

What to do in Extreme Times? An Analysis of the Astronomy Communication Actions in Brazil During the COVID-19 Pandemic

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In early 2020, the world was taken aback with the spread of the Covid-19 disease by an unknown coronavirus. Months later, the *World Health Organization* characterised this outbreak as a pandemic, urging decision makers to take actions to slow down the infection rate. Science communicators had to adapt their activities in support of recommendations for social distancing. In this article, we describe the mobilisation of astronomy communicators in Brazil, one of the most affected countries, as a consequence of social inequality, cuts in science funding and science denialism by the government. Practitioners filled out a survey, and the results showed that the amount and diversity of online activities increased considerably. Initiatives such as virtual exhibitions, transmission of sky observations and collective planetary sessions engaged thousands of people. Discussions about the pandemic and how science works were also present in several activities. The pandemic forced the community of astronomy communicators in Brazil to adapt to the situation, and motivated many of them to offer online activities. The diversity of those who communicate astronomy is extensive and appears to be increasing.

Introduction

Brazil is one of the most populated countries in the world, with an estimated population of over 213 millions inhabitants according to the Brazilian Institute of Geography and Statistics¹ and also one of the most affected countries by the Covid-19 outbreak in the world. By September 2021, when these lines were being written, over 590,000 Brazilians had lost their lives, and more than 21.3 million cases have been officially reported since the beginning of the pandemic². The number of daily deaths and contamination keep increasing, although at a slower rate since the mass vaccination started.

Nevertheless, caution is still a necessity, as the process of vaccination evolves slowly and Delta variant is spreading quickly over the country. Financial assistance for the population is still important, but has been far from what is actually needed since the beginning of the pandemic, and there are signs that human rights have been violated in Brazil during the pandemic (*Conectas Direitos Humanos, 2020*).

This situation is worsened by a strong anti-science feeling among some groups of the society (*Teixeira & Santos, 2020*) and even stimulated by the Federal Government, which persistently spreads fake news, ignores the seriousness of the situation,

and forces legally the use of unproven medical treatments against Covid-19, that may also be dangerous to the health of those who receive such treatments (*Taylor, 2021*). Moreover, the Federal Government has undertaken substantial cuts in science and education, making the development of these essential areas for the crisis unfeasible in the present and future. Furthermore, the world has bewilderedly watched the fast dismantling of environmental policies during the pandemic followed by intense destruction of the national natural environments, especially in the Amazon and Pantanal ecosystems, which might trigger future pandemics (*Vale et al. 2021*).

In the face of all these difficulties, the scientific community has strengthened efforts to stand up and to bring scientific information to the population. Public health communication has received lots of attention for obvious and necessary reasons, but communicators from other science fields, such as astronomy, have also mobilised and offered a variety of activities to the public during this period.

For instance, the Brazilian Association of Planetaria organised a collaborative virtual session in which professionals from various centres took part. It was broadcasted live on Youtube in September 2020, and as of September 19th, the video had 259,939 views³. Another example was the conjunction of Saturn and Juptier in December 2020, which was also broadcasted live by the National Observatory. The initiative was promoted with the help of amateur astronomers across the country and was followed by nearly 260,000 people⁴. Such examples show an unprecedented public attendance, and high interest for ephemeris.

Another moving activity was a virtual exhibition promoted by the Museum of Astronomy and Related Sciences, which received 142 drawings of children who expressed their feelings about a "pandemic sky". A similar project led by the same institution was dedicated only to indigenous children⁵.

Considering the potential that lies within virtual activities, and the current health, socioeconomic and political crises in Brazil that are worsened by the pandemic, we ask ourselves: has the astronomy community been involved and/or motivated with/by this context? How have astronomy communicators reacted to the new way of promoting activities due to social distancing? How have the activities been promoted? Which topics have they addressed? Has the audience of the activities increased?

With that in mind, we designed a study to try to answer these questions, through the perceptions of the astronomy communication community. In this paper, we present a picture of astronomy communication in the country and how the communicators mobilised to offer activities during this pandemic period within the national context raised above.



Figure 1. "Dissemination and popularization activities for astronomy in times of pandemic" Art advertising the questionnaire on social media, indicating the period the questionnaire was receiving answers and its link. Credit: Freepik, edited by Felipe Carrelli

Querying the Astronomy Communication Community

For the research presented in this paper, the authors prepared and publicly released a questionnaire to be filled in by any individual who might have performed some teaching or communication activity related to astronomy during the first year of the pandemic.

In order to reach as many people as possible, it was publicised on different channels, such as the official communication bulletin of the Brazilian Astronomical Society; mailing lists for planetaria, science centres and museums; and direct email to astronomy amateur clubs and teachers responsible for the Brazilian Olympiad of Astronomy and Astronautics in their schools. The questionnaire was also posted on the IAU National Outreach Coordinator Brazil⁶ social media accounts, such as Facebook⁷ and Instagram⁸, as well as on several Facebook and WhatsApp groups related to astronomy, always accompanied by a dedicated art for further dissemination (Figure 1).

The questionnaire was presented only in Portuguese, and consisted of 22 closed and open-ended questions and had three main sections. The first two aimed to characterise the demographic profile

of the respondents and the activities they performed from March 2020 to April 2021. The third and last section aimed to comprehend the motivations of the communicators and their perceptions about these activities. To that end, we decided to measure the dimensions of "adaptation to social distancing", "engagement" and "motivation" by measuring the participants' level of agreement with sets of three or four statements with Likert-type scale questions. The questionnaire can be found in its entirety in the IAU National Outreach Coordinator Brazil website⁹, both in its Portuguese and English versions, and the data can be obtained on request.

We accepted replies for two weeks in April 2021. Only answers from respondents who confirmed that they had promoted astronomy-related activities during the period of the pandemic were considered valid. Some other answers were also discarded from the final sample either because they were incomplete or because they presented some contradictions in the questionnaire. We received 204 valid responses out of a total of 247.

Who Is Communicating Astronomy During the Pandemic?

When asked how the communicators identified themselves when promoting

Category	Frequency
STEM undergraduates/graduates	72
Amateur astronomers	72
Science communicator in social media	65
School teacher	61
Professional scientists and/or university professors	41
Informal educators, explainers, facilitators of museums, science centres, planetaria or observatories	28
Undergraduate or graduate students of areas other than STEM	18
Project coordinator in scientific association	15
Project coordinator in non-governmental organizations	11
Postdoc	7
Journalist	4
Other	8

Table 1. How communicators identify themselves when promoting activities for the public, and the frequency each category was chosen.

astronomy activities for the wider public, respondents were allowed to select multiple options. Table 1 shows the frequency each option was chosen.

47% of respondents chose only one option, while 28% chose two options, 13% chose three options, 7% chose four options, and less than 1% chose five or more options. Among the 72 people who chose the category of STEM undergraduates or graduates, 27 also chose science communicator in social media. However, the number of amateur astronomers who also chose the category of communicator in social media was 38, the highest level of overlap in this category. By communicators in social media, we refer to those who post or replicate posts related to astronomy in their personal social media, which is different from online courses and talks, for instance, or online planetarium sessions. Live talks and podcasts are also considered different from communication on social media as these activities requires a higher level of compromise and time spent in the preparation of the activity, while posts on social media not necessarily.

We also asked for affiliations of the respondents, again allowing them to

choose multiple options. “Higher education level institutes” was the most frequently chosen (78 times), followed by “schools” (67) and then by “amateur clubs”(43). Informal education institutions such as “science museums, planetaria and public observatories” were selected 50 times (combined results). Finally, 87.3% of our respondents are frequent communicators, meaning that they were performing astronomy activities before the pandemic.

The results indicate a strong and vigorous community of astronomy practitioners in Brazil, consisting of students, amateurs, professionals, science communicators, and informal educators. Most of the professionals and students are affiliated with universities and science research centres, mainly in the public sector.

As a matter of comparison, the Brazilian Astronomical Society is the body that congregates the professional community, by September 2021 counting roughly 580 active affiliations¹⁰. The community of amateurs is also quite extensive. According to a census from 2018¹¹, there were about 780 active astronomical institutions in Brazil at that time, many of them amateur

clubs and public and private observatories, but also universities, planetaria, museums, and school groups.

Demographic Profile of the Astronomy Communicators

The demographic profile of the respondents was assessed through several questions that mapped the gender, age, ethnicity, geographic region of acting and educational level.

When asked about their gender, 53.4% of the respondents declared themselves as male and 45.1% as female. People who identified as non-binary and those who preferred not to identify their gender accounted for less than 1.5%.

With respect to ethnicity, as categorised by the Brazilian Institute of Geography and Statistics (IBGE-EDUCA) (2019), 62.7% of the respondents declared themselves as white (here translated from brancos), 30.9% declared themselves as brown or black (here translated from pardos or pretos), 2% as yellow (here translated from amarelos) and 4.4% preferred not to state their ethnic origins. There was also an option in our questionnaire for those who self-identified as indigenous (here translated from indígenas). The results reveal a strong discrepancy with the national census by IBGE-EDUCA, in which people of colour identifying as brown (referring to someone who is of mix of black or indigenous origin with any other colour or race) or black represent more than 56% of Brazilians.

Regarding age, there was a prevalence of respondents who were middle-aged or younger: those within the 35-49 years-old range represented 35.3% of the valid sample; those 25-34 represented 25% and those up to 24 years old corresponded to 19.6%. Those 50-64 also accounted for 19.6% and senior respondents, aged 65 or older, represented less than one percent. As a matter of context, the life expectancy in Brazil was 76.6 years in 2019¹², 73.1 year for men, and 80.1 years for women, while the median age is 33.2 years in total¹³. Due to the severe effects of the pandemic in Brazil, however, life expectancy at birth is estimated to have a reduction of 1.3 years in 2020, and 1.8 years in the first months of 2021 (Castro, 2021).



Figure 2. Geopolitical division of Brazil in macro-regions. Credit: Felipe Carrelli.

Activities were concentrated in the South-eastern region of Brazil, which is as expected since the majority of astronomers and astronomy-related institutions are concentrated here. Respondents from this region accounted for 53.4% of the sample. Respondents from the North-east accounted for 20.1% and from the South for 16.2%. Respondents from the Central-west part of Brazil were 5.9% and from the North 4.4%. The shift from southern Brazil to the North-east comes as a surprise, since the second largest hub of astronomers in Brazil is based in the South.

Regarding the educational level of the participants, the majority (22.1%) of the respondents held a PhD. Other respondents held other kinds of graduate diplomas like a master's degree or a lato-sensu specialisation degree (usually shorter than a master course, aims to offer professional and academic training to those already working in some field of knowledge). Those categories accounted for 19.1% and 17.6% of the respondents, respectively. Undergraduate students and respondents holding a bachelor's degree together accounted for 33.8% of the sample. People with high-school level education accounted for 7.4% of the respondents. Worth noticing are the cases of two respondents who are still enrolled in basic school, one of them being a 9-year-

old girl managing her own astronomy amateur club on Instagram.

Characteristics of the Activities

As expected in times of social distancing, most of the respondents, 85.8%, declared to have promoted virtual activities exclusively, while the remaining 14.2% developed both face-to-face and virtual actions. None of the respondents performed only face-to-face activities. With respect to the target audience, 40.1% of astronomy communicators aimed at the public, 34.2% to school students and 16.3% to teachers. Interestingly, 8.3% aimed the activities to astronomy experts which, in principle, are not science communication initiatives, but rather as dissemination to peers. Slightly more than one percent targeted other non-specified audiences.

Regarding the types of activities, participants could mark as many options as they wanted. The different categories were marked 1547 times by participants, being the most frequent the "actions undertaken in social networks", closely followed by "lives/talks". The activities promoted during the pandemic and the corresponding frequency are summarised in Table 2.

Activities	Frequency
Actions taken in social networks	297
Lives/talks	255
Informal chats	181
Creation of content for podcasts or videos	175
Writing to press, blogs or magazines	165
Live sessions of night-sky or Sun observations	125
Video exhibitions	113
Virtual planetarium sessions	72
Virtual exhibitions	64
Distance learning teacher courses	59
Science contests/tournaments	41
Other	94
Total	1641

Table 2. Activities promoted virtually by astronomy communicators in Brazil from March 2020 to April 2021.

Topics covered during the activities	Frequency
Classical Astronomy and Astrophysics	181
Astronomy in everyday life	118
Ephemeris	114
Topics on Astronomy communication and education	111
History of Astronomy	109
Astronomy research practised in Brazil	67
Pseudoscience and scientific negationism	62
How scientific method works and how research advances	50
How to become a professional astronomer	49
COVID-19 outbreak	48
Gender and ethnic issues in Astronomy	36
Everyday life of a professional astronomer	34
The participation of Brazil in international astronomical consortia	33
How astronomy is financed	28
Availability of Astronomy university courses in the country	25
Other	14
Total	1079

Table 3. Topics covered during the activities promoted virtually by astronomy communicators in Brazil from March 2020 to April 2021.

We also asked about the topics covered during the activities, again allowing respondents to select multiple options. In total, the suggested topics have been selected 1065 times, while “Other” were selected 14 times. Results show that themes related to “classical Astronomy and Astrophysics” such as stars, planets, galaxies, cosmology, were the most addressed by respondents. Other highly addressed topics were “Astronomy in everyday life”, “ephemeris”, “topics on Astronomy communication and education” and “history of Astronomy”. The topics and frequency by which they were chosen is summarised in Table 3.

Although the most frequent topics are those directly related to astronomy, other topics were also addressed, such as “History of Astronomy” and “How scientific method works and how research advances”. Interestingly, the topics range even further, such as “Pseudoscience and scientific negationism”, ranking closely to “Astronomy research practised in Brazil”, and even higher than “How to become a professional astronomer”.

Contemporary discussions, such as “Gender and ethnic issues in Astronomy” and practicalities, such as “How astronomy

is financed” were also present. Not surprisingly, the “COVID-19 outbreak” was another topic addressed by the participants, which, together with “Pseudoscience and scientific negationism”, shows that the public is interested in understanding what is science, how it works, and how it may help to mitigate the effects of the COVID-19 pandemic.

Respondents were also queried about the use of accessibility tools during their activities. Most of the answers (67.6%) said they “haven’t used any tool for improving the accessibility of people with disabilities” in their activities. Among those, 26.1% mentioned they “will not make use of any accessibility tools in future due to financial and infrastructure issues” while 22% declared they “will use some tools in future endeavours”, and 19.5% said they “had never thought about accessibility issues”. This brings us to the 32.3% which “did use some accessibility tool” as follows: 19.5% used “subtitles”, 6.6% included “Brazilian Sign Language (Libra) interpreter”, and 6.2% made use of “audio description”.

Communicators’ Responses to the Pandemic

As in many other places of the world, the pandemic in Brazil brought changes, challenges and even suffering. In order to understand how astronomy communicators reacted to the new way of promoting activities due to social distancing, which in the specific case of Brazil was unenforced due to the degradation of science by the government, we built three sets of statements aimed to measure the dimensions of “adaptation”, “engagement” and “motivation”.

To do so, the items of each set were built according to the Likert psychometric response scale, in which responders could endorse their level of agreement to statements, ranging from “totally disagree”, “disagree”, “don’t know”, “agree” and “totally agree”. Therefore, each set of items consisted of a complete Likert-type scale, whose sum over the statements indicate the measurement of the dimension as based on the perceptions of the respondents.

The dimension of “adaptation” was scaled using four statements. We asked the respondents “regarding the resources

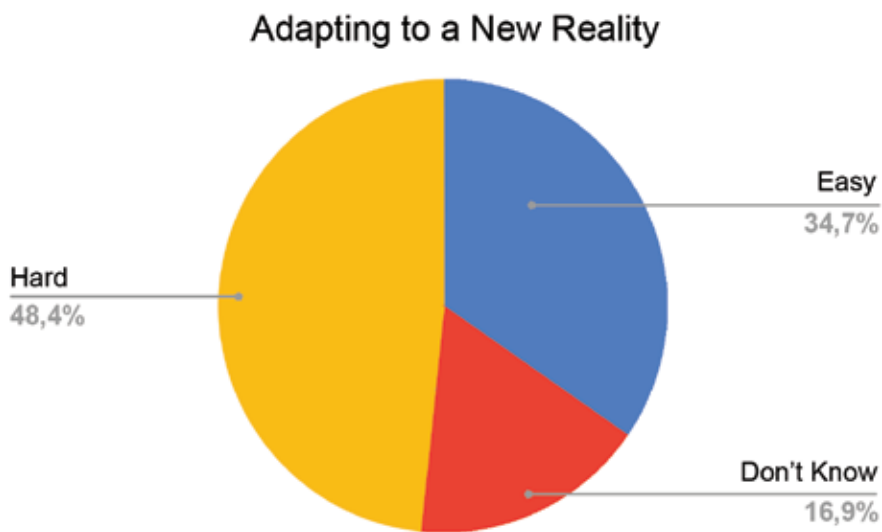


Figure 3. Level of difficulty to adapt to the new reality created by the pandemic. Credit: authors.

(financial, technical, human, etc.) necessary to carry out activities during the pandemic period..." and provided the following statements to be endorsed: (1) "my work institution provided me with the support"; (2) "it was necessary to use my own resources", and (3) "I had to adapt abruptly to digital resources" and (4) "The resources available for the activities were adequate for the amount of activities offered so far".

Each respondent was requested to indicate the level of agreement within these four sentences with the following options: totally disagree, disagree, don't know, agree, totally agree. Disagreement with sentences (1) and (4) indicate hardness of adaptation, while agreement indicates easiness. For the sentences (2) and (3) this is the opposite: disagreement indicates easiness, while agreement indicates hardness.

To draw our conclusions, we then decided to join the answers "strongly agree" with "agree" and "strongly disagree" with "disagree". Summing over the selected options of each level of agreement, the cumulative scale indicates easiness-to-hardness in adaptation, yielding in the following frequencies: 276 (easy), 134 (don't know), 385 (hard).

As a result, 48.4% of responses indicated difficulties in the adaptation, whereas those

who considered it easier to adapt were 34.7%. Those who didn't know correspond to 16.9% (Figure 3).

For the dimension of "engagement", we opted to split the items into two subcategories: "self-engagement" and "public-engagement". The term "self-engagement", refers to the level of engagement of communicators in offering activities during the pandemic, while "public-engagement" refers to the level of public engagement in the activities as seen by the communicators. Only respondents who were promoting science communication activities before the pandemic were asked to answer this set of questions.

For the first subcategory, by indicating their level of agreement, the respondents were invited to "think if...": (1) "your time devoted to developing the activity increased"; (2) "the number of activities offered during the pandemic increased" and (3) "even after the pandemic is over, you intend to keep offering on-line activities".

Here, disagreement to all three sentences indicates the respondents were less self-engaged with the activities, while agreement indicates they were more self-engaged. Similarly as described above, respondents were asked to indicate whether they strongly disagree, disagree, agree or strongly agree with

these sentences, or even if they don't know what to answer. Each respondent indicates their level of agreement with each one of these sentences, and answers are counted. The cumulative scale of answers for each sentence indicates if the respondents were less or more engaged with the promotion of activities during the social distancing period. The sum over the levels of agreement yielded in the following frequencies: 26 (strongly disagree), 76 (disagree), 122 (don't know), 176 (agree), 198 (strongly agree).

Comparing the totality of frequencies of those who think they were more self-engaged than before (374) with the totality of those who think they were less self-engaged (102), it is clear that Astronomy communicators believe they have self-engaged with the activities more during this period. As shown in Figure 4, the sum of frequencies that support this result accounted for almost 63% of all responses, whereas those who considered less engaged were 17%. The remaining 20% did not know.

Similarly, two statements helped us understand the perceptions of the communicators within the subcategory "public-engagement".

By indicating their level of agreement, the respondents were invited to "think if...": (1) "the public taking part in the activities has increased" and (2) "the public diversity has increased (age, gender, geographic location, and others)". The method of analysis is the same as described above: disagreement indicates that the respondents believe their public were less engaged, while agreement reflects the more engagement of the public as seen by the respondents. The cumulative scale indicates whether the respondents think that their public was less or more engaged with the promotion of activities during the first year of the pandemic. The sum of the levels of agreement yielded in the following frequencies: 11 (strongly disagree), 54 (disagree), 104 (don't know), 113 (agree) and 118 (strongly agree).

Comparing the totality of frequencies of those who thought their public was more engaged than before (231) with the totality of those who thought their public was less engaged (65), the results indicate that astronomy communicators believe that the

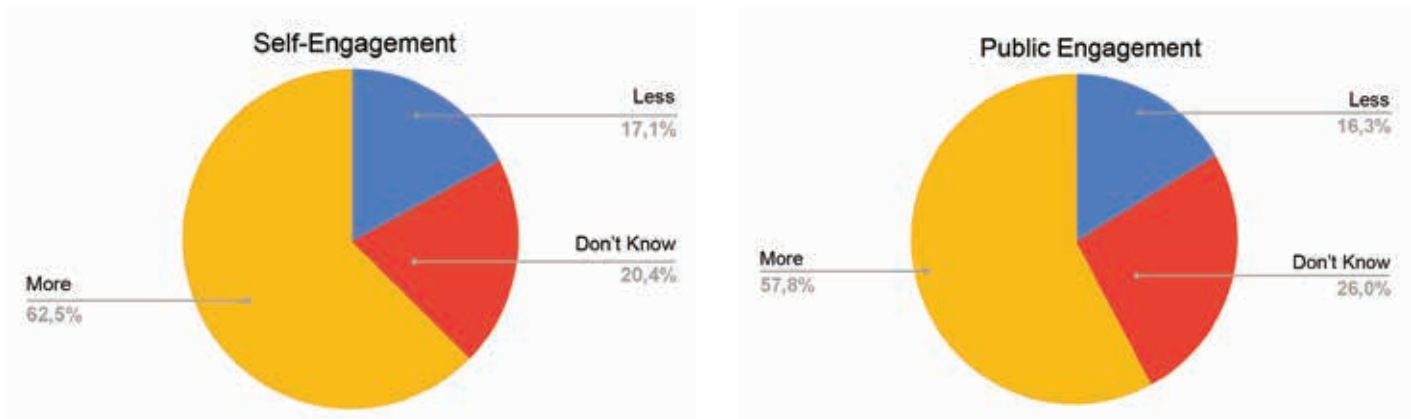


Figure 4. a) b) Level of self- and public-engagement within the activities according to astronomy communicators. Credit: The authors

public has engaged more with the activities during the pandemic than they did before, as the number and diversity of the public has increased. As shown in Figure 4, the sum of frequencies that showed agreement with the statements accounted for 58% of all responses, whereas those who considered the public less engaged were 16%. The remaining 26% did not know.

The “motivations” driving the communicators’ interest in promoting astronomy-related activities can be of different nature in their origin. In order to explore this dimension, the questions and the cumulative scale indicated if the motivations were of intrinsic and extrinsic nature, i.e. whether the motivation has a stronger personal component, or is due to some external cause.

The respondents were asked “according to your practice as a science communicators in Astronomy” and provided with the following statements to be endorsed: (1) “[you] consider communicating science as a moment of pleasure”; (2) “intend to make profit from the activities in the future” and (3) “[you] intend to obtain professional recognition with the activities”.

The statement (1) indicates whether astronomy is a topic of personal interest to the respondent, and not necessarily something related to their professional life or other component. Therefore, when the respondents agree with this sentence, they are indicating that they offer astronomy related activities following a genuine taste for this science, so they have a very personal reason to do so, characterizing intrinsic motivation. On the other hand,

when the respondents disagree, they are indicating that the reasons why they are offering activities should be something not related to personal reasons, therefore due to extrinsic reasons. This is indicated by two other statements, which carry a more professional reason behind the intention of the respondents in offering activities.

The levels of agreement indicated a range from extrinsic-to-intrinsic motivation. The cumulative scale yielded the following frequencies: 101 (strongly disagree), 111 (disagree), 97 (don’t know), 112 (agree), 181 (strongly agree). When adding the two levels of extrinsic (212) and intrinsic (293) motivations, our results show a slight tendency of communicators being driven by intrinsic purposes.

This result can be seen in Figure 5, which shows that 48.7% of respondents indicated intrinsic reasons driving them to communicate astronomy, while extrinsic reasons correspond to 35.2%. The remaining 16.1% said they don’t know the reason.

Finally, we also wanted to know whether the COVID 19 pandemic has played a role in communicators’ motivations. This was also possible by asking “according to your practice as a science communicator in Astronomy” and then offering a set of three statements which, again, the respondents could indicate their level of agreement. These items were: (1) “[you] consider important to explain how results in astronomy and science in general are obtained”; (2) “[you] seek to mitigate anti-

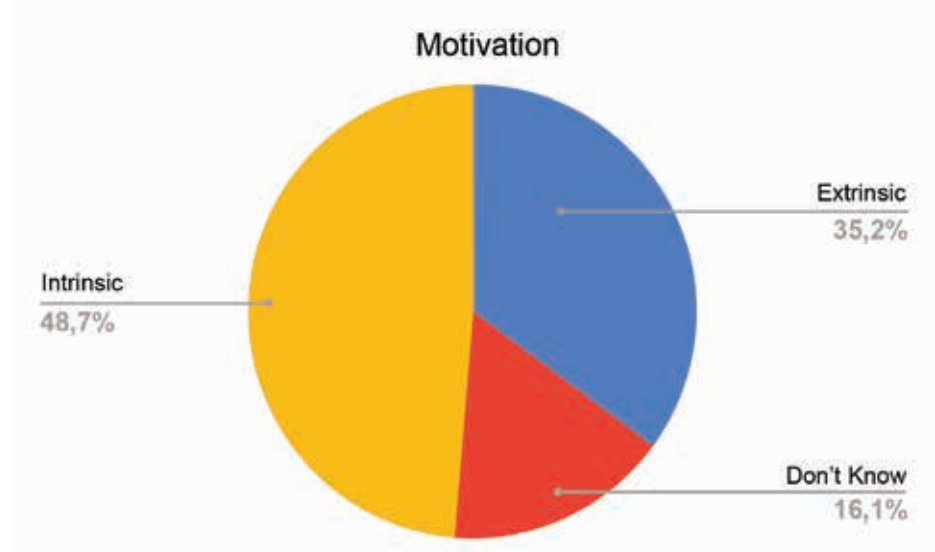


Figure 5. Nature of motivation driving the communicators’ interest in promoting astronomy-related activities. Credit: The authors

science thoughts and attitudes” and (3) “[you] felt it was necessary to engage with science communication as a result of the ongoing health, political and economic crisis”. The cumulative scale yielded in the following frequencies: 29, 46, 56, 198, 280, ranging from less to more motivated by the current context provoked by the pandemic. When adding the levels of more motivated (478) and less (75) motivated, the responses indicate that the pandemic, indeed, played an important role as a motivation for promoting the activities.

This is shown in Figure 6, as 78.5% of respondents are more motivated now than before, 12.3% of respondents are less motivated, and the other 9.2% don't know.

Discussion

Within the present work, we intended to draw a picture of how astronomy-related activities for the wider public are currently being carried out by science communicators in Brazil, one of the countries most affected by the pandemic and one of the worst with regards to mitigation efforts. Even during this period of pandemic, science has been severely attacked even by the President himself, who since the beginning tried to deny the severity of the pandemic, and did not make any effective effort to mitigate it (Hallal 2021).

We were also motivated to understand if the practitioners were motivated by the current context. As such, data were acquired from a questionnaire that was made public to the community of astronomy communicators.

We want to stress that the results presented here cannot be characterised universally. Therefore our conclusions are based solely on the answers received which may not represent the population of astronomy communicators in Brazil, and a direct comparison to the official demographic census is not straightforward.

Astronomy in Brazil, as an academic field, is mostly developed in the South-eastern and Southern regions of the country, where the majority of universities and research centres are concentrated. The two biggest cities in the country, São Paulo and Rio de Janeiro, are located in the South-eastern region, while many other important economic centres are located in the above-mentioned two regions, concentrating most of the cultural and educational institutions in the country.

In the year of 2019, the Southeast region accounted for 30 Physics and Astronomy graduate programs, while 13 and 12 programs were based in the Northeast and South regions, respectively, followed by 3 programs in the Central west region, while the North region accounted with only 1 graduate program in Physics and Astronomy (Ministério da Educação, 2019). Another study of 2015 shows that

the distribution of institutions of non-formal education and popularization of astronomy, such as observatories, planetariums, museums, are not well distributed in the national territory, as the regions of Southeast and Southern accounts for slightly over than three institutions per million of inhabitants, while the Northeast and Central-west regions account for a number between one and two, and the Northern region accounts for less than one institution per million of inhabitants (Marques & de Freitas, 2015). This trend doesn't seem to have changed much during the last few years.

This asymmetric geographic distribution, in a country of continental size, is related not only to the higher population density in those areas, but also the historically higher standards of living. The overall better social-economical indicators in comparison to other parts of Brazil favour the implementation of scientific, educational and cultural resources in those regions.

Our results confirm that the South-east region, which concentrates the most wealth in Brazil, also concentrates the majority of efforts towards astronomy communication. However, this association stops there, as the North-east seems to be the second busiest region regarding astronomy communication, instead of the South, which is the second biggest community of professional astronomers and presents overall better socioeconomic indexes. This could be due to either a higher adherence to the questionnaire or a real higher adherence to the promotion of activities mainly by amateur astronomers, teachers, science communicators in social media and graduate students, as discussed in the section *Demographic Profile of the Astronomy Communicators*.

It is also important to emphasise that Brazilian inequalities in science are not only geographically situated. There is a large underrepresentation of women and minorities in all science and technology careers (Oliveria et al. 2021). As a legacy of its colonial past and the late abolition of the enslaved Africans and their descendants, socio-economic vulnerability in Brazilian society is strongly correlated with ethnic origins and especially with skin colour. Afro-brazilians are therefore the most socially vulnerable group and those

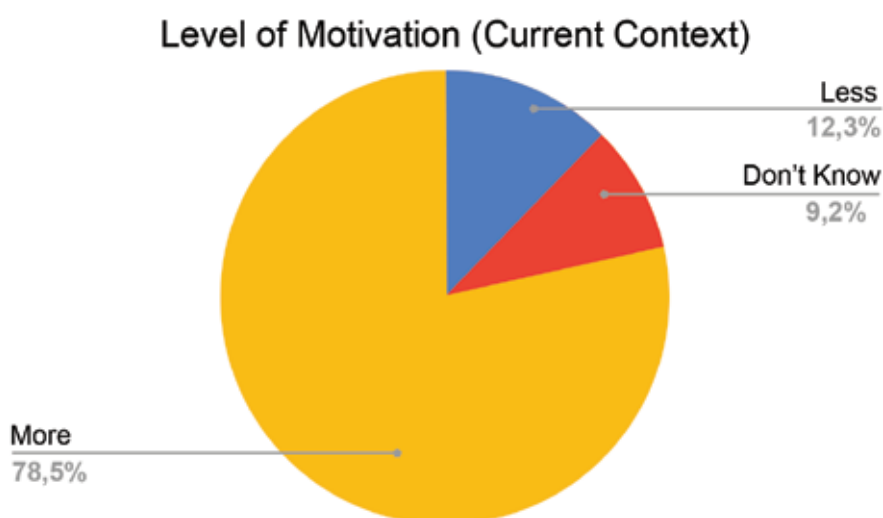


Figure 6. Level of motivation due to the pandemic. Credit: The authors

with least educational opportunities and barriers to access cultural activities (Alves-Brito, 2020), having also suffered the most from the impacts of the pandemic (Polidoro et Al. 2021).

The research field in physics, astronomy and all subareas have been predominantly dominated by white, heterosexual and well-off men, that is, white men from privileged social classes (Alves-Brito, 2020). Responding to ethnic-racial, gender issues, and their intersections in astronomy communication shows a democratic commitment to humanity in this century, and is important to include if we seek to improve society.

The participation of women is surprisingly high when compared to the gender statistics in the latest census¹⁰ of Brazilian Astronomical Society, where roughly 30% of active affiliates identified as female.

Respondents to our survey were able to indicate when they identify themselves as indigenous, but unfortunately no respondent selected this option.

Despite all this, our results indicate a non-negligible amount of astronomy communicators from underrepresented groups taking the lead in the promotion of activities. Although white men are the majority, the percentage of women and black people accounted for 45.1% and 30.9% of respondents, respectively. Even if this might be considered as a positive sign, the path towards a fairer society is still long, so that we can overcome the symbolic dimension of male domination (Bourdieu, 2002) still strong in Brazil, also in the astronomy communicators community. Results indicate that both female and male communicators felt similar levels of difficulties with adaptation. With reference to the ages of communicators, youngsters up to 24 years old seem to have felt mostly difficulties with adaptation, while all other ages also felt difficulties but at a lower level, although increasing with age.

Further regarding inequalities in science, it is evident that most astronomy communicators do not have proper conditions to offer activities specially created or at least properly adapted to those with an impairment. This is especially worrying if we consider that a significant percentage of those activities

have been designed for the academic community. According to a recent census about basic education in Brazil (Brasil, 2020), the percentage of students with disabilities, global developmental disorders, or high achieving enrolled in mainstream non-specialised schools has gradually increased over the years in all teaching levels, reaching 92.8% in 2019. It is therefore time to tackle accessibility in astronomy communication activities in a more effective manner.

Our results also indicate that communication of astronomy during the pandemic in Brazil is mostly being carried out by scientists still in school and by amateur astronomers. However, we have to be careful when extrapolating these results since our study cannot be characterised as universal or comprehensive, as mentioned above. Thus, it is also possible that scientists, university professors, and other high-level professionals have simply not joined our study. In fact, the number of respondents within this group, 41, is considerably lower than the number of effective associates of the Brazilian Astronomical Society, which is nearly 580 professionals. Nevertheless, the responses to our survey indicates that, overall, this category felt difficulties to adapt to the new reality, and most participants declared it was necessary to make use of their own resources to offer activities, although responses also indicate that the institutions where they work made some efforts to offer support. Therefore, even though this category had some support from their institutions, this should be not enough to handle all the demand for online work that has arisen due to the pandemic, probably decreasing the time available for this category to promote extra online activities at the same time the need for using one's own resources increase. On the other hand, Massarani & Peters (2016) have found that only 30% of top-career scientists in Brazil who took part in their study had a website with information related to their research and 63% of those in this group had not updated the content in the 12 months that preceded that study. The authors have also found that 80% of the responding scientists mostly used their social network to contact family and friends and learn about the latest political and cultural matters. Of course, since 2016, things might have changed.

In our survey, we found that topics mostly addressed were those related to basic concepts in astronomy and astrophysics, but social aspects of science have also been a matter of discussions. For instance, gender and ethnic issues in astronomy and the financing of science are among those topics. Topics mentioned which might be related to the current context were: pseudoscience and scientific denialism, how scientific method works and how research advances, and the Covid-19 outbreak itself.

Regarding the communicators' response towards the pandemic, we noticed that adaptation has been a hard process for the majority of them, as many had to adapt abruptly to unfamiliar online tools. They tend to agree that it was necessary to make use of their own resources, and the institutions where they work could not afford sufficient support. Therefore, the available resources to promote totally adequate activities were not enough to respond to the amount of offered activities. This might reflect on the fact that just a few activities accounted for accessible tools, which is usually costly to be implemented, except for subtitles.

Among all categories of communicators, only postdoctoral researchers haven't declared much difficulties to adapt to the new reality, they are probably used to employing digital tools to promote virtual meetings, while school teachers were the ones that mostly experienced difficulties, probably following lack of customary lack of investments, and increase of demanding work, as classes switch completely to remote mode.

According to the responses we received, the motivation driving the communicators to offer astronomy-related activities is mostly of an intrinsic nature for all categories of communicators, although extrinsic reasons are not negligible. This intrinsic motivation is led by a genuine feeling of pleasure when promoting astronomy-related activities. All ethnic groups declared mostly intrinsic factors that drove their motivation, feeling strong in the groups of yellow, black and white. Similar results were found when considering gender, as both male and female declared intrinsic reasons behind their motivation to promote activities.

Even though the pandemic has imposed several difficulties in everybody's daily

lives, this is still a reason for the motivation for communicators to offer activities, as declared by the overwhelming majority of respondents. Our study indicates that respondents tend to agree that “it was necessary to engage with science communication as a result of the ongoing crisis”, promoting activities that “explains how results in science are obtained” and trying when possible to “mitigate fake news.” As paradoxical as it may sound, the discourses of science denialism employed by the government triggered the astronomy communication community to promote virtual activities, who even spoke on subjects like the Covid-19 to engage their audiences.

Brazilian astronomy communicators also felt that they have been more engaged with their activities than before the pandemic, agreeing that they spend more time on outreach now. It is tempting to speculate that there is a connection between other tasks being put on hold during the pandemic and extra time now available for astronomy communication, but the questionnaire was not directed toward this specific subject. They also felt that their audiences are responding more, and becoming more diverse.

Despite all the difficulties, we see that the astronomy communication in Brazil is robust, being carried out by a variety of people across the country, from different segments of the society, ages, gender and ethnicity. There is still a long way to go before these activities can be offered in plenitude, but the efforts carried out until this moment are marvellous, reinforcing the capacity and commitment of astronomy communicators in Brazil, a breath of hope and potential for a country that has so suffered.

Conclusions

We conclude that the astronomy community dedicated to science communication in Brazil has been intensively involved in on-line activities during the COVID 19 pandemic. At this point, the authors wish to stress that the situation in Brazil is deeply aggravated by the local social and political context, as reported in several works (Barberia & Gómez 2020, Lotta et al. 2020, Polidoro 2021, Hallal 2021), even if not specifically tackled in this survey.

Yet, this reality can be perceived in some answers to the questionnaire as when 26.1% mentioned they “will not make use of any accessibility tools in future due to financial and infrastructure issues”.

Also, the fact that most of the respondents declared intrinsic reasons for offering astronomy-related activities might reflect not only the fact that the respondents have a taste for astronomy, but also because they cannot rely on work opportunities to do so, as there is scarce investment of resources in outreach.

Moreover, from the emergencies initially pointed out in this research, namely, the pandemic context together with the widespread of fake news and anti-science behavior including the Brazilian authorities, it is clear that part of the astronomical community is dedicated to the communication of astronomy as well as of contemporary issues related to it, such as gender and ethinical diversity in science.

Finally, this research showed that the pandemic has been a source of motivation for science outreach practitioners to discuss not only astronomy, but also to address contemporary issues, and to spend longer on the preparation of virtual activities despite all difficulties.

Notes

¹ Instituto Brasileiro de Geografia e Estatística, População do Brasil: <https://www.ibge.gov.br/apps/populacao/projecao/index.html> (access in September 2021)

² Johns Hopkins University and Medicine, Coronavirus Resource Center: <https://coronavirus.jhu.edu/map.html> (access in September 19th)

³ Collaborative Planetaria Session from the Brazilian Association of Planetaria: <https://www.youtube.com/watch?v=qJA-WKN4Q-w> (access in September 19th)

⁴ Saturn and Juptier conjunction by the National Observatory: <https://www.youtube.com/watch?v=4lrSJH1aDH4> (access in September 19th)

⁵ The Sky that Connects Us” (O céu que nos conecta) exhibition: <http://mast.br/ceueconecta/> and “The Sky of First Nations” (O céu dos povos originários) exhibition: <http://mast.br/ceus-originarios/> (access in September 19th)

⁶ National Outreach Coordinators national pages: <https://sites.google.com/oao.iau.org/iauoanews/national-pages> (Access in September 2021)

⁷ Facebook page of the IAU National Outreach Coordinator Brazil Facebook: <https://www.facebook.com/nocbrasil> (access in September 2021)

⁸ Instagram of the IAU National Outreach Coordinator Brazil: <https://www.instagram.com/iaunocbrasil/> (access in September 2021)

⁹ National Outreach Coordinator Brazil website, survey: <https://iaunocbrasil4.wixsite.com/iaunocbrasil/pesquisa-astronomia-e-pandemia>

¹⁰ Brazilian Astronomical Society: <https://sab-astro.org.br/sab/> (access September 2021)

¹¹ Grupo de Apoio em Eventos Astronômicos, census 2018: http://gaea-astronomia.blogspot.com/2018/05/censo-brasileiro-de-instituicoes_30.html (access in September 19th)

¹² Agência IBGE notícias: <https://agenciadenoticias.ibge.gov.br/agencia-sala-de-imprensa/2013-agencia-de-noticias/releases/29502-em-2019-expectativa-de-vida-era-de-76-6-anos> (access in September 19th)

¹³ (The World Factbook, Brazil, people and society, median age: <https://www.cia.gov/the-world-factbook/countries/brazil/#people-and-society>)(access in September 2021)

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