



Supplement of

Tracing the evolving actor network: a social network analysis of the 2018 Mayotte crisis in the press

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This document includes :

- Building the corpus

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Sect. S1: Building the corpus

S1.1. Selection criteria for newspapers

In order to study the online press coverage of Mayotte's seismo-volcanic activity, 6 newspapers were selected based on four criterias: 1) the number of articles published on the topic, 2) the newspaper's readership (average number of readers per month), 3) the geographical extension of readerships along with the structural and cultural links existing between this zone and the study case area, and 4) a targeted language (French in this instance). The first two criteria are typical of this type of study (see for instance Harris et al. 2012; Devès et al. 2019; Calabro et al. 2020). In the case of Mayotte, the third criteria is especially important to consider as we are dealing with an oversea territory and as we want to examine various scales of coverage: local, regional and national. We focused on French-written articles because it is the official language of the island and it is used for written content by most local media. In order to balance the number of local vs. regional vs. national newspapers to have an idea of the differences in the media coverage, in content, but also in frequency and volume, we finally selected six daily online newspapers matching these criteria among others.

Addressed primarily to **a public in mainland France**, *Le Figaro* and *Le Monde* are the two daily newspapers with the largest audience in the country. *Le Monde* also has a significant readership among the public services in the French departments overseas. At the **regional level**, *Le Journal de l'île de la Réunion* also published extensively on the topic. As the first website created in this area, it is historically an important media in the closest French *département* from Mayotte: La Réunion. The prefecture¹ of the Mayotte *département* refers to the prefecture of the Indian Ocean Zone which is hosted in this *département*, La Réunion is thus a logistical hub for civil protection between mainland France and Mayotte. Studying this newspaper is also interesting because its readership is particularly mindful of seismo-volcanic risks as the island hosts a very active volcano: the

1. In France, the prefecture is the representation of the State in the department. The prefect's official role is to ensure local branches of state services function properly and to represent the state and ministers.

Piton de la Fournaise. Similarly, *L'Express de Madagascar* is one of the five main newspapers in Madagascar, a country which also maintains close cultural ties with Mayotte. This newspaper is also read at a regional level in the Indian Ocean region since it is written in both Malagasy and French. Both La Reunion and Madagascar are areas geographically close to Mayotte. Finally, **at the local level**, we choose 2 of the 4 daily newspapers in Mayotte. *Le Journal de Mayotte* is by far the one that has published the most on these seismo-volcanic events. What's more, during four interviews conducted in June and July 2021, local journalists identified *Le Journal de Mayotte* as the most widely read in Mayotte. However, since 58% of the population of Mayotte is illiterate (according to INSEE, 2019) its readership concerns mainly people from mainland France living across the world, institutions, companies or education staff in particular. Apart from this newspaper, *Mayotte la 1ère*, is at the same time a radio station, an online newspaper and a TV set that broadcasts cost-free content in French and Shimaore which is the main spoken language in Mayotte. As a public service organization it is also committed to working with the authorities to inform the population in crisis situations. Its audio and visual contents are the most widely followed by inhabitants in Mayotte and are notably relayed by other local newspapers. TABLE S1 presents a detailed description of these six newspapers.

TABLE S1 : Description of the 6 online daily newspapers selected for the building of the database regarding the seismo-volcanic crisis in Mayotte in a period between 10/05/2018 and 10/05/2021.

Name of the media	Number of articles published on the seismo-volcanic crisis in Mayotte	Diffusion: number of readers or prints per month in 2021 ²	Geographical extension and readership characteristics	Financial sources (in percentage for one copy)
Le Figaro ³	16	~ 1.9 millions of readers	- National readership (edition board based in Paris and 55% of readers are from the Parisian region) - Mostly middle class, senior managers and small business owners	- State (10,7%) - Advertising (50%) - Subscriptions - Stakeholders (Dassault Group)

2. On difficulties to estimate diffusion and audiences, see Dupont (2004).

3. Sources consulted on the 06/02/2023 : https://fr.wikipedia.org/wiki/Le_Figaro, numbers from ACPM (<https://www.acpm.fr/Support/le-figaro>)

Le Monde ⁴	13	~2.8 millions of readers	- National and international readership (edition board in Paris) - Mostly read in France and international francophone communities, 63% of its readers are politically left-wing (Ifop, 2014)	- State (11,5%) - Subscriptions and sales (~ 60%) - Advertising (25%) - Stakeholders (Le Monde Group)
Le Journal de l'Île de la Réunion ⁵	21	Unestimated this day, media mostly accessible online (~ 600 000 visitors on the website in 2014)	- Regional readership (edition board in St Denis, La Réunion Island) - Widely followed on the island of La Réunion, an overseas French department	- Unknown (1,4 millions of euros of debt in 2019) - Belong to Cadjee and Hersant Media groups
L'Express de Madagascar ⁶	26	~ 300 000 prints	- Regional readership (edition board in Antananarivo, Madagascar) - French and Malagasy speakers, upper classes in Madagascar along with people in Mayotte and the Comoros	- Advertising - Subscriptions - Unknown
Le Journal de Mayotte	196	Unestimated this day, media exclusively online	- Local readership (edition board in Mamoudzou, Mayotte) - French readers, persons from mainland France, institutions, the youth⁷	- Advertising - Unknown
Mayotte la 1ère ⁸	87	Unestimated this day, media exclusively online, radio or television	- Local readership (edition board in Mamoudzou, Mayotte) - French and Shimaore readers, but their radio and television broadcasting is wide	- State and audiovisual royalties of La Première (90% of 7.9 million euros) - Advertising (10%)

⁴ See https://www.lemonde.fr/le-monde-et-vous/article/2021/01/21/les-audiences-du-monde_6067105_6065879.html lastly consulted on the 06/02/2023 and numbers from ACPM (<https://www.acpm.fr/>) and an Ifop survey from 2014.

⁵ Data seen on the 06/02/2023 on https://fr.wikipedia.org/wiki/Journal_de_l'Île_de_la_Réunion

⁶ Data seen on the 06/02/2023 on <https://annuaire.mg/presse/>

⁷ According to its own journalists.

⁸ Data seen on the 06/02/2023 on [https://fr.wikipedia.org/wiki/Mayotte_La_Première_\(télévision\)](https://fr.wikipedia.org/wiki/Mayotte_La_Première_(télévision))

S1.2. Selection criteria and keywords for the collection of articles

Articles were considered relevant for our study if they included at least one reference to the seismo-volcanic crisis, even in the form of news in brief. Mentions via pop ups or headings linked to other articles on a website were not considered relevant. Parametrization of Factiva and Europresse databases is detailed in subsection S2.1. The selection of an optimal keyword combination to search for relevant articles is discussed in subsections S2.2. and S2.3. A good keywords combination should allow one to find most of the articles covering the targeted events while minimizing the number of false positives and false negatives. False positives are articles listed up by the databases during the search despite the fact that they do not mention the topic of interest. False negatives are relevant articles where none of the selected keywords is mentioned, which does not allow to identify them. The keyword combination used to build this database is *mayotte and (seism* or sism* or volcan* or "tremblement de terre" or "tremblements de terre")*. Several keywords and keywords combinations were tested by Robert (2020) in order to find this optimal combination⁹. We confirmed his findings over a wider sample of articles published during this time period (see subsection S2.2.).

S1.2.1. Parametrization of Factiva and Europresse databases

Before the emergence of online newspapers in the years 2010, commercial databases such as Factiva and Europresse were the only way to retrieve media data for media studies (Severo et al. 2015). Nowadays, those two databases are still widely used by scholars (see for instance Reboul-Touré 2021; Barats, 2020 ; Rouquette and Bihay, 2022 among others) as they offer a selection of general and specialized newspapers (both licensed and free) with regional, national and international readerships along with publications on social networks. However they carry some drawbacks like an inherent instability over time, content biases, opacity regarding how the keywords are linked to contents and holes in the timeline of the dispatched data (Severo et al. 2015 and McCarthy et al. 1996). To bypass these limitations : 1) a keywords analysis was conducted beforehand , 2) several sources were used to compensate for the inherent instability of Factiva and Europresse and 3) complementary searches were regularly performed in order to guarantee the referencing of a maximum number of articles and a maximum number of journalistic sources

We activated the filter called "publication" on Factiva, and "press" on Europress, to search for press articles only. Logical connectors "AND" and "OR" were used to conduct

⁹ Some keywords are early discarded as they do not prove to select enough relevant articles (not shown in TABLE S2). It is the case of *géol** (the star refers to all the words including the root word preceding it), *sous-marin** and *sous marin** (for *submarin**) and *essaim** (*swarm**) which proved to be systematically associated with the words *seism** or *sism**

searches based on combinations of keywords. The search was performed in the title and the body of the article. “*Keyword1**¹⁰ or *Keyword2** and *mayotte*” returns articles containing at least one keyword and Mayotte. “*Keyword** or *Mayotte*” picks up articles that contain either the word “*mayotte*” or the word “*Keyword*”. The choice of a keyword combination is an important step to minimize false positive and false negative rates as much as possible while maximizing the final number of articles recovered. It is ultimately really important to maximize our collection of relevant articles even if it means increasing the false positive rate and then eliminating them manually.

S1.2.2. Estimation of a false positive rate

Because of the inherent instability of Factiva and Europresse databases, false positive rates are not easy to estimate (Severo et al. 2015; McCarthy et al. 1996). We made an estimation thanks to two human operators double checking the articles and comparing them with the databases’ results. While doing so, we considered a wide sample of the database (74,2% of our database including articles published in *Le Monde*, *Le Figaro*, *L’Express de Madagascar* and *Le Journal de l’île de la Réunion*) and with a time period from 10/05/2018 to 10/09/2019. This sample covers the two most active periods of coverage: the beginning of the seismic crisis (the first month aggregates 30% of the articles in our database) and the discovery of the volcano which represents the second peak of publications during a three-year period. Results are presented in TABLE S2. For the optimal keyword combination ultimately used and over a three-year period, we find false positive rates of 26% and 51% for Factiva and Europresse respectively.

TABLE S2 : Results of the analysis of 5 keywords and 4 keyword combinations in terms of number of articles listed and false positive rates for 4 sources : Factiva and Europresse databases along with *Journal de Mayotte* and *Mayotte la 1ère* website archives (modified after Robert, 2020). Tests were performed on a sample of 266 articles published between 10/05/2018 and 10/09/2019 and representing 74,2% of the final database and covering the two main events of this seismo-volcanic crisis : the beginning of the seismic crisis and the discovery of the volcano.

¹⁰ *Keyword** refers to all the articles containing the keyword, for instance, *volcan** refers to *volcanic*, *volcano*, *volcanoes*, *volcanology*, ect.

Sources	Factiva		Europresse	
Keywords or keywords combination	Number of picked up articles finally retained in our database	False positives rate	Number of picked up articles finally retained in our database	False positives rate
volcan*	693	98%	833	98,7%
séisme*	386	91%	944	98,2%
sism*	199	85%	359	96,1%
"tremblement de terre" or "tremblements de terre"	244	97%	571	98,6%
mayotte and séism*	41	14,6%	21	19,0%
mayotte and (séism* or sism*)	44	13,6%	26	26,9%
mayotte and (séism* or sism* or volcan*)	53	26,4%	28	32,1%
mayotte and (séism* or sism* or volcan* or "tremblement de terre" or "tremblements de terre")	54	25,9%	28	28,6%

S2.2.3. Estimation of a false negative rate

To evaluate the volume of false negatives, we proceeded to a systematic reading of the articles listed in the Factiva and Europresse databases over a given period of time (from 10/05/2018 to 10/09/2021) using only the keyword "mayotte". No false negatives were found with Europresse over this period and a rate of 0,2% was found with Factiva (2 articles over 842).

Sect. S2 : Actors chains analyses

S2.1. Protocol for actors identification and encoding chains of mentions/quotations

S2.1.1. Basic method and definitions

All articles were read separately by two human operators who then compared their results. When there were ambiguities, we discussed them and worked towards a common solution.

For instance:

“Depuis la découverte du volcan sous-marin de Mayotte, de nombreuses notamment associatives demandent la tenue de rencontre pour expliquer et informer la population sur ce phénomène qui attire les scientifiques du monde entier.” (30/10/2020, 20201030_la1ère_001, Mayotte la 1ère).

A missing word prevents us from identifying precisely the actor whose words are indirectly reported in the article, even if we can read that he/she is / they are connected to the associative world. Is this actor referring to both the following actors ? We finally agreed that it seems to be referring to the population, but we can not determine if the scientists were mentioned by this actor, or added later by the journalist.

=> [de nombreuses associatives]->{population},{scientifiques du monde entier}

For this work, we define an actor as an individual or legal entity, or a group of individuals sharing a common character or purpose such as a scientific mission or being impacted in the same way by the crisis. We also consider media quoted as sources (Agence France Presse, Twitter, etc.) as actors, since they also play an active role in the communication around the event. Places or buildings (mobile like a boat or immobile like a school) may be described in the media as actors when they are named as synonymous for the individuals they host and are then also selected.

S2.1.2. Actors chains identification and encoding

The basic unit of the methodology is the “named entity”, i.e. the exact denomination(s) of the actor in the press article. To avoid any misinterpretation and ambiguity of interpretation, we have chosen not to retain the mentions of actors made by means of a simple personal pronoun with the exception of the moments when this personal pronoun introduces a quotation chain mentioning another actor¹¹.

We draw a distinction between actors who are “given voice” and actors that are simply mentioned. We consider an actor is “given voice” when he/she/they is/are clearly interviewed by the journalist(s), when his/her/their speech is reported by the journalist or by an actor who has been given the floor directly or indirectly in the article, or via the report of a publication by the actor. What we

¹¹ e.g. “il répond [...] « je consulte en permanence tous mes amis qui travaillent dans la recherche, comme le géomorphologue volcanique de renom, **Franck Lavigne**, ou **le professeur Thomassin**, et ils voyaient tous des signes d’origine volcanique»” (Journal de Mayotte, 20/05/19)

identify as "a word given to an actor" includes everything that the journalist presents as being the word or opinion of this actor, whether it appears to be reported directly (with the use of quotation marks for example) or indirectly, or even distorted. For e.g. in the sentence : "In May 2018, when the swarm of earthquakes began to shake Mayotte, the first scientists rushing to the island did not believe in volcanic activity", we consider that a voice is given to the scientists since the news item is supposed to convey their beliefs. On the contrary, in the sentence "End of mission: French prefect Dominique Sorain leaves Mayotte", we consider that Dominique Sorain is "simply mentioned" in the paper.

We select actors that are both mentioned directly and indirectly in each article. As opposed to direct mention, indirect mention corresponds to the case when an actor is mentioned through a third party in the article. Without this third party, i.e. the first actor in the quotation chain, and regardless of its level of complexity (see Sect. S2.1.), this actor would not have been mentioned in the article, thus we qualify this mention as indirect (as opposed to a direct mention). For example, in the sentence "An earthquake with a magnitude of 4.0 was recorded by the Bureau of Geological and Mining Research (BRGM) informs the prefecture", the citation of the prefecture is declared as direct and that from the BRGM as indirect. For each actor mentioned indirectly in a news item, we associate a relational attribute containing the name of the "source" actor, and vice versa. This distinction allows us to measure the interactions between categories of actors in the press, and in particular the most frequent citation links, the direction of these relationships (and therefore their potential asymmetry) and finally the more or less central position of categories of actors within the citation network.

- Coding actor occurrences

Each time an actor's name appears in the article, his or her name is written down (keeping the order of appearance), and a distinction is made between :

- actors whose speech was reported, whose names we surround by "[]"

e.g.: "la population dénonçait l'apparente légèreté", (Journal de Mayotte, 7th of February 2020, 20200207_JDM_001) => [la population].

- actors whose names are simply mentioned without making them say anything, whose names we surround by "{ }"

e.g.: "La population sera bien sûr informée en amont ", (Journal de Mayotte, 7th of February 2020, 20200207_JDM_001) => {La population}

- when several actors are mentioned without one quoting or mentioning the other, their names are separated by " ; "

e.g.: "assurent de concert le préfet de Mayotte et son directeur de cabinet" (ligne 213, 01/08/2019, 20190801_JDM_001, Journal de Mayotte) => [le préfet de Mayotte];[son directeur de cabinet].

- Chain of quotations/mentions:

- when an actor A mentions another actor B we write: [A]->[B] or [A]->{B}

e.g.: "Il en va de la sécurité de la population explique le conseil départemental", (Journal de Mayotte, 2nd of February 2020, 20200202_JDM_001) => [le conseil départemental]->{la population}.

- when an actor A mentions several actors, we write: [A]->([B]+{C}) or [A]->({B}+{C}), etc.

e.g.: "il est important que la population participe pour faciliter la communication des autorités rappelle Lise Retailleau de l'institut de physique du globe de Paris (IPGP)" (Journal de Mayotte, 30th

of April 2021) => [Lise Retailleau de l'institut de physique du globe de Paris (IPGP)]-> ([la population] +{des autorités});

- when an actor is mentioned by several actors at the same place in the text, we write: ([A]+[B])->{C} or ([A]+[B])->[C]

e.g.: “«Une équipe internationale de scientifiques (...)», indique le communiqué du CNRS et de l’université Toulouse III Paul Sabatier.” (ligne 225, 10/01/2020, 20200110_JDM_001, Journal de Mayotte) => ([CNRS]+[université Toulouse III Paul Sabatier])->[une équipe internationale de scientifiques]

Of course, combinations of all these rules are often to be implemented. In order to facilitate processing the data, we annotated some of the named entities using star characters (i.e. actor*annotation*). This convention makes it possible to remove ambiguities while categorizing actors in post-processing and at the same time, to allow removing these annotations automatically in order to search for the expression and trace it back in the original article.

We then build a correspondence table (Table NamedEntitiesToGeneralName in TABLE SA) allowing us to identify the different ways of naming the same actor and we group them under a chosen “general name”. Following this, 965 different actors (i.e. general names) are identified. To allow us to build a structural analysis, we group these actors in categories (see Sect. S2.2. and S2.3.).

S2.2. Definitions and content of categories

Each actor’s denominations (or “NamedEntities”) were manually picked up in the articles and we attributed a relevant expression directly identifying each actor called “GeneralName” (an example of is presented in Figure S1 with the scientific actor BRGM (Bureau de recherches géologiques et minières)). Actors were then clustered in categories thanks to each actor’s unique name. These categories (see TABLE S4) were derived from typical classification of disaster risk management actors (Fearnley et al., 2018). TABLE S3 shows 3 examples of this treatment with actors identified in our corpus. See TABLE S4 for the name and definition of each category and Table GeneralNamesToCategories in TABLE SB for a correspondence table between “general names” and “categories”).

"BRGM (Bureau de recherche géologique et minière)","Bureau de recherche géologique et minière (BRGM)","Bureau de recherche géologique et minière","Bureau de Recherche Géologique et Minière","Bureau de Recherche Géologiques et Minières","Bureau de Recherches géologiques et minières","Bureau de Recherches Géologiques et Minières","Bureau de recherches géologiques et minières","bureau de recherches géologiques et minières","Bureau de Recherches géologiques et minière","Bureau de Recherches géologiques et Minières","bureau de recherches géologiques et minière","Bureau de Recherches Géologiques et Minières","Bureau de recherches Géologiques et minières","Bureau de recherches géologiques et minières","Bureau de recherches géologiques et minière", "Bureau de Recherches géologique et Minière","Bureau de Recherche géologique et minière","bureau de recherche géologique et minière","Bureau de Recherches Géologiques de Mayotte","Bureau de Recherches Géologiques et","BRGM","brgm"

(brgm)"; "brgm, le brgm"

Figure S1 : All denominations used in the articles for BRGM (Bureau de recherches géologiques et minières) separated by commas and enclosed in inverted commas. These denominations were clustered under “BRGM” for the analysis.

TABLE S3: Illustration of our process from the selection of the exact denomination of an actor in the source article (i.e. the “named entity”) to its categorization. We first associate a single general name with the several named entities identified as mentioning the same actor. We then group the name entities into categories determined according to the organization of risks and crisis management in France (Fearnley et al., 2018 and Section S2.2.). Finally we assign them a geographic level according to their geographical scope of action (local, regional, national or international).

<i>Example 1</i>		<i>Example 2</i>		<i>Example 3</i>	
“Dominique Sorain”	Named entity	“Le préfet de Mayotte”	Named entity	“Frédéric Mortier, délégué interministériel aux risques majeurs Outre-mer”	Named entity
Prefect of Mayotte	General name	Prefect of Mayotte	General name	Frédéric Mortier from the DIRMOM*	General name
Risk and crisis management actors	Category	Risk and crisis management actors	Category	Risk and crisis management actors	Category
Local	Geo-level	Local	Geo-level	National	Geo-level

*DIRMOM = Délégation Interministérielle aux Risques Majeurs Outre-Mer (Interministerial Delegation for Major Risks Overseas).

We consider 2 levels of categories. Level 2, *Category_of_actors*, (see TABLE SB GeneralNamesToCategories) is composed of 16 main categories determined according to the organization of risks and crisis management in France (see Fearnley et al., 2018 and TABLE S4). Level 1 (GeneralNames2 in the correspondence table GeneralNamesToCategories in TABLE SB) is an intermediate level of categorisation between the general name and the category, which groups rather generic expressions under a broader GeneralName2 (e.g. “Numerous mahorese”, “Older people in Mayotte” and “Panicked people in Mayotte” are grouped under GeneralName2 “Populations in Mayotte”). This level is only used in section 4.4 of the article in order to guarantee the readability of the graphs.

TABLE S4 : Correspondence table between general names identifying actors in articles and 16 categories of actors derived from typical classification of disaster risk management actors (Fearnley et al., 2018).

Categories (lvl 2)	Definitions
Scientific research and monitoring (groups, publications and institutions)	Scientific groups, publications, institutions and all groups of people involved in monitoring and research on the sismo-volcanic activity in Mayotte.
Scientific research and monitoring	Namely identified scientists involved in monitoring and research on the sismo-volcanic activity in Mayotte.

(named individuals)	
Risks and crisis management actors	Administrative authorities involved in risk and crisis management activities
Public and para-public services to the population (institutions and members)	French public or parapublic services to the population.
Elected local officials	Locally elected executive representatives.
Civil society, private sector and NGOs	Civil society, private sector and NGOs
Local identified personalities	Influential figures in Mayotte.
At-risk populations in Mayotte	Populations living in Mayotte and exposed to natural hazards
Other populations	Populations living outside of Mayotte.
Educational staff and institutions	Educational staff and institutions in Mayotte and mainland France.
Students and schoolers in Mayotte	Children living in Mayotte when mentioned in school contexts.
Social media/Internet	Social media or websites.
Mass media and associated journalists	Includes TV, radio, magazines, newspapers and associated journalists.
French political institutions	French political institutions involving members of the government, the French Parliament and the Senate.
Foreign states, communities and personalities	Foreign state actors, personalities or communities that are not involved in scientific or risk and crisis management activities.
Divers/Unidentified	All actors that could not be categorized in the previous categories because unidentified, or belonging to more than one category.

S2.3. Network analysis

In order to study the position of the actors in the simplified citation networks (source/destination binomial) derived from the corpus, we use two indicators from network analysis at the node level. We describe the system of actors in the Mayotte seismo-volcanic crisis reported in the press using two global network analysis indicators and further detect the presence of small communities using the Louvain clustering method.

Degree centrality measures the number of links held by a node. It captures the amplitude of the network with which an actor is connected in the media, through the citation process. We distinguish in- and out-degree centrality, i.e. the number of actors by which an actor has been mentioned and the number of actors that he/she has mentioned. The actors with the highest out-degree index values are those with the strongest activity in transmitting and communicating the experiences, opinions, speeches and actions of other stakeholders (including Mayotte's population). On the contrary, a high in-degree index demonstrates a central position in the network linked to strong interest from third parties. The study of the ratio between in and out-degree centrality makes it possible to study the level of reciprocity of these two states.

Betweenness centrality measures the number of times a node lies on the shortest path between two other nodes. The values are normalized by the number of node pairs in the graph (direction of citations are not accounted for). A high betweenness index indicates that an actor plays an important role in connecting the network of actors depicted in the media, and in particular the subgroups that the citation relationships update, either because he positions himself at the center of the network, or because it is positioned on the periphery of several clusters. Actors with high betweenness are key bridges between different parts of a network.

Network connectedness measures the proportion of the theoretical number of connections that had been achieved in the observed network through a density index (ratio of ties to the number of possible ties). Network reciprocity measures the proportion of mutual connections within a directed graph. It accounts for the level of hierarchy of the network as the probability that the opposite counterpart of a directed edge is also included in the graph (i.e. as the probability that an actor mentioning a third party is/are himself/herself/themselves mentioned by this third party). Both dimensions account for variations in the level of integration/fragmentation and hierarchy of the actors' citation network, overall, at different periods of the crisis or between media.

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