The role played by government communication on the level of public fear in social media: An investigation into the Covid-19 crisis in Italy

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A B S T R A C T

In situations of crisis, governments must acknowledge that communication is a major weapon in their armoury, and can be used to convince the public to accept sometimes stringent measures, while preventing a worsening of the situation by curbing any spread of panic. Theoretically, during a pandemic, fear can be contained at reasonable levels by governments counterbalancing uncertainty with information. However, there is no empirical evidence on how the flow of information during a crisis can influence emotional states among the population. In this process, social media appears to be a valuable tool for governments to observe emotional response in a population. In the light of this and within the context of the Italian government's social media campaign *#iorestoacasa* ('I'm staying at home') launched during the Covid-19 crisis, the current study utilises text analytics to explore the relationship between government and press communication, and the level of fear expressed by citizens through more than 200 thousand *#iorestoacasa* tweets. The results highlight how the content of the messages evolved in the early part of the outbreak and during the social media campaign. They suggest that in Italy the discussion regarding the efforts made by the European Council to find common solutions for dealing with the emergency has prompted a positive influence on public mood. Conversely, messages about people's individual vulnerability and the associated sense of an external *locus of control* correlated positively with levels of fear. This study opens new ways to support government communication during a crisis by monitoring public emotional response through social media.

1. Introduction

Over the past decades, the frequency of crisis outbreaks has risen rapidly in all countries, generally caused by poorly managed economic growth and climate change (Shrivastava, Mitroff, Miller, & Miclani, 1988; UNDP, 2014), and is a major concern in an interconnected world, where local outbreaks can rapidly escalate, destabilising the entire global community (Nicole A. Errett, Sauer, & Rutkow, 2020). Under such circumstances, it is crucial for public authorities to take a coordinated response (Jacobs, 2007).

From a governmental point of view, a crisis is an event that seriously challenges the institutional structure of public organisations (Jacobs, 2007). Crises today create new challenges (Topper & Lagadec, 2013) and governments must be prepared and so ready to manage emergency situations (Tokakis, Polychroniou, & Boustras, 2019). Crisis Management has become a core government activity, with various scholars attempting to propose structured frameworks (Zamoum & Gorpe, 2018)

that can improve a government's ability to foresee, respond and handle a crisis (Ren & Li, 2010).

Among the new challenges that need to be addressed, today's more interconnected world has heightened the probability of pandemic outbreaks (Bunnell et al., 2019), which can rapidly spread across countries and cause a dramatic impact on society (Reynolds & Quinn, 2008). The Covid-19 outbreak started in China at the end of 2019 and, in its first five months, affected more that 7 million people in 168 countries (Yas et al., 2021). Caused by the SARS-CoV-2 coronavirus, it created huge health, economic and social damage at global level, killing almost 2 million people worldwide in 2020,[1] driving many countries into recession, placing even more people below the poverty line, and has had an intense psychological impact (Hiscott et al., 2020).

While the world is vulnerable to these dramatic events, previous studies have shown that some effective actions can be taken to manage the crisis and contain the escalation of infection (Fineberg, 2014). Communication is one of the most effective weapons for public

administrators to deploy in the period before a vaccine is found and can be distributed (Barry, 2009). Communication is crucial to inform the public about the situation, so that a government can explain the measures in place and try to place itself as the reference figure during a crisis (Khodarahmi, 2009; Tokakis et al., 2019). Once a pandemic has broken out, the effectiveness of the measures depends on people's acceptance and government credibility (Reynolds, 2006). All in all, transmitting the right messages, at the right time, in a correct form, can help to curb the spread of panic and steer the public towards accepting measures designed to contain an outbreak, acting appropriately and limiting their exposure to risk (Hyland-Wood, Gardner, Leask, & Ecker, 2021).

In recent years, public authorities have used social media extensively in the management of various types of crises (J. Guo, Liu, Wu, & Zhang, 2021). The channel of social media removes the more traditional unilateral aspects of institutional communication (Bonsón, Perea, & Bednárová, 2019), which can take on various roles, from being the means to update people about urgent situations to being a channel for promoting collaborative support among the population (Chatfield & Reddick, 2018). Social media are also perceived to be a viewpoint for observing public opinion and behaviour during a crisis (Panagiotopoulos, Barnett, Bigdeli, & Sams, 2016).

Previous studies have highlighted that, in crisis management, one key reaction to be tackled with communication is fear (Degerman, Flinders, & Johnson, 2020; Lachlan, Spence, & Eith, 2014; Sandman, 2006). Managing fear is a delicate balancing act (Lachlan et al., 2014), since people who are not sufficiently afraid can become a threat for others (Degerman et al., 2020), while a situation of general unbridled panic has the potential to aggravate the damage, with severe and sometimes deadly consequences (Espinola et al., 2016). Public health officials, and crisis managers in general, will then have to cope with this epidemic of fear (Peitl, Golubić Zatezalo, & Karlović, 2020).

In this perspective, scholars, among whom Reynolds (2006) and Giardini and Vilone (2021), have suggested that fear can be limited to manageable levels by governments offsetting uncertainty with information. However, especially nowadays when sources of information are ubiquitous and far-reaching, governments need to factor in mediation (and distortion) of their messages (S. T. Lee & Basnyat, 2013). Mass media, which partially controls the information flow during a crisis (Pan & Meng, 2016), play a leading role in the public's understanding of events, even affecting their emotional state (Price, Tewksbury, & Powers, 1997). The influence of mass media is sometimes detrimental, as press coverage of scientific data tends to focus on the most dramatic findings with the greatest social impact (Kolb & Burkhardt, 2008), raising alarm among the population. In such a context, the relationship between a government's communication office and the various media outlets should be two-way and they should cooperate to manage a crisis (Pan & Meng, 2016).

While several studies have covered the importance of communication in crisis management and its role in limiting fear, there are no empirical studies assessing how the content of government communication can affect the level of fear and anxiety among the public (Lachlan et al., 2014; Peitl et al., 2020; Reynolds, 2006; Sandman, 2006). The objective of this study is, therefore, to explore the extent to which a government's and press patterns of communication had influenced the level of fear expressed on social media as part of the government campaign *#iorestoacasa* during the Covid-19 outbreak in Italy.

Italy was selected as the appropriate empirical case because of the dramatic impact of the pandemic, as it was the first Western country to become a coronavirus hotspot (Hiscott et al., 2020) and be severely damaged, with one of the highest mortality rates in the world by 2021, after Mexico and Peru.[2] Moreover, the government's social media campaign at the beginning of the crisis made Italy an ideal setting in which to study the relationship between government messages, press

news and the public emotional response. On the 9th of March 2020, the day Italy went into national lockdown, the government launched a social media campaign, backed by the hashtag *#iorestoacasa* ('I'm staying at home'), to encourage people to respect the restrictive measures, and also to raise hope.[3] The initiative went viral,[4] attracting thousands of messages in response.

This study is organised into two steps. The first step of the analysis involved examining communication patterns, analysing the messages published by government and framed by the media during the pandemic, revealing how the communications evolved over time. Then, in order to reveal which dominant themes (or topics) influenced the level of panic, in the second step, we measured the correlation between the communication patterns identified and the level of fear expressed by the public, who responded to the social media campaign on Twitter with tweets using the hashtag *#iorestoacasa*.

This study is structured as follows. The paper starts with a literature review of the main studies on the role of government communication during a crisis, the uses of social media during such circumstances made by public authorities and the importance of monitoring the public's level of fear during an emergency. This review was the starting point for formulating the research questions that are to be addressed in this paper. The context, research design and data collection process are described in the section on the methodology. The results are divided into two main sections, the first is concerned with analysing government and media communication patterns, and the second then explores how far these patterns influenced the level of fear among the population. The main outcomes and implications of the study are set out in the two sections containing the discussion and the conclusions.

2. Background and literature review

Crisis Management is described as a never-ending cyclical process (Tokakis et al., 2019), which requires constant testing, planning and readjustment, and enables public authorities to deal more effectively with future unpredictable events (Mitroff, Shrivastava, & Udwadia, 1987). Within an emergency, proper countermeasures taken by governments and public agencies can shorten the recovery time, and can help to reduce the negative impact of a crisis (Zamoum & Gorpe, 2018). Timeliness is particularly crucial when dealing with infectious diseases to reduce the spread of the illness (Pop, 2017) and is even more so in pandemics (Reynolds, 2006) because of their global reach, as we were recently forced to experience with Covid-19 (Dascalu, 2020). In any emergency, communication holds a crucial place within a government's portfolio of actions (Lee & Basnyat, 2013) and is described, particularly for pandemics, as "the second most important weapon against the disease" after a vaccine (Barry, 2009), due to its role of offsetting uncertainty with information (Giardini & Vilone, 2021; Reynolds, 2006), thus generating public trust (Hyland-Wood et al., 2021).

Among the different communication channels available to governments, social media has become increasingly pervasive in the management of various types of crises (Harrison & Johnson, 2019; Kavanaugh et al., 2012; Nicomedes & Avila, 2020). This channel complements the conventional one-way means of communication used by public authorities, providing an opening to reduce the exclusively top-down nature of institutional disclosure. Social media offer governments and public authorities the opportunity to consolidate or (re)gain public trust (Kavanaugh et al., 2012), whilst also enabling them to observe the public's opinion and reactions in a timely way (Panagiotopoulos et al., 2016). With this in mind, social media can also be employed to monitor the level of fear, a critical factor during a crisis that must be calibrated

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appropriately, to state the gravity of the situation and contain damage, on the one hand, and to avoid psychological after-effects by seeding excessive alarm among the population, on the other (Peitl et al., 2020). In the light of the above, the next three sub-sections present an overview of previous studies on government crisis communication, on the active role played by social media and on the importance of monitoring the level of fear to handle emergencies in the best possible way.

2.1. Government crisis communication and the role of the media

During a crisis, and in particular in a pandemic, the ability to communicate effectively is likely to make a difference in a government's success or lack of success in saving lives (Reynolds & Quinn, 2008). Appropriate and sufficient communication contributes to the speed of response, accuracy and efficiency in managing the emergency (Coombs, 2019).

More specifically, government communication plays a significant role in building institutional trust and credibility (Hyland-Wood et al., 2021; Kavanaugh, Sheetz, Sandoval-Almazan, Tedesco, & Fox, 2016), which are, in turn, necessary to convey crisis messages to the population and offset fear with information (Barry, 2009). Moreover, in pursuing effective and trustworthy communication, governments should be aware that, as the emergency progresses, it is important to keep in step with the population's needs as they evolve, and to modulate the information demand accordingly (Reynolds, 2006). Within this frame, several academics such as Talving and Vasilopoulou (2021) highlighted some relationship between national governments and International Institutions, such as the EU, in affecting the trust of population, especially in the countries most affected by the crisis.

While emergency risk communication is a tool used by crisis managers in public agencies, governments are not the only side responsible for the delivery of crisis messages. The media, by providing their own content and rewording government communications, are able to affect the public's perception and understanding of a crisis (Pan & Meng, 2016; Yang & Lee, 2020). As a consequence, the information flow that reaches the public is not the government's "pure" communication but, rather, it is integrated and transformed through news coverage (Lee & Basnyat, 2013). As the media tends to focus on information with the highest social impact (Kolb & Burkhardt, 2008), it is more likely to influence the readers' feelings (Price et al., 1997). Government is a common source of the media's risk information (Sandman, 1994) and the media, in turn, frame the official messages and spread them directly to the public (Fisher Liu, 2009). Previous studies have examined and compared the communication practices of these two conveyors of information, government announcements and media articles, during a crisis.

A first theme explored in several papers is the comparison between the content of information coming from the two sources, highlighting the integration enacted by the press on government announcements. Campbell (2019), studying communication in the context of the Fukushima disaster, revealed the importance of examining different sources thoroughly and comprehensively during a crisis in order to extrapolate the complete patterns that affect public trust. Lee and Basnyat (2013), analysing the joint communication of government and press, demonstrated that governments tend to concentrate on basic and preventive information, while newspapers covered a much larger spectrum of topics. In line with the previous results, Liao et al. (2020) concluded that, in an epidemic, government communications are mainly used to keep the public updated on the situation.

As a second significant theme, scholars examined the changes in communication content during different phases of a pandemic. Some studies, such as those included in the book of Aelst and Blumler (2021), studied the evolution of communication during the pandemic crisis in several countries with a narrative (i.e. qualitative) analysis. Alternatively, many studies successfully decomposed the messages published by the government or press into several themes, applying topic modelling algorithms (Pan & Meng, 2016; Poirier, Ouellet, Rancourt, Béchard, &

Dufresne, 2020; Yu, Lu, & Muñoz-Justicia, 2020). The topics that emerged most frequently were economic repercussions, outbreak updates, political actions and social impact of the crisis. In addition, the results also highlighted how the coverage of such topics, whether by the government or by the media, gradually evolved over time. For instance, Yu et al. (2020) observed that discussions on political matters tended to dip in the first stages of the crisis, while there were fewer updates on the spread of the pandemic as the crisis progressed, while Pan and Meng (2016) noted that discussions on the economic consequences and on health concerns increased as the crisis went into a later stage.

2.2. Social media role for government communication

Public authorities have recently ratcheted up their use of social media in the management of various types of crises (J. Guo et al., 2021), in particular during public health crises (Padeiro, Bueno-Larraz, & Freitas, 2021). Social media complements the conventional one-way communication deployed by public authorities, potentially allowing governments to expand their breadth beyond their more traditional top-down institutional communication (Bonsón et al., 2019), thus reaching further segments of the population (Zhao, Cheng, Yu, & Xu, 2020) and reducing information asymmetry. Social media have assumed multiple roles in the management of a health emergency (Padeiro et al., 2021). Public agencies frequently use social media as a means to spread information and updates on specific events, to inform the public about resolutions taken by the government and public institutions, as a general guidance on measures to be taken individually or by a community, and to announce the possibility of medical, financial and social support (Chatfield & Reddick, 2018). Potentially, social media could be also used to observe public opinion and behaviour during a crisis (Panagiotopoulos et al., 2016).

Previous studies have investigated the role of social media in influencing the way governments and public authorities disclose information during a crisis, thus how they affect communication and strategies internally (Gao, Ling, & Liu, 2018; Padeiro et al., 2021), and have also examined the external implications of using social media in these circumstances. On this point, some studies have highlighted how social media can help authorities to channel and mobilise resources, for example through volunteering campaigns (Lovari & Bowen, 2020; Sutton et al., 2014) and how they can contribute to driving home the gravity of the situation to more people and pointing out their responsibilities (Chen et al., 2020). There is little empirical evidence on how social media can help in examining public reactions to government response efforts (Roy, Hasan, Sadri, & Cebrian, 2020) and very few governments actively measure the impact of their social media networked interactions (Chatfield & Reddick, 2018). Nevertheless, monitoring social media patterns over time could give public authorities an insight into the perceptions and mood of the community, especially during a health crisis, which tends to be joined by an outbreak of fear among the population (Owusu Sarfo & Wilson Ansah, 2020).

2.3. Level of fear during a pandemic

Among the population's reactions that should be monitored and managed during a crisis, fear is a prime concern (Peitl et al., 2020). Government communication plays a major part in controlling fear (Petersen et al., 2022; Reynolds, 2006) and crisis messages should, ideally, both alert and reassure people (Lachlan et al., 2014). While a certain degree of manageable fear can induce people to protect themselves and follow the measures established by government, a higher level may turn into panic, becoming dangerous, and increasing harm and damage (Sandman, 2006). For instance, during the Chilean earthquake of 2010, in the absence of information about the relief effort and what steps the public could take, people began breaking the law, stealing and looting to ensure their own survival (Lachlan et al., 2014).

Fear is an important factor to be managed during any crisis, and

Covid-19 has recently shown that uncontrolled panic can arouse aggression, physical violence and the destruction of property (Keyes, McLaughlin, Vo, Galbraith, & Heimberg, 2016). The rapid diffusion and severity of the pandemic spread panic, notably about the looming social and economic repercussions (Padeiro et al., 2021), generating, for example, episodes of racism against people of Asian descent (Giampaolo Caladanu, 2020) and violence and abuse against shopworkers perpetuated by those who did not accept restrictions and social distancing measures.[5] These incidences highlight the importance of addressing the public's level of fear, and entails the need for this fear itself to be measured.

Other studies have highlighted that, to keep a population's level of fear under proper control, it is important to reduce uncertainty, and satisfy the public's high demand for information during the crisis (Giardini & Vilone, 2021; Reynolds, 2006). Zhao et al. (2020) revealed that the public's concerns increased when its request for information about the coronavirus outbreak was not satisfied. In addition, Lachlan et al. (2014) added that best practice during a crisis must reckon with the fact that the public's need for information and their psychological responses vary both over time and across different target audiences.

In order to analyse the level of fear, online surveys have been used in several studies (Kemp, Bui, & Porter III, 2021; Zheng, Luo, & Ritchie, 2021), since they combine accessible data, wide geographical reach and high time efficiency (Zheng et al., 2021). Other studies (Greaves et al., 2014; Samuel, Ali, Rahman, Esawi, & Samuel, 2020; Stella, Restocchi, & De Deyne, 2020; Widener & Li, 2014) have, instead, turned to social media, which can be a valuable resource for government to monitor the level of fear among the population during a crisis (Chen et al., 2020), given that users can describe their experiences in a more emotional way (Greaves et al., 2014). For instance, Samuel et al. (2020) analysed publications on Twitter and revealed the exponential increase in anxiety transmitted via tweets when the pandemic broke out. Zhao et al. (2020) used sentiment analysis to study user interaction on blogs during the epidemic, and plotted the positive, negative and neutral emotions over time, finding that negative feelings decreased as time went by, to be gradually replaced by more positive ones in the second half of the period being examined. Stella et al. (2020) mapped the emotional responses of Italian citizens during the first week of the country's national lockdown, revealing differences between the various hashtags they were examining.

Despite the fact that the communication messages put out by government and media have already been explored in previous research, and that social media data have been used to analyse fear among the population, it is not clear how far government and media messages sent out during a crisis actually affect the level of public fear. Theoretically, governments can reduce fear by addressing uncertainty through the communication of appropriate information (Giardini & Vilone, 2021; Reynolds, 2006), but there is no empirical evidence on the dynamics in play within this connection.

In line with this purpose, the aim of the study is to evaluate to what extend government communication can have an impact on the level of fear among the public monitored through social media. Empirically, the Covid-19 pandemic in Italy was considered as a suitable context, because it was the first Western country to be hit by the virus and, despite its universal and high-performing national health system (Ajay Tandon, Murray, Lauer, & Evans, 2000), was one of the worst affected, meaning that it was also met by high levels of fear. During the early weeks of the emergency, the Italian government ran a social media campaign with the hashtag *#iorestoacasa* ('I'm staying at home'), opening up a channel whereby the government could gather and then examine people's emotional responses in how they were reacting to the crisis.

This background led to the following research questions being defined:

RQ.1: What were the communication patterns of government press releases and their coverage by the media during the first weeks of the coronavirus pandemic in Italy, and how did they evolve over time?

RQ.2: To what extend are the communication patterns of government releases and their coverage by the media related to people's level of fear during the pandemic?

The purpose of the first research question is to analyse the content of public communications issued by the government and integrated by the press during the initial days of the Italian coronavirus crisis and the *#iorestoacasa* social media campaign. Given the previous studies, we expected a gradual evolution of these communication patterns over time (Lee & Basnyat, 2013; Pan & Meng, 2016; Poirier et al., 2020; Yu et al., 2020), reducing, after a while, the amount of information on the spreading of the pandemic (Yu et al., 2020) and, instead, increasing news on the social and economic ramifications of the pandemic (Pan & Meng, 2016) as well as the health situation and political matters (Yu et al., 2020).

The second research question seeks to explore the link between government communication and level of fear, monitored through Italy's government campaign *#iorestoacasa*, highlighting the potential role of social media to monitor the impact of communication during crises. We intended to verify whether the level of fear traced on social media reduces over time (Zhao et al., 2020), and which topics and sources affected it the most. In previous studies, it has been pointed out that discussions on social and economic repercussions generate fear (Padeiro et al., 2021), while it is reduced with discussions on measures established by government (Reynolds, 2006). The context of the research is described more precisely in the next section, with details of the data sources and the methodological steps pursued during the study.

3. Methodology

The methodology is structured as follows. A description and justification of the selected context is first presented, followed by a discussion on the research design, which details the overarching framework, the data collection method and the data analysis strategy.

3.1. The context

After the coronavirus pandemic spread across China and Asia in general, Italy was the first Western country to record a number of severe outbreaks (Hiscott et al., 2020), and soon became a hotspot for the pandemic, incurring serious nation-wide damage. The first case was reported on 21st February 2020, and the infection then spread exponentially across Northern Italy, placing a massive burden on the health system, which was rapidly overwhelmed. In order to tackle the situation, the Italian government placed the entire country under lockdown on the 9th of March, and was able to contain the first wave of the pandemic, which peaked on the 27th of March. After almost two months in national lockdown, the country gradually opened up from 4th May 2020 (Armocida, Formenti, Ussai, Palestra, & Missoni, 2020).

The coronavirus context is particularly suited to the purposes of this study because of the crucial role played by government communication in a pandemic (Barry, 2009), and Italy is interesting because of the government's social media campaign designed to help the population cope with the crisis. The initiative was launched at the start of Italy's country-wide lockdown on the 9th of March and reverberated among the population, generating thousands of social media posts over the days to follow. Against this background, our study covers the beginning of the outbreak and the first weeks of lockdown, when the popularity of the government's social media campaign was at its peak.

The way communication patterns evolved was assessed through two time periods. The initial period ran up to the launch of the social media campaign and the start of lockdown, 9th of March, and the second

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covered the following weeks, up to the 1st of April, during which time the campaign was proving highly successful. These two periods are intended to provide a picture of the patterns of communication during the most turbulent weeks of the crisis when, theoretically, the level of fear and anxiety in the population was at its height, given the high demand for information (Zhao et al., 2020).

3.2. Research design

Considering this context and the objectives of the research, the analysis is structured around two research questions, the first one addressed the communication patterns identified in the government and the press article releases during the pandemic. To recognize the dominant topics, the press and government messages were analysed using a topic modelling technique. The second research question was concerned with monitoring the level of fear on social media, constructed by measuring the number of fear-related words in tweets responding to the government's social media campaign using the hashtag *#iorestoacasa*.

The purpose was to explore whether there was an association between the topics of communication identified with the first research question and the level of fear expressed by people in their tweets. This discloses the potential use that can be made of social media campaigns deployed by governments to monitor public emotional response during a crisis. The details about how data were collected and analysed are presented below.

3.2.1. Data collection

Data were collected from three sources: the government's official releases, pertinent media news items and tweets. Details of the three sources are given below.

The first source consists of the government's official press releases. For this study, these refer to all press releases issued by the Italian government during the crisis, plus press conferences, interviews with the Prime Minister and official announcements. The texts were retrieved from the government's official webpage (www.governo.it), the Health Ministry's official webpage (www.salute.gov.it) and interviews given by the Prime Minister to newspapers, for the period from the 22nd of February 2020 (the day after the first case was officially reported) to the 1st of April 2020. The 77 items retrieved were doubled-checked with the Prime Minister's Office in order to ensure that they provided a satisfactory representation of the government's coverage of the crisis.

The second source consists of newspaper articles, representing media coverage, published in the Italian press during the pandemic. To ensure that all relevant press sources were included, the researchers asked the Prime Minister's Office for their official daily press review, which was supplied for the purposes of this study. Press staff from the Prime Minister's Office extracted the articles containing news relating to the Covid-19 crisis in Italy, which included daily chronicles and health, economic and political news items, as well as opinion articles about the emergency and the government's actions. The final selection included 1465 articles from 27 Italian newspapers, covering the same period as the government's official press releases, from the 23rd of February to the 2nd of April 2020.

The third and last source of data consists of social media posts on Twitter. As mentioned before, the Italian government's *#iorestoacasa* campaign was launched on the 9th of March 2020 to raise public awareness about the lockdown and the other severe measures in place to tackle the pandemic, which was then spreading all over the country[6] [3]. The hashtag *#iorestoacasa* proved to be highly successful among the public, generating hundreds of thousands of tweets during lockdown, in part because it was continuously pushed by the government, that largely adopted it in its communication (Aelst & Blumler, 2021).

The choice of this last source was driven by the fact that users can use more emotional expressions on Twitter than in a survey (Greaves et al., 2014). Furthermore, Twitter's Application Programming Interfaces (API), used to retrieve data, are not as limiting or restrictive as the APIs provided by other social media platforms (H. J. Lee, Lee, Lee, & Cruz, 2021). We collected a total of 201,098 tweets posted between the start of the lockdown, 10th of March 2020, and the 1st of April 2020, when the daily tweets had already dropped by more than 75% from the initial days of the outbreak.

3.2.2. Data analysis

With the first research question, the aim of the study was to identify the pattern of messages and communications issued by the government and by the press during the most intense period of the coronavirus crisis in Italy, and to assess how these communication patterns evolved, by examining the change in words used in each dominant topic before and after the launch of the government's social media campaign.

For this purpose, government releases and newspaper articles have been considered together, similarly to Lee and Basnyat (2013), to represent the overall flow of information that reached people during the pandemic. Indeed, some researcher such as Campbell (2019) highlighted the importance of considering these two sources in combination in order to study the patterns that affect public trust, which in turn affects the level of fear (Hyland-Wood et al., 2021; Reynolds, 2006).

The communication patterns were analysed through topic modelling, a probability model that can discover latent sematic constructs, i.e. the topics discussed most frequently, within a set of documents (like news articles or government announcements) (Y. Guo, Barnes, & Jia, 2017). Various techniques can be used to obtain topic models, and LDA (Latent Dirichlet Allocation) is particularly useful here as it is a method to discover underlying topics from massive volumes of unstructured text data (Arnaboldi & Diaz Lema, 2021), and can successfully analyse information coverage when processing newspaper articles and government announcements (Daud, Li, Zhou, & Muhammad, 2010). As its output, LDA revealed the dominant topics (or themes) discussed during the pandemic, these being interpreted as the main subjects of discussion by government and media.

The output then enabled the researchers to examine day-by-day coverage for the different dominant themes, and to assess the differences between the two sources of information. Moreover, in order to evaluate whether the communications had evolved over time, as stated by Reynolds (2006) and found by Yu et al. (2020), two LDA analyses were performed, one on the messages communicated in the initial stage of the crisis, just before the launch of the *#iorestoacasa* campaign, coinciding with the start of lockdown (22nd of February – 9th of March) in Italy, and the second on the articles and announcements released during the most lively period of the campaign (10th of March – 1st of April). The researchers were able to make a direct comparison between the dominant themes and assess whether they changed and, if so, how. In addition, running distinct LDA searches on the two periods meant that we could find out if the most frequent terms used to discuss these themes differed from one period to the other.

To answer the second research question, we measured the level of fear within the *#iorestoacasa* tweets. While various tools can be used to analyse emotions in tweets, *textual keyword spotting* is used extensively for social media as it can manage the large scale and noise of social network data, and remove irrelevant information (Bao-Khanh & Collier, 2013). This technique is considered effective to extrapolate the emotional content in tweets and especially useful for monitoring the different phases of a crisis (Deepa, Sangita, & Shruthi, 2022; Rothkrantz, 2021). Specifically, following the study by Samuel et al. (2020), we estimated the level of fear through the "Syuzhet" R package, a tool that uses sentiment analysis to reveal latent structures in a narrative.[7] The

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[6] http://www.governo.it/it/media/campagna-di-comunicazione-io-resto-casa/14446, op.cit.

[7] https://www.rdocumentation.org/packages/syuzhet/versions/1.0.6

Syuzhet package utilises several lexicons related to specific emotions, like fear, which were translated and expanded upon for this analysis, in order to recognize fear-related words as accurately as possible when processing tweets in Italian. The resulting lexicon is a compendium of 1486 related terms (e.g. alarm, chaos, fatal). In order to offset the variability in number of tweets posted each day against the peak of the first days, as well as the variation in tweet length, the output was measured in relative terms, whereby the number of fear-related words identified every day through the LDA algorithm was divided by the total number of words in the tweets, as per the formula below:

$$Level\ of\ fear = \frac{Fear\ related\ words\ recognised}{Total\ number\ of\ words\ in\ tweets}$$

A selection of *tweets* with a high level of fear measured through this formula are given below:

- "What worries me most about this situation is how we'll cope with things mentally, all the anxiety and the panic attacks. And the rise in loneliness and depression, from isolation or bereavement *#Iorestoacasa*" *(19/3/2020)*
- "How tough it is now, how heart-wrenching! I'll take my mind off things and watch a film. I can't decide between Contagious Deadly Epidemic, Patient Zero, Desperate Hours, Knot in the Throat, Prisoner of a Nightmare or Drifting… Suggestions, please! *#Iorestoacasa*" *(10/3/2020)*
- "I'm clapping for every doctor, every nurse and every healthcare worker facing the daily hard, painful and excruciating struggle in this battle against the damn Covid-19. Simply thank you *#Iorestoacasa*" *(14/3/2020)*

Although all these tweets clearly express different reactions, sometimes with a hint of sarcasm, sometimes with a message of positivity, they all provide evidence of the climate of fear, which is the important variable to be monitored.

In order to answer the second question about how far the patterns of communication had influenced the level of fear in the population, a correlation analysis was conducted between the daily discussion of the topics identified through the LDA algorithm, and the daily level of fear monitored through textual keyword spotting on #iorestoacasa tweets. For each topic k, the Pearson correlation coefficient was measured through the average coverage of the topic x_k discussed during each day t and the level of fear y extracted from social media during the same time interval, as shown in the formula bellow.

$$Corr = \frac{\sum_t (x_{k,t} - \overline{x_k})(y_t - \overline{y})}{\sqrt{\sum_t (x_{k,t} - \overline{x_k})^2}\sqrt{\sum_t (y_t - \overline{y})^2}} \forall topic\ k,$$

The dominant topics emerging from the LDA algorithm were expressed in percentage terms and also through a dummy variable, set to "1" for the days when the topic was discussed more than average, and to "0" otherwise. This enabled us to run a double analysis on the impact of communication on the level of fear, once considering the daily coverage of each topic and once the influence of that topic at the peak of its coverage. Lastly, a preliminary analysis of the level of fear revealed that it was significantly higher in the first three days of the lockdown than in the rest of the period considered. Fig. 1 illustrates the distribution of the daily level of fear in tweets in two consecutive time frames. The distribution in light grey shows the level of fear belonging to the first three days of the social media campaign #iorestoacase, whereas in dark grey, the level of fear of the following days is displayed. To provide more robust results about the correlations, the fear outliers from the first three days have been excluded from the correlation analysis, but are still discussed qualitatively.

4. Results

The results are separated by research question into two sections. The study of the patterns of government and media communication, during the first weeks of coronavirus outbreak and during the #iorestoacasa campaign are covered in the first section. The level of fear expressed through #iorestoacasa tweets is measured in the second section, which also explores the correlation between the previously identified communication patterns, represented by the topics found in the first step of the analysis and by the level of fear transmitted through tweets.

4.1. Analysis of patterns of communication

The LDA algorithms revealed seven dominant topics running through the press releases and news articles. One topic, *Epidemic Spreading*, was only discussed in the initial weeks of the outbreak, while five other topics were present also during the #iorestoacasa campaign throughout the whole period considered: *Health Situation, Decrees and Measures, Economic Downturn, Government Action* and *Life-Changing Scenario*. The seventh topic, *European Picture* was only covered during the campaign. In Fig. 2, each topic is identified with its ten most frequently recurrent words (graph on the left), with the report of its daily coverage (graph in the middle) and with the semantic changes that characterised it when the #iorestoacasa campaign was active (graph on the right). Specifically, this latter representation compare the changes in the words frequencies, highlighting on one side the terms mostly used in the first days of the crisis and on the other the ones mostly utilised during the campaign. Each topic is now detailed individually and compared to topics identified by other similar studies (S. T. Lee & Basnyat, 2013; Pan & Meng, 2016; Yu et al., 2020; Poirier et al., 2020).

4.1.1. Epidemic spreading

In the initial period, *Epidemic Spreading* focused on the evolution of the virus in Italy. Indeed, aside from the words related to the disease ("coronavirus", "virus", "epidemic", "contagions") the most frequent words report some geographical detail regarding the spread ("Italy", "north", "China", "countries"). Looking at its daily discussion, it clearly dropped out over time, and took place only in the first days of the outbreak. A possible explanation lies on the fact that when WHO (World Health Organisation) declared the coronavirus outbreak to be a pandemic (Cucinotta & Vanelli, 2020), with Covid-19 having reached 114 countries (including others in the West), different topics became more common and *Epidemic Spreading* slowly slipped back. *Epidemic Spreading* accounted for about 16% of the overall content of tweets in the initial period. Looking at comparable studies, a similar topic has been also identified by Poirier et al. (2020) and Yu et al. (2020), who also testified a similar decreasing trend.

4.1.2. Health situation

Health Situation covered mainly the difficulties faced by the national health system ("doctors", "hospital", "region") during the first wave of the pandemic, mainly regarding the influx of "thousands" of "patients", and the scarcity of beds "places". The topic was covered in about 18% of the messages. Looking at the semantic changes, while in the early days, the topic mostly related to reports on the initial outbreaks in Northern Italy, during the #iorestoacasa campaign, it generally shifted more to the precautionary measures in place during the lockdown, where words such as "protection" and "mask" became prevalent. This highlights some communication efforts arose during the social media campaign and during the lockdown that was established, that were aimed at promoting prevention to limit the spread of the pandemic. This topic is common in also all the other studies considered.

4.1.3. Decrees and measures

Decrees and Measures refer to discussions concerning all the new rules and regulations put in place by the Italian government, involving around
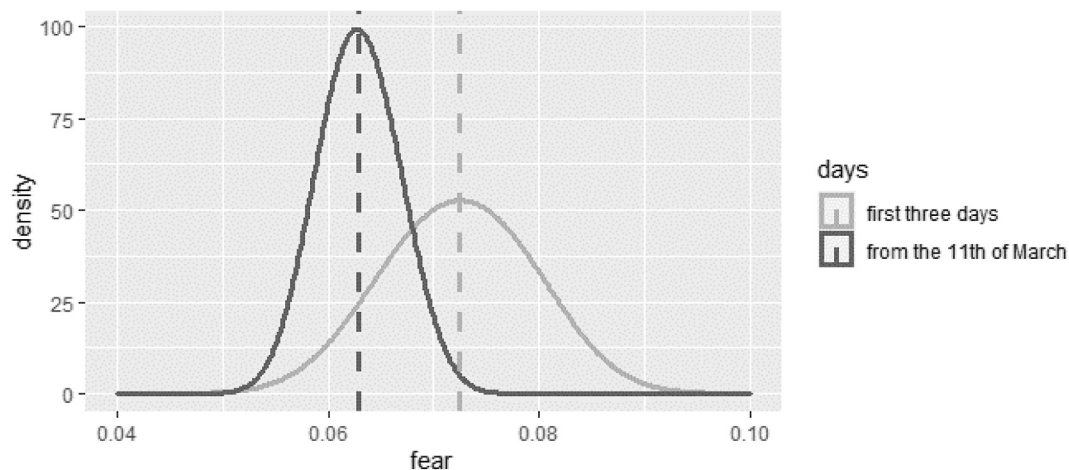
Fig. 1. Density plot of the daily level of fear in tweets, distinguishing fear outliers belonging to the first three days and the remaining period covered in the analysis.

16% of all messages. It is therefore a very and purely informative topic. Looking at the most frequent words of this topic, it is possible to identify some key priorities that were targeted, such as "safety", "health", "work", "services" and "closure" of "activities". The daily coverage shows some peaks in the topic that coincide with the introduction of new rules to contain the spreading of the epidemic (introduced on 1st, 4th, 8th, 11th and 22nd of March[8]). Moreover, the peak for the 7th of March can be attributed to information leaked on that day, where the press published parts of a decree the day before it was published.[9] Analysing how the words within the topic changed, it is possible to see that the decrees and measures discussions initially centred on the closure of many facilities and all schools, while once the lockdown became effective, the focus turned to the closure of all non-essential businesses. In the reference papers considered, no real counterpart exists that is entirely related to the description of governmental measures.

4.1.4. Economic downturn

Economic Downturn was concerned with the economic side of the coronavirus crisis in Italy, as can be indicated by the high frequency of terms such as "businesses", "millions", "economy", "euro" or "work". The discussion of this topic shifted frequently, being around 17% of overall content and it peaked on 28th of February, with the issuing of the decree "Cura Italia", which set out the level of financial support given to families, workers and enterprises affected by the crisis. Looking at how the terms used within the topic changed across the two periods, discussion moved from the immediate ("today") impact of Covid-19 on financial "markets" in the initial period to its impact on Italy's real economic system during the campaign ("workers", "million", "euro"). Considering reference studies, the discussion around economic context and consequences was always identified.

4.1.5. Government action

Government Action groups all the articles and announcements about what the government, in particular Italy's Prime Minister at the time Giuseppe Conte was doing during the crisis including many words such as "premier", "president", "state", "council", "minister" or "palace". Over time, the focus switched from local actors and local authority

officials to central government,[10] as the emergency escalated from a local to a national disaster, and the discussion moved from various members of government up to the Prime Minister. This could indicate a centralisation strategy of government communication to drag public attention towards few, nationwide, figures, probably to gain consistency and authority. This general rallying of communication towards the figure of the Prime Minister and efforts to present a unified messaging has been also highlighted by Aelst and Blumler (2021), in Italy but also in other countries such as UK. Considering the existing Literature, this topic could be paired by the more politics-related topics that some studies have found (S. T. Lee & Basnyat, 2013; Yu et al., 2020).

4.1.6. Life-changing scenario

Life-Changing Scenario is associated to about 16% of all messages and relates to the emotional state throughout Italy brought about by the pandemic and to the consequences on everyday life. The psychological impact of having to go into quarantine came to the forefront when studying how the terminology changed during #iorestoacasa campaign. Indeed, the national lockdown radically changed people's lifestyle, and the messages on this topic veered from talking about a "public" "crisis", not being able to go "outside", and being forced instead to stay at "home", interpreted by some as lack of "freedom". Looking at previous studies, this topic can be matched with "Societal Impact" in Poirier et al. (2020), "Societal Problem" in Pan & Meng, (2016) and "Personal Stories" in Lee and Basnyat (2013) topics, indicating that it has been a common theme as well.

4.1.7. European picture

European Picture groups all the discussions around handling the crisis in Europe as a whole, with a common set of economic, health and political actions. The topic first emerged when WHO declared Covid-19 to be a pandemic and Italy entered its first national lockdown. This topic gathered up 17% of all matters discussed during the second period under consideration and became increasingly more topical as the crisis evolved and, therefore, making it urgent to set up joint Europe-wide counter-measures. This discussion peaked on March 26th after the joint statement issued by the members of the European Council, when they finally agreed on common measures to handle the crisis. (European Council, 2020). This topic is peculiar to the context analysed and has no reasonably referable counterpart in the other studies considered (Lee &

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[8] https://www.governo.it/it/coronavirus-normativa
[9] https://www.theguardian.com/world/2020/mar/08/leaked-coronavirus-plan-to-quarantine-16m-sparks-chaos-in-italy

[10] Apart from Prime Minister Giuseppe Conte, the names mentioned were Attilio Fontana, president of the local government in Lombardy, a region hit especially hard by the pandemic, and Roberto Speranza, Italy's Minister for Health.
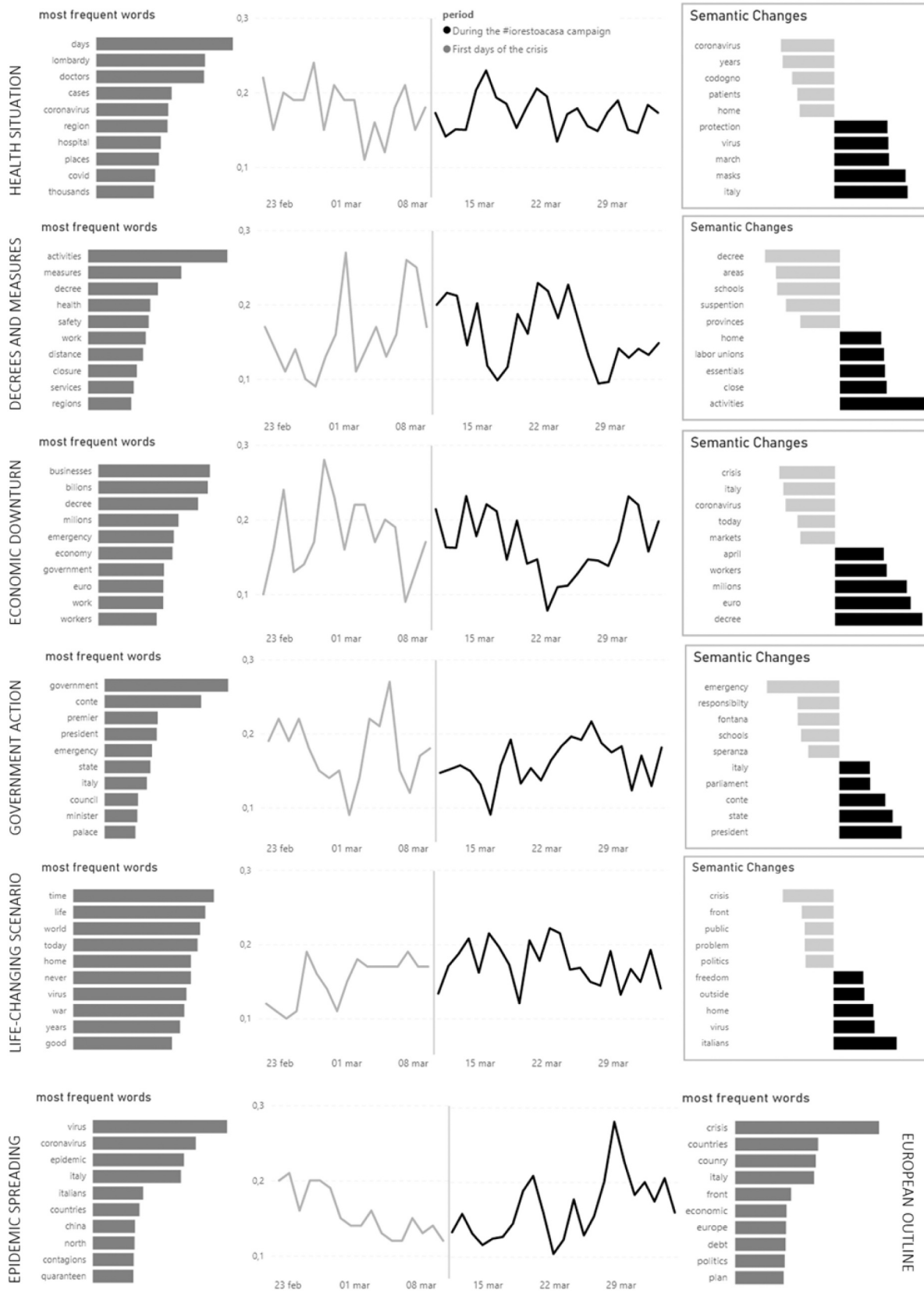
Fig. 2. Density plot of the daily level of fear in tweets, plotting the number of days in which the level of fear reached each of the fear intervals in the x-axis. The distribution in light grey to the right shows fear outliers belonging to the first three days of the social media campaign, that have been excluded from the correlation analysis.

Basnyat, 2013; Pan & Meng, 2016; Poirier et al., 2020; Yu et al., 2020).

4.1.8. Comparison of Government and Press communication

In order to represent more reliably the communication flow that reached and affected citizens during the pandemic, government communication has been integrated with press news in the topic analysis performed with LDA algorithm. This choice allow indeed a better representation of patters that affect public trust (Campbell, 2019). However, it is still possible to compare the different topics coverage of government and press, similarly to what has been done by Lee and Basnyat (2013). In fact, some significant differences can be recognised on how the topics were addressed individually by the two sources. A comparison of the two periods of the analysis, shown in Table 1, confirms that the national press tended to cover all topics more equally than the government, which focused on few informative topics, according to the study of Lee and Basnyat (2013) and Liao et al. (2020). The differences in coverage, across all topics, shows the transformation in the messages conveyed by the government to the public. During the initial period, when the level of fear and anxiety among the population was expected to peak, theoretically, because of the high demand for information (Zhao et al., 2020), in its press releases, the government concentrated on explaining the lockdown measures (*Decrees and Measures 38%*) that had been set up to contain the spread of infection. During the social media campaign, instead, it gave more room to a different set of topics. During this period, the main scope of government shifted towards communicating the status of the health system (*Health Situation + 4%*) and the efforts to handle the *Economic Downturn* (+6%), as the inevitable consequence of shutting down all non-essential businesses.

4.2. Relationship between communication and level of fear

The purpose of this section is to answer the second research question, which relates to studying to what extend communication patterns of government press releases framed by media had influenced people's level of fear during the pandemic. This objective was met first by measuring the level of fear in *#iorestoacasa* tweets during social media campaign, and then by running a set of correlation tests between the pattern of daily coverage and level of fear.

The daily level of fear revealed by the tweets is shown in Fig. 3. As it can be seen, although the number of tweets using the hashtag *#iorestoacasa* decreased over time, after its peak in the first three, the level of fear remained stable at around 1.5%. The tweets related to the first three days have been excluded from the analysis as explained in section 3.2.2, but they are still in line with the level of fear after the first days of the crisis testified by Zhao et al. (2020).

Considering the level of fear and the six dominant topics that were extrapolated during the social media campaign, we ran a correlation test to assess the sign, size and significance of the relationship between level of fear and patterns of communication. The results are summarised in Table 2. Two topics were proven to be significantly correlated to the public's anxiety expressed in tweets, *European Picture* and *Life-Changing Scenario*.

Table 1

Government and Press topics' discussion during the first days of the crisis and #iorestoacasa campaign.

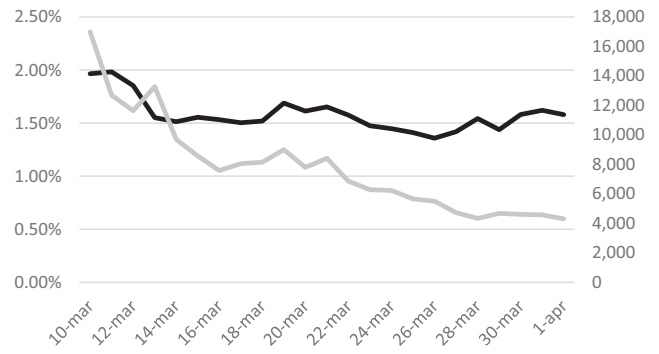| Topics	Firsts days of the crisis		During *#iorestoacasa* campaign	
	Government	Press	Government	Press
Epidemic Spreading	10%	16%		
Health Situation	16%	18%	20%	17%
Decrees and Measures	38%	15%	23%	16%
Economic Downturn	13%	18%	19%	16%
Government Action	14%	18%	11%	16%
Life-Changing Scenario	8%	16%	11%	18%
European Picture			16%	16%

Fig. 3. Daily tweets "#iorestoacasa" posted (in grey) and daily level of fear measured (in black).

Table 2

Correlation tests between level of fear and the topics discussed on a daily basis.

Topic	Coef.	*p*-value
Health Situation	–	15.52%
Decrees and Measures	–	8.24%
Economic Downturn	–	84.58%
Government Action	–	10.83%
Life-Changing Scenario	0.444	4.99%
European Picture	-0.562	1.00%

The results suggest that the topic *European Picture* is negatively correlated with the level of fear retrieved from the tweets. Therefore, the more communications there were about common European countermeasures, the less fear was expressed in the tweets. We, instead, found a positive correlation between *Life-Changing Scenario* and level of fear, which highlights the association between discussions into the impact of the pandemic on people's normal lives and the level of fear in the population.

In addition, the communication patterns were expressed with a dummy variable for each topic, which was activated when the overall coverage of the topic was higher than the average, as explained in the methodology. Instead of using percentage values, as above, which provide information about the trends over time, the six dummy variables indicate the days when any of the topics highlighted were the subject of government or press communications. Using these variables, an ANOVA test was conducted to assess how much each topic impacted on the level of fear. The results are presented in Table 3, which shows how the level of fear, normally 1.5% on average, increased by 0.01% when discussions linked to the *Life-Changing Scenario* topic peaked (a variation of about 6%).

5. Discussion

During a crisis, governments must try to keep the level of fear in subtle balance (Lachlan et al., 2014), to make sure that there is proper caution among the public (Degerman et al., 2020) without creating psychological harm (Peitl et al., 2020). In this perspective, social media

Table 3

ANOVA tests between level of fear and topics relating to dummy variable.

Dummy variables	Coef.	p-value
Health Situation	–	8.39%
Decrees and Measures	–	62.13%
Economic Downturn	–	79.00%
Government Action	–	15.79%
Life-Changing Scenario	0.01%	1.38%
European Picture	–	9.50%

represent a valuable source of information to monitor the reaction of citizens, especially during pandemics when governmental communication is the only weapon while waiting for the vaccine (Barry, 2009). The results of this study into government and media communication patterns, and how they affect the level of fear expressed in the tweets belonging to the social campaign #iorestoacasa, promoted by Italian government, explored this delicate balance during the Covid-19 pandemic in Italy.

Specifically, the first research question is to analyse the content of public communications issued by the government and by the press during the initial days of the Italian coronavirus crisis and the *#iorestoacasa* social media campaign. The results unveiled with Topic Modelling algorithm seven different dominant topics discussed by both government and press. Among them, *Economic Downturn, Health Situation, Life-Changing Scenario* and *Epidemic Spreading* have similar counterpart also in other studies that analysed crisis communication during pandemic crises. Instead, *Governmental Action* could be related to the more politics-related topics that are only present in few studies (Lee & Basnyat, 2013; Yu et al., 2020), while *Decrees and Measures* and *European Picture* have no counterparts, being thus specific of the context analysed. Regarding the evolution over time, the analysis in the two periods confirmed the drop over time of the discussion regarding the pandemic spread, also found by Yu et al., 2020 and Poirier et al. (2020). However, among the other topics that were discussed, no significant trend can be noticed and compared to existing literature. Indeed, in contrast to the study of Pan and Meng (2016) and Yu et al. (2020), no relevant increase in the discussion of Economic and Social consequences, health situation and political matters was detected, possibly due to the relatively short time frame analysed. Instead, the daily discussion was often affected by some peaks coinciding with important events that were strictly related to the topic (for instance, "*Decrees and Measures*" peaked the days in which a new decree was released). Moreover, the analysis of semantic changes disclosed some other interesting insights regarding the evolution of the terminology used to cover the topics. For instance *Health Situation*, found in both periods analysed, moved from descriptions about the outbreak to the importance of prevention. Likewise, discussions linked to the *Economic Downturn* shifted from financial markets to workers and the real economy. While currently no similar methodology was applied in other studies regarding communication in crises, we believe that semantic analysis could better support the description of communication content in the future.

The second research question seeks to explore the link between government communication and level of fear, monitored through Italy's government campaign #iorestoacasa, highlighting the potential role of social media to monitor the impact of communication during crises. Indeed, while theoretically fear can be kept within manageable levels by governments offsetting uncertainty with information (Giardini & Vilone, 2021; Reynolds, 2006), there is no empirical evidence about the dynamics of this relationship. This study sought to prove the value of data coming from social media (and directly addressed to government campaign #iorestoacasa) to monitor citizens reaction and demonstrate empirically the links between government communication and the level of fear. As a result, two out of the six topics discussed during the social media campaign seem to be correlated with the level of fear expressed in tweets. At first, *Life-Changing Scenario* is positively correlated with the level of fear. Therefore, discussions about the daily impact of life under quarantine could have raised concerns of population. A possible explanation lies on the repercussion that could have affected citizens' *locus of control*. Messages that address more directly individual habits and situations affect the public's perceived sense of vulnerability towards environmental factors, increasing the level of fear (Bachem, Tsur, Levin, Abu-Raiya, & Maercker, 2020). Secondly, the correlation tests also highlight a negative correlation between *European Picture* topic and the level of fear. This result is more complex to interpret and could have possible different explanations. For instance, it could be seen in relation to the findings of Talving and Vasilopoulou (2021), that revealed a

strengthening of the relationship between citizens trust on national government and citizens' trust in EU institutions during crises, especially in the most affected countries. Given the increasing consent that the Italian government was achieving[11] at the time, this correlation could be seen as an evidence of the positive effect generated by stronger trust in EU institutions. Also, this correlation could be related to the practical implication that EU negotiations generated, providing economic funding and financial sustainment for the recovery (European Council, 2020). This result could be therefore a reaction to the actual events that ended up on the establishment of concrete measures, in addition to the potential role of institutional trust.

Finally, an important consideration must be done considering the fact that, in this study, the level of fear measured in tweets was not correlated with four out of six topics discussed during the #iorestoacasa campaign, being partially in line with the expectation drawn from literature. Firstly, as previously stated, the correlation of *European Picture* can be interpreted in relation to the research of Talving and Vasilopoulou (2021) about the role of institutional trust in the reduction of population concerns. Then, Padeiro et al. (2021) argued that in crisis social and economic consequences affected citizens' fear. While the positive correlation of *Life-changing Scenario*, which could be related to the social impact of the crisis, is confirmed, the economy-related topic had no significant effects on the level of fear. Additionally, Reynolds (2006) strongly underlined the importance of providing timely information regarding the situation and the decisions of government in pandemic crises, but *Decrees and Measures* was not correlated to the level of fear. In a context such as the first weeks of a pandemic crisis, in which the level of fear is already altered per se (Zhao et al., 2020), the study tests the extent to which some topics are able to affect these persisting population concerns. Given that citizens could focus on only few priorities at a time, a possible interpretation could be that the correlations between communication content and the level of fear also varied over time depending on the events related to each topic. Indeed, during the period considered, the main important event that occurred regards the European Joint Statement, which indeed could explain the negative correlation of *European Picture*. Instead, for instance, the main decrees and measures were already established, suggesting that those topics were not anymore a priority potentially affecting population concerns.

6. Conclusions

In a world vulnerable to pandemic events (Bunnell et al., 2019), governments must be able to transmit the right messages to help limit panic from spreading (Barry, 2009), induce the population to act appropriately to contain the outbreak and reduce their exposure to the virus (or whatever is causing the pandemic) and so keep the death rate down (Hyland-Wood et al., 2021). Theoretically, fear can be kept within manageable levels by offsetting uncertainty with information (Giardini & Vilone, 2021; Reynolds, 2006), but there is no empirical evidence about the dynamics of this relationship. Against this background, our study highlighted the valuable role of social media to assess and monitor population reaction during crises. The results unveil some correlations between government and press communication, and the level of fear expressed in tweets addressed to the governmental social media campaign, launched in Italy at the beginning of coronavirus outbreak in 2020.

This research is the first to have empirically advocated some potential uses of social media data that could profit government communication during crises, and disclosed some preliminary information regarding its effects on the level of fear of citizens. Indeed, the results reveal potential consequences of addressing population locus of control during crises, since the related topic "*Life-Changing Scenario*" revealed to be positively correlated to the level of fear expressed in tweets.

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[11] https://www.istitutoixe.it/newsletter/2022/20220325.pdf

Moreover, the topic that covered the European negotiations leading to the EU Joint Statement, drafted in those days, appeared to have lowered population concerns. This outcome suggests a positive impact related to increased trust towards the institutions that were handling the crisis, and could disclose the effects on population mood generated by the financial support agreed within the EU Council. While the other correlation tests didn't appear as significant, this could be due to the main events occurred during the social media campaign that mainly regarded those two topics. That could also indicate that population interests is dedicated to only few priorities at a time. In general, the implications put in light the opportunity to improve the effectiveness of government communication in crisis with the use of social media, encouraging institutions to utilize those channels for gathering the response of population, for instance through the launch of ad-hoc governmental campaigns.

To conclude, this study has added to the methods and theory that can give researchers an empirical understanding of the crisis and emergency risk communication taking place during the Covid-19 pandemic, with relevant implications for practice. However, there is the need of further research with more extensive investigation to unveil the general dynamics that characterise this relationship during crises and it is necessary to acknowledge the boundaries of the previous insights. The period we analysed was much shorter than the overall duration of the first outbreak and subsequent waves, also considering that some days were excluded from the correlation analysis because of the abnormal circumstances marked by severe discontinuity in levels of fear. Examining a longer period would be important to provide more rich and robust evidence about the relationship among government communication and level of fear. Possible extensions to this study for a better may also deepen similar situations in other countries, in order to find similarities and cultural specificities that need not be considered by different governments. Another limitation is that the study is constrained to Italian Twitter users and one specific hashtag. Despite *#iorestoacasa* was selected because it was a channel promoted and related to government that citizens could address, many other hashtags were active in that period of time and also other social media could have represented a valuable source of information. Future studies could also explore possible differences in the patterns of level of fear expressed in different communication channels and assess eventual divergence in terms of relationship with government communication, also through the development of more sophisticated algorithm able to detect more precisely the level of fear. Finally, the relationship between communication patterns and level of fear have been investigated through the means of correlation tests. That method didn't assess the role that other variables could have played on the level of fear, for instance the influence of conflicting non-official information sources, misinformation generated in social media themselves, or the users' personal background. More complex models could instead exploit a larger spectrum of variables to disclose more in details the dynamics of the phenomenon, providing more evidence regarding the effects of government communication and causality that actually exists with population level of fear in crises.

CRediT authorship contribution statement

Romain Lerouge: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Melisa Diaz Lema:** Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration. **Michela Arnaboldi:** Methodology, Validation, Investigation, Resources, Writing – review & editing, Project administration.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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