The Relevance of Scientific Dissemination during the Vaccine Campaign: The Italian Virologist Communication on Social Media

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The scientist role has progressively gained an essential relevance during the 2020 pandemic. In fact, the virologists' exposition turned out to be fundamental for the public opinion, both for the well-informed and people unaware about health, transmission, infection and, today, vaccination programs. This paper aims to first set an explorative investigation about the social communication practices during the first three months of the vaccine campaign addressed on social media by Italy's most established virologists. The arising digital scenario and the resultant pervasive presence in our daily life of web platforms, such as social media, has revolutionized the nexus between science and society. More scholars argued about the disintermediated current shape of science communication that directly connects scientists and the larger public, driving the sociological debate towards the analysis of the current processes of sense-making construction. On this assumption, we aim to answer the research question about how Italian scientists communicate and approach the larger public on social media. Therefore, the empirical part of this paper consists of a data collection phase conducted on Facebook and Twitter. The collected data have been analyzed by a content analysis oriented to identify the contradictory or uniformity of disintermediated communication features of the observed social media profiles in order to push and follow, during the ongoing vaccine dosing program, a proactive reflection about the key role of scientific dissemination of information.

Keywords: communication of science, scientists' visibility, social media communication, content analysis, topic modelling

The Communication of Science Inside and Outside the Digital Environment

The relationship between science and society has become increasingly relevant nowadays. Following Ancarani (1996), science has been gradually faced with a variety of politically-relevant social and economic issues such as health, food, transport, communication, energy, innovation and so on. Meanwhile, the public space got transformed focusing citizens as, "the depositary of the structures and processes of democracy as the power control, the delegation of people's will, public discussion and public opinion" (Mazzoleni, 2004, p. 17).

Ty, therefore, institutions representing science and the researchers themselves cannot neglect communication in their daily work (Scamuzzi and Tipaldo, 2015).

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In particular, science's public communication has an essential role in defining the relationship between researchers and citizens (Bucchi and Trench, 2014) and now, a scientist is socially appreciated if he manages to reduce the distance between these subjects. In this perspective,

> "the need for a close relationship between science and society, between experts and the public, arises in a process of involvement that allows us to grasp the urgent needs of humanity" (Pellegrini, 2018, p. 33).

Beyond the different levels of analysis of communicative phenomena and consistent models that have outlined the relationship between science, scientists and the various types of audience (Jasanoff, 1997), scientific communication studies agree that the mediator role is

> "a central variable for the regulation of the processes of constructing meaning, able to orient exchanges between the issuer and the recipient towards outcomes not at all obvious, even with equal content of messages" (Scamuzzi and Tipaldo, 2015, p. 68).

In light of this assumption, the Internet represents the mediatic environment that has succeeded in revolutionizing the communication of science simultaneously to its evolution. Firstly, intended as a canonical medium deputed to the information storage (*read-write web*), the web changed over the last 20 years, transforming itself in an integrated participative environment (*people-centric web* and *participative web*) (Patel, 2013).

There are many web-based activities that scientists carry out daily, as for example document transmission, magazine editing, data sharing, article creation, publishing of conference proceedings and informal exchanges also via videoconferences. In this way, Pellegrini and Saracino in fact argue about "Science 2.0" as an

> "increasingly widespread practice among scientists of publishing online experimental results, emerging theories, claims of discoveries and drafts of articles that anyone can read and comment on" (Pellegrini and Saracino, 2019, p. 76).

Furthermore, Science 2.0 cannot disregard communication through the social media sphere, by which it is possible to create networks of collaboration (i.e. *Researchgate* is designed to allow relationships between researchers related to any type of discipline), to spread news and rebut scientific controversies. Today, science and society work together because they allow citizens to take a stand on scientific issues, which used to be "an exclusive prerogative of the scientific community and political decision-makers" (Bucchi, 2010, p. 141).

Before Internet affirmation, the mainstream media such as radio and TV were the only promoters of communication of science to citizens, although,

> "by their nature they point out the evident asymmetry between the scientific community and the general public and the clear directionality of science communication" (Scamuzzi and Tipaldo, 2015, p. 150).

In the past, traditional media acted as an intermediary between universities and the public sphere, for example through press releases, while with the advent of digital information shifted in an open-access vocation, accessible to anyone who is interested. In this way online media offers scientists more communication opportunities in dealing directly with the public, rather than relying on journalists as mediators (Peters et al., 2014).

The web, furthermore, connotes as an environment where a greater participation about scientific knowledge is possible, and at the same time, can reveal traps related to scientific controversies or misinformation in the way that

> "the web breaks that sequential order and the tightness of a series of 'filters' that previously distinguished the path of scientific results of the researcher to the general public" (Bucchi, 2006, p. 72).

Although it has finite limits, "the web can allow a faster and immediate access to scientific information (possibility to access original papers, databases, contacts of researchers)" (Scamuzzi and Tipaldo, 2015, p. 150), and in addition social networks become useful tools to simplify the communication of science and its results, as well the understanding of how research has been led.

Following Bucchi and Saracino (2021), it is relevant to point out how the science communication concept for scientific arguing has been recently rethought also due to the increasing public demand about science and technology discussions. The science communication overcomes the classical processes of mediated communication shifting to direct interaction between the sender and the public, driving towards a model pointed in 3 specific strategies (Pellegrini and Rubin, 2019, pp. 71–72):

1- The vertical one: featured by the direct dissemination of press release and scientists' statements to spread the research outcomes to a general public.
2- The dialogic one: featured by discussion events between experts and publics duly shaped on new scientific topics.
3- The participative one: the last strategy concerns the direct involvement of individuals in the research works in order to enrich the research purposes and shape the right interesting topics of investigation.

In accordance with this background, this paper aims to shed light on the current relation between scientists and citizens in Italy. Though a first exploration oriented around the scientists' social media presence, in fact, we will try to comprehend how they set their communication strategies and styles as a unit of analysis selecting the cultural products of their posting activities. For this reason, the empirical part of our work starts from a specific research question: referring to the topic of the current vaccination campaign, how do scientists communicate and approach the public on social media?

We tried to answer this question by first conducting explorative research related to the Digital Ethnography (Murthy, 2008; Coleman, 2010) in line with the Rogers (2009; 2013) vision of digital methods. We extracted the material directly connected with observed phenomena making a further primary use of secondary

web data. Later, during the data collection, we set a quantitative content analysis of social media posts uploaded by selected subjects whom we observed on two specific social media platforms during the first 3 months of the vaccine dosing campaign in Italy, from December the 27th 2020 to March the 27th 2021.

Crisis Communication in the Time of the 2020 Pandemic

Through traditional and digital media, scientific communication has taken on an important role during the COVID-19 pandemic. In the specific case of Italy, it increased the exposure of several scientific experts: virologists, immunologists, and so on, who have provided to the larger public important scientific information about health, transmission, infection and, today, vaccination programs, and also proper instructions to follow concerning the correct behaviour to adopt to face the pervasive contagion (Brondi and Pellegrini, 2021). The speeches, often discordant especially in the first phase of the pandemic crisis, occurred on traditional media and social networks, with different styles.

The COVID-19 crisis poses significant challenges for how science is conducted and communicated (Lasser et al., 2020). The 2020 agenda setting "was substantially monopolized by the COVID-19 pandemic, the most prominent feature in the news of the year" (de Sola Pueyo, 2021, p. 1). This drove an *infodemic*, following Hua and Shaw (2020),

> "as the overabundance of information, sometimes not accurate, that creates difficulties for society to understand which resources to use to access reliable information" (de Sola Pueyo, 2021, p. 1).

Following Hussain (2020), through social and mass media it is possible to transmit a sense of unity due to large public coverage as well the opposite:

> "Social media may also provide grounds for misinformation and discrimination. People can utilize the flexibility and pervasiveness of social media technologies to increase the public's adherence to the safety measures suggested by global health organizations to combat the spread of COVID-19."

Following Bucchi (1996) in certain situations, usually connected to scientific controversies, scientists start to address the public directly by skipping the usual stages of scientific communication in the way that

> "these situations create a new modality in science communication that is associated with different objectives and tactics compared to the traditional dissemination pathways" (Olesk, 2021, p. 6).

In accordance with this assumption, the best way to directly address the public is through the architecture of a digital scenario and the disintermediated communication assets of the web environment, i.e., the social media sphere.

Social media platforms such as Twitter or Facebook ensure, in fact, support and resilience between communities, "providing direct access to an unprecedented amount of content and amplifying rumours and questionable information" (Cinelli et al., 2020, p. 1).

Furthermore, according to Hussain (2020), the specialists are involved in a time of crisis, such as the pandemic, to turn their expertise into communicating with their followers what's happening and the overall situation in their premises at local, national and international levels.

Among these, of course, there must necessarily be scientists with strong disclosure skills called to deal with proper communication on social networks.

Research Design

To better comprehend which scientists are involved in our exploration among the few who have progressively exposed disseminating their expertise on social media throughout 2020, we referred to a recent study by *Reputation Science,* a research center specialized in crisis management consulting, particularly in the scientific context.

Figure 1. Virologists' Overall Classification

Source: Reputation Science.

This center synthesized an overall classification[1] concerning the scientist visibility on mass and social media from February 1st to November 20th. This classification (shown in Figure 1) followed two specific indexes based on the scientists' public statements. The *alert index* concerns scientists' most frequent opinion related to the control and containment solution for the pandemic, while the *coherence index* concerns the contradictions of their public statements over the last year.

An in-depth inspection of the biographies of all the scientists qualified in this classification was done, and we selected 5 of them according to their social media presence.

The Selected Scientists

The first one selected is Roberto Burioni, an Italian scientist with an international profile. In 1988 he was a Visiting Scientist at the *Center for Molecular Genetics* at University of California at San Diego, while in 1991 he was Visiting Investigator at *the Department of Immunology* of the Scripps Research Institute in La Jolla, California (USA) where he worked in Dr. Dennis R. Burton's lab.

In 2004, Roberto Burioni worked as a *Faculty of Medicine and Surgery* at the University Vita-Salute San Raffaele in Milan. Today he is currently a Full Professor of Microbiology and Virology, as well as the head of an immunological research laboratory. His research studies concern the field of development of human monoclonal antibodies against infectious agents. Burioni became famous during the late 2010 years with his media interventions, especially on the issue of vaccines to counter disinformation on social media. His activity on scientific dissemination also reached TV platforms, allowing his reputation to gain more visibility. In November 2018 he opened a website: Medicalfacts.it, dedicated to scientific dissemination in the medical field. In 2019 he founded the Association "Pact for Science" whose goal is to enhance the scientific evidence at the basis of the legislative and government choices of all political parties. He published several books on scientific divulgation and for this he has won several prizes. From the beginning of the pandemic crisis until today, he appears as a regular guest on the TV program "Che Tempo che fa" conducted by Fabio Fazio which airs every Sunday at dinner time on the national broadcasting service Rai3.

The second scientist involved in our exploration is Ilaria Capua, a virologist of national and international fame. In 2000 she developed the strategy Differentiating Vaccinated from Infected Animals (DIVA): the first vaccination strategy against avian flu, whose test is able to detect whether antibodies in a subject were induced by the vaccine or infection. Ilaria Capua is responsible for an atypical action in the scientific field dated in 2006: she challenged the system - obtaining international resonance - deciding to make the gene sequence of the avian virus public. This sparked a conversation around the birth of *open-source science.*

In 2013 Ilaria Capua decided to run for the Italian Parliament being elected as the leader of her Civic Choice party. From May to July 2015, she was vice-

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[1]COVID-19: The expert communication. Available at: https://www.reputationscience.it/analisi-dagli-esperti-italiani-sul-covid-19-sovraccarico-di-informazioni-e-indicazioni-incoerenti/.

president of the Chamber of Deputies in the Twelfth Commission (Social Affairs). She was put to criminal proceedings then acquitted (for conspiracy aimed at the commission of crimes of corruption, abuse of office and illicit trafficking of viruses) which caused considerable inopportuneness in her personal life. In September 2016, she decided to resign as a deputy and moved to Florida where she got employed as researcher. In the United States she heads a department of the *Emerging Pathogens Institute* of the University of Florida. She later became director of the University's One Health Center of Excellence. She is also currently a resident guest at *Dimartedi*, a program of the Italian Tv channel La7.

Furthermore, we involved Fabrizio Pregliasco, a researcher of the *Department of Biomedical Sciences for Health* of the University of Milano Statale. He is author of expert reports for *European registration of a vaccine and flu medication*. During his professional life he has collaborated in 12 clinical trials of vaccines and antiviral treatments. In 2015 he was selected as Director of Health at the Galeazzi Orthopaedic Institute in Milan. Subsequently he also became a consultant to the National *Council of Economy and Labour* (CNEL), as well as to the *National Council of the Third Sector* (social, economic and cultural reality in continuous evolution that includes bodies that are neither public nor commercial). Both these roles are carried out by the Ministry of Labour.

Since 2013 he has been the president of ANPAS (an association committed to provide public assistance). The efficiency in the activity of scientific dissemination is the primary reason behind the esteem that the community of experts has towards Fabrizio Pregliasco; during 2016 such an appreciation found concrete form in the conferral of National *Scientific Medical Union of Information* prize.

During the *coronavirus* emergency he is called to take on the role of scientific supervisor, a role assigned to cope with the many deaths that occurred in Milan at the *Pio Albergo Trivulzio*, a historic place of the city, residence for the elderly, which accommodates over 1,000 patients. After the numerous deaths and at the same time of the assessment of responsibilities, his role helped *Pio Albergo Trivulzio* to implement a new organizational structure. He is a sporadic guest in TV programs on La7 and Rai channels.

Antonella Viola is another scientist we observed in our research. She received a scholarship awarded by the European Research Council in 2014: two and a half million Euro in recognition of her STePS project, considered a revolutionary program with regard to the evidence on immune defenses against cancer. In the same year, she became associate professor in general pathology in the *Department of Biomedical Sciences* at the University of Padua. Today she is also a member of the scientific committee of the *Italian Association for Cancer Research*, as well as being an auditor for the European Commission dealt to the evaluation of scientific excellence projects. Thanks to her contribution to molecular biology, Antonella Viola became part of the *European Molecular Biology Organization*.

Finally, in parallel to her teaching and laboratory activities, she's responsible for promoting scientific dissemination, especially in the framework of the *European project Eufactor*[2]. Viola is also particularly appreciated as a speaker; her

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[2]The project of 2016 is aimed at young people between 16 and 19 years and was created to raise awareness of the study of science, technology and computer science, directing them towards

clear style leads her to travel the world as a speaker at conferences at prestigious institutions. Among the most appreciated speeches are those at TED Talks. She is a sporadic guest for TV programs on La7 Channel and on Radio tune *Radioradicale*.

Finally, the last scientist selected is Alberto Zangrillo, head of the *Operative Unit of Anesthesia and General Reanimation and Cardio-Thorax-Vascular*, Head of Clinical Areas of the IRCCS at the San Raffaele Hospital in Milan and collaborates at the *La Madonnina Nursing Home*. He is a pro-rector professor and Full Professor of Anesthesiology and Rianimation. Following SCOPUS[3] sources, today he is one of the top ten doctors in the world for the number of publications in the field of anaesthesia and intensive care, author of 800 publications, of which 400 are indexed in international journals which include randomized studies in *The New England Journal of Medicine, JAMA, Circulation and British Medical Journal*.

His media experience is linked with the former Prime Minister Silvio Berlusconi. Zangrillo has always been at his side, especially in the most difficult moments for his health, such as on 13th December 2009 when Silvio Berlusconi (at that time Prime Minister) was hit by a small statue; or seven years later, when the leader of the centre-right party was subjected to a complex cardiac intervention at the San Raffaele.

By virtue of its authorial activity, he collects numerous awards and honours from the scientific community. Also, the institutional offices seem to recognize the merit and confer the merit titles by the Presidents of the Italian Republic, Carlo Azeglio Ciampi and then Giorgio Napolitano. He takes part sporadically on TV programs on Rai, Mediaset and LA7.

Methodology

Social Platforms and Data Collection

As context units, we selected two specific social media platforms: *Facebook* and *Twitter*.

In the recent study of the Yearbook of science Technologies and society, Pellegrini and Saracino (2019) from the research center *Observa – Science in Society* showed interesting results related to how *Facebook* turned out to be a very suitable social platform where Italian citizens are reached by scientific-health

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training and professional paths that offer more opportunities, but they are often discarded because they are considered difficult or boring. The campaign also targets stakeholders and the general public, to draw attention to the importance of science and technology and to give visibility to the European Union's commitment in these areas.

[3]SCOPUS is currently the largest bibliographic database of abstracts and citations of scientific literature. Index over 17,700 titles of scientific, medical, technical and humanistic journals, published by over 4,000 publishers. Among the most important citation functions Scopus allows to obtain: the H-Index or Hirsch Index (proposed in 2005 by Jorge E. Hirsch of the University of California at San Diego), is a bibliometric indicator that measures the impact of authors within the reference scientific community, based on number of publications and number of citations received; -to carry out the citation analysis of the authors and their relatives publications (through the Citation Tracker); to carry out the research and analysis of the authors' profile and membership affiliations.

centered content, and through which the public fruition becomes more frequent. On the other hand, Twitter turned out to be the opposite (Table 1).

Table 1. Reading and Sharing of Contents Concerning Health and Medicine (Valid % N=978)

	I read contents about health and medicine			
	Never	**Sometimes**	**Frequently**	**Total**
Facebook	25.5%	52.7%	21.8%	100%
Twitter	67.4%	24.6%	8%	100%

Source: Pellegrini and Saracino (2019), *Yearbook of science Technologies and society*, An insight on the relation between scientists and publics.

According to this evidence, more scholars (Schultz et al., 2011; Eriksson and Olsson, 2016) argued about the perceived usefulness of *Facebook* and *Twitter* in crisis communication. Compared to other sources related to the digital scenario, Twitter leads to less negative reactions than blogs and newspaper articles, while Facebook results in a higher reputation and less secondary crisis reactions than crisis communication via an online newspaper (Eriksson and Olsson, 2016, p. 200).

On the base of these assumptions, we started the data collection procedure on Twitter using the *scraping* procedure via *Python syntax,* while for Facebook we used *CrowdTangle*, an insight tool reserved to the academic hub that only tracks publicly available posts on Facebook, Instagram and Reddit.

The data have been collected following the structure of a proper standard gather grid (Losito, 2003; Amaturo and Punziano, 2013) divided in 4 main domains (General information, Cross information, Engagement and Audiovisual and Text information) and then organized in a Cases per Variable Matrix composed by 1,306 observations[4] per 13 variables defined as follows in Table 2.

Table 2. Standard Gather Grid

General Information	Cross Information	Engagement	Audiovisual and Text Information
Account *(Viola, Burioni, Capua, Zangrillo, Pregialsco)*	**External Sources** *(No external source, Press, Institution and Government, Science Journal, Scientific Network, Scientific Press, Conference Promotion, Official website)*	**Like** *(Low, Medium and High Likes)*	**Audiovisual Description** *(No audiovisual elements, Data, infographics, Media promotion, Normative alert, personal promotion, Press screenshots, Scientific publication extracts, Social media screenshots, visual and logo, Web events)*
Date *(December, Early January, Endo of January, Early February, End of February, Early March, End of March)*	**Repost Account Source** *(original post, Repost from Press Institution and Government, Repost from Scientific network and Scientific Journals, Repost from other profiles)*	**Comments** *(No Comments, Low-medium comments and high comments)*	**Text** *(Post corpus)*

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[4]All the posts were composed in the Italian native language.

Platform *(Twitter, Facebook)*	Tag *(No Tag, Institution, Press and other profiles Tag, Scientific network and Scientific journals Tag)*	Share *(Low, medium and high share)*	Text length *(Short, medium and long length)*
Post Type *(Tweet, Retweet, Tweet Photo and Video, FB Status, FB Status Repost, Facebook Photo and video, Facebook Photo and video Repost, FB Link)*			

The selected scientists' profiles are situated in the account variable while the date variable concerns the month when posts have been uploaded. All content have been classified according to the platform uploading (Twitter and Facebook), and so too its classification unit (audiovisual or textual) duly specified in the post-type variable by which furthermore come possible to recognize the original or repost content.

The external sources concern the context from which comes the external links tied to the posts while the variable named Repost Account Source concerns the categorization of the account from where only reposts come. All Tags in posts have found place by a right categorization of the other mentioned social media accounts. As for the engagement, *likes*, *comments* and *shares* have been classified in tercile intervals that match low, medium and high engagement levels, while pictures and video descriptions have been categorized by the symbolic representation of audiovisual material posted in audiovisual description variable. Finally, we collected the text of every post as well as the text length, properly classifying them, following short, medium and long criteria cutting tercile intervals.

All the information contained in the dataset have been processed following multi-stage analytical procedures consisting of the application of the *topic modelling* aimed to point the features of the vaccination program discussion on social media during the timespan we observed. Then, it was processed in the application *Multiple Correspondence Analysis (MCA)* which makes it possible to detect the latent dimensions by which mark the correspondence between topics and the other context variables (platform, type of post, engagement and external sources). Later, the *Lexical Correspondence Analysis (LCA)*[5] turned out to be the best way to a right synthesis of the collected data; by a compact graphic representation of data relations projected on factors, we could point concepts not previously observable by which find the right key-interpretations based on the correspondence between the selected variables and most characteristics words of post texts.

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[5]The LCA is a factorial technique concerning textual data and useful to: synthesize information contained in texts; make graphic displays of association networks among words and between words and texts; show the connections between text and context data (Lebart et al., 1998).

Analysis and Discussion

The Topic Modelling

The post texts present a considerable amount of information by which is difficult to trace a semantic structure. For this reason, we offered the empirical base to a simple but statistically robust solution: the topic modelling.

As a first step, we imported the database in *T-Lab*, a specific software environment for the content analysis able to process proper patterns based on textual context. We submitted the text variable, consisting in the corpus extracted by Facebook and Twitter, to *T-Lab* thematic analysis procedure that is preceded first of all by the proper following automatic processes. Lemmatization consists of 1) the standardization of all the verb forms in the same mode; 2) the transformation of nouns and adjectives posed in singular number; and 3) the removing of definite-indefinite articles. The frequency threshold was set on 20 occurrences which led us to exclude all the words below this frequency value and finally reducing the database to 650 total words in the analysis. Finally, we proceeded with the exclusion of empty segments found insignificant or irrelevant to our analysis. Later we setup the modeling aimed to the topic extraction based on the *Latent Dirichlet allocation* (LDA),

> "a generative probabilistic model for text document collections based on a three-level hierarchical Bayesian model, in which each item of a collection is modeled as a finite mixture over an underlying set of topics. Each topic is, in turn, modeled as an infinite mixture over an underlying set of topic probabilities. In the context of text modeling, the topic probabilities provide an explicit representation of a document" (Blei et al., 2003).

Following this procedure, we extracted 10 topics properly renamed, respecting statistical criteria, such as the consideration of specific word occurrences featuring the topic, as well as the low-high shared words occurrences among all topics, and by the *semantic tagging* (Bolasco, 2013, p. 126) on selected content in order to "detect the right document meaning solving disambiguation and identifying concepts by a set of words."

Finally, we classified the 10 topics considering the 985 emerging elementary contexts intended as the document analyzed fragments in which the topic itself comes more relevant.

Following Habert (2005), in fact the more significance parts of documents are regarded by the information weight of its fragments featured by its discursive formulas, their position in the document, the specific weight of each word related to its scatter in the document, etc. In our case, the resume of elementary contexts in T-lab returned us to follow a hierarchical order based on the informative score of a single fragment, which text reduction had been synthesized by a 95% threshold. The emerged topics have been duly defined as shown in Table 3.

Table 3. Topics Description

Topic Name	Most frequent Words (Specific, Shared with high probability, Shared with low probability)	Elementary context examples
Virus Mutation	Variation, Virus, Our, New, Greater, Pandemic, Mutation, English, Government, South African, Sars, COV, Last, Child Bambino, Bring, Make, Feed, Hard	• What is the South African variation and why we worry about? Is a variation featured by 3 worrying mutations concerning Spike protein. The best known N501Y, usual also to the English variation and 2 others K417N and E484K further to increase the virus transmission. • The new viral variants distorted some of the data. The presence of virus variations in our country worries not only for their greater transmission power but also in the case of Brazilian and South African variation.
Effectiveness of Vaccine	Infection, Dosing, Patient, Before, Antibody, Use, Answer, Protection, Approve, Response, Serious, Demand, Base, Immune, Result, Generate, Immunity, Shape, Week, System	• The answer to a single dosing vaccination that must be administered twice, but it suggests that for those patients, we could think to new and different protection forms. We wait for the results of the second dosing. • The cover protection needs 7 days later the second dosing. The partial one 12 days later the first dosing. The news is "Outbreak in RSA in Prato" The fact that them were vaccinated or not one week before was not relevant."
AstraZeneca Case	Vaccinate, People, Astrazeneca, Population, Decide, Uscire, Subministration, Receive, Problems, Respect, Event, Contagious, Address, Happen, Trust, Avoid, Tranche, Old people	• L'AIFA has decided to advise against the vaccine use for the over 55. The reason is because data are not available about the vaccine efficiency for this year range and because it is a less effective vaccine than the others that protects only 6 people every 10 vaccinated. Can we vaccine the 40 years old people who suffer from diabetes? • I receive requests from those who have been vaccinated with the AZ tranche temporary removed by ISS. The tranche is not defecting as you ask me. The removal is precautionary and if you vaccinated you don't have to do anything. Fever is as this vaccine. No panic.
Relevance of Data	Data, Effectiveness, Risk, Effective, Clinic, Disease, Study, Modern, Demonstration, Lock, Safer, Subject, To limit, To work, Obtain, Community	• Do the vaccines work against the new variations? First data are here. A revised research conducted with data obtained by Moderna tells that the antibody generated by the vaccines mRNA continue to recognize the variations, but with less efficiency. Moderna has declared that has started to generate an upgrade of vaccines. • We based on pre-clinical data to declare that mRND vaccines let us hope that the infections could be stopped as well and that we have waited for other data never received. The mass vaccination held in Israel and UK let us to answer to this question basing on numbers and on the obtained data.
Preparation of Vaccine Campaign	Vaccination, Italy, Country, Us, Healthcare, Campaign, Scientific, Effect, School, Day, Citizens, Situation, Choose, to find, Amount, High, Serious, Take, Remember, Necessary	• I waited for a different atmosphere for this vaccination campaign. A hard mobilization, vaccination centers open 24h and a generous activism. A power, touching atmosphere, as a war, as a last chance.

Scientific Network	Years, Science, Put, Health, Woman, Life, Bus, Ilaria, Capua, San, Raffaele, Hospital, Pregnancy, Laboratory, March, Future, Human	• At San Raffaele we don't stop even during holidays! Here Ottavio Cremona, full professor in human anatomy who takes the vaccination against COVID-19. • I'm proud of this awesome multidisciplinar team IRCCS Ospedale San Raffaele Università Vita Salute San Raffaele!
Vaccine's Supply	Time, Arrive, Year, Production, Produce, Possible, First, Million, Think, Case, Delay, Available, Safety, Divide, Exclusive, United	• BioNTech, the company that pointed one of two mRNA vaccines has bought in September a factory from Novartis to be used for the vaccine production. Has been needed 28 days for the implementation, 60 to start the production the vaccine. • There's hype for the Russian vaccine Sputnik, thinking to a direct production here before to obtain the EMA or FDA approve. Overcoming the political and economic interest why should us interest this vaccine and not Johnson & Johnson? Both are based on the same adenoviral vector.
Response Capabilities	Pfizer, News, Dosing, Dayes, Protect, Europe, EMA, Phase, Hope, Publishing, Continue, EU, Problem, Leave, Great, Death, Italian, Start, Together, Chance	• "Good news. After millions of administrated doses (two also for me) the EMA confirm the safety of Pfizer BioNTech PS after the second dose I've a soft pain in the arm dopo, soft headache, but 15 days ago after a tennis match I felt worst. • The Pfizer vaccine seems to protect from the infection already from single dose. This is the better news of last times! We don't know how long last the immunity, so for now go on with the second doses respecting the schedule!
Scientist reputation	Burioni, Roberto, Doctor, See, EricTopol, Vaccine, Aske, Read, Tweet, Know, Iene, Rectify, Work	• I would spread the sources but newspaper will entitle as well "battle between scientists", "the doctors must agree each other before declaration" or the classic "nobody here is understanding". • In any case I am already famous. I deleted tweets and I don't go to bed worrying about reading the newspapers that will disparage me tomorrow or the tweet trolls who send me hate. Both are not important, and not pleasant. This is the reason why I deleted tweets.
Media Presence	Covid, Speak, Explain, Coronavirus, Text, Professor, Chetempochefa, Facts, Medical, Emergency, News, Virologist, January, FabFazio, Pandemic, History, Tell, Dangerous	• chetempochefa Tonight back #CTCF guest of ','fabfazio with the professor we we'll talk about the last news on the covid worsening in Italy and of vaccine situation, See you at 8pm on RaiTre. • Adnkronos #CovidItalia, ','"Real Variatons: real emergency "Covid Italy" Pregliasco "Variants real emergence. Following the virologist "we need focused actions and screening at school. The next three or four weeks will be the most difficult"

Multiple Correspondence Analysis (MCA): The Factors' Building

Further, the topics as active variables deemed useful for the factor building were pointed also to *engagement rates, platforms, type of post* and *date*.

Scientists' reputation and media presence topics characterized in the same way as both the two factors, while the topics Virus Mutation; Effectiveness of Vaccine; AstraZeneca Case; and Relevance of Data, instead, characterized the first factor, posed on the horizontal axis, which reflects the argumentations related to the vaccine clinical value assessment divided into two characteristic parts. As shown in Figure 2, on the right side, renamed *Discussion introduction* in fact, we can notice low engagement and no topics emphasized on the factor, while on the left side, renamed *Controversial discussion*, we can notice high engagement levels which appeared in February and correspond to the controversial and delicate topics such as the withdrawal of *AstraZeneca* batches and *Vaccine effectiveness*. For these argumentations, Facebook and its relative post types appear as the most-used platform by the observed scientists, while for the quieter discussion the elected platform is Twitter.

The second factor, posed on the vertical axis, is characterized by topics such as *Vaccine campaign preparation; scientific network; vaccine supplies;* and *response capabilities*. This dimension reflects the vaccination plan features and is divided into two specific phases of our timespan of observation. The first two months in fact reflect the *run-up* of the campaign while the last two months refers to the *follow-up* and rating of the ongoing process of the vaccine dosing program.

The plan synthesizes how most of the observed subjects are more addicted to Twitter posting practices compared to Facebook, which is preferred only by Antonella Viola. Most of them prefer a social media exposition on Twitter that, following Eriksson and Olsson (2016), connects the microlevel of interpersonal communication, the meso-level of follower–followed networks and the macrolevel of hashtag-based exchanges, while Facebook is usually preferred for horizontal support among users during crisis situation as the pandemic, in this case electing a posting-logic based on original contents (Viola, Burioni and Zangrillo) or on shared post from other social media accounts (Capua and Pregliasco).

Antonella Viola seems to be the only scientist open to controversial discussion. Her position on plan, in fact, clears how she benefits from high reactivity by her followers instead of Ilaria Capua and Fabrizio Pregliasco, more oriented to quieter exposition about the vaccine argumentation, whose posts are in fact characterized by low likes, comments and shares. Lastly, Roberto Burioni and Alberto Zangrillo's communication is characterized by a medium degree of reactivity of his followers. By the way, we must point out that the scientist of *Istituto San Raffaele in Milan* closed the comments options to all his followers, even those for his "following accounts" or the ones he spontaneously refers by a mention in the posts or in comments.

Figure 2. Multi-Correspondence Analysis
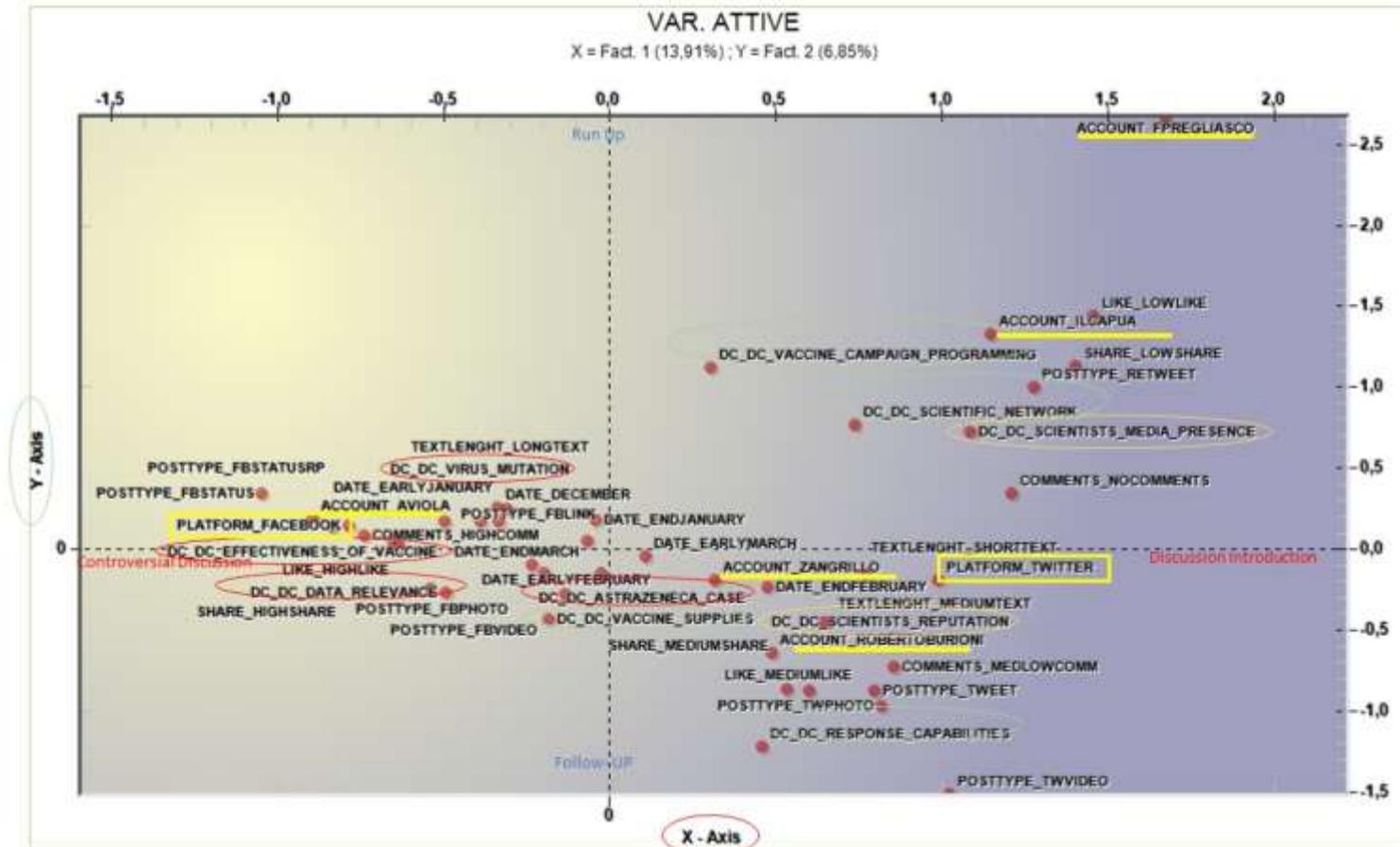
The Lexical Correspondence Analysis (LCA)

After this first analysis procedure, we synthesized the information contained in our data providing the further explorative step of *Lexical correspondence analysis (LCA)* and show graphically the multiple correspondences between words and context elements as for example who spread the message and the platform by which has been uploaded (Figure 3).

Starting from the right side we can see a relevant mass media exposition of the selected scientists. On both the up-down side are indeed marked words as: *Dimartedi*, the TV program that hosts Ilaria Capua; *chetempochefa*, the TV program that hosts Roberto Burioni every day at dinner time, duly complemented by the main character of their research network as; *One Health UF* and *Elastico*, the research centers and association tied to Ilaria Capua; *Eric Topol* and *Eran Segal*, two co-author scientist of Roberto Burioni; and *Anpasnazionale*, the association which Fabrizio Pregliasco is President. This content, posted over the timespan we observed and crossing the discussion introduction about the vaccine campaign, reflect how the positioned scientist in this side follow a kind of hybrid disintermediation made by *a social-mediatization process*. They, in fact, disseminate their statements via social media, originally conceived for mass media, finding on the web a new resonance chamber where the spread of the research outcomes is reluctant to react to Twitter's general public. On the other side, where the controversial discussion crosses the timespan observed, a dialogic strategy is applied by only Antonella Viola. The high engagement levels in fact remark an open possible discussion between the author and her public towards new scientific and mutable topics as the vaccines and its effectiveness due to the virus mutation as marked by words as: *risk, worry, mutation, production, effectiveness, data, lockout* etc. In this way, not relating with mass media frame, Antonella Viola looks as the only scientist truly according with a pure disintermediating process featured by contents thought specifically for the social media and the digital languages that promote a direct contact between sender and receiver, making outdated the figures deputed as intermediate in the communication processes.

Figure 3. Lexical Correspondace Analysis

Conclusions and Further Research Perspectives

This first exploration has finally shown how the most accredited Italian scientists set their public exposition related to the new media sphere. The main hybrid approach, followed by most of the scientists observed, can be related to several factors on which focus later for further needed deepening that must be planned also by continuing to follow the vaccination program and its communication trends held abroad. A further comparison between Italy and other European countries could be in fact useful to better comprehend these factors. More European countries such as France, Germany and the UK, in fact, frame the communication of science availing to few experts officially related to governments and institutional research agencies. In this way, the Italian framing turns out to be more liberalized in terms of contribution for the public scientific debate, suggesting that the distance from a pure disintermediated digital vocation could not only be related to the idea of Italy as a laggard country in terms of adaptation to the innovation in communication, while as sociopolitical context where arises a particular relation between science and politics. In this way, for example, we can wonder if the political sphere influences the scientific communication, scientists' interests, strategies and exposition styles related to this fundamental step fighting the pandemic.

Considering what has been shown, a further research perspective could be oriented on the base of the following hypothesis examples:

The social media use of Roberto Burioni seems to represent a resonance chamber of the framing processes he leads on TV, while Ilaria Capua adapts her twitter account as a promotion space, and her Facebook account as a press office managed by third people. Do they reject addressing controversial argumentation to protect their reputation and avoid troubles with the public broadcasting service? Does Pregliasco do the same to stay away from any ideological or political polarization misunderstanding of his government collaboration? Reading the *Science Reputation's* overall classification, Zangrillo has been qualified as the most contradictory scientist. Does he keep a low profile to avoid any other public embarrassment?

In conclusion, in light of this first exploration, it is evident that a more required deepening of the scientific communication frame worked during the pandemic era is needed, maybe starting from the above mentioned example-questions.

Moreover, since we are talking about a current and an in progress mutable phenomenon, we are forced to press further on our investigation following and observing the related events that feature the vaccination issue due to the multiple surprises and releases that the vaccinal program can reserve in terms of scientists' exposition in the public debate.

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