The Coronavirus in the mobile device ecosystem: developers, discourses and reception

El coronavirus en el ecosistema de los dispositivos móviles: creadores, discursos y recepción

Alicia Gil-Torres. The University of Valladolid. Spain.
alicia.gil@uva.es
[CV]
Juan Martín-Quevedo. Rey Juan Carlos University. Spain.
juan.martin.quevedo@urjc.es
[CV]
Salvador Gómez-García. The University of Valladolid. Spain
salvadorgomez@hmca.uva.es
[CV]
Cristina San José-De la Rosa. The University of Valladolid. Spain
cristina.sanjose@uva.es
[CV]

This manuscript is the result of the R + D + i Research Project "Politainment in the post-truth environment: new narratives, clickbait, and gamification" (CSO2017-84472-R), subsidized by the Ministry of Economy, Industry, and Competitiveness of the Government of Spain for the period 2018-2020.

Dates:
- Start of the research: January 15th, 2020.
- End of the research: June 15th, 2020.

How to cite this article / Standardized reference
Gil-Torres, A., Martín-Quevedo, J., Gómez-García, S., & San José-De la Rosa, C. (2020). The coronavirus in the ecosystem of mobile devices: creators, speeches, and reception. *Revista Latina de Comunicación Social*, 78, 329-358. https://www.doi.org/10.4185/RLCS-2020-1480

ABSTRACT
Introduction: This research explores the impact of the COVID-19 crisis on the ecosystem of mobile applications. **Methodology:** The search and location of apps on COVID19 on the Google Play and Apple Store platforms are used to select the ones with the greatest impact and diffusion for which a quantitative analysis was performed. **Results:** The research has focused on four aspects: (1) the appearance of these applications and their evolution according to current events during the first months of 2020; (2) the characteristics, purposes, and features of the discourse; (3) what traits identified the issuers and, finally, (4) the reception that users made about the apps. **Discussion:** the two main types of developers (government entities and private initiatives) focused on disease control and diagnosis applications, along with others that tried to alleviate the growing demand for information.

KEYWORDS: COVID-19; 2019-nCoV; apps; mobile environment; Android; iOS; Smartphones.

RESUMEN
Introducción: Esta investigación explora el impacto de la crisis de la COVID-19 en el ecosistema de las aplicaciones móviles. **Metodología:** Se parte de la búsqueda y localización de apps sobre COVID19 en las plataformas *Google Play* y *Apple Store* para seleccionar aquellas de mayor impacto y difusión a las que se practicó un análisis cuantitativo. **Resultados:** La investigación se ha centrado en cuatro aspectos: (1) la aparición de estas aplicaciones y su evolución a tenor de la actualidad durante los primeros meses del año 2020; (2) las características, propósitos y rasgos del discurso; (3) qué rasgos identificaron a los emisores y, por último, (4) la recepción que hicieron los usuarios sobre las apps. **Discusión:** los dos grandes tipos de desarrolladores (entidades gubernamentales e iniciativas privadas) se centraron en aplicaciones de control y diagnóstico de la enfermedad junto a otras que trataban de paliar la creciente demanda de información.

PALABRAS CLAVE: COVID-19; 2019-nCoV; apps; ecosistema móvil; Android; iOS; Smartphones.

CONTENT

Translation by **Paula González** (Universidad Católica Andrés Bello, Venezuela)

1. Introduction

On December 31st, 2019, the World Health Organization (WHO) notified the first case of a new respiratory infection that would become known as COVID-19 or 2019-nCoV (WHO, 2020) and that would eventually spread throughout the world. In the first weeks, the epicenter of the disease was located in the city of Wuhan (China) and the local and national governments undertook a series of measures aimed at controlling and containing the spread of the virus. The general confinement was complemented with a strategy to monitor suspected cases, to be able to address infections before they got out of control, something essential given that the incubation period of the virus means that a person can be infected and contagious for several days before manifesting appreciable symptomatology.

With the expansion of the registered cases, which soon went from hundreds to tens of thousands, the use of information technology, and particularly *smartphones* and applications (apps), became essential both for citizen geolocation and to provide information (Ye; Zhou; Wu, 2020). The Chinese government launched several population monitoring applications, a strategy that proved particularly effective in preventing the uncontrolled spread of cases across the country during the Chinese New Year displacements (January 31st, 2020) (Chen et al., 2020). Thus, the Chinese government launched the *Query of Same Itinerary with Patient* app, which made it possible to reconstruct the user's movements during the last month to find out if they had met infected people and, if so, receive immediate advice. Likewise, the application *Diagnosed Cases in Community* made it possible to track in which areas of each city registered cases were concentrated, to better plan outings (Pan, 2020).

It was not the only case. The spread of the virus on a global scale led other States such as Israel, Taiwan, or South Korea, to approve legislation that would allow the tracking of geolocation data from mobile phones. On the other hand, another less aggressive/invasive strategy insofar, as it requires the explicit approval of the citizen, was chosen by the Singapore government, which launched the *TraceTogether* application. This allowed users who had been close to each other to be tracked via Bluetooth so that, if a contagion occurred, the Ministry of Health contacted all those who could be affected to follow up (Cho; Ippolito; Yu, 2020). The Spanish government has also tried similar applications, although of much less scope, such as *COVID-19 Assistance*, in this case, more oriented to self-diagnosis and tested only in five autonomous communities (La Moncloa, 2020), or *COVID Radar*, which activation has been produced throughout Spain during the second half of 2020.

While it is true that it is early to measure the real impact of these applications to reduce the number of infections, there are indications that they have had a very positive impact, even in countries where only a relatively low percentage of the population has installed these apps (Howell, 2020), although always as a complement to other measures (Kitchin, 2020). In any case, the use of applications for the possible diagnosis and containment of pandemics has only been approached as a tangential aspect. Following the 2014-15 Ebola outbreak in West Africa, a systematic review was published on a sample of 58 apps created for crisis management (Tom-Aba et al., 2018), but was not followed up with further articles. Regarding mobile applications about the coronavirus, academic research has been focused on practical aspects of their design (Kishore et al., 2020; Betarte et al., 2020). And although there have been some texts published in specialized technology journals (Kim, 2020; Gvili, 2020), in general, they have not been paid attention beyond the invasions of privacy that the use of these tracking apps will generate (HRW, 2020; Cho, Ippolito; Yu, 2020).

To this must be added the proliferation of non-governmental applications, and with purposes other than tracking, motivated, for example, by the desire for information from citizens. A desire for information fueled and, in part, motivated by the extensive media coverage of all matters related to COVID, with up to 63.74% of the information in digital media dedicated to the coronavirus in Spain (Lázaro-Rodríguez; Herrera-Viedma, 2020: 7). This interest has also been reflected in the increase in radio consumption and specifically in information programs during confinement (Rodero, 2020). The desire to obtain reliable information has been especially present in the first weeks after the declaration of the state of alarm, marked by great uncertainty and behavior of the media and institutions that oscillated between over information and sensationalism (Masip et al., 2020; Costa-Sánchez; López García, 2020). In this sense, Spaniards mostly sought information in the media, but also, although to a lesser extent, through digital media and Internet searches (Badía, 2013; Igartua; Ortega-Mohedano; Arcila-Calderón, 2020), linked in many cases to the use of *smartphones*.

This situation has occurred in a context in which the penetration of *smartphones* (and apps) in everyday life has grown consistently in recent years (Berlanga-Fernández et al., 2018; Montero-Díaz, J. et. al.). In 2018, the number of mobile phone lines exceeded the world population. According to the GSMA's annual Mobile Economy report, at the end of 2017, a penetration rate of 66% (5,000 million) was reached but the number of SIM cards used stood at 7,800 million. This figure corresponds to 103% of the current world population (Muñoz, 2018). Since the arrival of the first *smartphone* at the beginning of the 21st century, the total number of smartphone users around the world has not stopped growing, reaching 3.2 billion users of this type of device in the world with China (which represents 27% of the total) at the top (Newzoo, 2019).

The increase in devices has influenced so that, in 2019, the Internet reached an average consumption of 170 minutes per day per person, surpassing television (167 minutes on average) for the first time

in history. This is because this consumption includes the growing use of the internet on mobile phones, taking up 130 minutes per day (Statista, 2019). These data have increased due to the confinement that has been suffered due to the coronavirus. As countries limited social mobility, the time of use of smartphones increased: in March consumption increased in China by 30%, and in Italy, also at the epicenter of the pandemic, by 11%, with an increase in 20% world average in the first quarter (App Annie Intelligence, 2020).

Not only has the time spent on mobile phones increased, but the new confinement situation has led to experimentation and the search for new uses for devices, partly marked by the desire to maintain social contact (Fu and Lee, 2020), and partly driven by the need to adapt to teleworking (Anghel, Cozzolino, and Lacuesta, 2020). In the first quarter of 2020, Google Play increased its downloads by 5% annually and iOS by 15% (App Annie Intelligence, 2020). The increase has been particularly marked in videoconferencing applications: only in the third week of March (14^{th} to 21^{st}) 62 million applications of this type were downloaded worldwide, an increase of 45% compared to the previous week and 90% more than the same period in 2019 (App Annie Intelligence, 2020). This is coupled with the reaction of citizens in many countries, marked by the search for alternative sources of information, in many cases due to mistrust in traditional institutions and media (Scolari et al., 2009; Boberg et al., 2020).

Therefore, this research aims to explore how the ecosystem of mobile applications about the coronavirus has been transformed, an environment characterized by its ability to address current issues in a very short time, due to the ease of development and the expansion of applications. apps (Gómez; Cabeza, 2016; Gómez-García et al., 2019; Navarro-Sierra and Quevedo-Redondo, 2020). Besides, the reception that audiences have made of these applications is explored, both in terms of what they have downloaded and their reactions, and, above all, the purpose of the applications they have chosen.

2. Objectives

The above issues underscore the focus of this research: the role of mobile device apps in the flow of information about the coronavirus during the initial months of the pandemic. Due to the exceptional situation under study, quantitative exploratory research is proposed to identify the type of transformations that have occurred in the ecosystem of distribution platforms for mobile applications in Android and iOS operating systems, as well as their characteristics of production, consumption, and user responses. This analysis of the mobile ecosystem of apps is proposed around four main axes: (1) the emergence of this type of apps, (2) their characteristic features, (3) the identification of the issuers, and (4) the reception of the apps by users. Based on these pillars and the theoretical foundation proposed in the previous section, the following research questions will try to be answered from a series of variables that are also indicated:

RQ_1. What was the impact of the news about COVID-19 on the number of mobile applications that addressed this situation and what scope did they obtain in the different countries affected by the virus? This question was addressed based on the number and distribution of the apps according to their countries of origin and the downloads achieved.

RQ_2. What kind of purpose did the apps serve regarding COVID-19 and which ones received the greatest acceptance? An aspect that will be addressed from the different categories recognized by the distribution platforms, as well as the coding of the services they offered, with special attention to the apps that received the most downloads.

Received: 29/06/2020. **Accepted:** 17/09/2020. **Published:** 30/10/2020

RQ3. What was the profile of the developers of the apps on COVID-19? To answer this question, it was considered that the identification of the issuers is the key. This way you can know if they are the governments, companies, or citizens. The number of apps previously developed by each of these profiles also makes it possible to identify whether they are professionals in the mobile ecosystem looking for a benefit or not.

RQ4. What type of reception and evaluation have the most downloaded apps received? What were the comments users gave them and what aspects did they consider effective or useless? This question seeks to know which is the user's reactions to these apps, based on the comments that have been registered through the content distribution platforms.

The four previous questions define the triple front of this research. The first one is the analysis of the quantitative evolution of the app sample and its characteristic elements. Second, it seeks to identify the traits of developers and their apps. And finally, look at the elements that define how users have welcomed these types of applications.

3. Methodology

The methodology of this research has tried to respond to this triangle of interests by the search and identification of all the apps that have as their topic some aspect related to the coronavirus within the framework of the current academic challenge that the development of a tool implies theoretically and methodologically for this research (Costa-Sánchez, 2014; Light; Burgess; Duguay, 2016; Gómez-García et al., 2019; Cano-Orón, Vengut-Climent, & Moreno-Castro, 2020). To do this, a search was carried out using keywords (COVID-19, coronavirus, and 2019-nCoV) and different Boolean operators on the content distribution platforms *Google Play* and *App Store*. This search was carried out with *Sensor Tower*, an app monitoring software. The initial screening was completed with a snowball sample (Baltar; Brunet, 2012) thanks to the suggestions offered by the platforms based on the initial results. In this way, it is expected to have located almost all of the most relevant apps published from January 2020 to May of this year.

The results yielded a total of 415 applications: 271 corresponding to the Android operating system and 144 to iOS. Of these, 82 were available for both systems and were considered duplicates. However, for the data encoding, it was decided to exclude the applications from the App Store due to the opacity of the Apple platform in certain fundamental variables for this research, such as, for example, the country of creation or the number of downloads, factors that have already shown limitations in other research (Gómez; Cabeza, 2016).

For operational and analytical integrity reasons, the content analysis focused on those apps that on May 31st, 2020, had exceeded 1,000 downloads. That is 137 of the total of 271 apps that had been located on Android. In other similar research (Gómez García et al., 2019; Zamora-Medina; Losada-Díaz; Vázquez-Sande, 2020) other coding thresholds have been defined, but with larger populations or with a greater accumulation of downloads due to the passage of time. Based on these considerations and due to the novelty of the object of study, the size of the sample, and the speed of the events, it was decided to set the limit in those apps that exceeded 1,000 downloads because the World Health Organization declared the COVID-19 as a pandemic on March 11th, 2020 (WHO, 2020) and data collection ended only 11 and a half weeks later, being a short term so that the phenomenon is no longer considered as novel. Besides, Table 1 shows that the estimated total of downloads is 128,845,546, of which 128,813,568 correspond to the study sample of this work (n=137 and +1,000 downloads), which is 99, 98% of world downloads. Thus, the applications that were left out of the sample have been considered not very relevant, regardless of their total number.

Table 1. *Distribution of apps according to the number of downloads.*

Downloads	Number of apps	Summatory apps	% of the sample (summatory%)	Downloads stimations	% Downloads (% accumulated)
>50,000.001	1	1	0.73% (0.37%)	50,000,000	38.81% (38.81%)
5,000,001 – 50,000,000	1	2	0.73% (0.74%)	27,500,000.50	21.34% (60.15%)
1,000,0001 – 5,000,000	5	7	3.65% (2.58%)	37,500,002.50	29.10% (89.25%)
500,001 – 1,000,000	4	11	2.92% (4.06%)	3,000,002	2.33% (91.58%)
100,001 – 500,000	18	29	13.14% (10.70%)	5,400,009	4.19% (95.77%)
50,001- 100,000	14	43	10.22% (15.87%)	4,200,007	3.26% (99.03%)
10,001 – 50,000	31	74	22.63% (27.31%)	930,015.50	0.72% (99.76%)
5,001 – 10,000	21	95	15.33% (35.06%)	157,510.50	0.12% (99.88%)
1,001 – 5,000	42	137	30.66% (50.55%)	126,021	0.10% (99.98%)
501 – 1,000	25	162	18.25% (59.78%)	18,762.50	0.01% (99.99%)
101 - 500	31	193	22.63% (71.22%)	9,315.50	0.01% (100.00%)
0 - 100	78	271	56.93% (100.00%)	3,900	0.00% (100.00%)

Source: Self-made

The coding was carried out through a codebook that allowed the authors and an associate researcher to collect the data that made up the quantitative content analysis. The coding responded to the formal patterns offered by the content distribution platforms complemented by *Sensor Tower*, although some aspects of it should be specified. On the one hand, the developers were classified according to taxonomies located in the reference literature (Wang et al., 2017; Gómez-García et al., 2019), recognizing 4 categories according to the total number of apps of each creator: sporadic (1 or 2), moderate (from 3 to 9), active (between 10 and 20), and, finally, the prolific or professional (more than 20 applications developed).

Besides, in data collection, when coding the variable of the category in which the purpose of the app was framed, the following division has been made that may be useful in future research.

- Personal help: The developer seeks to make the situation more bearable by offering advice and relaxation exercises or ideas to lift the mood.
- Information and medical attention: The data found in the app refer to the effects that the virus generates in the body and how it evolves; numbers to call for professionals to answer medical questions; or information on the nearest health centers.
- Self-diagnosis without sending: Explanation of the symptoms and possibility that the user performs a self-examination without the possibility of sending the results to any database.
- Content for professionals: Apps with medical and healthcare content so that professionals in a certain area have instructions on how to proceed.
- Monitoring and tracking of people: Here we refer to two possibilities of the apps. On the one hand, the possibility of collecting information from the user (anonymously or not) and thus being able to establish guidelines for the movements carried out to control their environment and possible infections. On the other, the apps that monitor patients infected with the virus and be able to carry out a follow-up outside the health center.
- Research on COVID-19: Tools for scientific purposes to be able to collect data and behaviors of the coronavirus through the cooperation of users.

- General data on the pandemic: Applications developed to report on the evolution of the data of infected, deceased, sick who have overcome COVID-19, and active countries.
- Others: Subject not related to the above. Games or forums to channel help between neighbors, for example.

The application of this typology has been carried out according to the dominant or main function of the application. Thus, one application can offer a prominent service, and others as a complement (for example, applications on pandemic statistics that provide advice on frequent hand washing), but they have been considered to be secondary functions. The determination of which is the dominant function has been made by examining the operation of the application and taking into account what the creators themselves highlight in the description of it.

Finally, the coding of the reception took into account the rating *breakdown* of the distribution platforms, as well as an analysis of the tone of the comments to establish the general sentiment they conveyed. In this sense, the apps were classified by the majority tone that could be positive, negative, divided (in the case of not appreciating a greater presence of one than the other), or non-existent (in those cases in which there were no comments). For this, the number of comments and their evaluation according to the stars awarded have been observed: five and four stars corresponded to positive comments; three, neutral; and two and one, negative. Also, the last 20 comments that appeared on the platform were read to verify that the user's assessment and the comment corresponded to the classification given.

This coding process was carried out in the last two weeks of May 2020. To certify the reliability of the coding, a common sample of 54 apps was analyzed which, after two rounds of coding, obtained 99.3% agreement on the data obtained by the researchers, With this percentage, reliability is accepted, as it is appropriate "when nominal measures are used and all disagreements are considered equivalent" (Riffe et al., 2019: 123).

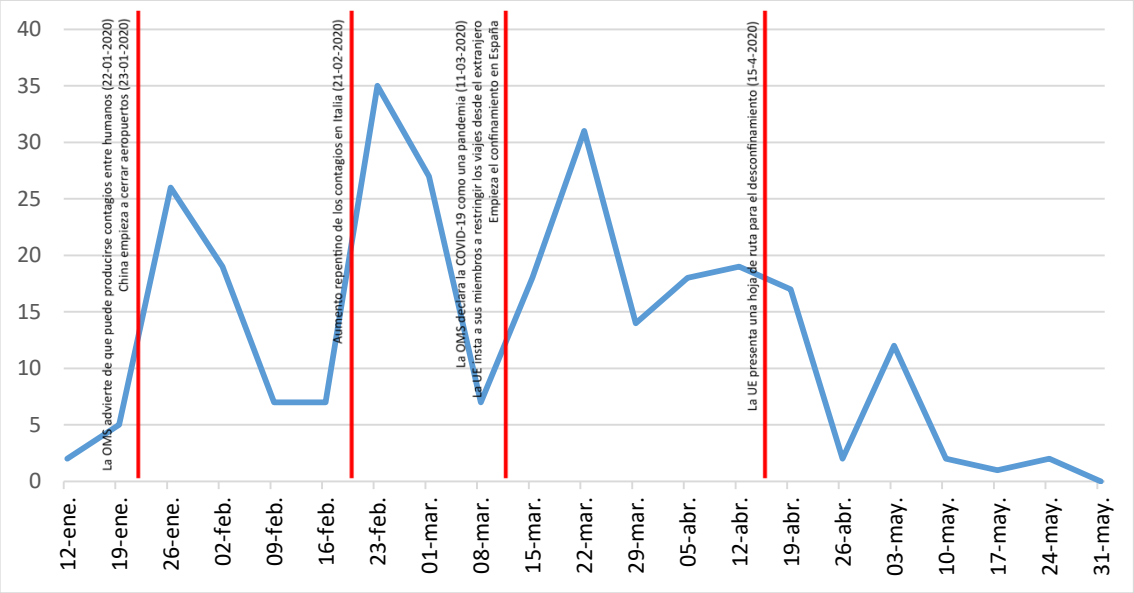
4. Results and discussion

4.1. Evolution of the ecosystem of mobile applications on the coronavirus

The first app created exclusively for 2019-nCoV was *Coronavirus: Info & Live Tracker* (January 22nd, 2020) and it was launched by a developer that had 158 more apps on distribution platforms (*Programming Is Fun*). In the analysis of the sample, it was found that at the end of January there were already 19 apps (13.87% of the sample) related to the subject. Starting the following month, with the increasingly rapid spread of the virus outside the borders of China, the numbers increased considerably: in February 45 applications appeared (32.85%); in March, with the beginning of confinement in countries such as Italy (March 7th) or Spain (March 15th), 61 apps were published (44.52%) and in April there were 47 (34.30%). However, in May there was a marked decrease in the appearance of new applications on the subject, with only 9 new apps (6.57%), possibly because it was no longer so new, the market was more saturated, and the intensity of the pandemic had subsided in the countries that had first suffered its effects. The case of March is significant since it is where the inflection point that marked the acceleration of the publication rate and the peak of developments occurred: 46 of the 61 applications were published in the 20 days that elapsed between the 11th (when the WHO declared the pandemic) and the 31st.

The previous data raises the need to establish a relationship between the development of applications and the perception of worsening of the pandemic, with the measures of social distancing in several European countries, the declarations of supranational organizations, and the increase in cases of

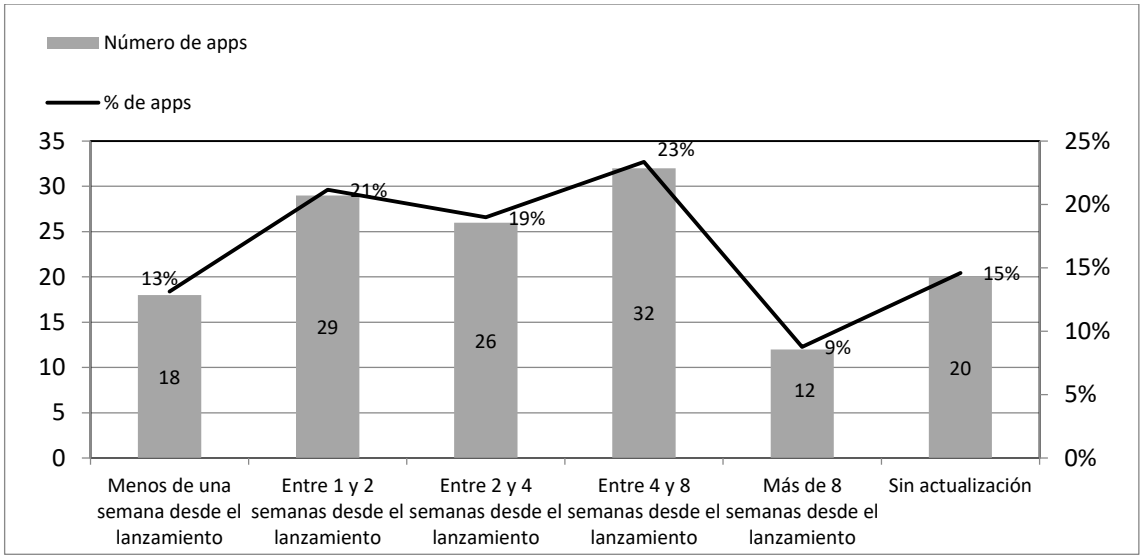
deaths and infections. This is in line with previous research, which had already pointed out the influence of external factors in the production of apps (Hilkert; Benlian; Hess, 2010; Heffernan et al., 2016; Di Ionno; Mandel, 2016). The data obtained allow different elaborations on the different rates with which the mobile ecosystem reacted to the COVID-19 pandemic. The production of apps during the first months of the year 2020 presents some interesting features that are reflected in graph 1.



Graph 1. *Time evolution of the publication of apps about Covid-19.*
Source: self-made based on our data, from WHO (2020), and the Council of Europe.

In this sense, it can be verified that there is no clear correlation between the number of deaths and the applications developed, but rather that it would be necessary to look for correspondence with the signs of the evolution of the pandemic in the news discourse. However, it must be taken into account that there must be a time difference between the news and the appearance of the apps, due to the development time. Thus, the largest percentage increases occur as the virus begins to spread outside of China and to transcend in the media, albeit as a distant event. Similarly, a second peak can be seen a few weeks after the airport closures begin in China, and another peak, smaller, in this case, a few weeks after the first infections begin to register in Europe.

An important factor in an event with a global dimension and continuous evolution, such as a health crisis, is that the data is updated to adapt to a changing medical, human, and social scenario. In this sense, apps, due to their nature, can be modified and updated whenever the developers deem it appropriate. However, almost 15% of them (20) did not carry out any retouching. The bulk of the applications received updates between the first and eighth weeks after their launch, accounting for 65.50% (125) of the total. Of the 18 apps that took less than a week to make an update, 13 carried out a readjustment the day after their launch.



Graph 2. *Updates of the most popular apps.*
Source: Self-made

The above data are related to the periods of higher app production that preceded, as already mentioned, significant events, such as the declaration of an international health emergency, the first confinements, or the recognition of the disease as a pandemic. In any case, this growth in the launch of applications was not, on the other hand, simultaneous or uniform from the geographical point of view. If one takes into account that the mobile ecosystem encompasses the entire planet and that a relationship between applications is established with the countries that have developed them (Lim et al., 2014; Khaskheli; Jun; Bhuiyan, 2017), the world map presents the distribution of apps developed according to their country of origin:

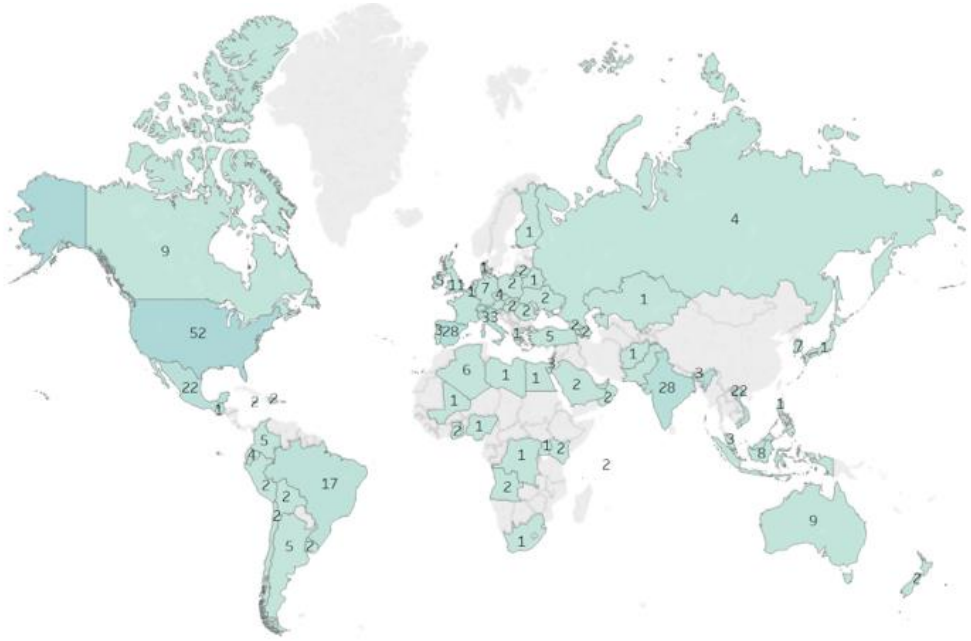
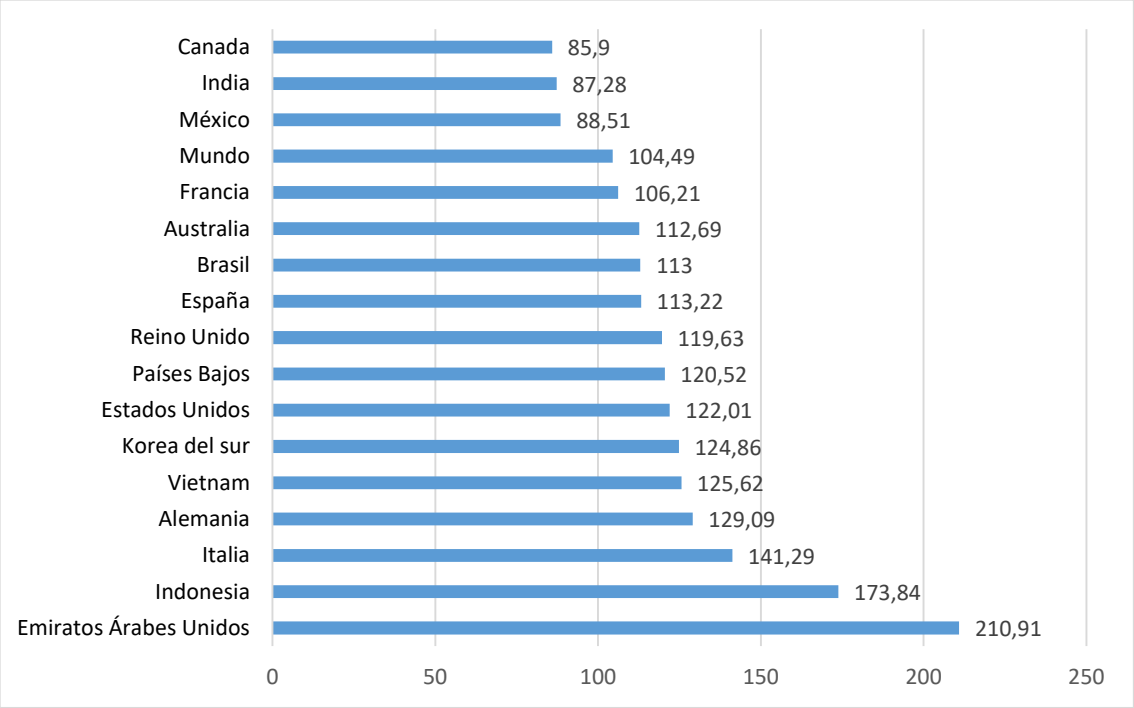


Image 1. *Number of apps by country*
Source: Self-made.

This image reflects that the United States has been the nation with the most developed apps (52), followed by Italy (33), and with Spain and India in third place (28 each). These data contrast with the production of apps in previous years: in 2017, the United States was also the country that developed the most apps, although with a greater market share (33.5%), followed by China (15.9%), India (5.1%), and the United Kingdom (3.3%) (Statista, 2017). Although the data change from one year to another, the variation is significant enough that it is interesting to cross the production data by countries with the virulence that COVID-19 has had in them to determine if this may be a relevant factor, as there is a greater stimulus to develop apps related to a particularly serious crisis.

According to *Worldometer* data (2020) for June 12th, of the 213 countries and territories affected, it could be assumed that the countries most affected by the pandemic would be the most prolific in terms of creating apps about the coronavirus. A circumstance that is manifested in that 8 of the most affected countries (United States, Brazil, Spain, United Kingdom, Italy, India, France, and Germany) account for 44.59% (185 apps) of the total. On the other hand, the countries that have produced the most applications are also developed states, with a high rate of Internet connections, higher in all cases (except Canada, Mexico, and India) than the world average, and with more than one mobile connection per person.

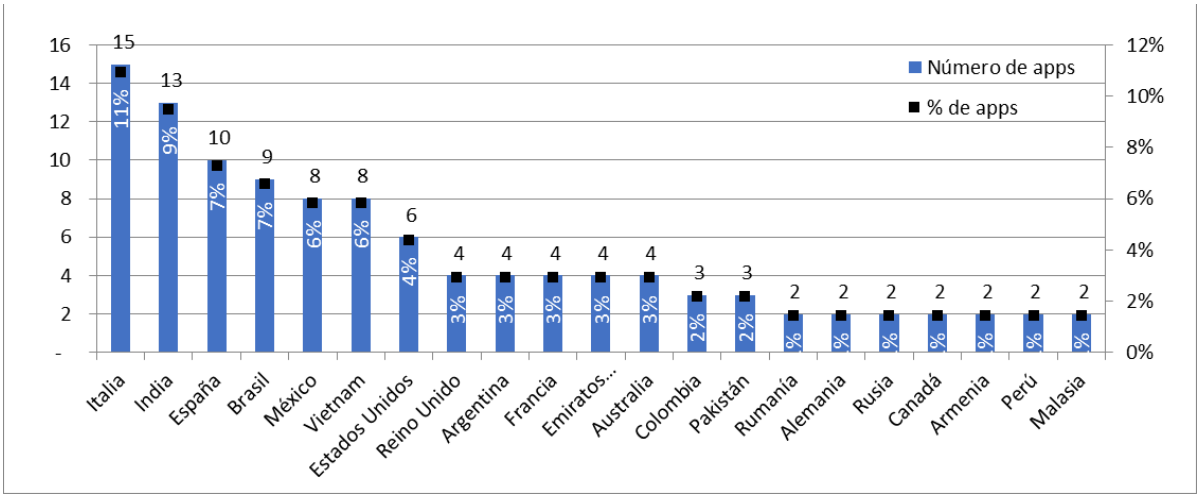


Graph 3. *Monthly subscriptions.*
Source: Self-made from WorldinData

However, these numbers only reflect a part of reality, because the abundance of apps does not necessarily imply popularity or a great diffusion. In that sense, the number of downloads (data only available on Android, because the Apple Store does not offer that information) is decisive. Therefore, of the 271 applications distributed by Google Play, it is interesting that the most downloaded applications were developed in developing countries. One factor that produces this fact is that the only countries that developed apps that exceeded 5,000,000 downloads were Colombia and India. In the first case, through *Coron-App Colombia*, whose launch was reinforced by a support campaign that included the gift of 1gb of data and 100 minutes of calls to all users who reported their symptoms. A claim that, in the context of the country, justified its high demand, although as will be

seen later, its reception was controversial. In the second case, *AarogyaSetu* (which in mid-June 2020 has exceeded 100 million downloads according to Google Play) was developed by the Indian Ministry of Health and its popularity can be placed both in its status as the second most populated country in the world (1,379,500,000 people, *Worldometer*, 2020) as well as the effort to localize the app to the different languages of the country (including English, promoting foreign consumption) or the Google Store algorithm, which presents the suggestions nationwide.

The number of downloads is due to many factors and it cannot be specified with the data that we have where the bulk of them comes from. However, if it is considered that, on the total of downloads, there is a proportionality between the internal and external consumption, it could be identified, the countries in which the apps of mobile devices generated more interest among users, and, therefore, were mostly used as tools to meet various needs during the coronavirus crisis. Therefore, based on the sample of the most popular applications (n=137), that is, those that exceed 1,000 downloads, it is observed that Italy is the country with the most downloaded apps (15 and 11%), followed by India (13 and 9%). Spain ranks third with 10 applications that together account for 7% of worldwide downloads.



Graph 4: *Number of apps (Android) by country*
Source. Self-made.

In this sense, it is interesting to highlight that, in Italy, the country with the most applications with more than 1,000 downloads each, the most popular was *LazioDrCovid*, which also remained from its appearance (March 19th) until April 9th in the Top 3 of the most downloaded free apps in the country, most of the time in the first place. It is an app promoted by the government and focused, as its name suggests, in the Lazio region, of which Rome is the capital, one of the epicenters of the pandemic. The application is used to track the user's vital signs (temperature, pulse, etc.), contact the nearest medical center, or even have the patient make a virtual consultation with their doctor. On the other hand, the second most popular was *Coronavirus Statistics*, which made it possible to follow the evolution of the pandemic in the world through data from the Johns Hopkins University. It is a free commercial application, but with integrated purchases, although the evaluation of users was mostly positive.

In the Spanish case, the most consumed application was *STOP COVID19 CAT*. Developed by the Government of Catalonia, the app had a double function: on the one hand, through a questionnaire the user was warned of the risk they had of having contracted the virus. On the other hand, through

these data, the possible infected were monitored, offering heat maps of areas with a high concentration of infections.

4.2. Features of the most popular apps

An emergency like COVID-19, which in its first weeks was of a health nature, but with wide social and economic ramifications, could have given rise to very diverse applications. However, of the 36 categories of apps in the Google Store, those referring to the pandemic were concentrated on only 12 (Table 3) to categorize them. Many users resorted to already available applications in the first weeks of the pandemic, mainly for videoconferences or games, and the presence of apps developed specifically for the pandemic was a minority (Valverde, 2020).

The *Health and Fitness* category accounted for more than 40% of the total apps in the sample, followed by *Medicine* with 27%. Two solitary applications were classified as *Productivity* and *Travel and guides* which, due to their content, could perfectly fit into the two majority. These are *CONFINAPP*, developed by the Government of Catalonia to provide information on confinement and (un)confinement (classified in *Travel and guides*), and *COVAPP*, a self-diagnosis application (in *Productivity*).

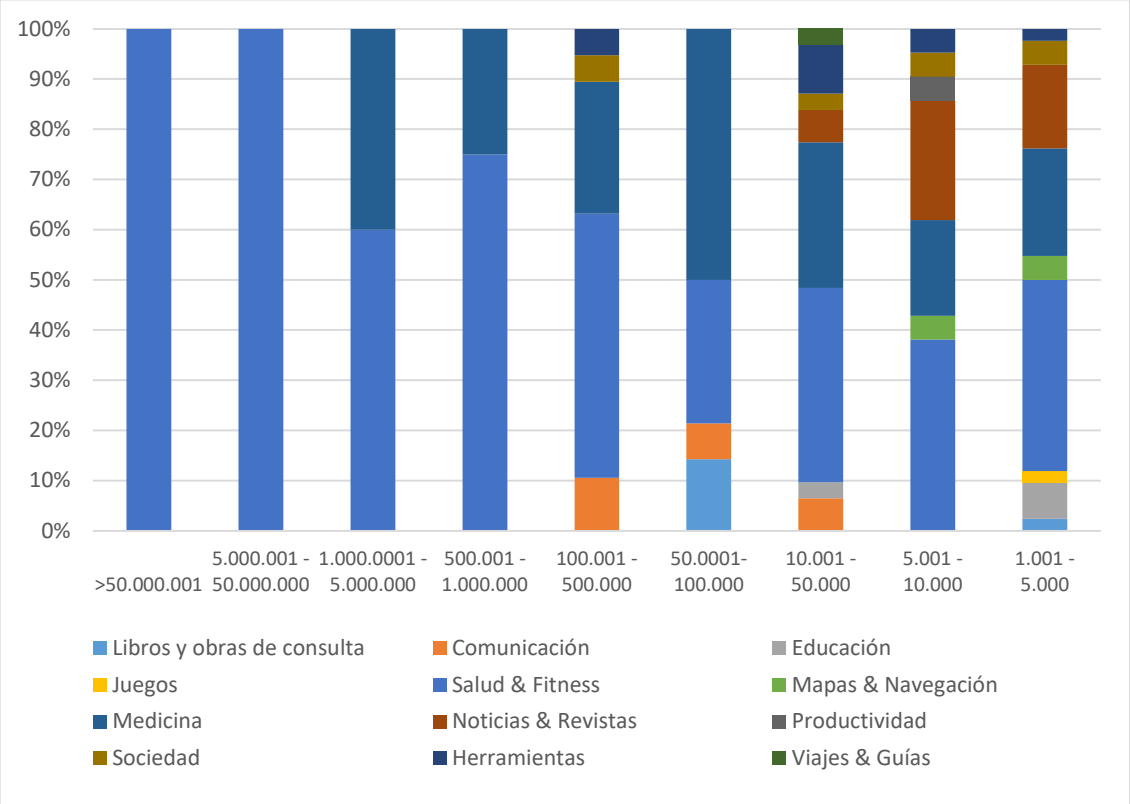
Table 2. *App categories*

Category	Number of apps	% of the sample
Health and fitness	55	40,15%
Medicine	37	27,01%
News and magazines	14	10,22%
Tools	6	4,38%
Communication	5	3,65%
Society	5	3,65%
Education	4	2,92%
Games	3	2,19%
Books and reference works	3	2,19%
Maps and navigation	3	2,19%
Productivity	1	0,73%
Travel and guides	1	0,73%
Grand total	137	100,00%

Source: Self-made

This data reflects the categorization chosen by the developers and their intentions when creating this content. It is clear that the efforts focused on two specific fronts: health and information. In this sense, apps with medical information such as *AarogyaSetu* (India) or *Coronavírus - SUS* (Brazil) or general information applications such as *CovidSafe* (Australia), *COVID Symptom Study* (United Kingdom) stood out. In *Medicine*, *NCOVI*, an official application of the Vietnamese Ministry of Health and the Ministry of Information and Communications, and *Cuidar COVID-19 Argentina*, an app of the Ministry of Health of the Argentine Republic, aimed at the prevention and care of citizens against the New Coronavirus pandemic Covid-19, stand out, both in the *Health and Fitness* category

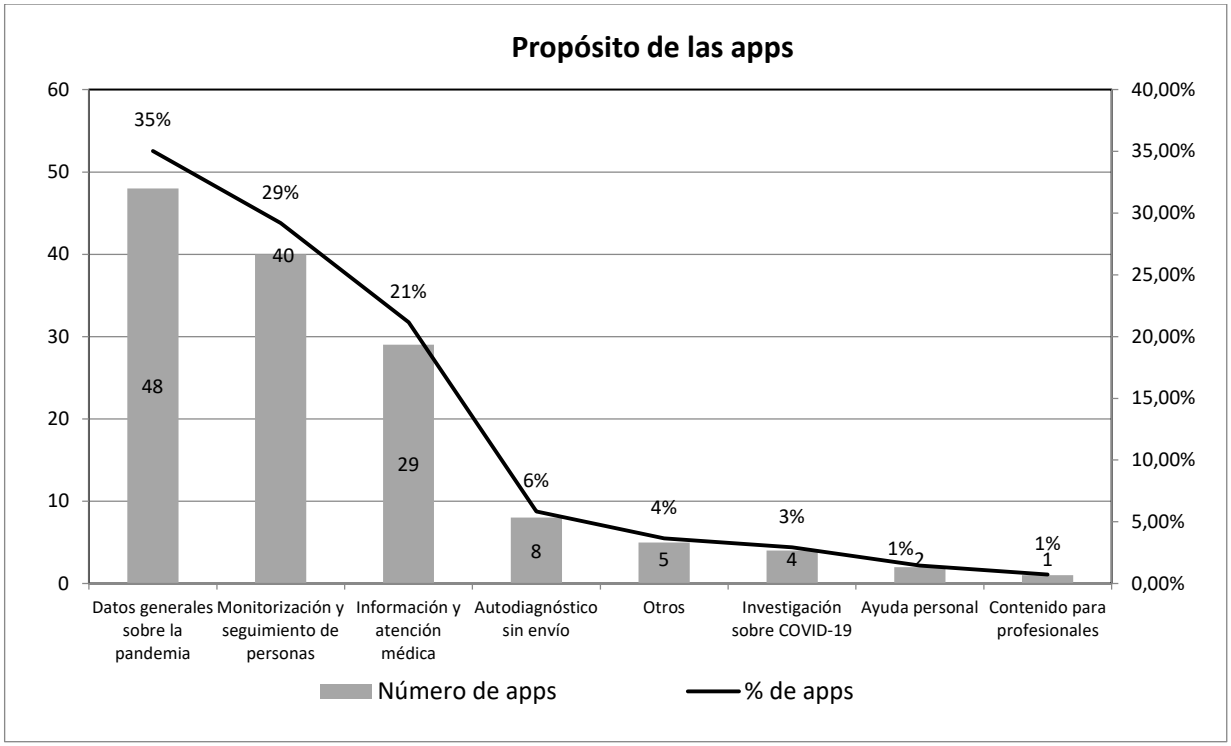
that widely exceed one million installations. However, this data can be qualified according to the range of downloads generated by the apps included in these categories.



Graph 5. *Categories of apps according to their download range (%)*
Source: Self-made

Graph 5 reflects these categories by percentages according to the download range. The majority predominance of the *Health and Fitness and Medicine* categories identifies that the consumption of apps responded to the main vectors of the epidemic in the first weeks, in which the public's concern was more focused on the immediate aspects than on the long-term consequences of the crisis. However, it should be noted that 23.81% and 16.67% of apps included in *News and Magazines* in the latest download forks, although the Android system itself defines this category as "newspapers, news aggregators, magazines, blogs" (Google, nd.), none of the apps found meets these characteristics. Besides, the two apps with more than 5 million downloads were in the *Health and Fitness* category: the aforementioned *AarogyaSetu* (official application of the Indian government to provide health services) and *CoronApp Colombia* (tracking application of the Colombian Administration).

Graph 6 presents 3 main utilities in the creation of apps on COVID-19: updated information on the evolution of the pandemic, monitoring and follow-up of the population, and, finally, information of immediate use about the disease. The rest of the proposals received much more minority attention.



Graph 6. *Purpose of the apps*
Source: Self-made

It can be noted that the highest percentage is found in the sought purpose of "General data of the pandemic", with 35% (48). They show how data on the evolution of the crisis are provided: the number of deaths, infected, affected countries, and a wide range of others. On the other hand, some of them collect basic hygiene data, interesting data to observe how the virus spreads, and the evolution of infections. This reflects the uncertainty and anxiety of the first moments, dominated by a lack of certainty about what was happening or the scope it would have. This fits in with the rise of websites like Worldometer, which has become the quintessential provider of statistical information on COVID-19 for governments, institutions, and the general population (Meo et al., 2020). The contents are very uneven, finding apps where the data appeared fixed without any update (*Coronavirus Map*) or others that updated them several times a day *(Coronavirus - Live Monitor (nCOV-2019)*. The use of maps to locate countries is a constant and some of them reflect it in their content (43) or their name (6).

In the second place, with 29.2% and 40 units, the apps developed for the monitoring and follow-up of sick people are located. Here two large types are distinguished: those aimed at the general population and those that focus on monitoring patients who are not admitted to the hospital. An example of the latter is *Canada COVID-19* designed to know what actions to take and the steps to follow since the recommendations are personalized and receive timely alerts from the Canadian Ministry of Health with updates. The management of the information provided individually is a complex aspect that some apps want to soften by openly specifying the use that will be given to this private data. The Australian app *CovidSafe*, for example, is very aware of the individual control of the information poured into it, but almost all follow the line of the New Zealand *NZ COVID*, in which no guarantees are offered.

Image 2. *Examples and people monitoring and tracking: Covid Safe and NZ COVID Tracer*
Source: Authors' compilation through the use of *Sensor Tower*

Despite the large percentages above, information and medical care are still relevant, occupying third place with 21.17% and 29 apps. They contain medical information on what the virus is, what symptoms it produces, and how to proceed to minimize infections. Besides, some provide an immediate self-evaluation, but without the possibility of sending data or show the nearest medical centers. As an example, the Indian application *Covid-19 Feedback*, where information and feedback on medical treatment can be provided, although -it should be emphasized- this function does not respond to a real or two-way interaction with a medical body, but rather a series of tips that are displayed based on the information that users enter in the applications.

The apps in the category "Self-diagnosis without sending" represent a group characterized by showing a classification of signs that may lead to the suspicion of suffering from the disease (*COVID-19 NI Symptom Checker*). Although quantitatively the category of "Research on COVID-19" is reduced, qualitatively it has relevance: the request for help to carry out research projects on the coronavirus. *The How We Feel Project* (estimated 250,000 downloads and launched in the United States) is a developed app "founded in March 2020 by a volunteer team of scientists, doctors, and technologists from Harvard, MIT, the Howard Hughes Medical Institute, the Universities of Pennsylvania, Stanford, and Maryland, or the Weizmann Institute of Science (*How We Feel Project*,

2020). The app asks for personal data and the presence or absence of symptoms, all anonymously. It also has a social aspect, because when it is downloaded for the first time a meal is donated in collaboration with Feeding America. The analysis detected that other university organizations such as Universitaetsklinikum of Freiburg and Leiden University Medical Center launched applications so that users who had passed it could provide data to help their research.

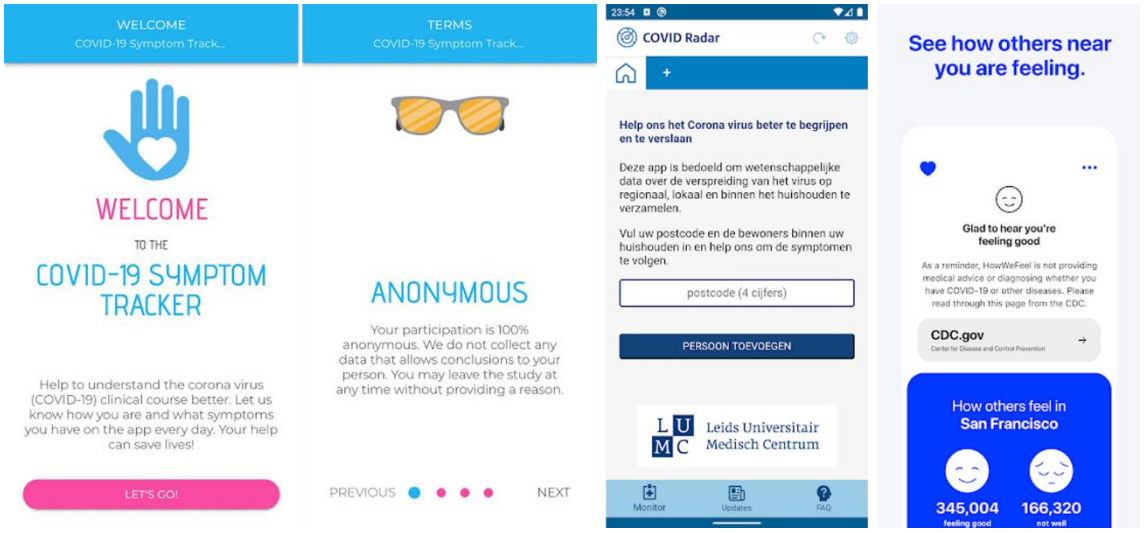


Image 3. *Examples of scientific research: COVID-19 Symptom Tracker, COVID Radar, and How We Feel.*
Source: SensorTower.

The morale of the population was an essential aspect for the governments, particularly in those countries forced to more rigorous confinement, such as Spain, France, or Italy. Therefore, it is not surprising that applications appeared that would help citizens to face the situation generated by COVID-19, framed in the category "Personal help". Along these lines are *ConfinApp* (Spain) and *COVID Coach* (United States), apps that sought to make more bearable the confusing situation experienced. The "Other" category includes the rest, such as *Coronavirus The Game*, but there are also *COVIDA*, humanitarian in nature, which provides social or medical aid to the most vulnerable. Also, COVID-19 Province of Santa Fe, in which users can make reports of shortages or overprice in stores, inquiries, request assistance and stay informed concerning the issue. It is striking that in the study sample there was also an application aimed at learning about the coronavirus (*EndCorona*, from Indonesia) to be able to teach specific groups about how the virus behaves and protect themselves.

4.3. X-ray of the developers of the apps about COVID-19

The traits that identified content creators present some interest in a context that was defined by the abundance of information, of heterogeneous nature, and, also, with a propensity to misinformation (**Cuan-Baltazar** et al., **2020; Smith; Ng; Ho Cheung Li, 2020**). For this reason, it was also considered of interest to identify the traits that defined content developers. From the study sample (n=137), it was found that governments have been active actors when developing apps, staying very close to companies or individual developers (70). In this sense, the difference is barely one percentage point since governments directly promoted 67 of the most popular apps (48.9% of the total). However, as Table 7 points out, of the 11 developers that exceeded 500,000 downloads, 10 of them were the governments themselves, which, in most cases, launched their presence in the mobile ecosystem through apps dedicated to the COVID19.

Table 3. *Developers and countries with the most estimated downloads*

Developer	Country	Sum of estimated downloads
NIC Egov Mobile Apps	India	50.000.000
Ins.Gov	Colombia	27.500.000,50
Cục Tin Học Hóa	Vietnam	3.000.000,50
Zoe Global	United Kingdom	3.000.000,50
Presidency of the Argentine Nation	Argentina	3.000.000,50
Government of Brazil	Brazil	3.000.000,50
Australian Department Of Health	Australia	3.000.000,50
Government of Catalonia	Spain	750.000,50
Ministry of Health of Mexico	Mexico	750.000,50
Digital Transformation Agency	Australia	750.000,50
National It Board	Pakistan	750.000,50
Total		95.500.005,00

Source: Self-made

This data reflects that official messages reached a greater diffusion than their private counterparts. The only direct exception to this trend was the developer Zoe Global which, in any case, is owned by the Government of Gales and the Government of Scotland together with King's College London. Therefore, it can be concluded that, despite the private initiatives regarding COVID19, the confidence of a greater number of users was directed towards official sources in those countries where governments incorporated apps as part of their informational strategy. In this sense, it is noted that issuers are government entities in 3 of the ranges of download percentages (between one million and 5 million, between 5 million and 50 million, and more than 50 million). Besides, governments continue to maintain that primacy up to 100,000 downloads, where non-governmental organizations are the majority.

The traits of the developers, as defined in the methodology, took into account their global content creation profile for *Google Play* or *Apple Store*. Table 4 shows the popularity of apps with the production of developers to ask whether "the more apps they have created, the greater the chances that they will be popular" (**Wang** et al., 2017: 167). This thesis does not correspond to the case of study, since the data obtained show that sporadic (38.69%) and moderate (34.31%) developers have reached downloads of more than half a million, while active developers (15.33%) and prolific ones (11.68%) are also present in the lower ranks.

Table 4. *Download range and developer type*

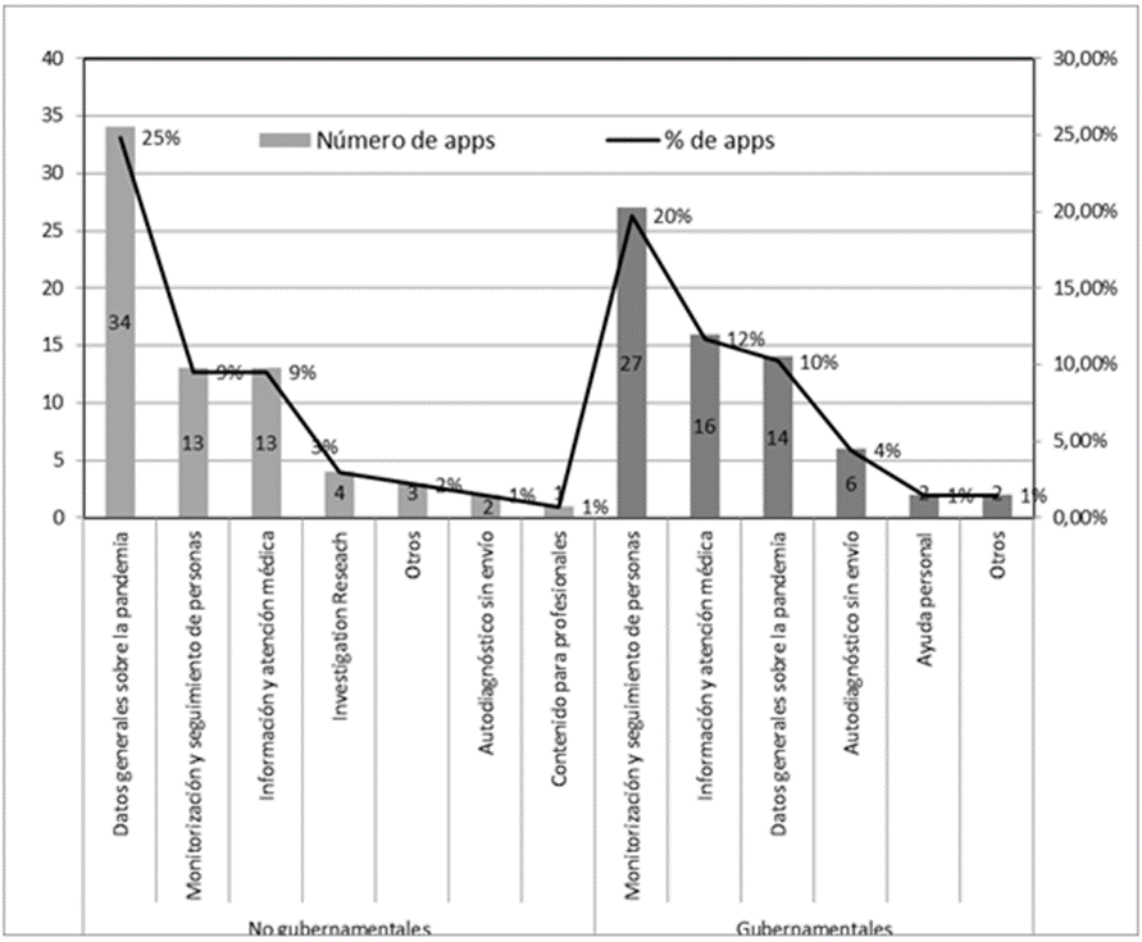
Download Range	Sporadic (1-2)	Moderate (3-9)	Active (10-20)	Prolific (> 20)	Total
>50,000,001	0	0	0	1	1
5,000,001 – 50,000,000	1	0	0	0	1
1,000,001 – 5,000,000	2	1	1	1	5
500,001 - 1.000,000	2	1	0	1	4
100,001 - 500,000	8	8	2	0	18

Received: 29/06/2020. **Accepted:** 17/09/2020. **Published:** 30/10/2020

50,001 – 100,000	5	3	5	1	14
10,001 – 50,000	8	13	6	4	31
5,001 – 10,000	7	6	4	4	21
1,001 – 5,000	20	15	3	4	42
Total	**53**	**47**	**21**	**16**	**137**

Source: Self-made

The intersection of the variables of the purpose of apps and the nature of their creators reflects heterogeneous values. For individuals and private entities, the category of data on the pandemic is paramount, with 25% (34) of the total, as well as information for professionals is a minority category, with only 1% (1). As for governments, their main purpose is the monitoring and follow-up of people with 20% (27) followed by information and medical help with 16 applications (12%). Therefore, it is appreciated the different interests that moved those who perceived the use of apps as a public or state service compared to private initiatives, although they do not present conclusive data on their motivations.



Graph 7. *Purpose of apps according to governmental and non-governmental entities*
Source: Self-made

Finally, all the apps that exceeded 1,000 downloads were free, although many of those linked to non-governmental initiatives responded to a logic of monetization through advertising (specifically, 57.1% of them).

4.4. The reception of apps among users

The analysis of the data related to the reception of the applications presents a different logic. Even though the average appraisal of apps that exceeded 1,000 downloads stood at 3.57 points, their tone showed a significant inclination towards positive comments, which is reflected in Table 5.

Table 5. *Tone of comments*

	Number of apps	App percentage	Average rating	Average comments
Divided	17	12,41%	3,325	1.307,53
Negative	20	14,60%	2,64	195,45
Non-existent	6	4,38%	0,00	0,00
Positives	94	68,61%	4,04	11.131,03
Total	137	100,00%	3,57	7.828,13

Source: Self-made

This data, therefore, reflects a fundamentally positive reading of the functionalities of the apps. A consideration that can be qualified through the qualitative analysis of the users' comments that articulate reading of the aspects in which the apps came to cover a social need or, on which occasions, they generated displeasure and for what reasons.

When evaluating apps positively, users focused mainly on the concept of “usefulness” which was summarized, simply, as the “help provided to understand what to do, how to do it, or what the government is doing” (*BCCOVID-19 Support*). This utility, although recognized, was not, on many occasions, explicitly defined by users. When it was done, the help to detect symptoms or the possibility of having a “quick check-up” (*COVID-19MX*) stood out, which, although important in this context, used to refer to apps developed by individuals or companies without sanitary solvency. It can be noted that the element most indicated as positive by users was the possibility of accessing the information of the apps in different languages. Paradoxically, more than a reliance on the information offered, reference was made to the languages in which the application was offered. Users also highlighted their comparative evaluation of many applications when celebrating that "this app is really useful and, besides, it is available in 10 other languages, which is one of its best advantages" (*Corona Virus Track*).

The main criticism present in the negative opinions was related to the request for personal data, although this assessment had different nuances. On the one hand, the uncertainty surrounding its subsequent use, although, curiously, some users required some of these functions to determine the effectiveness of the apps: “And the geolocation is not there? Well, what do I want it for? Uninstall” (*Corona Madrid*). Sometimes, the users themselves questioned the explanations of the apps about the request for such data: “You need to activate the location. Why? Explanation: is it necessary for Bluetooth to work??? And why can I connect my speakers via Bluetooth with location disabled? Why I can connect to my Tablet via Bluetooth when the location is disabled? Why can I connect to the car handsfree via Bluetooth with the location turned off? Why can I connect to my laptop via

Bluetooth when the location is disabled? I could continue this list to infinity" (*Coronavirus Australia*).

Other users did not complain about providing such data, but rather because they did not perceive that giving them had a definite utility or, even, because they considered that those that they considered "pertinent" such as "headaches, digestive problems, muscle problems, etc.", were not requested. (*Corona Madrid*). Finally, the most critical users ended up questioning the app in its entirety from visceral positions: "An application worthy of the government. Useless!" (*Coronavirus Australia*).

Some apps concentrated this critical load, such as *NZ COVID Tracer* –which had more than three times as many negative comments as positive- because the service it offered –monitoring and tracking people through a series of stations- was not working. In other cases, more spurious purposes can be sensed in the download of apps such as *Coronavirus map* that did not offer what its own name indicated (a map): "*Coronavirus map* does not have a map!!! It is the worst app I have ever seen, there is no map, it is stupid, and I wish I could give it 0 stars", or apps that, directly, did not work correctly, as the users of *Crush COVID RI* reported.

However, this perception was not so unanimous in all apps. Some apps received polarized opinions as a result of uneven experience from users. This was the case of *CoronApp-Colombia*, a location app promoted by the Colombian government with a gift for its users of 100 minutes of calls and 1 Gb of data. The comments ranged from the lucky ones who could access these advantages without setbacks to those who, outraged, complained about an alleged government deception or who explained the need for its activation in different contexts: "I am a teacher and many of the families of my children have installed this App in the hope of receiving the Giga navigation and 100 minutes of calls, but some even after a month of installed never received anything. They are families who do not have Internet in their homes and do not have a data plan on their cellphones. And the Ministry of Education spoke of this App as an opportunity to access education. I hope that is corrected and becomes a reality" (*CoronApp-Colombia*).

The crossing of data between the comments of the apps and their developer reflected that the contents developed by governments are the best valued by users. Of the 67 applications of government origin, 42 received mostly positive ratings, and they were also the ones that generated the most interaction with users, with an average of 22,516.10 comments, and an average rating of 4.03 out of 5. The ratings of applications from non-governmental developers were also mostly positive in tone, but the average number of comments was notably lower, 1,935.40, less than a tenth of that of government apps. The sum of the applications of negative (11) and divided tone (10) and the total comments of both (2,422.41) are still lower than the positive ones. The better reception of the contents of the states may reflect the awareness of greater media exposure, besides technical and human teams that are not available to small developers.

5. Conclusions

This research offers a first X-ray of the trends in the creation, distribution, and consumption of apps about COVID19 that were developed during the first four months of 2020. In this sense, this research explores how applications, the most personal manifestations of a hyper-technified world, have responded and have been transformed in the face of an exceptional situation experienced throughout the planet. This is done through the four previously posed research questions.

The production of apps had a clear correspondence with current news, in line with previous research (Tom-Aba et al., 2018; Gómez-García et al., 2019; Planells, 2020), in which the main informative milestones (the declaration of a pandemic, the most significant increases in the numbers of infected

or deceased, etc.) had repercussions and set the pace for the appearance of a greater number of apps in the immediate aftermath. In this way, the development of apps responded to the interests of the public, both when it was growing, in the first weeks, and with the slowdown in the appearance of new products when the danger of the pandemic seemed to become less pressing.

However, the interest in producing apps was not necessarily due to the force with which the pandemic hit each country, but to other issues. On the one hand, socioeconomic factors have had more relevance in the production of apps than the incidence of the pandemic in each state. For example, Vietnam, despite being one of the countries least affected by COVID-19 (position 148), was one of the most active developers, something that could be related to its high penetration rate of mobile Internet, one of the highest in the world (WorldInData, 2020). On the other hand, political factors, such as the decentralization of a country, were also relevant: Thus, for example, in Spain applications developed by regional governments coexisted, without, on the contrary, an application for the entire national territory launched by the central government existing. Some of these governments, such as the Government of Catalonia, launched various applications throughout the state of alarm, which could have a search reading to make the government's work visible in the face of close elections.

The predominant discourse features in the COVID19 apps were, predictably, those related to health and information (77.3%). In this sense, and given the variety of dimensions of the crisis, the absence of applications in categories such as *Economy or Finance* (for example, to advise regarding the requirements of government aid), *Education* (due to the need to pass with practically no prior notice to online teaching at all educational levels), or *Games* (to help pass the sudden amount of free time). On the other hand, the most downloaded applications were those that provided statistical data on the evolution of the pandemic, which shows a striking feature in the consumption of citizens, who were looking for raw information, especially maps. In this sense, the influence of the present on the behavior developed by the user when consuming news on a mobile device is appreciated (Westlund, 2015). Another reading is a contagion effect of a media logic that has offered "ranking coverage", focusing the information on the count of victims and which countries had more deaths than others (Masip et al., 2020).

The second major category of most downloaded applications were those for tracking the infected. The expansion of these applications is logical, since in almost all cases they were products developed by governments, and implemented with their support. In some countries, this support was manifested through the legal obligation to install the app (as in the United Arab Emirates), and in others with incentives and gifts, as was the case in Colombia, or, simply, through institutional advertising, as happened with the various applications developed by autonomous governments in Spain. In any case, this emphasis on ensuring that they were accepted by the public responds not only to political reasons, but also to health reasons: its capacity as a tool for early detection and prevention of new infections depends directly on the extent of its use, and its effectiveness increases exponentially as they are adopted by a larger percentage of the population (O'Neill, 2020).

However, precisely because of all this support and the media coverage of the pandemic, it is striking that informational applications have been more in demand. Probably the reason must be found in the feeling of uncertainty of the first weeks of the crisis.

The COVID-19 pandemic has supposed a sudden entry of many governments into the app ecosystem. Most of them had not published any other applications previously but became very present actors, almost equaling private developers in number. More importantly: a vast majority of the most downloaded apps, 7 out of 11, are from the government. In part, this popularity is because

they concentrated most of their efforts on infected-tracking applications, which, as we have seen, received a lot of support to be downloaded, along with health care oriented content. App development has been configured during the crisis, therefore, as a public service and an extension of the traditional role of the state as the guardian of public health.

On the other hand, the purposes of private/particular developers responded to economic interests, which recognized the benefits of creation and distribution in the logic of "earned media" or in the direct income from the monetization of the app promoted thanks to the information demand that exists in much of society. In this sense, some of the most popular applications were extremely simple, such as *Coronavirus Statistics*, which limited itself to reproducing public statistics, adding advertising. Likewise, some showed a performance improvement, or an absolute absence of activity, despite which they maintained a notable presence in the download rankings, such as *Coronavirus Map*. In this sense, it seems that the citizens' desire for information was not accompanied by too many demands.

Besides, a relevant feature of the applications that appeared in these weeks, both public and private, is that the haste to develop them and the changing situation did not translate into a frequent updating rate of the code. With the data found, it cannot be specified if this was due to the lack of interest of the developers, the polish of their initial design, or the simplicity of many of them.

One of the marked features of the media situation created by the COVID-19 pandemic has been the encounter between a highly changing current situation and dynamics that are increasingly present in societies in recent years, such as over information, misinformation, and abundance of fake news (Pérez-Dasilva; Meso-Ayerdi; Mendiguren-Galdospín, 2020), in some cases, with a marked anti-government bias. Despite this, the most downloaded applications (more than 95 million installations) and the best valued (both in the average evaluation and user participation, with ten times more positive reviews in public applications than in commercial ones) have been official productions. This official status allowed citizens to clearly know the source of the information they were receiving, which does not necessarily imply a guarantee of veracity. In this sense, the motivation to seek security cannot be ruled out in government discourse in the face of an uncertain situation, although the data from this research did not allow it to verify it.

In short, the emergence of COVID-19 in the ecosystem of apps for mobile devices came from the combination of a set of factors. On the one hand, the applications were constituted as one more element of the governments' monitoring and informative strategy to combat the spread of the virus and the optimization of available resources, although leaving some long-term considerations in the air, such as data privacy or the possible problems of medical practice derived from remote or little personalized consultation (Guseh; Brendel; Brendel, 2009; Díaz; Chaparro-Domínguez, 2018).

Finally, another fundamental factor has been the acceptance of the popularity of mobile devices by developers and, above all, governments, who have assumed the continuous presence of these devices in everyday life, and knew how to take advantage of their potential to communicate directly with citizens.

Regardless, a major limitation of this research should be noted: as previously stated, the sample only spans 11½ weeks. Nonetheless, given the exceptional nature of the situation, the rapid evolution of the crisis -the sample ranges from the first news of the phenomenon to the beginning of de-escalation processes in various countries- and the consequent difficulty of comparing with similar situations, it was chosen to prioritize immediacy rather than doing long-term research. This is intended to reflect the situation during the first wave and the first lockdown, which opens up the possibility of making comparisons with the second wave and subsequent lockdowns if any.

6. References

Anghel, B., Cozzolino, M., y Lacuesta, A. (2020). El teletrabajo en España. *Boletín Económico*, (2/2020), pp.1-20.

App Annie Intelligence (2020). *Weekly Time Spent in Apps Grows 20% Year Over Year as People Hunker Down at Home.* https://www.appannie.com/en/insights/market-data/weekly-time-spent-in-apps-grows-20-year-over-year-as-people-hunker-down-at-home/

Badía Valdés, A.T. (2013). La radio. Un salto de la web al móvil, que pasa por las redes sociales. *Chasqui (Quito)*, (13), 27-33 https://doi.org/10.16921/chasqui.v0i123

Baltar, F. y Brunet, I. (2012). Social research 2.0: Virtual snowball sampling method using Facebook. *Internet Research*, *22* (1), 57-74. http://dx.doi.org/10.1108/10662241211199960

Berlanga-Fernández, I., Gozalvez-Pérez, V., Renés Arellano, P. y Aguaded-Gómez, I. (2018). Diez años de Smartphones. Un análisis semiótico-comunicacional del impacto social de la telefonía móvil. *Aula Abierta*, 47(3), 299-306. https://doi.org/10.17811/rifie.47.3.2018.299-306

Betarte, G.; Campo, J. D.; Delgado, A.; Ezzatti, P.; Forteza, Á.; González, L.; Martín, Á.; Muracciole, B. & Ruggia, R. (2020). Desafíos de seguridad y privacidad en el diseño e implementación de soluciones de rastreo de proximidad. *PEDECIBA*. http://www.pedeciba.edu.uy/docspd/covid_CT_position_betarteetal-1.pdf

Boberg, S., Quandt, T., Schatto-Eckrodt, T. y Frischlich, L. (2020). Pandemic populism: Facebook pages of alternative news media and the corona crisis--A computational content analysis. https://arxiv.org/abs/2004.02566

Cano-Orón, L., Vengut-Climent, E., y Moreno-Castro, C. (2020). Mental health images on the Internet: A Facebook and digital media content analysis in Spanish. *Revista Prisma Social*, (29), 240-259. https://revistaprismasocial.es/article/view/3338

Chen, S., Yang, J., Yang, W., Wang, C. y Bärnighausen, T. (2020). COVID-19 control in China during mass population movements at New Year. *The Lancet*, *395*, (10226), 764-766. https://doi.org/10.1016/S0140-6736(20)30421-9

Cho, H., Ippolito, D. y Yu, Y. W. (2020). Contact tracing mobile apps for COVID-19: Privacy considerations and related trade-offs. https://arxiv.org/abs/2003.11511

Consejo de Europa (2020): C*ronología: actuaciones del Consejo en relación con la COVID-19*. https://www.consilium.europa.eu/es/policies/coronavirus/timeline/

Costa-Sánchez, C. (2014). Las singularidades del medio móvil: integración multimedia, personalización, geolocalización y participación. Estudio de su presencia en las apps de la prensa española. *Palabra Clave*, 17(3), 672-694. http://dx.doi.org/10.5294/pacla.2014.17.3.5

Costa-Sánchez, C. y López-García, X. (2020). Comunicación y crisis del coronavirus en España. Primeras lecciones. *El profesional de la información*, *29* (3), e290304. https://doi.org/10.3145/epi.2020.may.04

Cuan-Baltazar J. Y.; Muñoz-Pérez M. J.; Robledo-Vega C; Pérez-Zepeda M. F y Soto-Vega, E. (2020). Misinformation of COVID-19 on the Internet: Infodemiology Study. *JMIR Public Health* Surveill, *6,* (2), e18444. https://doi.org/10.2196/18444

Cuesta, U., Cuesta, V., Martínez, L. & Niño, J. I. (2020). Smartphone: en comunicación, algo más que una adicción. *Revista Latina de Comunicación Social*, 75, 367-381. https://doi.org/10.4185/RLCS-2020-1431

Di Ionno, M.& Mandel, M. (2016): Tracking Colombia's App Economy. Progress. *Policy Inst*, 1. https://www.progressivepolicy.org/wp-content/uploads/2016/10/Colombia-ENGLISH.pdf.

Díaz del Campo Lozano, J. & Chaparro-Domínguez, M. (2018). Los desafíos éticos del periodismo en la era del big data: análisis de códigos deontológicos latinoamericanos. *Palabra Clave, 21*(4), 1136-1163. https://doi.org/10.5294/pacla.2018.21.4.8

Fu, Y. C., & Lee, H. W. (2020). Daily Contacts Under Quarantine amid Limited Spread of COVID-19 in Taiwan. *International Journal of Sociology*, 1-11. https://doi.org/10.1080/00207659.2020.1786636.

Gómez García, S. & Cabeza San Deogracias, J. (2016). El discurso informativo de los newsgames: el caso Bárcenas en los juegos para dispositivos móviles. *Cuadernos.Info*, *38*, 137-148. https://doi.org/10.7764/cdi.38.593

Gómez-García, S.; Gil-Torres, A.; Carrillo-Vera, J. A.& Navarro-Sierra, N. (2019). Creando a Donald Trump: Las apps en el discurso político sobre el presidente de Estados Unidos. *Comunicar: Revista científica iberoamericana de comunicación y educación*, *59*, 49-59. https://doi.org/10.3916/C59-2019-05

Google (sf.). *Categorías y etiquetas para aplicaciones y juegos*. Google Support. https://support.google.com/googleplay/android-developer/answer/113475?hl=es

Guseh, J. S., Brendel, R. W. & Brendel, D. H. (2009). Medical professionalism in the age of online social networking. *Journal of medical ethics*, *35*(9), 584-586. https://doi.org/10.1136/jme.2009.029231

Gvili, Y. (2020). Security Analysis <of the Covid-19 Contact Tracing Specifications by Apple Inc. and Google Inc. *Cryptomnium LLC, Tech. Rep*., 2020. https://eprint.iacr.org/2020/428

Heffernan, K. J., Chang, S.; Maclean, S. T., Callegari, E. T., Garland, S. M., Reavley, N. J., Varigos, G. A. & Wark, J. D. (2016). Guidelines and recommendations for developing interactive eHealth apps for complex messaging in health promotion. *JMIR mHealth and uHealth*, *4*(1), e14. https://doi.org/10.2196/mhealth.4423

Hilkert, D., Benlian, A. & Hess, T. (2010). Motivational Drivers to Develop Apps for Social Software-Platforms: The Example of Facebook. *AMCIS 2010 Proceedings*. Paper 86. http://aisel.aisnet.org/amcis2010/86

Human Rights Watch (2020). *Mobile Location Data and Covid-19: Q&A*. HRW. https://www.hrw.org/news/2020/05/13/mobile-location-data-and-covid-19-qa

Igartua, J.-J., Ortega-Mohedano, F. & Arcila-Calderón, C. (2020). Communication use in the times of the coronavirus. A cross-cultural study. *El profesional de la información*, *29* (3), e290318. https://doi.org/10.3145/epi.2020.may.18

Khaskheli, A., Jun, Y. & Bhuiyan, M.A. (2017). M-commerce and mobile apps: opportunities for SMEs in developing countries. *Journal of Internationa Bussines Reseand and Marketing*, *2*, (2), 20-23. https://doi.org/10.18775/jibrm.1849-8558.2015.22.3003

Kim, M. S. (2020). *South Korea is watching quarantined citizens with a smartphone app*. MIT Technology Review. https://www.technologyreview.com/author/max-s-kim/.

Kishore, N.; Kiang, M.; Engø-Monsen, K.; Vembar, N.; Balsari, S. & Buckee, C. (2020). Mobile phone data analysis guidelines: applications to monitoring physical distancing and modeling COVID-19. *OSF Preprints*. http://doi.org/10.31219/osf.io/5arjy.

Kitchin, R. (2020). Using digital technologies to tackle the spread of the coronavirus: Panacea or folly. The Programmable City Working Paper 44.: http://progcity.maynoothuniversity.ie/wpcontent/uploads/2020/04/Digital-tech-spread-of-coronavirus-Rob-Kitchin-PC-WP44.pdf

La Moncloa (2020). La aplicación oficial de autodiagnóstico AsistenciaCOVID-19, disponible ya en cinco nuevas comunidades autónomas. https://www.lamoncloa.gob.es/serviciosdeprensa/notasprensa/asuntos-economicos/Paginas/2020/060420-asistencia-covid19.aspx.

Lázaro-Rodríguez, P. y Herrera-Viedma, E. (2020). Noticias sobre Covid-19 y 2019-nCoV en medios de comunicación de España: el papel de los medios digitales en tiempos de confinamiento. *El profesional de la información*, *29* (3), e290302. https://doi.org/10.3145/epi.2020.may.02

Light, B.; Burgess, J. y Duguay, S. (2016). The walkthrough method: An approach to the study of apps. *New Media & Society*, *20* (3) 881-900. https://doi.org/10.1177/1461444816675438

Lim, S. L.; Bentley, P. J.; Kanakam, N.; Ishikawa, F. y Honiden, S. (2014): Investigating country differences in mobile app user behavior and challenges for software engineering. *IEEE Transactions on Software Engineering*, *41*(1), 40-64. https://doi.org/10.1109/TSE.2014.2360674

Masip, P.; Aran-Ramspott, S.; Ruiz-Caballero, C.; Suau, J.; Almenar, E. y Puertas-Graell, D. (2020). Consumo informativo y cobertura mediática durante el confinamiento por el Covid-19: sobreinformación, sesgo ideológico y sensacionalismo. *El profesional de la información*, *29* (3), e290312. https://doi.org/10.3145/epi.2020.may.1

Meo, S. A.; Al-Khlaiwi, T.; Usmani, A. M.; Meo, A. S.; Klonoff, D. C. y Hoang, T. D. (2020). Biological and epidemiological trends in the prevalence and mortality due to outbreaks of novel coronavirus COVID-19. *Journal of King Saud University-Science*, *32*(4), 2495-2499. https://doi.org/10.1016/j.jksus.2020.04.004

Montero-Díaz, J.; Cobo, M.; Gutiérrez-Salcedo, M.; Segado-Boj, F. & Herrera-Viedma, E. (2018). A science mapping analysis of 'Communication' WoS subject category (1980-2013). *Comunicar*, 55, 81-91. https://doi.org/10.3916/C55-2018-08

Muñoz, R. (2018). *El número de líneas móviles supera por primera vez a la población mundial*. El País, 27 de febrero. https://elpais.com/tecnologia/2018/02/27/actualidad/1519725291_071783.html

Navarro-Sierra, N. & Quevedo-Redondo, R. (2020). El liderazgo político de la Unión Europea a través del ecosistema de aplicaciones móviles. *Revista Prisma Social*, (30), 1-21. https://revistaprismasocial.es/article/view/3731

Newzoo (2019). *Newzoo Global Mobile Market Report 2019. Light Version*. https://newzoo.com/insights/trend-reports/newzoo-global-mobile-market-report-2019-light-version/

O'Neill, P. H. (2020). *No, coronavirus apps don't need 60% adoption to be effective*. MIT Technology Review. https://www.technologyreview.com/2020/06/05/1002775/covid-apps-effective-at-less-than-60-percent-download/

Organización Mundial de la Salud (2020). *Alocución de apertura del Director General de la OMS en la rueda de prensa sobre la COVID-19 celebrada el 11 de marzo de 2020*. *OMS*. https://www.who.int/es/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020.

Pan, X.-B. (2020). Application of personal-oriented digital technology in preventing transmission of COVID-19, China. *Irish Journal of Medical Science*, *1-2*. https://doi.org/10.1007/s11845-020-02215-5

Pérez-Dasilva, J.-Á.; Meso-Ayerdi, K. y Mendiguren-Galdospín, T. (2020): Fake news y coronavirus: detección de los principales actores y tendencias a través del análisis de las conversaciones en Twitter. *El profesional de la información*, *29*(3), e290308. https://doi.org/10.3145/epi.2020.may.08

Planells de la Maza, A. (2020). Los videojuegos como mundos ludoficcionales críticos: el caso de la crisis política española en el ocio digital móvil (2008-2015). *Comunicación y Sociedad*, 1-16. https://doi.org/10.32870/cys.v2020.7365

Riffe, D.; Lacy, S. y Fico, F. (2014). *Analyzing media messages. Using quantitative content analysis in research*. New York: Routledge. https://doi.org/10.4324/9780203551691

Rodero, E. (2020). Radio: the medium that best copes in crises. Listening habits, consumption, and perception of radio listeners during the lockdown by the Covid-19. *El profesional de la información*, v. *29*(3), e290306. https://doi.org/10.3145/epi.2020.may.06

Scolari, C.A., Navarro Güere, H., Pardo Kuklinski, H., García, I. y Soriano. J. (2009). Comunicación móvil: actores y producción de contenidos en Cataluña Mobile. *Comm & Soc.*, 22(2), 159-186.

Smith, G. D.; Ng, Fowie y Ho Cheung Li, W. (2020). COVID-19: Emerging compassion, courage and resilience in the face of misinformation and adversity. *Journal of clinical nursing*, *29*(9-10), 1425–1428. https://doi.org/10.1111/jocn.15231

Statista (2017). "Leading countries based on mobile app releases in 2017". https://www.statista.com/statistics/934739/countries-most-app-releases/

Statista (2019). *En 2019 el consumo de internet superó al de la televisión*. Satista. https://es.statista.com/grafico/14411/el-consumo-de-internet-sobrepasa-al-de-la-tv/

Tom-Aba, D., Nguku, P. M.; Arinze, C. Ch. y Krause, G. (2018). Assessing the Concepts and Designs of 58 Mobile Apps for the Management of the 2014-2015 West Africa Ebola Outbreak: Systematic Review. *JMIR Public Health Surveill*, *4*(4), e68. https://doi.org/10.2196/publichealth.9015

Valverde, B. (2020). *Menos Tinder y más Zoom, el confinamiento según las 'apps' más populares*, en El País Verne, 2 de mayo. https://verne.elpais.com/verne/2020/05/01/articulo/1588330590_985171.html.

Wang, H., Liu, Z., Guo, Y., Xiangqun, C., Miao, Z., Guoai, X., y Jason, H. (2017). An Explorative Study of the Mobile App Ecosystem from App Developers' Perspective. *International World Wide Web Conference Committee*, 163-172. https://doi.org/10.1145/3038912.3052712

Westlund, O. (2015). News consumption in an age of mobile media: Patterns, people, place, and participation. *Mobile Media & Communication*, *3*(2), 151-1. https://doi.org/10.1177/2050157914563369

WHO (2020). *Novel coronavirus (2019-nCoV): situation report-1*. World Health Organization. https://apps.who.int/iris/handle/10665/330760

Worldometer (2020). *Reported Cases and Deaths by Country, Territory, or Conveyance*. https://www.worldometers.info/coronavirus/

World in Data (2020): *Internet*. En https://ourworldindata.org/internet#all-charts-preview

Ye Q.; Zhou J. y Wu H. (2020). Using Information Technology to Manage the COVID-19 Pandemic: Development of a Technical Framework Based on Practical Experience in China. *JMIR Med Inform* 8(6), e19515. https://doi.org/10.2196/19515

Zamora-Medina, R.; Losada-Díaz, J.-C. y Vázquez-Sande, P. (2020). A taxonomy design for mobile applications in the Spanish political communication context. *El Profesional de la información*, *29*(3), e290327. https://doi.org/10.3145/epi.2020.may.27

Authors

Alicia Gil-Torres
Doctor in Journalism (Extraordinary Award), Master in Political Consulting, Graduate in Advertising and Public Relations and Graduated in Journalism. Assistant Professor at the University of Valladolid in the degree of Journalism. Member of the research project "*Politainment* in the post-truth environment: new narratives, *clickbait*, and gamification" and of the GIR Nuteco. Her lines of research are political communication, electoral campaigns, and communication.
E-mail: alicia.gil@uva.es
Index H: 3
Orcid ID: http://orcid.org/0000-0002-8042-2208
Google Scholar: https://scholar.google.es/citations?user=sYmJrS4AAAAJ&hl=es
ResearchGate: https://www.researchgate.net/profile/Alicia_Gil-Torres
Scopus ID: https://www.scopus.com/authid/detail.uri?authorId=57195761187

Received: 29/06/2020. **Accepted:** 17/09/2020. **Published:** 30/10/2020

Academia.edu: https://uva-es.academia.edu/AGilTorres

Juan Martín-Quevedo
Assistant Professor of Projects in the network in the degrees of Journalism and Audiovisual Communication of the Rey Juan Carlos University. Member of the Communication and Digital Society research group at the International University of La Rioja. His lines of research are social networks, scientific communication, and media history.
Juan.martin.quevedo@urjc.es
Index H: 7
Orcid ID: http://orcid.org/0000-0003-1005-0469
Google Scholar: https://scholar.google.es/citations?user=BmywGm8AAAAJ&hl=es
Scopus ID: https://www.scopus.com/authid/detail.uri?authorId=56045554400

Salvador Gómez-García
Doctor, with international mention, from the Complutense University of Madrid, Associate Professor and Coordinator of the Journalism Area of the University of Valladolid. He has been a visiting professor at the Erasmus University of Rotterdam, the Catholic University of Santiago de Chile, and I.T. Copenhagen, among other institutions. His current line of research is part of the narrative of the new media. He has published more than twenty articles in indexed scientific journals, such *as Comunicar, Intefaçe: Comunicação, Saúde, Educação, Revista Latina de Comunicación Social, Estudios del Mensaje Periodístico, Cuadernos.info, or Palabra Clave.*
salvadorgomez@hmca.uva.es
Index H: 12
Orcid ID: https://orcid.org/0000-0001-5126-6464
Google Scholar: https://scholar.google.es/citations?user=O6F3WoYAAAAJ&hl=en
ResearchGate: https://www.researchgate.net/profile/Salvador_Gomez2
Scopus ID: https://www.scopus.com/authid/detail.uri?authorId=55329857100
Academia.edu: https://uva-es.academia.edu/SalvadorG%C3%B3mezGarc%C3%ADa

Cristina San José-De la Rosa
Doctor in Journalism, Master in Compulsory Secondary Education and High School Teaching, Professional Training and Language Teaching, Bachelor of Journalism and Bachelor of Hispanic Philology. Professor at the University of Valladolid in the degree of Journalism. Her lines of research are journalism, and film, and mass media.
cristina.sanjose@uva.es
Index H: 2
Orcid ID: http://orcid.org/0000-0001-6891-3170
Google Scholar: http://orcid.org/0000-0001-6891-3170
ResearchGate: https://www.researchgate.net/profile/Cristina_San_Jose_De_La_Rosa
Academia.edu: http://uva-es.academia.edu/CristinaSanJos%C3%A9delaRosa

Received: 29/06/2020. **Accepted:** 17/09/2020. **Published:** 30/10/2020