



ARTICLE

Public communication of science by Argentinean researchers: changes and continuities in a digital world

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Abstract

Starting from the premise that public science communication practices have changed in recent years, this paper asks where these changes are heading and what factors can explain them. We conducted a survey among researchers at CONICET¹ in Argentina, asking them about these changing practices. Considering the major technological changes that have taken place in recent years, we find that science popularisation activities have intensified, but with significant differences in the means used to communicate informed by the career stage of the researcher. We also consider the different motivations of scientists to engage in science communication activities.

Keywords

Popularization of science and technology; Public understanding of science and technology; Scholarly communication

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1. CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas) is the National Council of Science and Technology.

1 - Introduction

Over the last two decades, and especially in the last years, we have witnessed significant changes in the way science is communicated. The literature reports changes in the general dynamics of connecting scientists and scientific institutions with society [Entradas et al., 2020], in the actors and types of activities [Jensen, 2011; Kreimer et al., 2011], in the formats [Kopecka-Piech & Łódzki, 2022], in the languages and media [Büchi, 2017; Liang et al., 2014; Väliaverronen, 2021], among others. As the Bodmer Report [The Royal Society, 1985] recognised, the research community is a key player in institutional practices of public communication of knowledge and those activities should be promoted. Since the mid-1990s, there have also been numerous studies analysing the way scientists communicate science at the national level. Only a few studies have led to policies to promote public communication of science (PCS), such as the Royal Society report [2006]. In addition, political motives were reported to be the major driving force behind science communication programmes [Weingart & Joubert, 2019]. With a few exceptions, notably in the United Kingdom [Bhatthachary, 2016], France [Jensen, 2011] and the United States [Iyengar & Massey, 2019], there are few studies at the national level that show the evolution of these changes over time and their relationship, if any, with the national policies to promote the activities related to PCS.

Over the past two decades, the context in Argentina has undergone significant transformation: CONICET, the National Council for Scientific Research, has more than doubled the number of scientists. PCS also plays a very different role since the activity has become more institutionalized. There have been specific policies that have tried to promote institutional activities, the emergence of master's degrees and specialisations in national universities. Specific media in PCS have emerged (while some others have disappeared), and several science book collections targeting wider audiences, written mostly by CONICET's scientists have had some impact in society and in basic education.²

Consequently, the population, institutional arrangements, social contexts and the role of science communication in society have undergone profound changes. The study we will discuss in this article considers some issues that were also analysed in our previous study but introduces new ones and disregards those that are no longer of interest. Therefore, it should not be perceived as a mere replication and comparisons should be made with caution.

In this paper we propose to answer the following research questions:

- a) What are the main characteristics of the PCS activities of CONICET researchers in Argentina today?
- b) What changes (continuities and differences) can be observed in the pattern of PCS activities of researchers in Argentina in relation to what was observed about 20 years ago?
- c) Could those changes be correlated to some structural, demographic or institutional shifts?
- d) How have certain global trends, such as digitalisation/mediatisation and the pandemic, affected PCS activities at local level (CONICET)?

2. See for example "Ciencia que ladra" collection, Siglo XXI eds.
https://sigloxxieditores.com.ar/catalogo/?filter_colecciones=ciencia-que-ladra-serie-clasica or Iamiqué publishers, <https://iamique.com.ar/>.

To answer these questions, we firstly describe historical-political aspects, which provide the context in which this study was carried out. Following this, we utilize quantitative data obtained from a survey questionnaire that was distributed among the country’s primary scientific community. This survey ascertains the nature of PCS that was performed.

To look at PCS practices carried out by CONICET researchers we organised them according to the disciplines they belong to, their hierarchical position in the career and their gender, among other variables.

2 - CONICET and PCS in Argentina

CONICET is the most important scientific institution in Argentina. It was founded in 1958 following the model of a “National Research Council”, like the French CNRS [Feld, 2015] and host currently more than 12,000 researchers in all knowledge fields. It has a tenured research career structured in four research areas and five categories: Assistant Researcher, Adjunct Researcher, Independent Researcher, Principal Researcher and Senior (Superior) Researcher. The research areas are: Social Sciences and Humanities (SSH); Biological and Health Sciences (BHS); Agricultural, Engineering and Materials Sciences (AEMS); Exact and Natural Sciences (ENS). CONICET researchers are the most prestigious in the country, mainly because they enter their research career through a very demanding and competitive process. Their performance is rigorously evaluated every two years by discipline-specific committees.

The number of researchers has grown remarkably in recent decades (see Table 1), more than doubling in less than 15 years from 5,034 researchers in 2007 to 11,007 researchers in 2021. However, this increase has not been uniform: the proportion of researchers in the more senior categories have slightly decreased as a proportion of total staff (Principal from 12.2% to 11.1% and Superior from 3.7% to 2%), while the mid-career stages have become more populated (Adjunct from 33.7% to 38.9%).

Table 1. CONICET researchers in 2007 and 2021.

	2021		2007		<i>Dif</i>
	#	%	#	%	
Assistant	2555	23.2	1260	25.0	-1.8
Adjunct	4282	38.9	1695	33.7	5.2
Independent	2737	24.9	1278	25.4	-0.5
Principal	1218	11.1	613	12.2	-1.1
Superior	215	2.0	188	3.7	-1.8
	11007	100.0	5034	100.0	

Source: own elaboration according to data provided by CONICET.

Doctoral and post-doctoral fellowships, and in particular the entry into a CONICET research career, have been the main ways to expand the science system in the country, since most of the researchers paid by CONICET work in public and private universities. Indeed, between 2007 and 2015 there were considerable public funds to explicitly promote the scientific system. Moreover, the number of fellowships (doctoral and postdoc) also doubled from 5,599

in 2007 to 11,464 in 2022, which means that there are as many fellows as researchers.³ These policies, however, were not neutral in relation to the promotion of fields/disciplines and the applied orientation of science: while AEMS have significantly grown (17% in 2007 versus 25% in 2023), as well as the SSH (20% versus 25%), ENS have decreased their relative share (29% in 2007 versus 21% in 2023) and also BHS (32% versus 27%). These changes, together with the dramatic increase in the number of scientists, compel us to reconsider the demographic variables of the analysed population. It cannot be assumed that these variables are stable, as has been suggested in other studies [Besley et al., 2021].

In the most comprehensive analysis of public policies in science communication in Ibero-America, Cortassa and Polino [2015] have shown that Argentina is one of the most active countries engaged in science communication in Latin America, only followed by Brazil.

Since 2003 and especially since 2007, with the creation of the Ministry of Science and Technology (MINCyT), CONICET has been very active in generating policies to promote different PCS activities. Among them, we have the creation of a sector for the production of audio-visual content for the general public, called “CONICET Documental”, the Voc.Ar programme for the promotion of scientific culture through PCS activities, created in 2013, the “País Ciencia” platform, also created in 2013 with the aim of expanding the scope of PCS in Argentina, [Bandin, 2017], as well as a programme of grants for PCS activities, have been some of the instruments for the implementation of these policies

These policies should not be seen as mere socialisation activities. Some studies report that they have had an impact on the scientific community, as the emergence of institutional spaces for the management of PCS in almost all universities [Cortassa et al., 2020; Wursten & Cortassa, 2023] and, to a lesser but important extent, on society as a whole bringing scientific knowledge to wider audiences to better engage with universities and to spread the idea of the use of knowledge in everyday life [Rodríguez, 2022; Neffa, 2014; Bandin, 2017].

An important policy to promote PCS activities has been the inclusion of these activities as one of the items that counts in the CONICET’s evaluation process for all stages of the research career: for obtaining doctoral and postdoctoral grants, for entry into the research career and for the promotion between categories. These additions have been integrated into the online curriculum data management system for each individual (known as SIGEVA). Within this system, designated sections have been created for inputting information regarding PCS activities, as well as other pursuits like technology transfer or social/technical services. These items are included (and scored) alongside the traditional evaluation criteria, such as scientific production, teaching, grants received, participation in scientific events or institutional management.

This policy broadened the evaluation criteria and valued PCS activities by taking them into account in competitive processes alongside other background criteria. Currently, for example, PCS activities can account between 3% and 7% of the total score, varying according to the specific research area in the recruitment competition. Although it may not seem significant, since it is a competitive call, in cases of parity with the other candidates in terms of scientific production or other achievements, having carried out PCS activities can mean success in admission. If we consider that the evaluation criteria can be seen as ‘implicit science policy’ [Kreimer, 2015; Trochim, 2009], then the changes in scientific evaluation system may have

3. CONICET in numbers. <https://cifras.conicet.gov.ar/publica/>. Accessed: December 10th, 2022.

— as a hypothesis — the potential to encourage PCS activities and, also, generate changes in the habitus of researchers [Bourdieu, 1997] who could deploy different individual strategies in obtaining social and institutional recognition (symbolic capital).

Finally, it should be noted that in the second trimester of 2020, during the COVID crisis, the Argentine government, in collaboration with a group of scientists, initiated the CONFI.Ar platform.⁴ This initiative, also supported by CONICET, conducted PCS activities across various media platforms including audio-visuals, written press, social networks, and advising on official government statements, to combat false information in Argentina. This movement aligns with a growing trend of scientists (generally young scientists) taking on more active roles in direct science communication and data-checking amongst their peers.

3 - Background

3.1 ■ *Main findings from a previous study on the PCS activities of CONICET scientists*

In order to put the current status of PCS activities of CONICET's scientists into perspective, we summarize the results of a survey conducted in 2007 [Kreimer et al., 2011].

The study revealed that the most prominent scientists tended to engage more in communication activities. Specifically, those with higher academic ranks and professional recognition participated more actively in disseminating their research, suggesting a correlation between status and communication efforts within the Argentinean scientific community.

However, a substantial proportion of scientists, approximately 75%, were involved in communication activities, although most of them only engaged in a single outreach activity. This suggests that, although communication is widespread within the scientific community, its intensity and scope are conducted by a limited proportion of researchers. These findings also suggested that there may have been barriers or limitations that restricted a more active participation in PCS, even among those who recognized its importance.

The analysis of the communication patterns across scientific fields showed that SSH scientists were the most active communicators, followed by researchers in BHS. This suggests that the nature of a scientific discipline might have influenced the extent to which scientists participated in public communication, with SSH potentially having a greater emphasis on outreach and engagement with the public (this seems to be quite common and has been found in other studies [Kreimer et al., 2011; Jensen, 2011; The Royal Society, 2006]). This trend may have reflected the perceived relevance of their work to societal issues and public interest.

Regarding gender distribution, a slight predominance of male scientists engaging in communication activities was observed.

In terms of the type of communication activities, conferences (defined as talks addressed to a wide audience, not exclusively academic) appeared to be the most common form of outreach, with senior scientists engaging more frequently in interviews (especially in TV,

4. The word *confiar* in spanish, means “to trust”:
<https://www.argentina.gob.ar/noticias/confiar-la-plataforma-oficial-para-combatir-la-infodemia>.

radio and newspapers) and other forms of media communication. This suggests that as researchers gained experience and professional recognition, they may have been more inclined or better positioned to participate in media outreach, further amplifying their visibility within the scientific community and beyond.

Despite the acknowledgement of the importance of communication, many scientists found it challenging. The communication process was often perceived as quite difficult, primarily due to the technical nature of their work and the complexities of effectively conveying scientific findings to non-expert audiences. As a result, many scientists expressed reluctance to engage in communication activities, especially if they felt that their work might be misinterpreted or oversimplified.

Nevertheless, in the scientists' discourse, altruism was the primary motivator for many scientists to engage in PCS activities. Many saw science communication as a way to "contribute to society and to share their findings for the greater good", rather than for personal gain. This altruistic motivation underscored the value that many researchers placed on public engagement and the dissemination of knowledge.

Our current study considers some issues that were investigated in this earlier study. It also introduces new issues and disregards those that are no longer relevant. Therefore, it should not be perceived as a replication and comparisons between findings should be made with caution.

3.2 ■ *Studies about scientists' PCS activities*

While almost twenty years ago there were few studies analysing how scientists communicate science (and none in Latin America), there is now a significant body of national and regional contributions [Anzivino et al., 2021; Ho et al., 2020; Jensen, 2011; Ndlovu et al., 2016; Valinciute, 2020]. These studies no longer focus on descriptive variables at the local level or on individual cases, but rather on broader dynamics and forms of diffusion of practices [Bauer, 2009; Bucchi & Trench, 2021; Levin & De Filippo, 2021; Suerdem et al., 2013].

In turn, the spread of new paradigms of science organisation and communication also has an impact on the way scientists relate to society. For example, Colson [2011] shows, due to the rise of Web 2.0, how scientists take on science journalist work creating their own blogs and exploring the ways they see each other. Holmberg and Thelwall [2014] explores the ways that scientists from several disciplines use Twitter, while Liang et al. [2014] explores this with nano scientists. The topics became so relevant that there are also some handbooks that explore these changes like *Cyberscience 2.0* [Nentwich & König, 2012] where the whole process, from research to science communication is analysed in terms of the impact of the digital media. When analyzing scientists' attitudes toward science communication, it is important to consider the impact of open science processes [Bartling & Friesike, 2014; Ferpozzi et al., 2019; Rosman et al., 2022] as well as the emergence of misinformation and infodemics [Fährnich et al., 2023]. Undoubtedly, the COVID-19 pandemic also played an important role where the combination of social media, need and urgency, creates the basis for a new governance of public sphere [Colombo, 2022].

The study of PCS activities carried out by scientists is a dynamic and evolving field, characterised by varied participation, motivations and perceived barriers in different national

contexts. A comprehensive review of the existing literature reveals several recurring themes and specific nuances that influence scientists' engagement with the public.

A notable feature of PCS activities has been the strong correlation found between a scientist's advanced career and their significant commitment to these activities [Bauer & Jensen, 2011; Bhatthachary, 2016; Bentley & Kyvik, 2011; Kreimer et al., 2011; Valinciute, 2020]. This trend was also observed in relation to higher scientific productivity, which surprisingly often correlates with greater PCS activity. This contradicts the common belief held by many social actors, including scientists themselves, that 'dissemination is done by those who are not good enough for an academic career' [Jensen et al., 2008, p. 9].

In this vein, a significant study in the UK found that younger scientists participate less in PCS, with career progression and institutional support limitations identified as key explanatory factors [Bhatthachary, 2016]. Similarly, Mexican researchers from CONACYT face comparable restrictions, experiencing reduced PCS activity among early-career scientists [Sanz Merino & Tarhuni Navarro, 2019]. In Lithuania, career stage was again a reliable indicator of increased PCS activity [Valinciute, 2020]. Research on the Chinese case further supports this trend, showing that scientists with higher levels of autonomous motivation, typically those who are more experienced, exhibit more persistent intentions and behaviors regarding PCS participation. The status of a primary research work can also significantly influence the involvement of young and mid-career scientists in China [Li & Zhang, 2023].

The motivations that drive scientists to engage in PCS are diverse and range from personal fulfilment to a strong sense of social responsibility [Jensen et al., 2008]. Studies in the US revealed that a small group of scientists found PCS activities enjoyable and beneficial for enhancing their social skills, though they did not initially perceive them in professional terms [Andrews et al., 2005; Pearson et al., 1997]. According to Peters [2013] American scientists considered it their duty to respond to journalists, emphasizing the importance of media visibility. In the United Kingdom, the primary motivation behind scientists' actions was found to be "educating" the public rather than engaging in debate, suggesting the continued prevalence of the deficit model and indicating that policies aimed at fostering dialogue have limited impact [Bhatthachary, 2016]. A study across seven European countries showed strong similarities in motivations, with personal enthusiasm, the desire to educate others, and the perception of PCS as part of their job role being the most crucial factors. Notably, in Poland, Portugal, Italy, and Serbia, countering misinformation emerged as the most significant motivation [Wilkinson et al., 2022, 2023].⁵ In China, internal factors such as attitudes, perceived efficacy, and habits directly influence participation. In China, external factors like organizational culture, policies, and facilitating conditions also directly impact scientists' willingness and participation in PCS. Motivations also include here a sense of responsibility to maintain scientific accuracy or combat misinformation, alongside controlled motivations like job demands or funding requirements [Li & Zhang, 2023].

Despite these motivations, significant barriers and reluctance hinder scientists' broader participation in PCS. A recurring obstacle identified in early US surveys was the lack of time and the low priority given to PCS by institutions [Andrews et al., 2005; Pearson et al., 1997]. Australian scientists similarly perceived limited institutional support, viewing PCS activities as "optional" rather than required by their institutions or evaluation systems [Gascoigne &

5. However, the results of this study should be considered with caution due to the highly undefined populations from which the data was drawn, the study's findings nevertheless represent a valuable source of information.

Metcalfe, 1997]. In Italy, scientists view concerns related to the work of science journalists as obstacles. These concerns include the risk of being misquoted, the unpredictability of journalists during the editing process, and the consequent risk of “bad press” [Bucchi & Saracino, 2012]. These concerns highlight a complex relationship where scientists acknowledge the importance of journalists’ work but often perceive them as “informants” whose autonomy is secondary to the scientists’ discourse. Mexican CONACYT researchers, like their US counterparts, cited lack of time and insufficient recognition as major constraints [Sanz Merino & Tarhuni Navarro, 2019]. Lithuanian academics also identified time commitment, a low PCS culture, and limited institutional support as primary barriers [Valinciute, 2020], while in Zimbabwe, a low commitment from the State, manifested through limited funding and lack of incentives, significantly impedes PCS activities. Furthermore, some scientists in Zimbabwe reported state censorship regarding sensitive or panic-inducing topics [Ndlovu et al., 2016].

The role of institutional support and policies seems to be crucial. The need for greater institutional support for PCS activities has been emphasized at the European level [Casini & Neresini, 2012; Neresini & Bucchi, 2011]. Australian scientists also perceived little support [Gascoigne & Metcalfe, 1997]. In Zimbabwe, the state’s low engagement, coupled with limited funding and incentives, creates a communication system that is often unclear, disjointed, and overly focused on academic publications [Ndlovu et al., 2016]. In Lithuania, Valinciute [2020] has seen few and very recent institutional processes for integrating PCS practices into institutional evaluation. In the UK, the aforementioned study suggests that policies aimed at fostering dialogue have a limited impact. Furthermore, constraints on institutional support contribute to lower engagement among younger scientists in PCS [Bhatthachary, 2016].

The perception of journalists and the media among scientists is often nuanced. While Australian scientists found that working experience with the media improved their perception of the quality of journalists’ work [Gascoigne & Metcalfe, 1997], Italian scientists — as mentioned above — tend to view journalists as informers whose autonomy is secondary to the scientists’ narrative, despite recognising their importance [Bucchi & Saracino, 2012]. American universities expressed a preference for more structured and well-designed scientific communication, recommending greater engagement between science communicators and scientists to better understand audiences and tailor PCS objectives [Dudo & Besley, 2016; Besley et al., 2021].

As we can see, the landscape of scientists’ public communication is complex, marked by varying levels of engagement influenced by career stage, productivity, and diverse motivations rooted in personal enthusiasm, a sense of duty, and a desire to combat misinformation. Yet, persistent barriers such as time constraints, insufficient institutional support, and concerns over media interactions underscore the critical need for more robust and coherent policies and support systems to facilitate scientists’ vital role in informing and engaging the public.

3.3 ■ *The changing international context of science communication*

As one of the objectives of this paper is to compare current PCS practices and activities which those founded almost 20 years ago, it is important to consider national changes (demographics and policies) and three major changes reported in the literature across the

world: a) changes in the relationship between scientists and the public, b) the rise of social networks and the wider digitalisation of social interactions, and c) the impact of the COVID-19 pandemic.

The first major change is related with the role of scientists in PCS activities. Martin Bauer points to an increase in both the involvement of mediators in PCS activities and the nature of their involvement. These mediators are addressing the “public trust deficit”. He also points out that this role is more often played by scientists themselves, who have to deal with this deficit by adopting more participatory strategies. This period, which Bauer calls Science-in-and-for-Society [Bauer, 2009], is relevant when considering the ways in which PCS is conducted. It differs from previous periods, which were characterised by less public participation. In the same vein, Levin and De Filippo [2021] have identified a new period, around the 2010s, in which processes of democratisation of science are the main issue. It is important to consider the period where practices under investigation happen because this shapes changes in the issues selected for communication, the communication strategies selected and the platforms that are used.

More recently, Szüdi et al. [2022] found that there is a greater connection between science communication and policy when the two are analyzed in more specific detail. They observe more open and trusting practices between science communicators and policy makers, and an increasing digitalisation and visual formats of science communication. Bucchi and Trench, point to diversification in the forms of PCS, an increase in participation and digitalisation, and a trend (not yet widespread) towards what they call the “cultural-turn”: audiences are no longer passive actors, but actively involved in generating the meanings of activities [Bucchi & Trench, 2021].

These processes, applied to the specific field of science communication, have had effects such as the increase in online PCS activities [Fährnich et al., 2023], besides the low participation reported few years ago [Collins et al., 2016]. The rapid changing role of scientists and mediators of PCS activities [Bucchi & Trench, 2021], where scientists communicate more directly with the public, or the emergence of new PCS functions, like data checking or monitoring [Krause et al., 2020; Milillo et al., 2022] are also new tendencies. Similarly, a number of studies focusing on online activities suggest that younger scientists are more engaged in this type of activity, while more senior scientists prefer face-to-face activities [Rainie et al., 2015].

The second change is that the growing participation of scientists in social networks engages multiple audiences and opens up debates exponentially. This of course has the effect of broadening the base of the public sphere around scientific issues, but it also opens the door more easily to rebuttal by anti-science, anti-climate change, anti-vaccine, etc. groups [Edelsztein & Cormick, 2023; Pulido et al., 2020; van Schalkwyk et al., 2020; Huber et al., 2019].

The third major change to be taken into account is the impact of COVID-19 pandemic, particularly the lockdowns implemented in most countries (in Argentina it was extended throughout 2020 and part of 2021). These lockdowns caused important changes in the way the media and audiences operated. In a comprehensive study on the challenges posed by the COVID-19 pandemic for the media, Kopecka-Piech and Łódzki [2022] analyse the changes produced in three aspects, production, contents and contexts. They highlight the

increase in the dynamics of datification [Bolin, 2022], the infodemic [Colombo, 2022], the greater use of statistical data [Beliga et al., 2022], images [Zagidullina, 2022] and the use of social networks [Edelsztein & Cormick, 2023; Jarynowski & Płatek, 2022].

Certainly, these processes are not independent and may exhibit a degree of synergy. Given that increased direct interaction between scientists and their audiences had already been reported [Bauer, 2009; Szüdi et al., 2022; Bucchi & Trench, 2021], and that this interaction was increasingly taking place through digital media, the impact of the pandemic served to amplify this effect. This placed greater emphasis on the scientists' role as data verifiers in these processes.⁶

Interestingly, data on institutional or national PCS policies (implemented by research funding agencies or research councils and centres) remain limited and are often based on academics' perspectives. The analysis of their impact on PCS activities and institutional support is scarce.

Present-day research indicates that strategies for fostering PCS activities among scientists ought to tackle a range of issues, encompassing training, the inclusion of PCS activities in evaluation systems, more explicit objectives for these activities, better support efforts and institutional coordination [Kreimer et al., 2011; Bao et al., 2023; Bhatthachary, 2016; Gascoigne & Metcalfe, 1997; Valinciute, 2020; Wang & Jia, 2017]

4 - Theoretical background

To analyse changes in PCS activities among CONICET scientists, we consider that PCS activities can be understood through specific drivers such as attitudes, perceptions and policies [Besley et al., 2018].

According to Ajzen [2020], the Theory of Planned Behaviour (TPB) states that “behavioral intentions are determined by three factors: attitude toward the behavior, subjective norm concerning the behavior, and perceived behavioral control” [p. 315]. TPB has proven to be effective in both predicting and analysing the impact of those drivers on intention [Ajzen, 2020; Davis et al., 2015]. In addition to the classic drivers, we also include resources: a) material resources, usually in the form of grants and other instruments, b) time resources, usually as planned opportunities to perform PCS activities, and c) cognitive resources, in the form of training and preparation. We also include contextual information, such as institutional changes, the general processes of digitisation and the impact of the pandemic.

The analysis of attitudes entails an evaluation of motivations and personal objectives pursued through PCS activities. In the context of perceptions, inquiries are made regarding self-perceptions of the scope of activities undertaken, along with the justifications for their execution within the framework of professional scientists.

An important factor influencing the intention to engage in PCS is whether or not specific policies exist to support it. In particular, we are interested in how much weight the inclusion of PCS activities in the evaluation of scientific careers has on the propensity to engage in

6. For example, the European Union, through the Horizon 2020 program, launched a specific call, who has funded a dozen of projects to address information veracity. For the Argentinean case see Milillo et al. [2022].

PCS activities. At the same time, the subjective perception of these standards in the evaluation was included in the interpretation.

Finally, we analyse the resources mobilised to perform outreach activities. To this end, the material, institutional and cognitive resources deployed by public S&T policies and CONICET during the period under study (2020–2021) were taken into account. In order to evaluate the perceived cognitive resource, we asked about the perceived level of training. It should be noted that ‘degree of difficulty’ is not a resource in itself (but rather a self-perception of the capability to perform PCS activities). However, this driver was analysed in conjunction with ‘training’ because they are intimately related. The above variables were analysed in our study in terms of a) the change in their values between the last known data (2007) and b) the change across a number of demographic and institutional variables. There is some controversy in the literature about the usefulness of demographic variables for analysing changes in PCS activities [Besley et al., 2013, 2018; Jensen, 2011; Kreimer et al., 2011; Rainie et al., 2015]. Nonetheless, these dimensions are crucial for elucidating the dynamics of PCS activities in Argentina during the periods analysed: as mentioned above, the number of CONICET researchers has more than doubled between 2004 and 2020; and the characteristics of that population (which exhibited a significantly lower average age and years of work) also underwent change. Therefore, it is not possible to apply the criteria obtained by works carried out in more stable institutional and political contexts of science, since it had a direct impact on the way in which population dynamics affect behaviour.

Figure 1 shows how the theoretical framework was combined with the results of the key variables identified in the literature review and previous studies to develop our analytical strategy, the methodology of which is explained below.

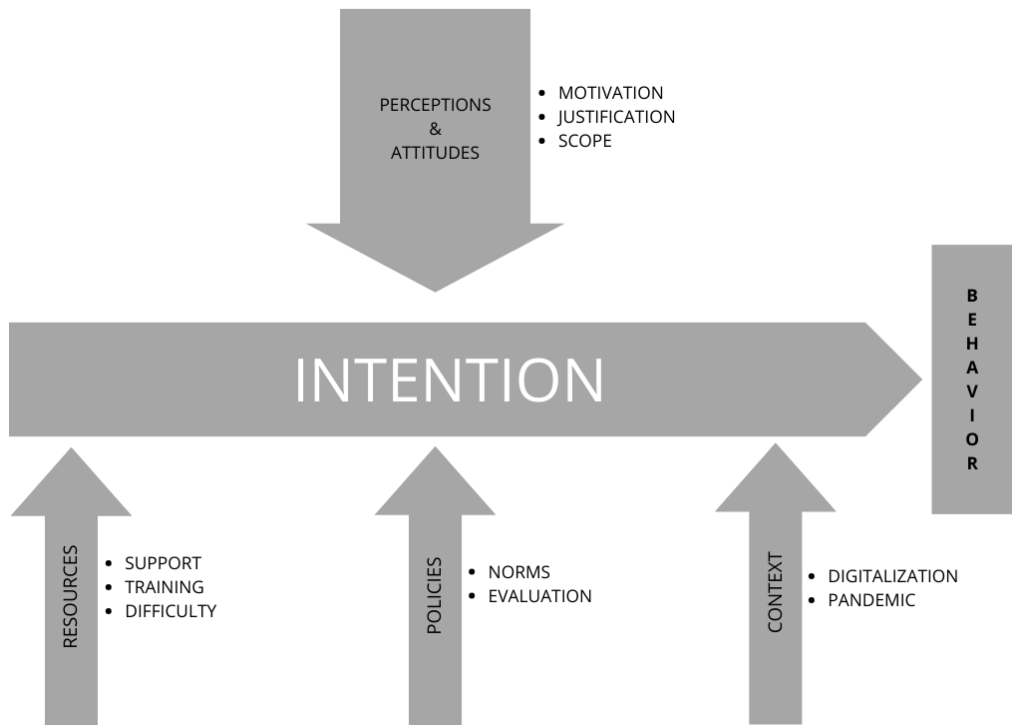


Figure 1. Theoretical model with the most relevant variables.

5 - The study. Methodology and characterization of the population

To collect the data, we designed a questionnaire with closed questions, structured in 5 sections: 1. Personal data, 2. PCS activities,⁷ 3. Characteristics of PCS, 4. Why not PCS, 5. Interdisciplinary PCS. The questionnaire can be found in the Supplementary material.⁸

The questionnaire was distributed via email to the entire database of CONICET scientists and postdoctoral fellows active in November 2021. Two waves of distribution were made, a first one on 03/11/2021 and a second on 12/11/2021. 3,895 responses were received from a population of 13,956 active researchers (including 2,949 postdoctoral fellows), representing almost 30% of the population.

The representativeness of the sample and its distribution with respect to the population were tested with a χ^2 test, which did not show significant differences for any variable tested (Thematic Area: $\chi^2 = 311.71$, p-value 1.14E^{-61} , df = 4; Sex: $\chi^2 = 11.24$, p-value 0.010 , df = 1; Region: $\chi^2 = 61.73$, p-value 1.24E^{-7} , df = 7 and Category: $\chi^2 = 68.97$, p-value 1.88E^{-50} , df = 5; Discipline: $\chi^2 = 284.13$, p-value = 1.97E^{-65} , df = 27). Only a small positive bias is found in one of the 21 subcategories considered (SSH + 7.6%)⁹ (details in Supplementary material).

In order to standardize the responses, a definition of “PCS activity” was operationalized, as a way to maximize the adequacy of the responses with the objectives of the study, as we asked in the questionnaire:

“Understanding by Public Communication of Science (PCS) to all practices of communication of science aimed at an audience other than that of its own discipline, carried out by any media...”

We also wanted to distinguish regular PCS activities from those for colleagues from other disciplines. To this end, we introduced a specific section with a definition of interdisciplinary PCS:

“CONICET’s researchers are grouped into 4 main areas: Social Sciences and Humanities; Biological and Health Sciences; Agricultural Sciences, Engineering and Materials Science and Exact and Natural Sciences. Within them there are different disciplines. In this sense, we are interested in interdisciplinary PCS, i.e. PCS carried out for audiences in disciplines other than their own.”

A logistic regression was applied to the data to study the influence on the popularization activity of the different scientists’ characteristics: research area, hierarchical position and

7. We established the following set of categories: Open Doors, Science Café, Science Fair, Conferences for the general public, Radio interviews, TV interviews, Interviews in newspapers and magazines, Interviews in electronic media (excluding newspapers and magazines), own posts on websites or social networks, Articles published in newspapers and magazines, Radio host and/or panellist, Popularisation book.
8. Supplementary material available in <https://zenodo.org/records/14974665>.
9. The 21 subcategories analysed are: AREA: Social Sciences and Humanities; Biological and Health Sciences; Agricultural, Engineering and Materials Sciences; Exact and Natural Sciences; Technological and Social Development; SEX: Male, Female; REGION: Center, Cuyo, Litoral, Metropolitan, Northeast, Northwest, Pampeana, South, CATEGORY: Postdoc, Assistant, Adjunct, Independent, Principal, Superior.

Table 2. Logistic regression.

<i>Name</i>	<i>Coeff</i>	<i>%OR</i>	<i>p-value</i>
Intercept	0.92	232	63.77
Research area			
Biological	0.14	31.4	0.18
Agrarian	0.15	28.18	0.17
Social	1.45	52.51	0
Gender			
Male	-0.23	32.6	0.005
Hierarchical position			
Asistente	0.11	50.64	0.39
Adjunto	-0.003	39.11	0.98
Independiente	0.16	36.03	0.24
Principal	0.17	35.18	0.30
Superior	0.63	49.3	0.06

gender. Our results, summarized in Table 2, show that there are no very significant correlations except for SSH and ‘male researchers’. While SSH scientists appear to be the most active, researchers in AEMS appear to be the least active. Other areas are not significantly different from our reference (ENS). We found no correlation with age.

The explanatory variables are: Research Area, Gender and Hierarchical position. The reference levels are: “Exact sc.” for the Research Area, “Posdoctoral F.” for the position and “female” for the gender. The columns give the coefficients of the fit and their significance (p-value). To interpret the results, one can use the “% odds ratio” which gives the ratio of the odds of a scientist being active and sharing this characteristic to the odds of a scientist being active in the reference group. For example, the odds that a social scientist is active are more than a half time higher (52.51%) than for an ENS scientists. Standard significance level for the p-values was 0.05.

6 - Results¹⁰

6.1 - Intensity and type

Almost 80% of CONICET researchers stated they had carried out at least one activity in the last two years. Nonetheless, when individuals were asked about the number of activities they engaged in (1, 2, or more than 5), 8% of them (315 individuals), had participated in a single activity during the period, while 11% (447 individuals) had undertaken a moderate number of activities, ranging from 2 to 5.

The number of CONICET’s scientists that perform at least one activity surpasses in this study the figure reported in the previous survey, which stood at 72%. These figures, which represent a population we described in 2011 as “occasional popularisers”, are lower than

10. In our analysis, we only mention subcategories when they are relevant to the explanation. For example, for virtually all the variables examined, the intersection by geographical location does not yield significant results and is therefore generally ignored in the analysis.

those found a decade ago, suggesting that not only more researchers are carrying out PCS activities today, but they are doing so more intensively. In summary, there are now 20% of researchers who do not disseminate at all, around 20% who communicate science infrequently (1 to 5 activities in two years) and a larger proportion (60%) who communicate science more intensively.

When the data were analysed by gender, it becomes evident that women now communicate science more than men and engage in a greater number of PCS activities. In 2011, there was a slight preponderance of activities carried out by men: 75% carried out at least one activity, compared to 68% for women. Currently, these percentages are 77% for men and 80% for women.

In our current study, the results are homogeneous according to the hierarchy in the research career, and contrast sharply with what was observed in our previous study. In 2011 there was a growth effect on the intensity of PCS activities throughout the career: 90% for senior researchers and 64% for assistants (see Supplementary material). This was also observed in other countries [Bauer & Jensen, 2011; Bentley & Kyvik, 2011; Kreimer et al., 2011; Valinciute, 2020], making this variable a “predictor” of PCS intensity. Currently this effect has virtually disappeared, with the difference between the lower and higher categories falling from 28 in 2007 to only 4 percentage points in 2021. In general, there appears to be a normalisation effect, where all categories are communicating science with similar levels of intensity (as evident in the change in the linear regression in Figure 2; $R^2 = 0.5127$ compared to 0.9265).

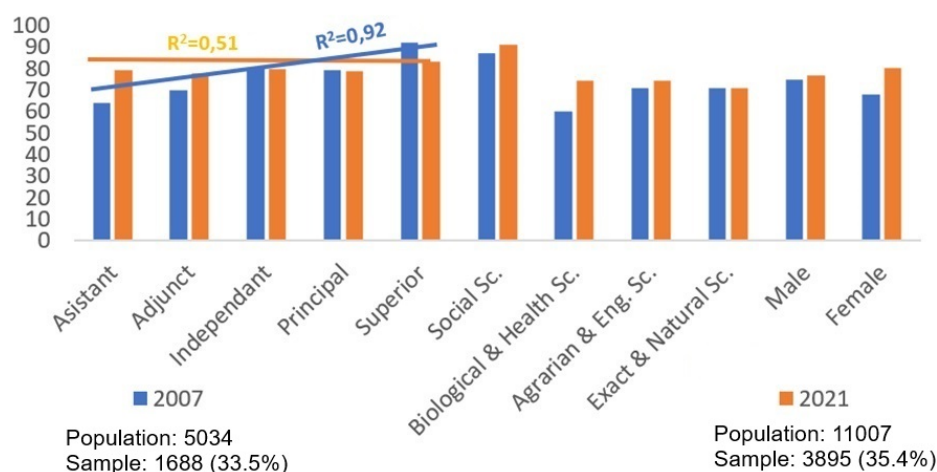


Figure 2. Researchers performing at least one activity. Comparison 2007/2021 (Hierarchical Position, Thematic Area and gender).

As with researchers in other countries, Argentine researchers in the social sciences and humanities continue to be the most active communicators. The increase in BHS was important too, probably influenced mainly by the COVID-19 pandemic and by a growing public interest in biomedical issues.

A more disaggregated analysis by scientific discipline reveals three groups (see Supplementary material): (1) very active disciplines in PCS (> 85%), (2) moderately active disciplines (65%–85%), and (3) less active disciplines (< 65%). The least active disciplines include the ‘hardest’ sciences, such as Mathematics, Physics, Chemistry and Food Sciences. On the opposite, the most active disciplines belong mainly to the SSH, with the exception of

Astronomy and Technological and Social Development (T&SD): History, Anthropology, Archaeology, Habitat, Environment, Psychology, Sociology, T&SD, Astronomy, Literature and Law. Finally, in the intermediate category (65–85%) we found mainly biomedical and applied disciplines: Biochemistry, Processes, Computer Science, Materials, Medicine, Veterinary Medicine, Earth Sciences, Biology, Agriculture and Philosophy.

The PCS activities that CONICET researchers claim to engage frequently are associated with virtual media, such as their own posts. This constitutes a fundamental difference from the activities documented in the previous survey, in which digital media were less significant and social networks were virtually non-existent. However, as expected, this difference is greater in the lower categories, since younger researchers use to be the most accustomed to using and the most active users of new communication technologies and social networks.

As per our 2007 study, we define conferences as talks addressed to a wide audience, not exclusively academic. Public talks are still the most common science communication activity, account for over 35%, in both studies. However, it evidently drops for the less senior employment categories, who are more inclined to participate in online social networking. In order to observe the relationship between the hierarchical position in the career and the type of PCS activity performed, we have selected the activities at the end of two axes: the virtual axis and the “time in front of the public” axis. At one end we have the posts, an activity that does not require a face-to-face audience and that can be done almost instantaneously, and at the other end we have conferences and radio interviews. We take the most representative activities and display them by career category using a proxy to count the activities, being 1 = 1; 2 to 5 = 3.5 and +5 = 7.5. If we take the first category (postdoctoral fellows) and the last one (Superior researchers), it is evident that there is an inversion in the frequency of the types of activities, an effect that is quickly reversed as the career progresses: postdoctoral fellows are more likely to make more posts compared to conferences (45% of posts vs. 25% of conferences), while in the highest categories this ratio is reversed (40% of conferences vs. 25% of posts).

Only 6% of scientists carry out PCS activities on television, which, in principle, signals a clear decline in this means of communication. However, recent studies on audience show that most people still consider television to be one of the most important ways of learning about science: according to Polino et al. [2021], citizens choose TV with 40%, second only to the Internet with 45%. This can be explained in two complementary ways: a) most PCS-related TV content does not feature scientists as protagonists, or b) the group of scientists involved in TV activities is small but enormously active (“professional communicators”).¹¹

Conferences remain the most popular way of communicating science, followed, by radio interviews¹² (Figure 3). In both activities, emphasis should be placed on the fact that the presentation time is greater than in other types of activities, such as television or social networks. Furthermore, interaction is mostly unidirectional, with questions being answered on occasion, in contrast to the more interactive communication characteristic of social networks. Articles and interviews published in newspapers and magazines also continue to have a high relative importance.

11. In our previous study, we termed ‘professional communicators’ those researchers who carried out more than 8 PCS activities per year [Kreimer et al., 2011].

12. Given the period under study, although we did not explicitly ask to distinguish between face-to-face and online conferences, we assume that most of the conferences must have been held remotely due to the pandemic.

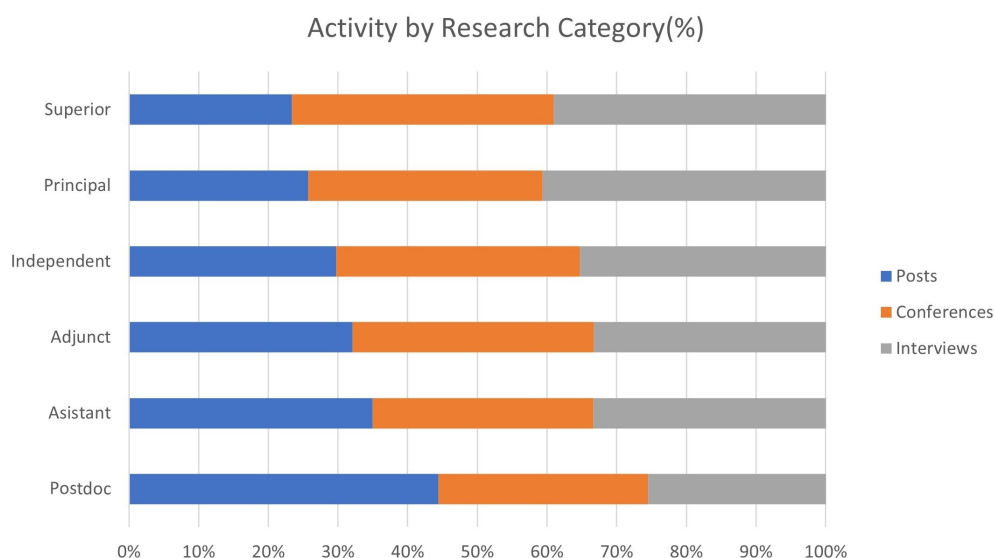


Figure 3. Type of PCS activities by category.¹³

We can observe an evolution in the degree of difficulty that PCS activities represent for CONICET researchers over the last 15 years: whereas in 2007 the percentage of researchers who considered the performance of PCS activities easy/very easy was 20% and difficult/very difficult was 80%, this ratio is currently established at an average of 35/65 for all disciplines.

In 2007, we found that ‘lack of institutional support or encouragement’ was one of the main reasons given for not engaging in PCS activities. At that time, this effectively corresponded to low institutional support. In comparison, it seems that institutional support has greater recognition, although it is considered to be far from sufficient.

6.2 ▪ *TPB drivers*

As we present in the theoretical section, we analyse four kinds of drivers to understand scientists’ willingness to communicate science: Perception and attitudes, resources, policies and context.

Perceptions and attitudes

Motivations and justifications are very similar drivers that need to be correctly identified. While by ‘motivations’, we mean the subjective drivers that actors identify as most important, ‘justifications’ refer to the rational explanations that actors identify between means and ends.

In order to analyse the motivations that lead CONICET scientists to engage in PCS activities, we organized the motivations surveyed into 4 groups: 1) motivations related to the search for greater dissemination of their work; 2) social motivations, which seek collective benefits; 3) individual motivations, which seek personal benefits; 4) finally, utilitarian motivations, related to strategies for obtaining resources (whether human or capital), to work more and better. A synthesis of the responses and their categorisation according to four criteria are displayed in Table 3.

13. 2007 data are not shown because the Post category did not exist as an activity and the results are confusing.

Table 3. Categorisation of motivations according to four criteria.

		#	%	# (%)
1. Dissemination	a. To intervene in public debates	1295	14	4470 (48.6%)
	b. To make my discipline known to the public	1549	17	
	c. To give greater visibility to my research	1626	18	
2. Social	a. To fight against irrationality	468	5.1	1992 (21.7%)
	b. To convey social and ethical implications	1524	17	
3. Individual	a. To better understand my research	409	4.4	1699 (18.5%)
	b. Because it gives me pleasure	1290	14	
4. Utilitarian	a. To get financing	220	2.4	1033 (11.2%)
	b. To attract students	526	5.7	
	c. Because I will be better evaluated	287	3.1	

As we can see, the motivations that most mobilize CONICET researchers to carry out PCS activities are those mostly related to the dissemination or visibility of their work and/or discipline, followed by social motivations. In a lower position are individual issues and, finally, utilitarian issues, such as obtaining funding or symbolic resources.

It is interesting to note that the fact that PCS activities are taken into account in researchers' evaluations is an issue to which they attach very low relevance.

According to the professional hierarchy, researchers at all levels rank the motivations for grouping in the same descending order — primarily dissemination, followed by social, individual and utilitarian.

When we asked them about their justification, that is, the primary reasons why scientists communicate science, the four main reasons they provided were: a) social responsibility (25%), b) enhancing public understanding of science (20%), c) promoting informed public decision-making (20%), and d) raising awareness about scientific applications (19%). Collectively, these responses (84%) align with the previously identified motivations of dissemination and social responsibility. Conversely, other possible responses that reflect a more confrontational stance, such as 'to confront corporate interests' (4%) and 'to confront religious dogmas' (3%), were deemed less pertinent. Thus, the relationship is conceived in terms of more direct connections between researchers and the public, and to a lesser extent, with the state.

When analysed by research area, researchers in the ENS find more justification than others in combating a negative image of science, while those in the SSH do so in the fight against corporate interests and dogma — issues that seem to concern AEMS researchers less.

With regard to the range of content that is the subject of PCS activities, we wanted to know how close or distant their areas of expertise are. We inquired whether researchers carried out PCS activities based on: a) their own or their group's research, b) their field or speciality, c) their discipline, d) science in general, e) issues on the public agenda, or f) the relationship between science and society. Three-quarters said that they base their public interventions on what is closest to them, such as their own research (52%) or their subject area (25%). Also of relative importance are interventions on the relationship between science and society (14%). On the other hand, few activities relate to their own discipline (7%) or science as a whole (3%).

Across research areas, our data show that social scientists are those who carry out most PCS activities on their own research and, to a lesser extent, on their field and discipline. ENS scientists report higher levels of PCS activities for “science in general” and lower levels for their own work. Predictably, the researchers in the SSH indicate they carry out more PCS activities on social, public issues and relations with society, followed by researchers in BHS.

There is a slight, but significant, change with career progression: post-doctoral fellows, assistants and adjunct researchers focus more on disseminating their own research (55% for assistants, 52% for adjuncts and 50% for post-doctoral fellows). On the other hand, superior researchers devote only 35% of their interventions to the dissemination of their own topics, while the PCS on ‘Science-society relations’, together with ‘Public agenda issues’ and ‘Science in general’, account for more than 30% of their interventions. All categories of researchers devote around a quarter of their time to disseminating knowledge about “their own field or specialty”.

In a sense, this is an observation of a phenomenon that has already been noted by sociologists of science: Shinn [1988] points out that as researchers progress in their careers, their level of generality increases, that is, while the most junior researchers are dedicated to the study of limited and well-defined phenomena, more senior researchers work with a higher level of generalisation and the search for analogous phenomena beyond specific cases. Bourdieu [1997] has argued that those who have accumulated a significant amount of scientific capital are able to assume the representation of their field of research and even of science as a whole. Furthermore, due to their high hierarchy in the field, the most prestigious scientists are able, according to him, to intervene in public — and wider — debates.

Resources

As stated above, we observe three types of resources owned by researchers: cognitive resources (perceived difficulty in communicating science and self-perceived training level); material resources (grants, institutional support); and time resources (time released from other activities to focus on PCS activities).

Concerning the difficulty of communicating science (very easy, easy, difficult, very difficult) researchers consider that it becomes easier to communicate science as they progress in their careers. While 42% of researchers corresponding to the highest categories (Superior, Principal and Independent) consider that it is easy or very easy to communicate science, the percentage decreases for the lowest categories: 35% for Adjuncts, 32% for Assistants and 30% for Postdocs. Taken together, two thirds of researchers consider it difficult or very difficult to communicate science.

The perceived level of difficulty is closely linked to researchers’ self-perceived training levels. While 52% of researchers consider themselves to be fairly or very well trained in communicating science, 48% consider themselves to be poorly or not at all trained. Here, the position in the research career matters. The number of those who consider themselves to be better trained increases significantly as they progress in their careers: 45% in the lowest category (postdocs) to 78% in the highest (superior researchers). Crossed by area, these data are relatively homogeneous, with a minor exception in SSH, where researchers assert that they are fairly or very highly qualified by 10% more.

As far as institutional support for PCS activities is concerned, 71% of researchers say there is some support through institutional policies (6% a lot, 22% quite a lot, 43% some), while

20% say there is no support and 9% do not know. However, the majority of researchers (72%) feel that there is some or no support, or that they are unaware of this support (i.e. they do not use or are unaware of the previous policy).

Policies

To understand the intensity of PCS activities carried out by CONICET researchers, two factors are taken into account: institutional policies and the inclusion of these activities in performance evaluations.

We presented above the policies deployed by CONICET to encourage PCS over the past 20 years. These policies include plans for creating dissemination content, implying that there are now more spaces for the public communication of science with varying degrees of institutionalisation. Researchers can voluntarily turn to these spaces, while others can be called upon or invited by the institution to disseminate their work. However, despite these policies, only 15% of researchers think that the existence of these policies could be an effective driver to promote PCS activities and only 10% think that a specific institutional area could do this.

In regard to evaluation, we highlighted the importance of including it in career entry, regular evaluation and cross-category promotions as a possible driver for intensifying PCS activities. Almost 60% of the researchers report that the inclusion of PCS activities in the evaluation had a positive effect: 43% consider that it made possible a better assessment of performed activities and 16% that it encouraged more activities. Ten percent more men than women report that it had no effect (30% vs. 20%), while 10% more women report that it increased the value of the activities (55% vs. 45%).

It is interesting to note that, researchers have a positive view of specific policies that stimulate outreach activities. However, only 15% of them respond that they are motivated by these policies when asked about their motivations. Therefore, policies should not be considered a significant driver.

Context

When we reviewed the literature on science communication by scientists, we identified two key contextual factors that needed to be considered: digitalisation and the pandemic. In line with the description of the international context, the PCS activities of CONICET researchers were increasingly carried out in digital media, reducing the time spent in front of audiences and addressing general scientific issues in personal posts or intervening in public debates in social networks. As mentioned above, younger researchers tended to carry out these activities more intensively, whereas more experienced and older researchers preferred conferences or interviews. It is interesting to note that the data reflects a clear graduation from the lowest to highest categories.

Regarding the changes brought about by the pandemic, 35% of researchers (39.8% male and 32.5% female) reported that the number of PCS activities they carried out was unaffected by the pandemic, while 25% (23.8% male and 25.1% female) reported an increase. The exception was researchers belonging to the SSH, of whom 30% reported an increase in activities, compared with an average of 20% in other areas. Strikingly, researchers in BHS, who may be supposed as highly linked to such an important health issue, do not report having carried out more PCS activities during the pandemic. The highest-ranking researchers

are those who report the greatest increase in their activities during the pandemic (40% of them) but, in general all the categories increase their activities more than 20%.

7 • Discussion

Changes, continuities and global trends

In relation to the questions we posed at the beginning of this paper, the first fact is that there is a larger group of CONICET scientists communicating science and doing so more intensively. However, in contrast to most of the international literature reports, and our previous findings, career position no longer functions as a direct predictor of PCS intensity among Argentine researchers, since all the categories communicate science with the same intensity. We attribute this situation to four factors, closely related to institutional and contextual changes. Table 4 presents a synopsis of the most notable differences between the conclusions drawn from the 2007 and 2021 research. Regarding the institutional changes, the most important was (1) the dramatic change in the population of CONICET researchers, which more than doubled in about fifteen years (from about five thousand in 2007 to eleven thousand in 2021). Since most of the new researchers entered in the less senior employment categories, this increase was not only a quantitative change, but also a qualitative one: the mass of researchers became “younger” than in the past; (2) the fact that PCS activities have been included in the researcher’s evaluation system (it is possible that young people are more aware of this change). Although it is impossible to determine its exact weight, it is clear that there is a positive correlation between the inclusion of PCS in the career evaluation score and the intensity of PCS activities; (3) the existence of institutional policies that support and encourage these activities. According to the TPB, this could be attributed to attitudes [Ajzen, 2020]. However, we have also shown that norms and policies are also drivers for those attitudes. Certainly, the same can be said about the weight of policies that encourage PCS activities: the effect of PCS support policies carried out by the CONICET and the Ministry of Innovation, Science and Technology (MINCyT) work together to establish a culture that connects scientific research with its communication to society. In science policy discourse, they are presented as “two sides of the same coin”. As researchers internalise behavioural norms that encourage researchers to socialize in the early stages of their careers, it is possible that PCS practices are incorporated as part of a “secondary socialisation”.

In Argentina, it seems that the Sagan effect — whereby scientists who engage in public outreach are devalued and their careers are damaged in terms of their prestige among the scientific community — has been reversed or at least mitigated. Perhaps the inclusion of PCS activities in evaluations has helped to value this activity rather than seeing it as a “distraction from what is really important”.

Lastly, regarding the contextual changes, (4) the rise in online activities (particularly on social networks) provide younger scientists with an opportunity to communicate science without the involvement of intermediaries due to lower accessibility barriers.

The technological change that has taken place over the last 15 years allows scientific communication to be less elaborate, more spontaneous and more interactive (including a larger range of actors) than traditional forms. It also encourages the intervention of non-scientists in scientific issues, while creating spaces for debates or discussions, but — importantly — also for misinformation [Iyengar & Massey, 2019]. This change also affects

Table 4. Comparison of the findings from 2007 and 2021.

<i>Findings</i>	2007	2021
Intensity of communication	Scientists in the highest categories communicate more with society. the higher the category, the more active they are	Younger scientists communicate more. The scientific status is no longer a predictor.
Activity level	72% communicate, but 75% of them do only 0 or 1 activity (occasional popularisers).	80% communicate. Everyone communicates more and do it more intensely. 60% are “very active popularisers”.
Field	Social scientists were more active, followed by biomedical researchers.	Similar are presented in the figure, involving in this case more medical and astronomy scientists
Gender	Slight male predominance.	Slight female predominance.
Type	Conferences were the main activity. The more senior the researchers, the more interviews with the press.	Virtual media are the preferred means of communication, even more so among young scientists.
Ease of popularizing	Most scientists consider difficult to popularise.	More scientists consider it easy to popularize. More senior, easier.
Reasons for popularizing	They say they do PCS mostly for altruistic reasons.	They state that they perform PCS to promote their topic/discipline and secondly for altruistic reasons.
Perceived obstacles to communicate	Those who don't communicate say it is because of a lack of institutional support, societal disapproval, or the overly technical nature of their work.	Active communicators recognize institutional support, but those who don't communicate cite lack of institutional support, competition for research time, inadequate training, and lack of consideration in evaluations.

the new generations differently. While younger researchers may favour using social networks or virtual spaces for communication, as they are more accustomed to engaging on and communicating through social networks (and therefore interact with lay people), those in higher categories tend to be less active in social networks and hold more conferences and participate in interviews. Conversely, older researchers prefer activities that can be conducted in a more relaxed dynamic, with more time to talk and interacting with people. They tend to generalize more, discussing general, political, social and economic issues much more present on the public agenda.

Prior research [Bucchi & Saracino, 2012; Weitkamp et al., 2023] has characterized the relationship between scientists and journalists as complex, suggesting that this dynamic may affect public communication of science (PCS). However, the aforementioned evidence shows that the rise in digital engagement, coupled with the increasing proportion of early-career researchers, could potentially render scientists less reliant on journalists for conducting PCS activities, thereby circumventing traditional media intermediaries.

Interestingly, while institutional and demographic changes are local phenomena, the increased use of social networks by researchers to engage publicly in the public sphere is a global trend. In this regard, Argentinean scientists have attitudes similar to those of scientists in other countries.

When analysing the continuities between two periods we studied, we see that the disciplinary patterns remain very similar, with SSH leading the way. The most common explanation is linked to the general public's greater familiarity with the language of these disciplines [Peters, 2013; Lewis et al., 2023]. Additionally, political, social, and economic issues receive more attention in the mass media and social networks compared to other subjects such as immigration, violence, crime, heritage conservation, and particularly in Latin America, corruption, marginality, poverty, migrations, and indigenous issues [Besley et al., 2018; Entradas et al., 2020; Jensen, 2011; Lewis et al., 2023]. Indeed, SSH researchers state that they are frequently asked to intervene on those public issues. While other issues related to different disciplines, such as climate change and its consequences (floods, droughts and deforestation), the development of artificial intelligence and local and global health issues, are also very present, the languages used by these disciplines mean scientists are less likely to participate in wider public discussions.

Researchers in the BHS have increased their activities compared to what we observed two decades ago [Kreimer et al., 2011]. This is certainly due to the impact of the COVID-19 pandemic on society's "demand" for information and the changes already observed in the role of scientists (fact-checking, risk communication, etc.). Once again, this is not an isolated case for Argentina, but rather a trend observed in several countries [Weitkamp et al., 2023]. It is not possible to say whether this tendency will be restricted to important but isolated emergencies (like pandemics) or if it will continue to increase over time.

The scientists declared motivations for carrying out PCS activities that were also very similar in our both studies: 'social' and 'dissemination' concerns were at the top, indicating that the population is still more concerned about the effects of science on society than on their own personal careers, at least discursively.

It seems clear that scientists' engagement in PCS activities has intensified in general, as well as in terms of disciplines and the career positions of researchers. At the same time, we observe a shift towards digital media and social networks and away from traditional media, as well as the gradual disappearance of science journalists as mediators. This has been accompanied by a certain 'homogenization' of practices, given that all hierarchies communicate science with a similar level of intensity. This process has several causes, which we have already discussed. However, we must further investigate the consequences of these changes on the content of PCS activities developed by CONICET researchers.

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