

# The visibility of women scientists in universities' external communication through social networks

## *La visibilidad de las mujeres científicas en la comunicación externa de las universidades a través de las redes sociales*



**Maider Eizmendi-Iraola.** PhD in Social Communication from the University of the Basque Country (UPV/EHU), Master in Equality between Women and Men and Graduate in Journalism and Social and Cultural Anthropology. She works as an assistant professor in the Journalism department of the Faculty of Social Sciences and Communication of the UPV/EHU. She is a member of the work team of the Gureiker research group (IT1496-22). Among her lines of research, the study of the participation of women scientists in the media and in dissemination initiatives stands out. As a result of these investigations, she is the author of several articles published in scientific journals indexed in JCR and SJR in the field of communication and has participated as a speaker in a dozen national and international conferences. In addition, she has a career of more than 17 years as a journalist.

University of País Vasco UPV/EHU, Spain

maider.eizmendi@ehu.eus

ORCID: 0000-0002-5894-8238



**Simón Peña-Fernández.** Full Professor in the Department of Journalism at the UPV/EHU. Graduated in Journalism and Audiovisual Communication from the University of Navarra and PhD in Information Sciences from the UPV/EHU, he has published 70 articles in academic journals. All these publications have always been associated with continued participation in around thirty research projects funded in competitive public calls, including eight European projects (Horizon 2020 and Erasmus+) and four National Plan projects. He has also led eight relevant research and transfer contracts with public entities and has participated in five teaching innovation projects. He is a member of the research group of the Basque university system Gureiker (IT1496-22).

University of País Vasco UPV/EHU, Spain

simon.pena@ehu.eus

ORCID: 0000-0003-2080-3241

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### Abstract:

As agents of innovation and knowledge generation, universities take advantage of their high symbolic capital to expand the communication work they were already carrying out through legacy media on to social networks. For its part, science communication has been characterized

### Resumen:

Como agentes de innovación y de generación de conocimiento, las universidades aprovechan su elevado capital simbólico para extender a las redes sociales la labor divulgadora que ya realizaban a través de los medios de comunicación. Por su parte, la comunicación científica se ha

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by a gender gap in which, despite initiatives to boost their presence in the field of science, women have a reduced visibility that has repercussions on their social image. This research analyzes the content that three leading universities have published on Twitter and Facebook through a gender perspective with the aim of understanding what type of content they publish, the scientific areas to which it belongs, and the engagement it generates. The results indicate that science communication constitutes a significant part of the communicative activity that universities develop through their social network accounts. The data also indicate that, at the same time, quantitatively fewer women are present and that their positions are qualitatively more subordinate, particularly in STEM areas.

**Keywords:**

Dissemination; innovation; science; women; gender; university; social networks.

*caracterizado por una brecha de género en la que las mujeres, a pesar de las iniciativas para promover su presencia en el ámbito de la ciencia, logran una visibilidad reducida que repercute en su imagen social. Esta investigación analiza con una perspectiva de género los contenidos publicados en Twitter y Facebook por parte de tres centros universitarios de referencia, con el objetivo de conocer qué tipo de contenidos publican, las áreas científicas a las que pertenecen y el enganche que generan. Los resultados indican, por una parte, que la divulgación científica constituye una parte relevante de la actividad comunicativa que las universidades desarrollan a través de sus cuentas en las redes sociales. Por otro lado, los datos también apuntan a una presencia de las mujeres cuantitativamente menor y cualitativamente más subordinada, en particular en las áreas CTIM.*

**Palabras clave:**

*Divulgación; innovación; ciencia; mujeres; género; universidad; redes sociales.*

## 1. Introduction

During the last decades, universities have developed communication policies that have allowed them to disseminate the knowledge they generate more effectively to society (Busto, 2013). The use of the Internet and social networks has played an important role in this expansion, which has benefited from the significant symbolic capital that higher education institutions have as agents of innovation and knowledge generation.

Social networks have become an indispensable communication tool for universities, which have actively and extensively incorporated them into their communication work (Rodríguez; Santamaría, 2012; Paniagua; Gómez, 2012; Brito; Laaser; Toloza, 2015; Motta; Barbosa, 2018; Bellucci; Biagi; Manetti, 2019; Eizmendi; Peña, 2023). Because of them, they have been able to overcome the technical and economic barriers that limited the public's access to them (Peters *et al.*, 2014; Paladan, 2018) and expand the impact that they already had through traditional media (Guzmán, 2013; González-Pedraz *et al.*, 2017).

This social network activity has prompted academic interest in learning how universities use them to disseminate their activity, whether it is to promote their researchers' scientific results, improve their public image, or attract potential students (Cancelo; Almansa, 2013; Voss; Kumar, 2013; Bélanger *et al.*, 2014; García; Alonso, 2014; Castillo; Pérez-Latre, 2016; Amaral; Correia, 2020).

### 1.1. Women in science and academia

In parallel to the rise in the use of social networks, the study of science communication has also been approached from a gender perspective, taking into account that narrowing the gap between men and women in science through different strategies and programs has become one of the priorities of academia, in line with the fifth sustainable development goal of the 2030 Agenda (United Nations, 2015).

Thus, since 1999, concern about the gender gap in science has prompted changes to encourage the involvement of women in the European Commission's research framework programs (Díaz; Samper, 2014). In the same vein, in 2015 the United Nations General Assembly proclaimed February 11 as the International Day of Women and Girls in Science, with the aim of improving their access to education, training, and research in the fields of science, technology, engineering, and mathematics, as well as supporting women scientists (United Nations, 2022).

Despite these and many other initiatives that seek to promote equality in the field of science, several studies show that the gender gap is still present in this field, from both a vertical and a horizontal point of view, and this fact also affects both production and the visibility received upon dissemination (Elsevier, 2020; European Commission, 2021; Ministry of Science and Innovation, 2023). As regards universities, the legislation that promotes these institutions as agents of equality is extensive, at both a state and an international level, since it is understood that they are uniquely positioned to implement equality policies. However, in this area, the data indicate that, although women make up the majority of the student body, their participation in the highest positions in academia is declining. According to the latest Times Higher Education (THE) report "Gender Equality: How Global Universities are Performing" (UNESCO, 2022), women are still underrepresented among faculty and research staff and, particularly, in leadership roles. According to this report, universities focus their efforts on women's access to higher education rather than on the advancement of their academic careers.

Thus, while it is true that the role of women in academia has changed during the last 50 years and that more and more women are attaining positions of greater responsibility, they are still underrepresented in many scientific disciplines (Meho, 2021). Their presence is greater in lower-ranking positions, and a greater proportion of women than men work in subdisciplines that receive less funding and less recognition (Sá; Cowley *et al.*, 2020). There is also a gender gap in the output, citation, and promotion of these professionals (Llorens *et al.*, 2021; Sá, Cowley *et al.*, 2020). Among the factors contributing to inequality in science and academia, studies point to family responsibilities, stereotypes, biases, work culture, and the lack of effective measures to address gender inequalities (Charlesworth; Banaji, 2019; Funk; Parker, 2018; Wang; Degol, 2017).

## 1.2. Gender and dissemination of science

Gender inequality in science communication is an area that has been extensively analyzed from multiple perspectives, with studies indicating that the amount (Larivière *et al.*, 2013; Mueller *et al.*, 2016; Holman *et al.*, 2018) and impact (Duch *et al.*, 2012) of research conducted by scientists varies according to an author's gender.

Multiple factors that explain this structural imbalance have been identified because gender bias in science calls for a multifactorial analysis (Larivière *et al.*, 2013). Disparities in the calling to study science (Fisher, 2020), hiring policies (Moss-Racusin *et al.*, 2012), access to funding and resources (Duch *et al.*, 2012), work-life balance (Palomar Vereá, 2009; Krukowski *et al.*, 2021; Krukowski *et al.*, 2021), composition and leadership of research groups, and existing social stereotypes about people who pursue science (Carli *et al.*, 2016) have been highlighted among the multiple causes of the gender gap in this field.

As a result of all of this, the representation of women is more limited in the science communication content being disseminated through the media (García Nieto, 2013). Also, in the scientific field, recent studies show that women publicize their academic works through social networks less (Peng *et al.*, 2022) and that they receive fewer citations in academic papers (Klar *et al.*, 2020; Dinu, 2021).

The amount of visibility women scientists have in the media and on social networks undoubtedly has an impact on their social image and also on that of science itself, a field that has traditionally been considered masculine. In fact, several studies have observed the underrepresentation of women scientists both in traditional and on digital media (Aladro *et al.* 2014; Mitchelstein *et al.* 2019); moreover, they indicate that the image projected by these media is biased and stereotyped (Husu; Tainio 2016; Mitchell; MacKinnon 2019).

Since social networks offer a greater opportunity for engagement with and dissemination of messages, especially for underrepresented groups (Vásárhelyi *et al.*, 2021), messages posted through social networks can also have a positive impact on the social image of these professionals and on the academic impact that their work can achieve.

Therefore, science communication free from gender bias has great potential to help reverse the existing inequality in the scientific field, since it enables the public see the work of female academics.

In this context, the objective of this research is to analyze the involvement of men and women in the content related to science communication and innovations posted on universities' social networks.

Therefore, the research questions of this study are:

RQ1. What roles do women and men play in the content about science communication and innovation disseminated through universities' Twitter and Facebook accounts?

RQ2. What are the formal and thematic characteristics of the science communication and dissemination about innovation carried out by men and women?

RQ3. What level of interaction is generated by messages about science communication and innovation in relation to the gender of their authors or of the people featured?

## 2. Methodology

To address the proposed objective, the role women and men played in the content posted on *Facebook* and *Twitter* by Harvard University, the University of Oxford, and Universitat de Barcelona was analyzed. These three institutions are the most prestigious academic institutions in the United States, Great Britain, and Spain, respectively, according to data collected for the Webometrics ranking ([www.webometrics.info](http://www.webometrics.info)) by the Cybermetrics Lab research group of the Spanish National Research Council (CSIC). The United States and the United Kingdom rank second and third after China in terms of impact and volume of scientific output. The case of Spain, however, is of interest owing to the contrast between its volume of scientific output and its impact, as in number of articles it ranks 11th globally and 1st among Spanish-speaking countries, but it drops to 74th place when it comes to citation impact per article (Scimago, 2022). This choice was also based on the fact that the United Kingdom, the United States, and Spain (along with Canada and Australia) are among the five countries in which universities have more data available regarding their activities in the area of gender equality (UNESCO, 2022), which demonstrates their interest in the issue.

In addition, *Twitter* and *Facebook* are the platforms on which the three institutions have the largest number of followers, and choosing to analyze them is in line with other existing studies on use of social networks by universities across the globe (Motta; Barbosa, 2018; Valerio-Ureña *et al.*, 2020).

The period analyzed covers two months –from January 1, 2022, to February 28, 2022. This period is in the middle of the academic year: for Oxford, at the beginning of the second term; for the Universitat de Barcelona, at the end of the first semester and the beginning of the second semester; and for Harvard, at the beginning of the second semester. In all cases, this is a period of normal academic activity that, as it is after the winter holidays, does not include any vacation period that could affect the sample.

After the study period was set, content was extracted manually by analyzing the three institutions' accounts on the social networks and the content that their university communications office posted. Therefore, the delimitation of the final sample did not require a significant screening process. A total of 1,271 messages were analyzed.

Subsequently, the coding process, analyzing each of the posts and categorizing them, was carried out using an analysis sheet. To ensure the reliability of the study, 20 units of analysis were randomly selected, and each variable was analyzed by two coders. The percentage of agreement was 86.75%, according to Holsti's formula, which indicates acceptable reliability (Neuendorf, 2002).

First, to study the presence of a gender in the science communication that universities carried out on social networks (RQ1), the genders of authors of the content or of the people featured in the messages and in the content that was linked to it were identified, in addition to the gender and the authorship order of the persons who act as authoritative sources in them.

To determine the thematic and formal characteristics of the science communication (RQ2), in addition to the messages' baseline data (date of post, university), the type of content and the topics addressed were studied. To this end, a distinction has been made between (1) content aimed at making the results of a study or scientific project known, (2) activities of an informative nature (congresses, conferences, etc...), (3) informative or opinion articles published on the university's own web pages or in the press, and (4) more practical posts, including analyses of current issues and interviews posted by university communication offices or the traditional media and redistributed through these networks.

With respect to the scientific areas that the content corresponds to, they have been classified using the UNESCO International Standard Nomenclature for Fields of Science and Technology, which –despite the problems with obsolescence and representativeness ascribed to them (Ruiz-Martínez *et al.*, 2014)– is widely used as a model by academic institutions today. This code classifies the fields of knowledge into 24 fields, to which one more, communication, has been added, in line with what other studies in this field (García, 2007; Marzal-Felici *et al.*, 2016) have proposed.

Finally, to study the engagement generated by the posted messages according to the gender of their author or the person featured (RQ3), the number of comments received by the messages, the number of likes obtained, and the number of times they have been retweeted or shared were analyzed.

### 3. Results

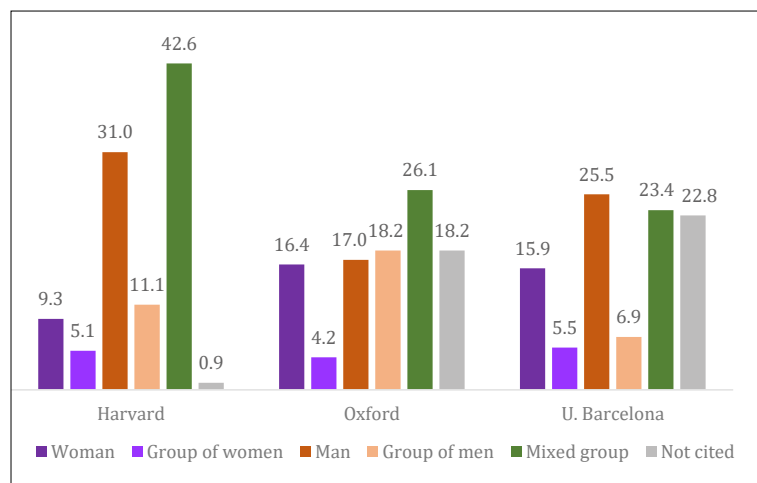
The analysis of the messages that the three leading universities posted on *Twitter* and *Facebook* corroborates, first of all, the relevance of the science and innovation communication on their social networks, since, of the 1,271 messages posted on their accounts, 41.4% ( $N = 526$ ) were aimed at disseminating knowledge generated by the institution. The results indicated that there was a difference in the use of these platforms, with *Twitter* playing a key role, accounting for slightly more than three out of four of the messages posted (78.7%,  $N = 414$ ). Among the universities, there were no major differences in the volume of their social networking activity. During the period analyzed, Harvard was somewhat more active in disseminating science communication content.

#### 3.1. Representation of women

In regard to gender, according to the data analyzed, there is a greater number of men acting as disseminators on university *Facebook* and *Twitter* accounts. Thus, there were twice as many institutional messages created by or featuring men or groups of men (37.3%,  $N = 196$ ) as those mentioning women or groups of women (19%,  $N = 96$ ). The rest of the content was divided among mixed groups (32.1%,  $N = 169$ ) and those that did not specify the source (12.4%,  $N = 65$ ). Between platforms, there were also differences in terms of gender. On *Facebook*, mentions of women were 21.5% of the total, whereas on *Twitter* this percentage dropped to 14%.

Therefore, there were fewer women were represented in the informative content disseminated through the universities' *Twitter* and *Facebook* accounts (RQ1) than men, both individually and in groups, especially on *Twitter*. This trend continued across all of the universities, although to varying degrees (Figure 1). Harvard University showed the greatest inequality, whereas Universitat de Barcelona's posts showed a somewhat better balance.

**Figure 1. Percentage of posts from each university according to the gender of the person who wrote or was featured in the content**



Source: prepared by the authors

Looking beyond the data and percentages, the mathematician and crew member of the Hypatia I simulated mission Ariadna Farrés and professor of biology Conxita Ávila in the case of the Universitat de Barcelona; professor of psychiatry Jacqueline Olds and political scientist Claudine Gay at Harvard; and professor of sociology and demography Melinda Mills and vaccinologist Sarah Catherine Gilbert in the case of Oxford were among the names of the most prominent women scientists on the analyzed universities’ social networks.

Moreover, there were significant differences from a gender perspective in terms of message content (Table 1). In total, 54.6% ( $N = 287$ ) of the informative content posts were aimed at disseminating the results of research carried out at the institution itself, followed distantly by analyses carried out by experts (13.1%,  $N = 69$ ), informative activities (congresses, seminars, etc.; 12.4%,  $N = 65$ ), interviews (9.7%,  $N = 51$ ), and informative texts (9.5%,  $N = 50$ ).

By type of content, interviews (68.6% versus 25.5%), informative articles (48% versus 20%), and the dissemination of research results (34.5% versus 11.8%) underscored that men have greater representation. In contrast, women had somewhat greater representation in posts that covered outreach activities (30.8% versus 23.1%), whereas analyses were somewhat more balanced in terms of the authors’ genders.

**Table 1. Number of posts according to the gender of the person who wrote or was featured in the content**

	Woman	Man	Group of women	Group of men	Mixed group	Not cited
Study results	17	52	17	47	107	47
Informative article	7	16	3	8	14	2
Analysis	17	16	2	7	19	8
Outreach activity	16	13	4	2	24	6
Interview	13	35	0	0	3	0
Other	0	0	0	0	2	2

**Source: prepared by the authors**

With respect to scientific areas, 2 of the 25 disciplines accounted for almost half of the content disseminated (Table 2). The study showed that interest in informative content is concentrated in medical sciences (30.2%,  $N = 159$ ) and life sciences (16.3%,  $N = 86$ ), far outstripping other disciplines such as economics (7.6%,  $N = 40$ ), political science (4.9%,  $N = 26$ ), or history (4.6%,  $N = 24$ ). Science, technology, engineering, and mathematics (STEM), therefore, monopolized a large part of the attention in universities’ communication activity.

3.2. Formal and thematic characteristics of dissemination from males and females

Expanding upon the points above, it is interesting to analyze from a gender perspective which areas of knowledge women were cited in within the content that universities posted (RQ2). With some exceptions due to the fact that some categories of the sample had a limited number of findings, in general there was a greater proportion of women or groups of women in the social sciences and humanities. Women made up the majority in disciplines such as communication and psychology, and pedagogy and liberal arts were gender balanced. Meanwhile, the two fields most commonly disseminated on social networks –medical sciences (37.1% versus 12.6%) and life sciences (39.5% versus 8.1%)– were heavily dominated by men.

Table 2. Topics covered in posted content according to the gender of the cited authors

	Woman	Man	Group of women	Group of men	Mixed group	Not cited	Total
Mathematics	6	2	0	0	0	0	8
Astronomy	0	2	0	0	2	3	7
Physics	0	3	0	2	3	0	8
Chemistry	0	3	0	0	1	0	4
Life sciences	7	21	0	13	27	18	86
Earth sciences	5	7	0	4	5	1	22
Agricultural sci.	1	0	0	0	2	0	3
Medical sciences	14	32	6	27	60	20	159
Technological sci.	0	1	0	5	1	4	11
Demographics	1	0	0	0	3	0	4
Economics	5	13	4	9	8	1	40
Geography	1	2	0	0	0	0	3
History	3	12	0	0	6	3	24
Legal sciences	2	6	0	0	8	0	16
Linguistics	0	3	0	1	0	0	4
Pedagogy	1	2	2	1	5	2	13
Political science	8	9	0	2	7	0	26
Psychology	9	6	4	0	2	1	22
Liberal arts	1	2	1	0	4	0	8



Sociology	0	0	0	0	4	0	4
Philosophy	1	1	0	0	0	0	2
Communication	5	3	1	0	8	3	20
Other	0	2	8	0	13	9	32
TOTAL	70	132	26	64	169	65	526

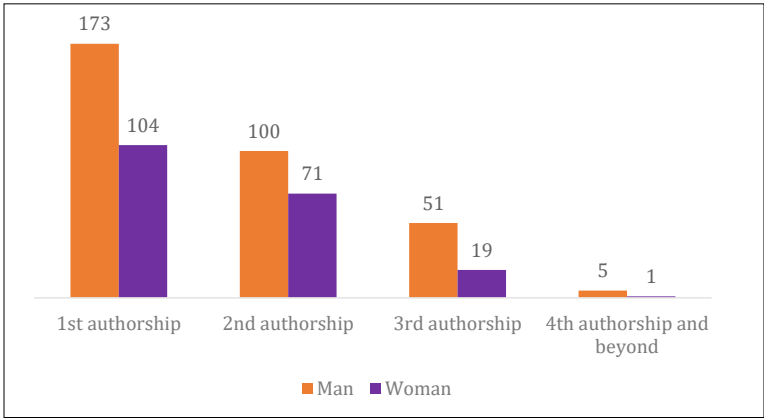
Source: prepared by the authors

Therefore, the formal and thematic characteristics of the content that cited men and women were different. Male scientists were cited to a larger extent than women scientists in messages that covered research results, and therefore, a greater proportion of them were presented as generators of knowledge. Meanwhile, women were more often associated with the social sciences and humanities, and were more frequently mentioned in relation to content on outreach activities or as analysts.

In addition to the direct mentions of male scientists, either as the author of or the person featured in the post, the authority attributed to them as sources of information for the published texts was also studied. The findings indicated that, of the total number of people presented in the posts as authoritative sources, 62.8% were men and 37.21% were women (Figure 2).

Therefore, in response to the third research question (RQ3), men make up the majority when it comes to acting as sources of information, since a greater proportion of men directly present scientific content than women do, and men do so at all of the levels studied, particularly as the first cited author.

Figure 2. Number of men and women serving as direct sources, according to place in the sequence of authorship



Source: prepared by the authors

In this sense, informative content with mixed citations –that is, those in which both men and women have been requested to act as authoritative sources and give statements– were of interest. In these mixed groups, men also remained slightly in the majority, particularly as the first source cited, whereas women were in the majority as supporting authors. Therefore, the subordination of women was not only quantitative but also qualitative in the content analyzed.

### 3.3. Interaction generated by informative messages according to the gender of their author or the person featured

Finally, in relation to RQ3, posts featuring or written by men or groups of men achieved better engagement metrics than those featuring or written by women or groups of women.

Men achieved an average of 14.5 comments per post, taking into account those received both individually and as a group; for women, this averaged at 11, and in mixed groups at 12.7. In regard to likes, men achieved 186.5 interactions per post individually and collectively, women 146.4, and mixed groups 197.9. Finally, content featuring or produced by men was shared an average of 32.9 times, compared with 23.8 times for women and 35.2 times for mixed groups.

**Table 3. Engagement of posts according to the gender of their author or the person featured**

	Woman	Man	Group of women	Group of men	Mixed group	Not cited
Comments	13.2	9.0	4.9	25.7	12.7	4.0
Likes	163.0	137.5	101.8	287.5	197.9	70.2
Shares	25.8	26.5	18.5	46.2	35.2	15.4

Source: prepared by the authors

## 4. Conclusions and discussion

There is no doubt that the dissemination of scientific knowledge and innovations has become increasingly important in recent years, even more so in the wake of the Covid-19 pandemic, which has highlighted the work involved in research and the high demand for and impact of scientific information, especially through social networks (Pulido *et al.*, 2020; Mheidly; Fares, 2020).

In this sense, the social network activity of the three leading universities analyzed in this study corroborates the importance of science communication in their communication work, since two out of every five messages posted on their institutional accounts cover this type of content. The dissemination of the results of the research carried out at these institutions is, therefore, an important part of these centers' communication activity, which through social networks reinforces their image as agents for generating knowledge and innovation, taking it further than the simple educational work that society usually associates with them.

The analysis of their *Facebook* and *Twitter* accounts also revealed other trends regarding science communication, such as the predominance of content related to medical sciences and life sciences, which monopolize almost half of the posts, in line

with what has been stated in previous research (Bauer *et al.*, 2013; Olvera; López, 2015). Research communication (Cassidy, 2021) continues to demonstrate, therefore, an imbalance in the dissemination of the “hard” and “soft” sciences, in a setting in which the social sciences and humanities have less visibility on social networks than the areas known as science, technology, engineering, and mathematics (STEM). These data show that, regardless of the overall level of scientific production in the fields of knowledge, research results in STEM areas are considered more newsworthy and have better visibility on social networks, in line with what already happens in the media (Eizmendi; Peña, 2021).

An analysis of universities’ science communication and dissemination of innovation also indicated a considerable gender imbalance in the content of the messages posted, which was evident both quantitatively and qualitatively. First, there were twice as many texts posted by or featuring men or groups of men than posted by or featuring women or groups of women. This difference was notable in the dissemination of research results, interviews, or informative articles –that is, in content that was more focused on scientific activity itself and therefore, reinforced the identity of its authors and people featured therein as men (or people) of science. In this regard, it can be seen that men were also more commonly presented as sources of first-hand information, that is, as authoritative sources for texts. Therefore, the representation of women was quantitatively and qualitatively subordinate on social networks, as well as in external communication, which undoubtedly conditions the social perception of their contribution to scientific production.

By scientific discipline, gender inequality is significant in content regarding medical sciences, which mostly featured or was written by men. This fact is interesting to note, since in this research field, the proportion of women exceeds that of men. For example, according to the latest data in the United Kingdom, the percentage of female researchers in medical sciences in academia is 61.4% (She Figures, 2021). Meanwhile, women only made up the majority when it came to organizing outreach activities, and to a similar extent, when it came to texts about analysis –that is, in more peripheral activities, ones that are more distantly connected to the core of research work. In this regard, it would be interesting to delve deeper into the criteria that communications offices use when they post content and to study qualitatively the potential difficulties that women might encounter when it comes to disseminating their work.

However, these results cannot be attributed –at least not primarily– to university institutions’ policies regarding their communication on social networks; they are also a reflection of the structural inequalities of research work, of which science communication is an indirect reflection. When the two identities differentiated by Settles (2004) –that of the scientist and that of the woman– come head-to-head in the academic and scientific spheres, the data show that the latter is what stands out.

Therefore, despite the progress made by women in this field, on universities’ social networks scientific work is still presented as a primarily male undertaking. And this fact becomes all the more important since the message could reinforce the social stereotypes that associate scientific activity with men, directly or through the media that rereport the information posted on academic institutions’ social networks. In this regard, the results of this study align with many other studies that have highlighted the gender inequality that exists in science content in both traditional and digital media (Aladro *et al.* 2014), as well as the impact this has on the social image of science and of male and female science professionals. This disparity can be seen in the engagement generated by posts featuring or authored by men or women, which are also influenced by factors such as the topics covered, the type of center, or the type of content shared (Peruta; Shields, 2017).

Ultimately, this study shows that, although the priority objectives of the universities analyzed include gender equity and that they promote the visibility of female scientists and academics through their equality units –the Equality Unit at the Universitat de Barcelona, the University of Oxford Equality and Diversity Unit, and Harvard University Office for Equity, Diversity, Inclusion & Belonging– they fail to harness social networks' potential to publicize scientific work in a more equal way considering that none of these units has a guide or resource for promoting visibility in external communications. Their efforts, particularly at Oxford and Harvard, focus on preventing and responding to sexual harassment and gender-based violence, as well as women's access to higher education (UNESCO, 2022).

However, the results need to be monitored, and the gender inequalities that still remain for women when it comes to scientific careers need to be effectively addressed. This would require, of course, a comprehensive initiative that studies the reasons why the gender gap still persists in academic institutions and in which giving visibility to female academics is an important, if not the primary, focus. It is necessary to foster gender equality in science communication by promoting a greater diversity of voices in science communication (Cambronero *et al.*, 2021) and thereby avoid perpetuating gender stereotypes in science. In this effort, as this study suggests, it would be interesting to work on resources and guides to give women scientists and academics visibility, in both universities' internal and external communication and, specifically, that which is carried out through social networks.

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## 6. Specific contributions from each author

	Name and surname
Conception and design of the work	Maider Eizmendi-Iraola and Simón Peña-Fernández
Methodology	Maider Eizmendi-Iraola and Simón Peña-Fernández
Data collection and analysis	Maider Eizmendi-Iraola
Discussion and conclusions	Maider Eizmendi-Iraola and Simón Peña-Fernández
Drafting, formatting, version review and approval	Maider Eizmendi-Iraola and Simón Peña-Fernández

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