularised by international bestsellers on the subject; in particular those of Debaun and Debaun (2017) and Mercola (2020), whose commercial success is sometimes cited in support of the criticism of electromagnetic waves and against 5G in particular.

Dr. Paul Héroux, a professor of toxicology and the effects of electromagnetism on health in the Faculty of Medicine at McGill University, is currently one of the leading academic figures opposed to 5G and has produced multiple publications and conferences on the dangers of 5G. During a conference given at the University of Montréal on 03 February 2020 (which was filmed and widely circulated on the Internet among anti-wave groups), he made the following arguments:

One of the things that we see when we apply electromagnetic waves to biological systems is that the DNA becomes unstable. And the reason why the DNA – illustrated here – becomes unstable is that DNA is stabilized by hydrogen pumps. In other words, the protons oscillate between the two halves of the DNA. And if we change the mobility of the protons, we make the DNA less stable. (Paul Héroux in Christian Aubry, 2020)

The criticism regarding the danger posed by electromagnetic waves has been rekindled since 2013 by the World Health Organization (WHO), through its research unit on cancer risks (International Agency for Research on Cancer), which classified electromagnetic waves in category 2B 'possibly carcinogenic to humans'. A frequent response is that the ranking in category 2B means that they are not in category 2A (probably carcinogenic for humans), or worse in category A (carcinogenic for humans). Playing on the shade of meaning between 'possibly' and 'probably', the opponents in our corpus

¹¹ A line of reasoning is considered significant in an opponent's argument if the relative weight of the corresponding topic following the topic modelling process is greater than 20%. See Appendix 3.

nevertheless assert that it is necessary to adopt a precautionary approach, justified by the international stature of the WHO.

With 5G, a new front has opened against electromagnetic waves, particularly for those who claim to be 'electrosensitive', that is, suffering the effects of electromagnetic waves on their body.

It adds to the ambient electro-smoke which is already intense. And it will be the straw that breaks the camel's back for many people in terms of feeling the symptoms. But 5G is not the same thing as what we already have (Jean Hudon, member of the Montréal group Stoppons la 5G – Vivons sans danG). (Jean Hudon in Michel Marsolais, 2020)

In France, associations such as Robin des Toits, presenting themselves as a national organisation for health safety in the face of wireless technologies are fighting for electrosensitive people by opposing the installation of 5G cell towers. They also encourage participation in local and national coalitions of associations for action at the European level, engaging in influential lobbying of the European Parliament, particularly through the 5G appeal movement,¹² which advocates an urgent European moratorium.

It is noteworthy that, to demonstrate that 5G is carcinogenic or that it engenders heightened effects on the electrosensitive, opponents to 5G have mobilised a significant amount of scientific literature. In general, the methodologies are either based on animal experiments (often on mice) whose relevance to humans is debatable (especially given the levels of exposure tested) or on cohorts of cancer patients (often brain cancer), which they correlate to an intense use of wave-emitting devices (particularly mobile phones).

Furthermore, we have evidence from animal models. These are very large studies which over time have confirmed that the electromagnetic waves from cellphones cause cancer: I'm talking about 4,288 rats and 2,180 mice whose incidence of cancer is three to four times higher when they are exposed to electromagnetic waves. And I like to point that out because sometimes when I present these ideas people say, 'But you are very biased Dr. Héroux, that's what you study'. It's much harder to convince rats and mice to have cancer because they are exposed, because they don't know. So it's not a psychological thing, it's very real. (Dr: Paul Héroux) (Paul Héroux in Christian Aubry, 2020)

Nevertheless, in our corpus, the academic literature is used by certain actors to draw conclusions which are either absent from the cited scientific studies, or exaggerated. Certain actors have also been criticised by the academic, especially medical community.¹³ The weight of these scientific arguments is however, very specific to this line of criticism against 5G; it is more moderate in other lines of argument.

¹² 5G appeal movement website: <http://www.5gappeal.eu/>

¹³ For example, Dominique Belpomme, president of Association de recherche thérapeutique anticancéreuse (Association for therapeutic cancer research), is being sued by the French board of physicians concerning some of these studies on electrosensitivity.

Disturbance of humans and ecosystems

Not only accused of being dangerous, 5G is also blamed for causing disturbance. This notion may be heard from electrosensitive opponents, though it is found in a set of themes that have adopted a more holistic approach.

In particular, opponents criticise the disturbance of 'balance', which may be at the level of an individual or an ecosystem.

At the individual level, the disturbance of balance is said to be manifested in anxiety disorders and 'bad waves' for one's mental state. The multiple meanings of the word 'wave' are exploited to the maximum here: as a wave in the scientific sense, 5G is also accused of interfering with beliefs built on the concept of spiritual waves (magnetism, geodesic waves, chakras, etc.). Obviously, some extracts from our corpus are simply advertising in disguise and refer people to commercial services and products that are supposed to help in combatting the harmful effects of 5G.

For example, Espace mom, a distributor of anti-wave products, promotes an energy pendant called mom@I, which 'converts electromagnetic waves into good waves. Perfect for protecting yourself against daily aggressions (mobile phone, cordless phones, Wi-Fi, 5G technology, etc.)'.

Hubert Mauerer, who designs the anti-wave devices produced by this brand, presents himself as follows:

An independent researcher who has created Mom@ products, anti-electromagnetic wave devices, drawing on a gift which is manifested in what might be called intuitive design, similar to the automatic writing of certain authentic mediums, as well as radiesthesia, which for forty years has allowed me to draw the radiation emitted by living beings and things.

At the ecosystem level, the balance is upset by disruptions to natural spaces which are polluted by electromagnetic waves coming from human infrastructure. The arguments may at times dip into various spiritualities, but for the most part they are built around demonstrations that oscillate between biology and an explorer's log book. Typically, a demonstration is a video where we follow volunteer experimenters in boots who go deep into the woods to take readings of exposure to electromagnetic waves and explain their effects on the animal and plant kingdoms: dead tree trunks within range of an antenna, cadavers of bats whose sonar was jammed, they say, by electromagnetic waves. While scientific studies may occasionally be offered to support the argument, it is mainly based on empirical observation. The strength and weakness of these arguments rests on how spectacular the observations are. The demonstrations combine the appearance of a scientific protocol (e.g., with a device to measure exposure to waves) and the force of evidence (the explorers go to see things with their own eyes).

The argument of an energy-consuming innovation: Is there no limit to technology?

The third line of argument targets the high energy consumption and pollution produced by 5G. By multiplying the connectivity of data-exchanging devices, 5G will dramatically exacerbate the ecological impact by exponentially increasing the amount of data consumed. And by making many devices obsolete (including telephones), new devices will have to be manufactured, causing pollution and the overconsumption of rare metals.

In a video published on 18 February 2020 and widely circulated by groups of ecological activists opposed to 5G, Aurélien Barrau, an astrophysicist (director of the Centre for Theoretical Physics at Grenoble-Alpes) and militant ecologist who is well known in the media, presented his position on 5G as follows:

I believe we need to have a public debate on this issue... First of all, there are the effects of electromagnetic waves on human health, about which there has been a great deal of debate and which really require further study. I am glad that the public debate about this will lead to more precise investigations. But I am much more concerned about the energy aspects. I am referring in particular to the figures produced by the Shift Project; there is no doubt about them knowing how to conduct a carbon footprint study or an energy consumption study. It appears quite likely that, owing to the shift to 5G, the energy consumption of telecom will triple in a few years. That's an exorbitant cost. (Aurélien Barrau, 2020)

In our corpus, the argument about energy overconsumption is separate from the argument about waves disturbing ecosystems. Although they are sometimes voiced at the same time, they are often considered to be different.

Interestingly, the argument about overconsumption often rests on quantified studies, not necessarily publications in scientific journals (contrary to topic A), but from reports by advisory and legislative bodies, consulting firms, and lobbying groups. Arguments in this line often point to the same underlying question: Is there no limit to technology? They denounce society's blameworthy indecisiveness.

Industrialized civilization is a civilization of machines, and 5G is machines, even more machines, obviously. But the goal of this civilization is to create more and more machines and consequently to dehumanize us. That's why we are opposed to this type of civilization and we are fighting to dismantle it (Leon, member of Deep Green Resistance,¹⁴ a movement that promotes radical activism, who was interviewed with his face masked for a documentary broadcast by Arte about groups involved in sabotaging telecom antennas). (Arte, 2021)

¹⁴ Deep Green Resistance France is an environmental group that promotes radical activism.

Citizens against the system

The argument about indecisiveness is taken up again in a different way in the last topic, which denounces 5G technology being forced upon us, against public opinion.

Dr. Paul Héroux presents the dangers of 5G from the point of view of chemical engineering. This wireless telecommunication technology is currently being deployed in most places around the world, although science clearly demonstrates its harmful effects on the environment and on natural organisms, including the human genome. It seems we have learned nothing from the revelations of lies from tobacco manufacturers and the petroleum industry because our governments are getting ready once again to put the future of humanity in danger in order to give free rein to a handful of multinational corporations that want to impose this new industrial insanity on us, which we have basically no need for (Christian Aubry, former journalist, communicating online, summarising the above-mentioned conference of Paul Héroux, which he released on YouTube).

There are several intertwining theories about the origin of this forced deployment of 5G and the political implications of this realisation. Some arguments point to industrial interests, taking aim at private corporations, in particular telecom operators and manufacturers, seen as wanting planned obsolescence for devices as well as current phone plans. The 'foolishness' of consumers is lambasted. Additionally, there is criticism regarding the dangers of 'surveillance capitalism', to borrow Shoshana Zuboff's (2019) term, whereby 5G represents the telecommunications infrastructure that will enable the deployment of a network of devices (including IoT) whose ultimate goal is to constantly collect information on individuals and to monetise this data. Similarly, some activists also warn against an imminent dystopian techno-police, making intensive use of a video-surveillance network supported by facial recognition.

In an opinion piece entitled 'Brisons le totem de la 5G' (Let's smash the 5G totem), published on 09 October 2020, substantiating its opposition to 5G, a group called La Quadrature du Net, which presents itself as an association that 'promotes and defends fundamental freedoms in the digital environment', sums it up as follows:

It doesn't matter whether these promises are credible or not, we are warning against what they represent. They are a reminder, from the techno-security industry – which exists only for itself and imposes its agenda everywhere – that we have never had a say in these major industrial programs, that this industry and its accomplices within the state have given themselves the right to control us through their countless gadgets, even if it means contributing to ruining this world and endangering the humanity we have left. (Quadrature du Net, 2020)

Some arguments are directly rooted in conspiracy theories, denouncing an alleged worldwide plan for sterilisation through 5G. The proponents of these arguments see the fight against 5G as an opportunity to spread these theories to people who are sensitive to the question of electromagnetic waves or for other reasons (see topics A, B, and C).

The 'citizens against the system' argument also targets the inability of politicians to uphold the precautionary principle and to defend the public interest. The legislative system is considered to be too easily influenced by lobbies and too complex, which explains the apathy of citizens even when faced with threats to their interests and to their health. Sometimes the opposition to 5G is combined with other local struggles, becoming a symbol of the fight for increased citizen participation in the legislative process. Numerous municipalities in France and Switzerland are strongly in favour of moratoria, which reflects a broader debate on citizenship.

Disparities in goals and scale

There are significant disparities between these lines of argument in terms of goals and scale. The movement combines opposition groups focussed on 5G, and the perceived risks of this technology with groups that want to make 5G an exemplary case in a broader fight. The impacts of 5G are assessed on different scales, ranging from an individual level to more systemic approaches, evoking the risks not only for humans but for ecosystems. Splitting the arguments along these two lines reveals four subgroups, identified in Table 2. For each of them, we identify the type of proof offered in support of their arguments. We also indicate the main disciplines in which a response may be provided, to highlight the ontological disparities that distinguish the four quadrants of this .

The disparities in terms of goals and scale partly explain the success and resilience of the anti-5G movement. The opposition to 5G is spread across a variety of arguments that are

Table 2. Opposition to 5G divided along goals and scale

| Disparities in scale | Individual | | System | |
|--|---|----------------------------------|--|---|
| Disparities in goals | | | | |
| An exemplary combat (making 5G technology an example of a bigger problem) | <p>The citizen against the system</p> <p>Citizens are deprived of their ability to choose and influence policy, faced with powerful groups formed against their interests. They are limited to the role of consumer:</p> <p>Proof offered: the presence of pressure groups (lobbies) and conflicts of interest.</p> <p>Key actors: associations for civil liberties, local activists, municipal opposition; conspiracy groups</p> | <p>Political science and law</p> | <p>An energy consuming innovation: no limit to technology?</p> <p>Society is engaged in a headlong race towards over-production and over-consumption, spurred by cycles of fundamentally superfluous innovations</p> <p>Proof offered: society's indecisiveness and disarray of modern man; socio-economic relations on consumer society</p> <p>Key actors: associations and environmental activists; academia and peri-academics on the ecological transition</p> | <p>Economics sociology and philosophy</p> |
| A combat focussed on this technology (denounce problems arising directly from 5G and what it engenders on humans and ecosystems) | <p>Health: electromagnetic waves are dangerous to health</p> <p>Waves are carcinogenic and cause heightened electro-sensitivity</p> <p>Proof offered: clinical studies and the symptoms of electro-sensitive people</p> <p>Key actors: associations and activists urging the recognition of electro-sensitivity; (peri-)medical actors; vendors of anti-5G products</p> | <p>Medicine, physics</p> | <p>Disturbed ecosystems</p> <p>5G infrastructure disturbs the cycles of flora and fauna, and the internal balance of humans</p> <p>Proof offered: <i>in situ</i> observations of various imbalances</p> <p>Key actors: groups and associations that defend alternative practices and spiritualities (soft medicine, esotericism); local activists (defending the natural space); vendors of services (training courses, meditation, personal development)</p> | <p>Life sciences</p> |

Source: Own elaboration

Table 3. Extract from Appendix 3 on the distribution of argument types by source

| Source | Electromagnetic waves are a danger to health | Disruption of humans and ecosystems | Energy-consuming technology | Citizens against the system |
|--|--|-------------------------------------|-----------------------------|-----------------------------|
| Discourse of a member of a French association defending digital freedoms | 0.17056 | 0.01246 | 0.08184 | 0.73514 |

Source: Own elaboration

quite different, even divergent, which illustrates the 'all over the place' nature of this movement. This makes it impossible to respond with a single pro-5G argument, given the diversity of academic disciplines needed for a debate.

But how do 5G opponents adapt to such a diversity of arguments? The following section explores the way opponents refer to lines of argument that are not initially theirs through a rhetorical practice we call 'argument decentring'.

Argument decentring

Our qualitative study of these extracts from the corpus sheds light on what we call 'argument decentring', the principle of which is that opponents use the existence of a controversy fed by other 5G opponents to their advantage. To present this phenomenon, we begin by showing that opponents do not remain confined to their line of argumentation; instead, they (1) identify and denounce the difficulties encountered by other opponents. Next, we explain how they (2) present these difficulties as a controversy and how they exploit these difficulties to their advantage by shifting the focus. Finally, we examine how this practice of argument decentring leads to (3) the different opponents reciprocally strengthening each other, in particular through interconnected communication, and thanks to the algorithms of platforms such as YouTube.

Identification and denunciation of difficulties encountered by other opponents

The above-mentioned four main lines of argumentation constitute the core of the arguments in opposition to 5G. Nevertheless, 5G opponents do not adopt all four arguments simultaneously. In our corpus, opponents' arguments are mainly structured around one or two major lines (see 3 and Appendix 3 for a detailed view of the distribution of arguments). For example, in the discourse of a member of the Quadrature du Net group regarding their participation in an anti-5G demonstration, the majority (74%) of the arguments invoked fall under the 'citizens against the system' heading. This constitutes the core of their arguments. Nevertheless, other lines of argument appear in a

supporting role: 'electromagnetic waves are a danger to health' (17%) and 'an energy-consuming technology' (8%).¹⁵

Indeed, apart from one or two major lines of argument, 89% of the corpus also contains mentions of other arguments to a lesser extent (see Appendix 3): 37% of 5G opponents refer to a single line of argument other than the major one(s) at their core; 56% to two and 6% to three. Although they focus their discourse on one or two arguments, 5G opponents are not unaware of the arguments of other opponents and 89% of them integrate them to a lesser extent in their own discourse.

This phenomenon of the intertwining of arguments raises the question of how several lines of argumentation are articulated with each other within the same resistance. To answer this question, topic modelling allows us to quickly identify extracts of discourses that contain mentions of these secondary arguments borrowed from other opponents. Thanks to these selections, we can concentrate specifically on the way anti-5G activists refer to the arguments of other opponents.

The presentation of these difficulties as an exploit controversy in order to bring about a shift

The purpose of argument decentring is to shift an argument borrowed from other groups of opponents into one's own argumentation. To achieve this, the speaker begins by describing the difficulties encountered by these other opponents in their struggle. These difficulties may vary from one speaker to another: censorship, the influence of lobbies, or the inability of 5G promoters to adopt a broader perspective (ecological, spiritual, etc.) that would facilitate dialogue. For example, Felix Tréguer, member of Quadrature du Net (whose main line of argument is 'citizens against the system'), describes the challenges facing the activists who point out the health dangers of electromagnetic waves, while making it clear that he differs on the basis of their argument:

¹⁵ The threshold for a line of argument to be considered major is set at 20% and minor between 2% and 20%. See Appendix 3.

I find that there is something rather unhealthy about the aggressiveness toward the 'anti-wave' people. When Anses [French Agency for Food, Environment and Occupational Health and Safety] estimates that 5% of the population is electro-sensitive and although scientists haven't managed to prove a link between the waves in our daily environment and these symptoms, we cannot, in my view, mock the position of the anti-wave group as if 'Science' had ruled on this question once and for all. Granted, we can't necessarily give the benefit of the doubt to the anti-wave people, but we also know that science is mostly a series of postulates that have yet to be disproved. We don't know everything, and when there are unexplained questions about pathologies that have been widely observed, scientific doubt and a basic sense of empathy should lead us to exhibit comprehensive humility regarding the suffering of these people and to be attentive when they express their defiance about the functioning of health agencies and when they document the conflicts of interest around them. (Tréguer, 2020)

For the speaker, denouncing the difficulties experienced by electro-sensitive people is a way of echoing the difficulties encountered by members of the Quadrature du Net group: by drawing implicit or explicit parallels between their struggle and his, the speaker uses the example of the controversy about the health risks of 5G to legitimate his own discourse on adopting a vigilant or critical stance towards the official positions of the authorities. Opening up to other groups of opponents, and other distinct lines of argument helps to build bridges between communities fighting 5G.

We observe this practice of argument decentring on the conspiracy channel 'CielVoilé', whose main thrust is to circulate theories about the manipulation of populations, particularly through the dissemination of chemical agents in the air.¹⁶ Its main argument is rooted in the 'citizens against the system' stance with an acknowledged conspiratorial take.

In their discourse, we find several instances of argument decentring: Ciel Voilé uses the controversy about the 'health danger' of 5G to promote its own analysis on the loss of sovereignty of individuals over the democratic control of technology. For CielVoilé, the obstacles faced by those who raise the alert about the health dangers of 5G amount to censorship. Picking up on the arguments of Cece Doucette (a figure in the American anti-5G movement), Ciel Voilé published the following:

The public health department in California published a long list of facts in 2009. And it was suppressed by industry. A professor at UC Berkeley launched a lawsuit so that these statistics would be published and the public would become aware of them. Industry has conducted its own studies ... they did not invoke the principle of precaution. They did away with it and had the Telecom Act passed. (CielVoilé, 2018)

¹⁶ The name Ciel Voilé (hazy sky) echoes conspiracy theories on 'chemtrails', that is, the climate and populations are being controlled with chemical substances sprayed into the air by the airplanes, leaving white cloud-shaped traces in their wake.

By denouncing a kind of censorship, CielVoilé was able to shift the borrowed line of argument (health dangers) to its own line of argument (citizens against the system), which hence became stronger. Ciel Voilé commented the following:

Before the pandemic, our association disseminated information essentially about the ongoing control of climate, about ongoing geoengineering, and about the destruction, deliberate or not, of the atmosphere, ground, water and every living thing on earth. But faced with the outrageous decisions made by so many governments that all seem to follow the same road map, faced with very serious breaches of law and the infringement of individual and collective liberties, faced with unprecedented economic devastation, we are giving a voice to those that the controlled media have ignored or censored. We are witnessing a shift in civilization. (Ciel Voilé, presentation of the section on electromagnetic waves and 5G)

Like CielVoilé, other conspiracy websites that we examined do not specifically emphasise the health problems linked to 5G in their arguments. The controversy surrounding 5G is leveraged to support their idea that secret groups are plotting to control the world, citing the difficulties encountered by people who raise the alert about the dangers of 5G as additional proof.

In the case of Ciel Voilé, argument decentring proceeds from the 'health danger' argument to the 'citizens against the system' argument, but these practices are not specific to those lines of argument, and we find other combinations in the corpus.

For example, the 'health danger' argument may be decentred and shifted towards arguments other than 'citizens against the system', such as that decrying the 'disruption of humans and ecosystems'.

For Espace mom, an actor in the anti-electromagnetic waves current (whose main line of argument is 'disruption of humans and ecosystems'), the 'health dangers' of 5G serves as a pretext to demonstrate the limitations of apprehending the world and individuals solely through the prism of modern medicine, underscoring the urgency of adopting a different perspective on the power of electromagnetic waves. Referring to studies on the 'health dangers of 5G', Espace mom reminds us that:

Numerous studies that demonstrate the dangers of electromagnetic waves struggle to be published and to be heard by the general public. Our role is not to create more stress and to tell you to go live in a cave. . . Just to be more aware and try to live better in the current world. [. . .] The invisible surrounds us. We only know a tiny part of our world. Every day science evolves; what was false yesterday becomes self-evident today. [. . .] Our vision is being shared more and more by everyone, because it is becoming evident that we are interconnected and are subject to influences that are beyond our understanding.¹⁷

¹⁷ Espace mom (2022, January). Welcome to Espace mom. Espace mom. <http://www.espacemom.com/> (our translation).

Like Espace mom, several adherents of the 'disturbance of humans and ecosystems' argument evoke the health debate to highlight the impasse in which modern science finds itself, unable to decisively resolve the question because it is blind to certain spiritual dimensions.

Argument decentring can be observed between all four lines of argument that emerged from the corpus. This practice also helps to explain the presence of secondary lines of argument, borrowed from the arguments of other 5G resistance groups.

Reciprocal strengthening through interconnected communication and amplified by social media algorithms

Interactions between groups of 5G opponents – albeit divergent – are greater online because of algorithmic recommendation mechanisms which amplify the effects of convergence. For example, when a channel reposts a video made by actors espousing a different line of argument, the community behind that argument tends to congratulate the channel. In return, reposts are explicitly linked to the sharing of the initial video, thus 'returning the favour' and increasing the visibility of these actors. For example, for the conspiracy channel Ciel Voilé, video reposts on the health dangers or ecological dangers of 5G are among the 10% most popular on their channel (according to the YouTube metric), even though the question of 5G appears to be secondary with respect to their original concerns.¹⁸ As a sign of convergence, comments left under the videos on the subject of 5G encourage these reposts: 'Thanks! It's important that we stick together', says one user. Another adds, 'covid-5G-chemtrail, we're fighting the same fight'. 'Thanks so much, we'll post your video on Savoir&Co', says Mediatekpopulaire, who runs another YouTube channel. Significantly, for the 39 videos about 5G posted on Ciel Voilé's channel, the comments encouraging people to share videos or linking to other YouTube channels (such as BioticTV) receive 132% more likes¹⁹ than the average comment. And for 82% of this sample of videos, at least one comment of this type appears among the five most liked. As the YouTube platform often displays the most relevant comments by default, and this 'relevance' is mainly a function of the number of likes, these comments automatically rise to the top of the thread of comments posted.

¹⁸ In January 2022, 55 videos posted by the channel are about wave technologies (cell phones, Wi-Fi, 5G, radar, etc.), which accounts for 11% of the 490 videos posted by the channel. Of the videos on wave technologies, 71% are about 5G. The ranking of the most popular videos is done by YouTube according to the total number of views and the trends (time series) for the period.

¹⁹ Measured by the number of 'thumbs up' under the comment.

By posting videos made using the practice of argument decentring, Ciel Voilé promotes actors whose arguments are distinct from its own main line (citizens against the system). In return, the channel is credited and its videos reposted by other channels such as BioticTV, which is more about alternative medicine and spirituality linked to waves (main line of argument: 'disturbance of humans and ecosystems'). By proceeding in this way, these actors give greater visibility to the arguments of other groups, algorithmically increasing their visibility on platforms such as YouTube. We thus observe reciprocal strengthening.

This reciprocal strengthening occurs at the level of YouTube's recommendation algorithm. When someone clicks on a video, the platform proposes a selection of videos that will come up next. During our data collection we observed that, owing to these interactions and video reposting, certain channels whose lines of argument differ became 'linked', which means the recommendation tab associates their videos and suggests watching them one after the other. For example, the Robin des Toits association, which fights for the recognition of electro-sensitivity (main line of argument: 'disturbance of humans and ecosystems'), and the Alterte PhoneGate association, which advances the idea of serious collusion at the highest level between politicians and telecom (main line of argument: 'citizens against the system'), have been engaging in argument decentring between their respective lines of argumentation since 2020 by referring to each other. The result is that several of their videos are linked by recommendation algorithms, even when the user reinitialises their settings (clears cache and cookies). Without taking any particular action, a normal user that clicks on one of these channels is highly likely to be recommended a video from the other channel, and vice versa. The practice of argument decentring whereby they use other opponents' arguments to their advantage is amplified by video recommendation algorithms, which tend to make this content more visible by recommending it to a broad base of viewers.

Discussion and avenues for future research

These results underscore several dimensions that merit discussion: the heterogeneity of the resistance movement and the role of maintaining controversy in resistance strategies, the diversity of arguments in resistance movement, the aggregation of divergent arguments, the algorithmic mechanism of argument decentring and finally, in terms of methodology, topic modelling for rhetorical studies in management.

Heterogeneity of the movement and the role of maintaining controversy in resistance strategies

Research in the social sciences has shown the importance of controversy, both in resistance strategies and in the promotion of innovation (Jarrige, 2010). In general, the rhetorical perspective frames controversy as a confrontation in which actors tend to disseminate a narrative that sets two camps against each other. Authors such as Ruebottom (2013) illustrate how the different camps legitimate themselves with respect to this opposition, using rhetorical strategies aimed at giving credibility to their role as protagonists (with the underlying narrative structure of a hero on a quest) and confining the other camp to the role of the antagonist (which only exists because of its opposition to the hero).

Thus we find the pro- and anti-sides, whether for electric cars (Noel et al., 2019), smart electric meters such as Linky (Chamaret et al., 2020), biotechnologies (Davies & Macnaghten, 2010; Halstead et al., 2021), among others. The opposition between two unified camps is a central dimension in the rhetorical strategies of resistance movements. Our study sheds light on what is at play beyond this binary schema. In this regard, our findings about argument decentring reveal not only on how a camp persists in spite of a kind of internal heterogeneity, but how that heterogeneity may even constitute a strength. The concept of argument decentring responds to a question in the rhetorical perspective in management studies (see Sillince & Brown, 2009) on the construction of argument strategies which not only allow actors to maintain multiple institutional identities, but to leverage this heterogeneity to gain legitimacy in the eyes of the public.

Consequently, this finding raises questions about the role of controversy in the rhetoric of the anti-5G movement. A substantial part of the literature on the question presents controversy as an opposition between camps, with the assumption that each side wants to supplant the other through various strategies aimed at undermining their arguments or their credibility (Peng et al., 2023; Shepherd & Challenger, 2013). Other studies have added an analysis of the benefit to certain actors of maintaining the controversy over time, in a strategy of raising doubt, and suggesting that the controversy is at an impasse rather than a direct confrontation between camps. An example is the tobacco industry which, when confronted in the 1950s with solid scientific data on the harms of smoking, deployed considerable efforts to maintain a scientific controversy aimed at discrediting these studies and minimising the perception of the harmful effects of smoking (Brandt, 2012). Our results make another contribution to the literature by showing how the heterogeneity of a movement such as the one against 5G may help to maintain the controversy in the medium term by introducing groups of opponents who, although they do not necessarily share the same

reading of the problem, have an interest in seeing the controversy sustained over time. Our results also illustrate how the controversy may be used to raise doubts or mistrust, not only at the heart of the debate – in our case about 5G – but also regarding actors or subjects adjacent to the controversy, such as the purported collusion between public authorities and large corporations, or the ecological question. This use of controversy favours the creation of links between different struggles, and may facilitate movement from one to another. The practice of argument decentring may explain the proliferation of bridges between the arguments of opponents who apparently espouse different political and ideological viewpoints. Certain actors in our corpus clearly acknowledge the need for a kind of convergence, achieved by sharing and relaying the arguments of other opponents, without necessarily agreeing with them. This analysis thus opens up promising research avenues to examine the role of argument decentring in boosting a controversy that is running out of steam or as a source of resilience for the different groups of resistance engaged in these struggles.

The controversy around 5G reached a kind of apogee during the period of our study (2019–early 2022), with the *de facto* construction and maintenance of a diversity of arguments. As Hughes (2018) remind us, there is a kind of 'processuality' in the rhetoric of resistance to innovation that our study struggles to apprehend and which constitutes one of the limitations of this research, because topic modelling using LDA does not take into account the chronology of the arguments. To improve on this study, one avenue for future research would be to study the evolution of the rhetoric of resistance to innovation during the period of fragmentation and dissolution of these movements, with or without the maintenance of certain bridges between resisters or the shift from one resistance movement to another. This point is especially significant as the anti-5G movement is part of a line of recent socio-technical controversies, such as the one against Linky smart meters (Chamaret et al., 2020), but also against COVID-19 vaccines (Flaherty et al., 2022). In the future, some major resistance movements are expected to arise, in particular against AI (Smith, 2021), for which 5G may serve as a linchpin, providing the network infrastructure needed for the massive and rapid transfer of data. Our results, which focus on the upstream phase of the movement, also suggest looking at the downstream phase, in particular by setting our sights on the mechanisms that may facilitate or prevent the shift from one resistance movement to another. One of the key points for consideration emerging from our results would be to study whether or not the convergence of arguments between opponents who have different motivations is maintained during this shift between two resistance movements.

The diversity of arguments in resistance

This study contributes to the research on resistance to innovation by analysing processes at the level of the movement, not the individual.

Several studies have stressed the importance of examining resistance through the lens of its complexity: the multitude of resistance practices and sabotage (Lamoureux, 2022), and the intertwining of several competing identity discourses (Hughes, 2018; Trapero-Llobera, 2020).

In this study on the resistance to 5G, we show that resistance to innovation stems from a combination of ostensibly different or divergent arguments. This finding adds to earlier research which highlighted the diversity in the profiles of resisters to a given innovation (see e.g., Chamaret et al., 2020, who have shown the multiplicity of profiles that might get involved in the resistance to smart meters) by describing how resisters combine several types of arguments in their rhetoric.

Our analysis further details this observation by showing that in the case of 5G such a diversity of arguments results in significant disparities in terms of the goals of the resistance movement. Some opponents focus on 5G because it is perceived as risky. In addition to the arguments in our corpus which illustrate this point, we also find this idea more generally in the opposition to technologies using electromagnetic radiation, as expressed by bestselling books such as Debaun and Debaun (2017) and Mercola (2020). On the other hand, some opponents target this technology, making it an emblematic fight against a larger problem. Then it is a matter of resisting what the technology represents rather than the danger posed by the technology itself. In this respect, our results confirm certain studies on social networks (Bruns et al., 2020, 2021; Meese et al., 2020), which point to the irruption within the anti-5G movement of theories that were initially completely exogenous to it, such as conspiracy theories.

Alongside this distinction about the goals of the resistance movement, our analysis also reveals a difference in the level at which the problem is considered: between opponents thinking at the level of the individual and others who subscribe to more systemic thinking, at the level of society. This observation resonates with the work of Wynne (2001, 2006) who shows that one of the causes of resistance to GMO crops among the general public is a reaction to the tendency of the technology's promoters, especially scientists, to try to narratively frame the controversy, effectively eliminating any form of dialogue with individuals who wish to engage in a more fundamental debate about the relationship between technology and society. This diversity in terms of goals (focussing on 5G or making it emblematic of a larger problem) and level (individuals or systems) complicates the nature of the arguments, and

therefore the responses to be brought. These two distinctions and the four lines of argument allow us to better apprehend and understand the phenomenon of resistance to 5G and technology in general.

The diversity of arguments in the resistance also opens up new avenues for research such as investigating the promoters of the technology and the way they interact with the resisters' different lines of argument. Although studies have often focussed on the confrontation between pro- and anti-arguments, effectively blurring the complexity of positions within each of these camps (Chamaret et al., 2020; Symon, 2005; Symon & Clegg, 2005; Wynne, 2006), future research could seek to better understand the diversity of responses within the pro-camp and the rhetorical strategies implemented in the interaction with the anti-group.

Aggregation of a resistance movement

Our research reveals the great diversity of opponents in the 5G resistance movement. We observe very different resisters who may appear to be radically opposed: activists on the far right and on the far left, Catholic traditionalists, libertarians, scientists, conspiracy theorists, among others (see in Appendix 1.2). This diversity makes one wonder how these individuals can constitute a 'movement'. Digital technology and online platforms appear to play an important role in the phenomenon of aggregating individuals with very different sensibilities (Etter & Albu, 2021; Hietschold et al., 2020; Vaast et al., 2017). The work of Hietschold et al. (2020) shows the importance of certain actors – the 'aggregators' – who bring about this crystallisation of diverse opponents within the same movement. Our study contributes to understanding this phenomenon by highlighting the role of rhetoric in this aggregation, in particular through argument decentring, whereby some opponents leverage the controversy generated by others to their advantage, without necessarily agreeing with their arguments, which leads to a mutual reinforcement between lines of argumentation which at first glance appear to be very different and are voiced by contrasting socio-political profiles.

Owing to their plasticity, social media offer a particularly important 'sounding board' to resistance movements (Etter & Albu, 2021; Vaast et al., 2017). Platforms such as YouTube and Facebook have demonstrated their ability to crystallise movements, such as that of the yellow vests in France (Boyer et al., 2020), QAnon (Garry et al., 2021) or resistance to a technology such as COVID-19 vaccines or 5G (Bodner et al., 2020; Bruns et al., 2021). With 70% of the corpus made up of YouTube videos, our research improves our understanding of the way activists use social media

platforms in their resistance. It would be interesting to continue this research by investigating the way online platforms enable resistance actors to play with the diversity of lines of argument and the different audiences of the platforms. For example, by advancing more consensual arguments to bring the movement together or, on the contrary, by diffusing conflictual arguments in a more targeted way.

The algorithmic mechanism of argument decentring

The notion of argument decentring is to be considered in the context of the media through which the arguments are disseminated. In keeping with the literature that underscores the importance of free video platforms in the viral dissemination of certain controversies (Anthony & Thomas, 2010; Hess, 2009; Marchal & Au, 2020), a significant share of our corpus was collected on YouTube. The importance of the argument decentring that we identify in our results is potentially amplified by the fact that the resistance to 5G occurs mainly on YouTube, whose algorithms give more weight to mutual recommendations and referrals between video creators (Arthurs et al., 2018; Bryant, 2020). Because YouTube offers an abundance of videos, it would be futile to try to confine viewers to an overly restricted perspective. At the same time, the creation of algorithmic 'filter bubbles' such as that of the Alt-Right on YouTube (Bryant, 2020), spur video creators to engage in this game of mutual recommendations and video linking, adopting the Hofmann (2001) codes and the (relative) diversity of viewpoints that exist there. By including links in their videos to another viral opponent to 5G, even one with a very different profile and motivations, video creators may improve the visibility of their videos thanks to the algorithm. Consequently, the spread of argument decentring tends to augment the reciprocal strengthening of visibility between these actors, and thus the visibility of actors who engage in argument decentring to the detriment of those who do not.

This hypothesis could account for the significance of rhetorical mechanisms such as argument decentring. These results raise questions and open new possibilities for research into the role of social media in the current and future structuring of resistance-to-innovation movements, with the emergence or strengthening of rhetorical mechanisms coming from the digital media upon which the movement is built.

Topic modelling for rhetorical studies in management

Our last contribution is a methodological one. While the use of methods such as topic modelling is growing and gradually being structured in management science (Aranda et al., 2021; Goldenstein & Poschmann, 2019; Kang et al., 2020; Kherwa &

Bansal, 2020) and in related areas such as political science (Lo, Proksch & Slapin, 2016; Slapin & Proksch, 2008) or sociology (DiMaggio et al., 2013), our results show that topic modelling using LDA (Blei et al., 2003) can significantly contribute to the rhetorical approach thanks to its ability to computationally identify lines of argument within a corpus. Latent Dirichlet allocation thus joins a broader and growing array of lexicometric methods alongside other tools such as top-down hierarchical cluster analysis (e.g., Bueno Merino & Duchemin, 2022; Cristofini, 2021), which offer new opportunities for research in management science. As underscored by Aranda et al. (2021), the algorithmic approach is necessarily combined with a qualitative analysis part. But the qualitative phase is greatly strengthened epistemologically by the uniformity and impartiality of the first phase of computational textual analysis. In keeping with the rhetorical perspective on resistance (Symon, 2005), this methodology appears to be particularly suitable for capturing the production and dissemination of discourse at the 'mesoscopic' level, to use the term coined by Alvesson and Kärreman (2000). This is an intermediate level between 'micro-discourse' (discourse at the level of a precise organisational situation) and 'grand and mega discourse' (which are discourses that structure representations at the level of society). The idea is not to obscure the 'grand discourses': the lines of argument identified by topic modelling may borrow from grand discourses on the evolution of society, the world, mankind, but will be treated as arguments, not as the marker of a structuralist perspective on the discourse of individuals. Indeed, the purpose of rhetorical analysis is not to demonstrate the power of these grand discourses on our subjective constructs, but simply to see how they can be manoeuvred at the level of a set of arguments. In this perspective, our study shows the utility of topic modelling using LDA to identify similar rhetoric used by opponents and, by contrast, the dissimilarities that split disjointed groups of opponents.

Conclusion

In conclusion, our study calls attention to the diversity of arguments that can coexist within a single movement, with significant disparities in terms of goals and scale. From a practical point of view, our results offer a new analytical framework for a set of actors (resisters, public authorities, industrial actors).

Unless arguments are identified carefully, an actor that hopes to have a dialogue with resisters runs the risk of bringing arguments that are incongruent with the reading of certain segments of opponents, and thus only talking to a limited part of the movement. For example, by limiting themselves to the health dimension, promoters of 5G and public authorities might develop an argument that would be unsuited to opponents who are aligned with the other lines of argument

identified. Such a mismatch would feed into the feeling of disconnect between promoters and opponents of new technologies, which is a growing and worrying dynamic according to authors such as Wynne (2001, 2006).

Finally, our results suggest that the success of a resistance movement also stems from its potential to aggregate heterogeneous groups of opponents. While a significant part of the literature gauges the potential of resistance against the perceived risk of the innovation (Jacoby & Kaplan, 1972; Kleijnen et al., 2009), our study tends to show that there is also a social and rhetorical element (Symon, 2005): the success of a resistance movement is also a function of its ability to bring about the convergence of several heterogeneous groups of opponents. Consequently, our study suggests that all stakeholders (industrial actors, public authorities, and the resisters themselves) should remain vigilant: even an innovation with a relatively low perceived risk may crystallise a significant resistance movement if and when such convergences should occur. We suggest that the practice of argument decentring may serve as a marker to anticipate such convergences and the emergence of a movement which goes beyond simple criticism of the innovation, turning it into a rallying point.

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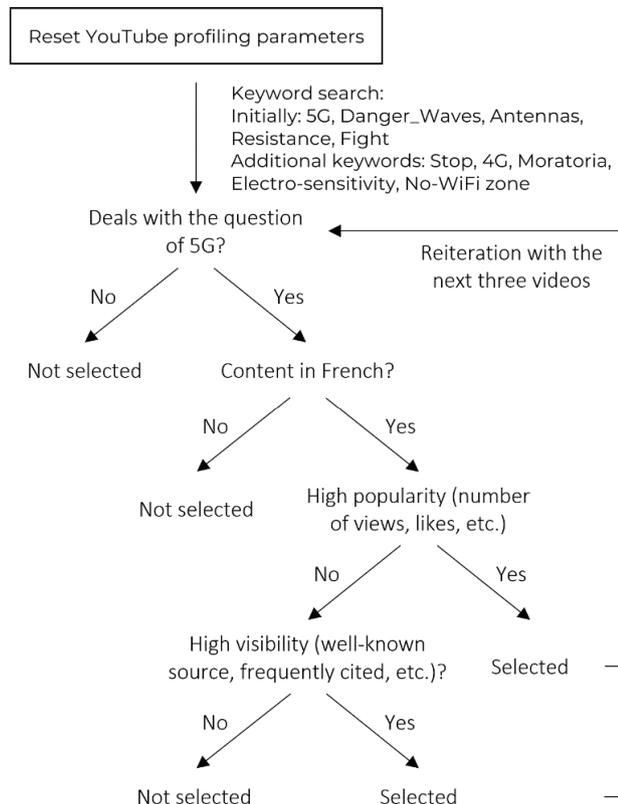
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Appendices

Appendix I. Details on the methodology for data collection and pre-processing



Source: Own elaboration

Appendix I.1. Data collection process for online content platforms

Data collection was conducted between November 2021 and January 2022 on online platforms using keywords in French (5G, danger; waves, antennas, resistance, fight). Additional keywords were added in a second stage (stop, 4G, moratorium, electro-sensitive, no-Wi-Fi zone) using the main search engines, especially YouTube. We applied two main selection criteria: popularity (high number of views and reactions such as likes and comments) and the visibility of the source in the credits of other visible actors (those regularly cited in the most viewed videos). The goal was to include arguments that could not be captured just using the criterion of views on YouTube. For example, when an opinion piece is published on an association's website, it may have an echo (activists mention it in their arguments) without being indexed by Google, YouTube, among others. YouTube videos account for a large share of our corpus (around 70%) as it is the medium of choice for a variety of opponents to 5G, with a broad audience and arguments that are sometimes more cogent than those advanced in pamphlets and legal proceedings against 5G (moratoria, etc.). Moreover, research has pointed out the platform's important role in the dissemination of viral controversies (Hess, 2009; Anthony & Thomas, 2010), recent concerning the dissemination of COVID-19 disinformation (Marchal & Au, 2020). Starting with the main videos, we then proceeded to follow the thread of the next three items of content suggested by the algorithms. This corresponds to the information pathway proposed to targeted activists in the anti-5G movement. We cleared our cache and cookies to reinitialise the recommendation algorithms before repeating the operation. Indeed, the 'netnographic' research method highlights the epistemological benefits of emulating the browsing process of the individuals and populations studied, adjusting one's own browsing (recommendation algorithms, etc.) to closely match the conditions of an ordinary subject under observation (Kozinets, 2006).

Appendix I.2. Table of sources and publication dates

| Publication date | Source | | Type of document | | Number of words |
|------------------|--|--|------------------|------------------------------|-----------------|
| | | | Videos | Pamphlets/ opinion pieces | |
| 2018 | 'Reinformation' influencer (conspiracy theorist) | Ciel Voilé | x | | 2,043 |
| 2018 | International media in French (interview with Annie Sasco, epidemiologist) | TV5 Monde | x | | 2,439 |
| 2019 | Online media (conspiracy theories) | Kla.TV | x | | 2,050 |
| 2019 | Production specialised in sensationalist documentaries | Investigations et enquêtes | x | | 5,312 |
| 2019–2020 | Information website (anti-wave pseudo-science) | EHS & MCS | | x | 9,836 |
| 2020 | French national daily news (reports) | France 3 | x | | 3,519 |
| 2020 | YouTube channel (alternative lifestyle and conspiracy theories) | Aphadolie | x | | 11,038 |
| 2020 | YouTube channel (fight against smart electric meters) | Stop Linky | x | | 8,399 |
| 2020 | Association (electro-sensitivity) | Robin des toits | | x | 9,062 |
| 2020 | Commercial website (anti-wave technology) | Espace Mom | | x | 30,689 |
| 2020 | YouTube channel (alternative lifestyles) | Appel à se réveiller | x | | 8,702 |
| 2020 | Online media | Le Média | x | | 2,110 |
| 2020 | YouTube channel (consumption) | Ariase | x | | 2,052 |
| 2020 | YouTube channel (evangelical) | Worship and Praise | x | | 3,918 |
| 2020 | Canadian 'reinformation' website | Reinformation TV Canada | | x | 5,376 |
| 2020 | Swiss online media | Nouvo/36.9 (including Jancovici interview) | x | | 6,833 |
| 2020 | Conference by a medical researcher | Dr. Paul Héroux | x | | 11,191 |
| 2020 | YouTube channel (ecology) | Cemil | x | | 2,627 |
| 2020 | Figure in ecological activism | Dr. Aurélien Barrau | x | | 1,527 |
| 2020 | YouTube channel ('reinformation' conspiracy theories) | MK White Rabbit/Reinformation dissident | x | | 2,947 |
| 2020 | YouTube channel (scientific popularisation) | La biologie fait des vidéos | x | | 5,290 |
| 2020 | Online media | Blast | x | | 5,523 |
| 2020 | French association promoting digital freedoms | Quadrature du Net | | x | 2,334 |
| 2020 | Talk by a member of a French association in defence of digital freedoms | Felix Tréguer | | x | 2,474 |
| 2020 | National daily (article) | <i>Le Journal du dimanche</i> | | x | 780 |
| 2021 | Interview with an MEP (EELV) | M. Ravasi | x | | 444 |
| 2021 | YouTube channel (anti-electromagnetic waves) | Fabien Moine – Exuvie TV | x | | 1,132 |
| 2021 | YouTube channel (anti-electromagnetic waves) | Nicolas Negri | x | | 9,763 |
| 2021 | Leader of an evangelical church | Pastor Tumasi | | x | 6,047 |
| 2021 | Founder of Electrosmogtech.cf/member of stop 5G | Olivier Bodenmann | x | x | 7,758 |
| 2021 | Swiss national media | RTS | x | | 1,858 |
| 2021 | Online media (French sister channel of a Russian media outlet) | Russia Today France/Ruptly | x | | 12,779 |
| 2021 | Grouping of European moratoria against 5G | Stop5G/5GAppeal | | x | 14,345 |
| 2021 | National media (parliamentary broadcasts) | La chaîne parlementaire (J. P. Lecoq) | x | | 2,641 |
| 2021 | Departmental councillor against electromagnetic technologies (interview) | Marc Arazi | x | | 5,798 |
| 2021–2022 | YouTube channel (alternative healthcare) | Fabien Moine – Exuvie TV | x | | 4,242 |
| | | | | Total | 214,848 |

Source: Own elaboration

| | |
|--|--|
| <p>La Quadrature du Net refuse le futur promis par les promoteurs de la 5G.</p> | <p>[1] "quadrature_net" "refuse" "futur" [4] "promis" "promoteurs" "5g"</p> |
| <p>Nous refusons le rêve d'Ericsson pour qui la 5G ouvrira à la « smart surveillance » un marché de 47 milliards de dollars d'ici 2026. Nous refusons que la vidéosurveillance puisse représenter le marché le plus important des objets connectés permis par la 5G, estimé à 70% en 2020, puis 32% en 2023. Nous refusons le fantasme sécuritaire dans lequel « l'obtention d'image d'une très haute qualité ouvre la voie à l'analyse intelligente de la vidéo via l'IA ». Nous refusons l'ambition de l'ancien employé de Safran, Cédric O, de procéder au déploiement de la 5G quoi qu'il en coûte.</p> | <p>[7] "refusons" "rêve" "d'ericsson" [10] "5g" "ouvrira" "smart" [13] "surveillance" "marché" "milliards" [16] "dollars" "d'ici" "refusons" [19] "vidéosurveillance" "puisse" "représenter"</p> |
| <p>Peu importe que ces promesses soient crédibles ou non, nous mettons en garde contre ce qu'elles représentent. Elles sont le rappel, fait par une industrie techno-sécuritaire qui n'existe que pour elle-même et impose partout son agenda, que nous n'avons jamais eu notre mot à dire sur ces grands programmes industriels ; que cette industrie et ses relais au sein de l'État s'arrogent le droit de nous contrôler au travers de leurs innombrables gadgets, quitte à participer à la ruine de ce monde ; quitte à risquer ce qu'il nous reste d'humanité.</p> | <p>[22] "marché" "important" "objets_connectés" [25] "permis" "5g" "estimé" [28] "refusons" "fantasme" "sécuritaire"</p> |
| <p>Si l'industrie de la surveillance a fait de la 5G le totem de son monde fantasmé, il nous faut briser ce totem. Nous l'affirmons avec d'autant plus de détermination que nous savons que les politiques en matière de télécoms pourraient avoir un visage bien différent, que les réseaux télécoms pourraient être faits pour les gens et par les gens. Partout en Europe et dans le monde, des alternatives existent. Elles se heurtent malheureusement à l'indifférence coupable et intéressée des gouvernants.</p> | <p>[31] "l'obtention" "d'image" "haute" [34] "qualité" "ouvre" "l'analyse" [37] "intelligente" "vidéo" "l'ia" [40] "refusons" "l'ambition" "l'ancien" [43] "employé" "safran" "cédric" [46] "procéder" "déploiement_5g" "coûte" [49] "promesses" "crédibles"</p> |

Note: on the left, an opinion piece about 5G by Quadrature du Net, on the right, the text after the first stage of pre-processing (table generated by R)

Source: Own elaboration, based on Quadrature du Net. (2020, October 9). Brisons le totem de la 5G. *La Quadrature du Net*. <https://www.laquadrature.net/2020/10/09/brisons-le-totem-de-la-5g/>

Appendix I.3. Example of the transformation of a document into a matrix of terms

A total of 134 significant terms were identified while insignificant terms were removed. These were stop words (definite and indefinite articles, etc.) and numbers, apart from 5 and 5G. The terms retained after filtering are shown in blue and numbered in order of appearance. Capitalisation is removed. Groups of words that regularly appear together are considered as a single term, such as 'Quadrature du Net', which appears as 'quadrature_net', or 'connected objects',

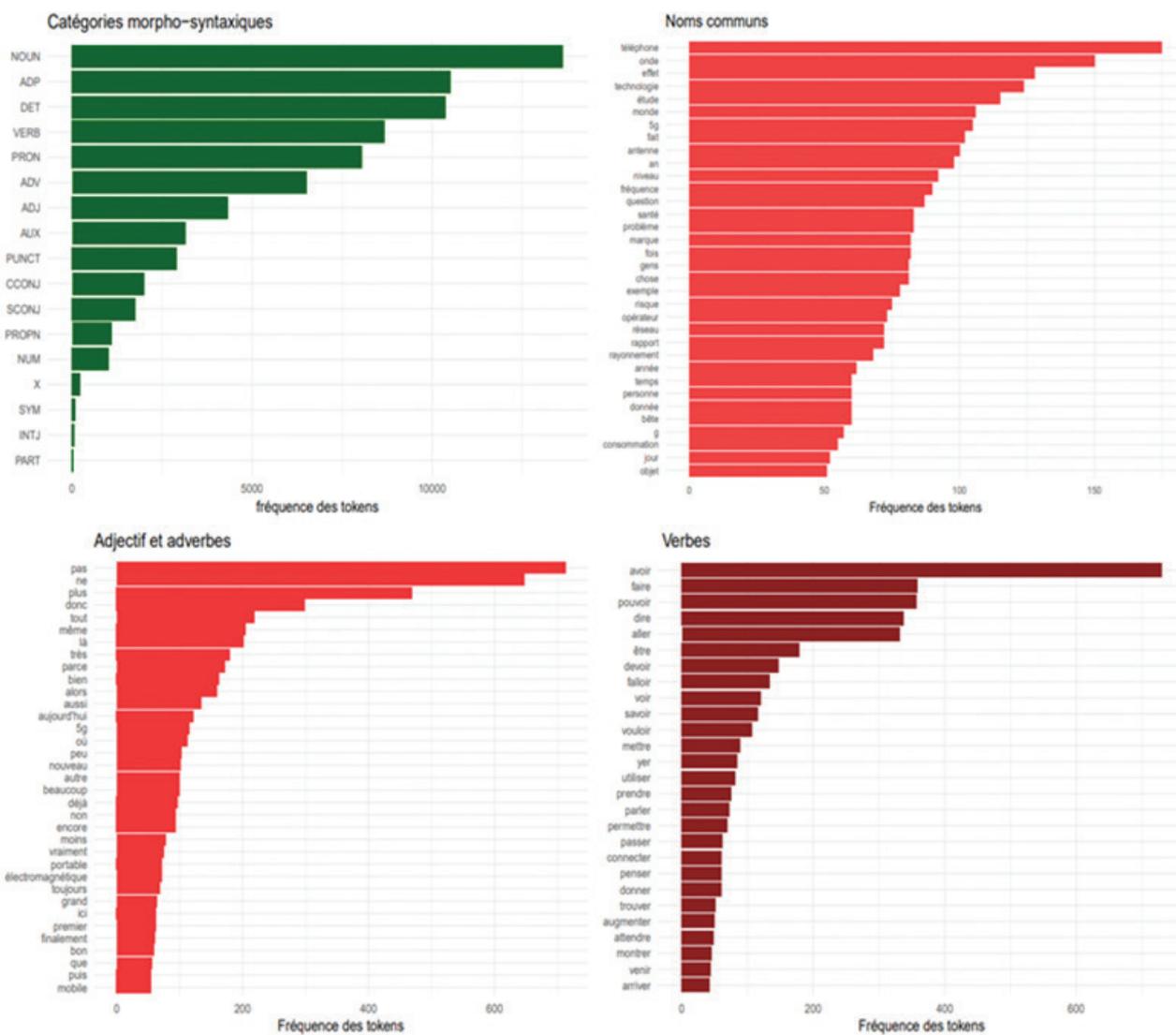
which appears as 'connected_objects'. These inseparable sets of words are underlined in the original text (left side).

Each term is then assigned a morpho-syntactical category and the software identifies the root (lemma) of the word (the process of stemming, where for example the words *am*, *are*, *was*, *been* all correspond to the verb *to be*).

When indexed, the opinion piece by Quadrature du Net gives the following (extract of the first lines):

| doc_id | sid | tid | token | token_with_ws | lemma | upos | xpos | feats | tid_source | relation |
|--------|-----|-----|------------|---------------|--------------|--------------|-------|---|------------|-----------|
| 1 | 32 | 1 | La | La | le | DET | NA | Definite=Def Gender=Fem Number=Sing PronType=Art | 2 | diet |
| 2 | 32 | 1 | Quadrature | Quadrature | Quadrature | NOUN | NA | Gender=Fem Number=Sing | 6 | nsubj |
| 3 | 32 | 1 | 3-4 | du | du | NA | NA | NA | NA | NA |
| 4 | 32 | 1 | 3 | de | de | ADP | NA | NA | 5 | case |
| 5 | 32 | 1 | 4 | le | le | DET | NA | Definite=Def Gender=Masc Number=Sing PronType=Art | 5 | diet |
| 6 | 32 | 1 | 5 | Net | Net | net | PROP | NA | 2 | nmod |
| 7 | 32 | 1 | 6 | refuse | refuse | refuser | VERB | Mood=Ind Number=Sing Person=3 Tense=Pres VerbForm=Inf | 0 | root |
| 8 | 32 | 1 | 7 | le | le | DET | NA | Definite=Def Gender=Masc Number=Sing PronType=Art | 8 | diet |
| 9 | 32 | 1 | 8 | futur | futur | futur | NOUN | Gender=Masc Number=Sing | 6 | obj |
| 10 | 32 | 1 | 9 | promis | promis | promette | VERB | Gender=Masc Number=Sing Tense=Past VerbForm=Part | 8 | acl |
| 11 | 32 | 1 | 10 | par | par | par | ADP | NA | 12 | case |
| 12 | 32 | 1 | 11 | les | les | le | DET | Definite=Def Gender=Masc Number=Plur PronType=Art | 12 | diet |
| 13 | 32 | 1 | 12 | promoteurs | promoteurs | promoteur | NOUN | Gender=Masc Number=Plur | 9 | obl:agent |
| 14 | 32 | 1 | 13 | de | de | de | ADP | NA | 15 | case |
| 15 | 32 | 1 | 14 | la | la | le | DET | Definite=Def Gender=Fem Number=Sing PronType=Art | 15 | diet |
| 16 | 32 | 1 | 15 | 5G | 5G | 5G | PROP | NA | 12 | nmod |
| 17 | 32 | 1 | 16 | . | . | . | PUNCT | NA | 6 | punct |
| 18 | 32 | 2 | 1 | Nous | Nous | nous | PRON | Number=Plur Person=1 PronType=Prs | 2 | nsubj |
| 19 | 32 | 2 | 2 | refusons | refusons | refuser | VERB | Mood=Ind Number=Plur Person=1 Tense=Pres VerbForm=Fin | 0 | root |
| 20 | 32 | 2 | 3 | le | le | le | DET | Definite=Def Gender=Masc Number=Sing PronType=Art | 4 | diet |
| 21 | 32 | 2 | 4 | rêve | rêve | rêve | NOUN | Gender=Masc Number=Sing | 2 | obj |
| 22 | 32 | 2 | 5 | d' | d' | d' | PROP | NA | 4 | appos |
| 23 | 32 | 2 | 6 | Ericsson | Ericsson | Ericsson | PROP | NA | 5 | flatname |
| 24 | 32 | 2 | 7 | pour | pour | pour | ADP | NA | 8 | case |
| 25 | 32 | 2 | 8 | qui | qui | qui | PRON | PronType=Rel | 11 | obl |
| 26 | 32 | 2 | 9 | la | la | le | DET | Definite=Def Gender=Fem Number=Sing PronType=Art | 10 | diet |
| 27 | 32 | 2 | 10 | 5G | 5G | 5G | NOUN | NA | 11 | nsubj |
| 28 | 32 | 2 | 11 | ouvrira | ouvrira | ouvrir | VERB | Mood=Ind Number=Sing Person=3 Tense=Fut VerbForm=Fin | 2 | act:rci |
| 29 | 32 | 2 | 12 | à | à | à | ADP | NA | 16 | case |
| 30 | 32 | 2 | 13 | la | la | le | DET | Definite=Def Gender=Fem Number=Sing PronType=Art | 16 | diet |
| 31 | 32 | 2 | 14 | « | « | « | PUNCT | NA | 16 | punct |
| 32 | 32 | 2 | 15 | smart | smart | smart | ADJ | Gender=Fem Number=Plur | 16 | amod |
| 33 | 32 | 2 | 16 | surveillance | surveillance | surveillance | NOUN | Gender=Fem Number=Sing | 11 | obl:arg |
| 34 | 32 | 2 | 17 | » | » | » | PUNCT | NA | 16 | punct |
| 35 | 32 | 2 | 18 | un | un | un | DET | Definite=Ind Gender=Masc Number=Sing PronType=Art | 19 | diet |

Source: Own elaboration



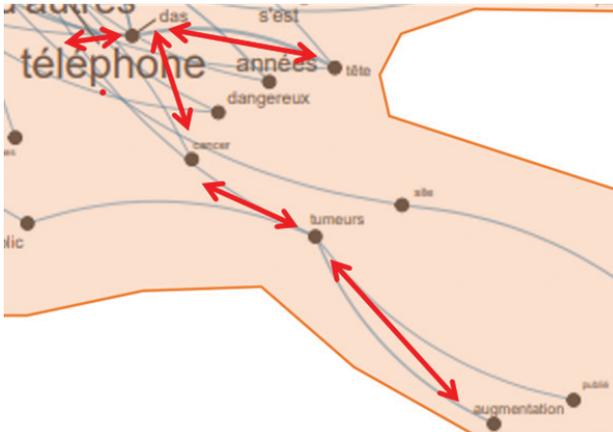
Source: Own elaboration

Appendix I.4. Distribution of the corpus by morphosyntactic category

Appendix I.5. Analysis of covariance graphs

An analysis of covariance graphs shows the existence of links between frequently associated groups of words, which gives us a first view of the corpus.

The following diagram (Appendix I.5.1.) shows the covariance distribution. We analysed it section by section, and then overall.



Source: Own elaboration

Appendix I.5.1. Focus on a covariance nod

For example, in this extract (Appendix I.5.1.) we see a set of linked words: *cancer*, *telephone*, *SAR* (specific absorption rate, a measure of the rate at which energy from radio frequency electromagnetic waves is absorbed by the user of

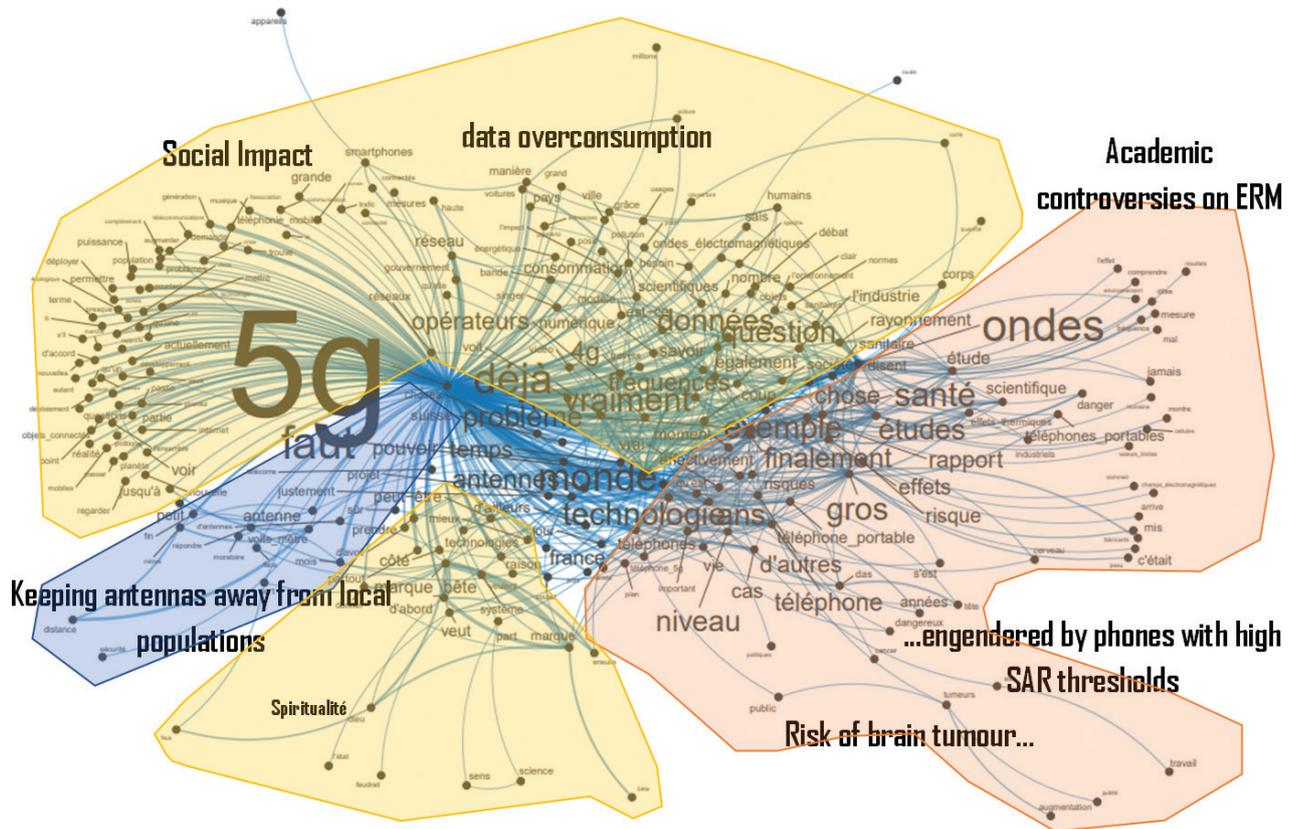
a wireless device), *head*, *tumours*, *increase*, *published* (in the sense of the publication of scientific results). Here we find the semantic field around condemnation of the carcinogenic nature of electromagnetic waves emitted by mobile phones, said to be amplified by 5G.

The operation is repeated by zooming in and out on the different covariance graphs, to examine them one by one and thus gain an overall albeit cursory understanding of the corpus.

Overall, we distinguish the importance of three consistent macro-networks (see Appendix I.5.2.):

- in red, networks linked to criticism of the health dangers of 5G;
- in green, the question of data consumption and the infrastructure needed to make 5G work, seen as highly energy consuming (this topic is also embedded in a social question, with terms such as generation, planet and the question how far?);
- in yellow, a specific semantic field around 5G deployment, possible citizen action, including moratoria, and the dangers of cell towers and antennas when distances are not respected.

This analysis of word associations is just a first step, needed to identify problems in attributing parts of speech (Bender, 2013) and to set up the list of stop words, among others. To improve this analysis by making it systematic, we conducted an algorithmic textual analysis of topics (topic modelling), whose method we detail in the following sub-section and the main findings in the results section.



Source: own elaboration

Appendix I.5.2. Word covariance network graph

Appendix 2. Corpus processing through topic modelling

Appendix 2.1. Topic modelling using LDA: initialisation phase and training phase

The texts were pre-processed using the operations presented in Appendix 2.3 and in section 2.4.2. of the methodology. A word (w) is a discrete unit. Each document is a sequence (S) of N words, where $S = (w_1, w_2, \dots, w_N)$. The corpus (C) is a set of M documents, where $C = \{S_1, S_2, \dots, S_M\}$. For each document, θ represents the combination of a number of topics.

The topic modelling process is done in two phases.

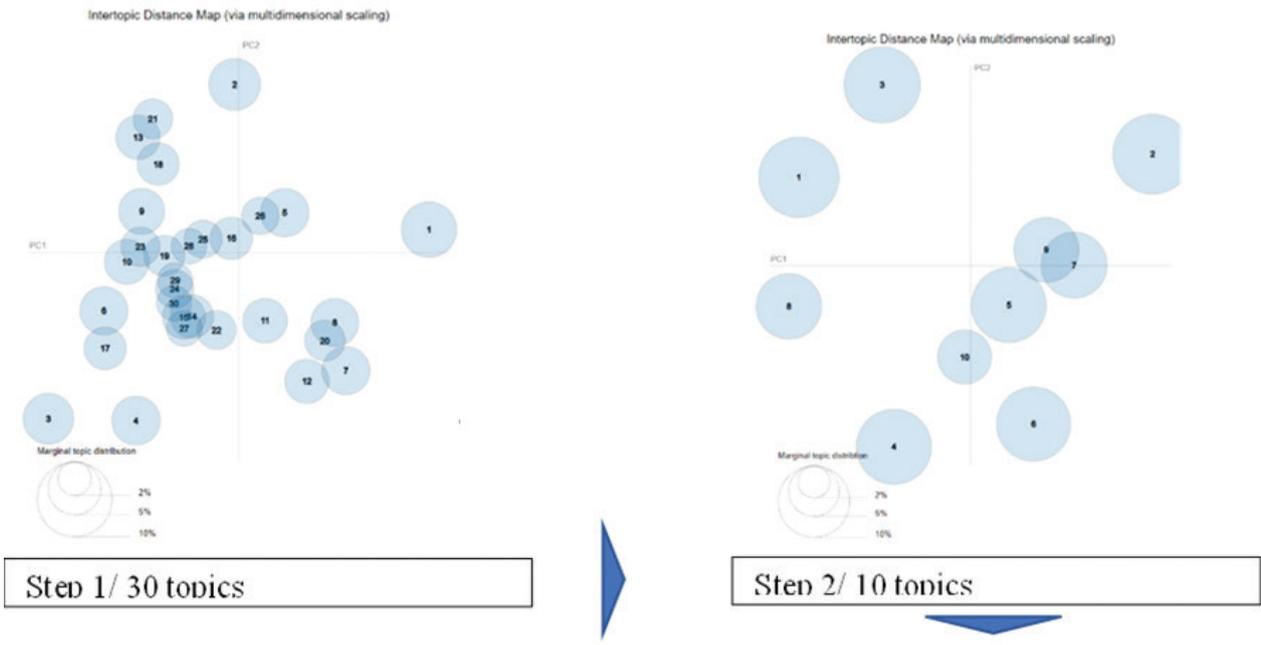
First, we set parameter α , the number of topics present in corpus C . Each word of document D is associated with a topic z (z is between 1 and α) according to a Dirichlet distribution on a set of k topics: $\theta_D \sim \text{Dir}(\alpha)$.

A k -dimensional Dirichlet random variable θ is a $(k-1)$ -simplex and the probability density on this simplex is:

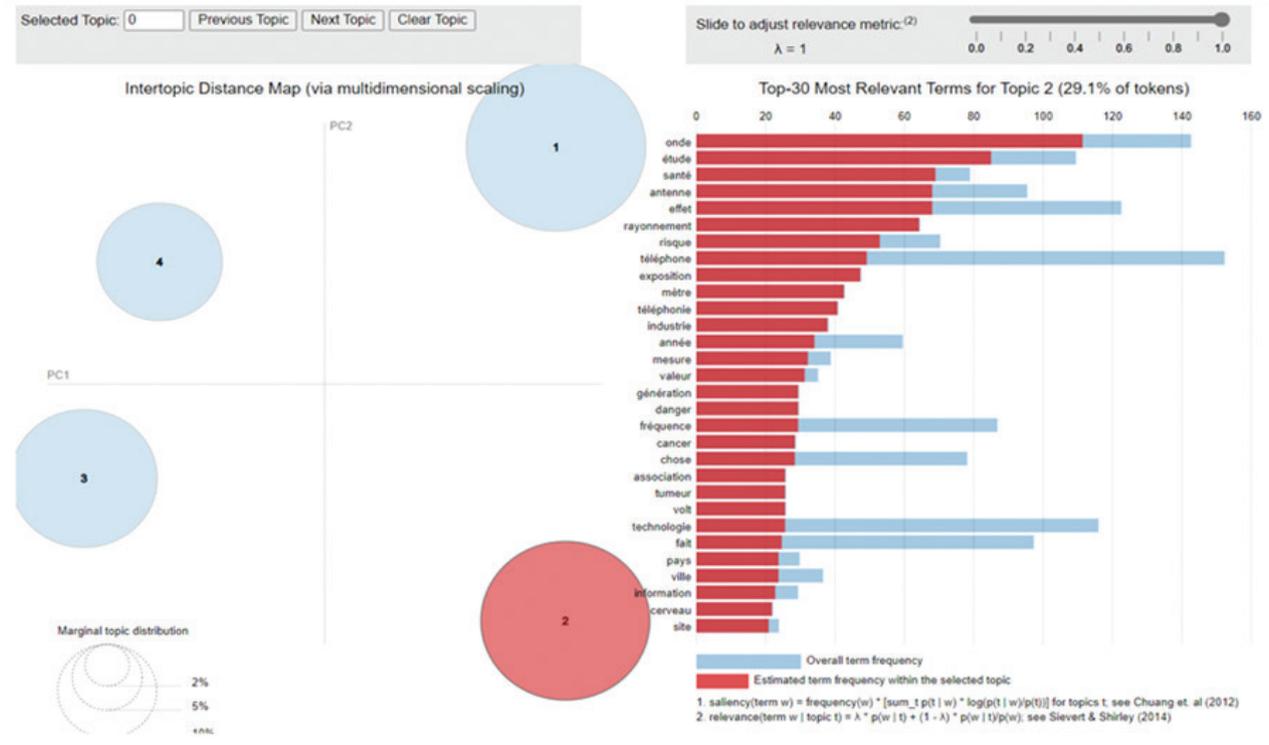
$$p(\theta|\alpha) = \frac{\Gamma\left(\sum_{i=1}^k \alpha_i\right)}{\prod_{i=1}^k \Gamma(\alpha_i)} \times \theta^{\alpha(1)-1} \dots \theta^{\alpha(k)-1}.$$

This phase initialises the model. Then we have to train it. In the second phase, the training phase, the model will refine its estimate of θ_i by recursion. The algorithm then proceeds word by word. We 'set' all the parameters, except those of the word in question, denoted w . We estimate the conditional probability for this word that each topic z , where z is between 1 and α , refers to document D , where $p(z|D)$. Likewise, we estimate the conditional probability that each topic z is associated with word w , where $p(w|z)$. By proceeding in this way for each topic z , we reassign the 'right' topic to the word by calculating the probability that topic z generates word w in document D , where $p(w|z) \times p(z|D)$. The formulas for calculating these operations are presented in Blei et al. (2003).

By repeating this step, we refine the parameters through better and better assignment of the right words to each topic (i.e., the words most likely to be generated by that topic) and the right topics to documents (i.e., the combination of topics with the highest probability of generating a set of words corresponding to the sequence S_w of the document, for all M documents making up corpus C).



Step 3/ 4 topics stables



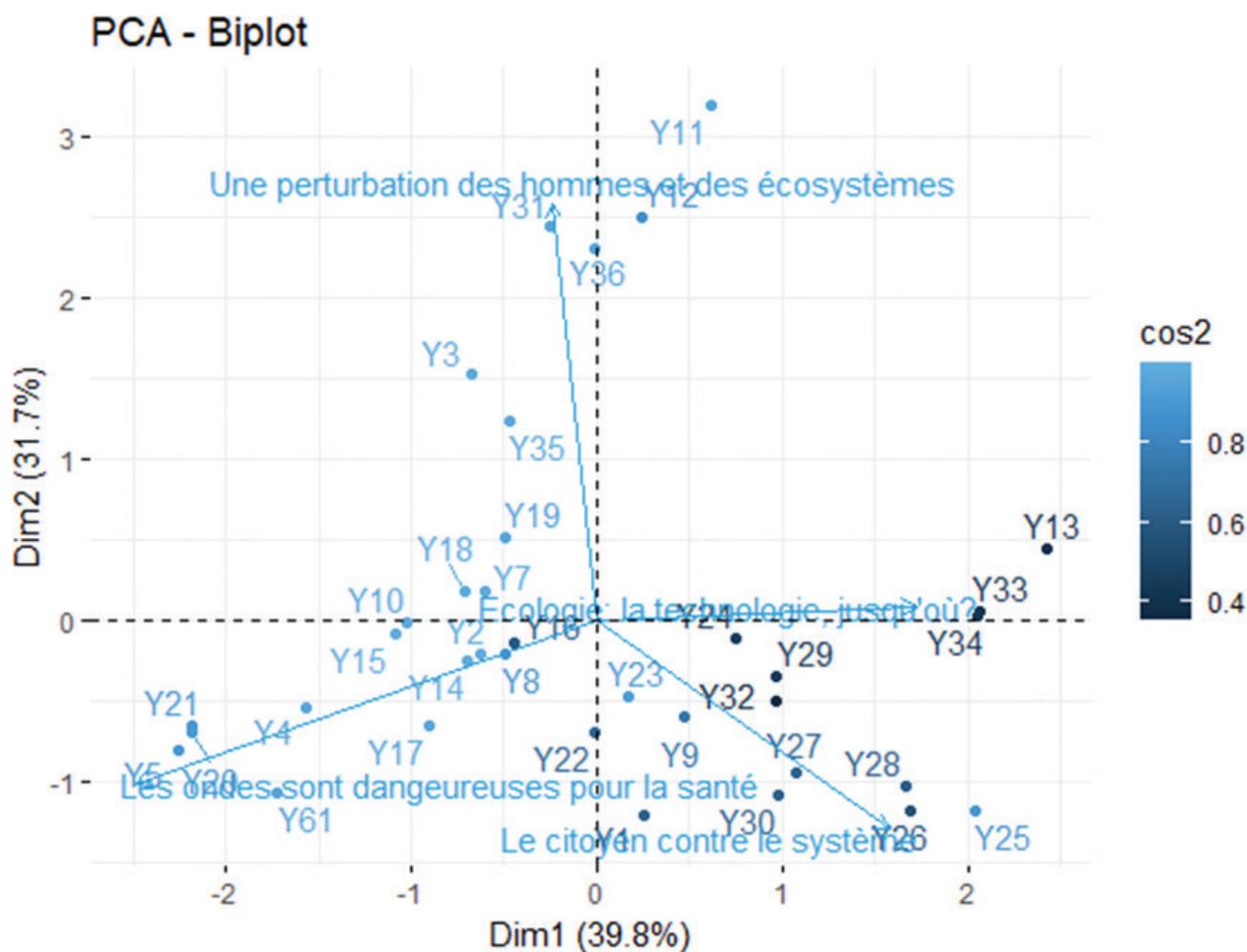
Source: Own elaboration

Appendix 2.2. Specifying parameter k: gradual refinement of topics via LDAvis



Source: Own elaboration

Appendix 2.3. Extraction of the most relevant words (saliency criterion) for the 10-topic stage



Source: Own elaboration

Appendix 2.4. Principal component analysis (PCA) of the four topics on the distribution of points (sources)

| Source n° | Topic 1 | Topic 2 | Topic 3 | Topic 4 |
|-----------|-----------|-----------|-----------|-----------|
| 1 | ○ 0,01246 | ○ 0,08184 | ● 0,73514 | ○ 0,17056 |
| 2 | ○ 0,02784 | ● 0,52268 | ○ 0,00014 | ● 0,44934 |
| 3 | ○ 0,15898 | ● 0,21372 | ○ 0,05786 | ● 0,56945 |
| 4 | ● 0,47628 | ○ 0,08212 | ○ 0,02628 | ● 0,41533 |
| 5 | ○ 0,09749 | ○ 0,10837 | ○ 0,00042 | ● 0,79372 |
| 6 | ○ 0,03171 | ○ 0,00009 | ○ 0,00000 | ● 0,96820 |
| 7 | ○ 0,00001 | ○ 0,12500 | ○ 0,00002 | ● 0,87497 |
| 8 | ● 0,22587 | ○ 0,17692 | ○ 0,06678 | ● 0,53042 |
| 9 | ○ 0,17080 | ● 0,25553 | ○ 0,03872 | ● 0,53496 |
| 10 | ○ 0,10283 | ● 0,42237 | ○ 0,10488 | ● 0,36992 |
| 11 | ○ 0,19231 | ○ 0,14024 | ○ 0,03531 | ● 0,63215 |
| 12 | ● 0,77442 | ○ 0,11163 | ○ 0,11395 | ○ 0,00000 |
| 13 | ● 0,68219 | ● 0,19542 | ○ 0,00407 | ○ 0,11832 |
| 14 | ○ 0,04952 | ○ 0,04663 | ● 0,87627 | ○ 0,02759 |
| 15 | ○ 0,15778 | ● 0,21889 | ○ 0,03889 | ● 0,58444 |
| 16 | ○ 0,19141 | ○ 0,16319 | ○ 0,00005 | ● 0,64534 |
| 17 | ○ 0,14677 | ○ 0,17849 | ○ 0,13495 | ● 0,53978 |
| 18 | ○ 0,07423 | ● 0,20309 | ○ 0,05361 | ● 0,66907 |
| 19 | ● 0,22283 | ○ 0,15957 | ○ 0,06261 | ● 0,55500 |
| 20 | ● 0,27632 | ○ 0,14079 | ○ 0,09947 | ● 0,48342 |
| 21 | ○ 0,05357 | ○ 0,00357 | ○ 0,00000 | ● 0,94285 |
| 22 | ○ 0,11071 | ○ 0,00102 | ○ 0,02100 | ● 0,86727 |
| 23 | ○ 0,09470 | ● 0,39205 | ○ 0,04040 | ● 0,47285 |
| 24 | ○ 0,09296 | ● 0,30000 | ○ 0,16479 | ● 0,44225 |
| 25 | ● 0,20618 | ● 0,45899 | ○ 0,07584 | ● 0,25899 |
| 26 | ○ 0,00011 | ● 0,68788 | ● 0,20909 | ○ 0,10292 |
| 27 | ○ 0,06232 | ● 0,78592 | ○ 0,01655 | ○ 0,13521 |
| 28 | ○ 0,06746 | ● 0,59864 | ○ 0,07153 | ● 0,26237 |
| 29 | ○ 0,07338 | ● 0,73087 | ○ 0,05970 | ○ 0,13604 |
| 30 | ○ 0,18069 | ● 0,54412 | ○ 0,04927 | ● 0,22592 |
| 31 | ○ 0,04728 | ● 0,60843 | ○ 0,05347 | ● 0,29082 |
| 32 | ● 0,64550 | ○ 0,07402 | ○ 0,03821 | ● 0,24227 |
| 33 | ○ 0,00104 | ● 0,20484 | ● 0,45806 | ● 0,33605 |
| 34 | ○ 0,02534 | ○ 0,13417 | ● 0,73167 | ○ 0,10883 |
| 35 | ● 0,42251 | ○ 0,12304 | ○ 0,05183 | ● 0,40262 |
| 36 | ● 0,62204 | ○ 0,11712 | ○ 0,05714 | ● 0,20369 |

Source: Own elaboration

Appendix 3. Distribution of topics by source

This chart summarises the distribution of topics by source (base 100). For example, for topic 20 (in the middle of the chart), topic 1 accounts for 28%, topic 2 accounts for 14%, and topics 3 and 4 account for 10 and 48%, respectively.

We set a threshold of 20%, above which a topic is considered major for the source. Between 2 and 20% a topic is considered minor; that is present but not central to the argument. See DiMaggio et al. (2013), Chuang et al. (2012), Sievert and Shirley (2014) or Aranda et al. (2021) for a discussion on quantitative and qualitative approaches to setting these thresholds.

We observe that 58% of the sources have at least two topics accounting for more than 20% of the total and 42% of sources only have a single topic accounting for more than 20% of the total.

We observe that 89% of the sources deal with at least one minor topic (a topic weighing between 2 and 20% in the source), that is although their discourse refers to this topic, it is not considered major in the discourse of that source. Among these 89% with a minor topic, 37% have a single minor topic, 56% have two and 6% have three.