Scientific Output by Gender in Spain (Web of Science, 2004)

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Abstract
The objective of this study was to obtain bibliometric indicators by gender applied exclusively to scientific publications registered in the Thompson Scientific databases. Aspects related with the volume of production, visibility, patterns of collaboration and networks of coauthorship will be analyzed below. The data are presented broken down by scientific field.

Keywords
Bibliometrics, scientific production, gender, Spain, Grupo SCImago.

Introduction

There is ever greater interest surrounding the participation of women in science as an indicator of social progress, and of how their presence in academic and scientific circles has increased over the years. For this reason, numerous persons and organizations have embarked on gender studies, focusing mainly on demonstrating how scarce female representation in scientific and technological areas may be, as well as on differentiating the professional categories largely occupied by women versus the achievements of their male peers.

The interest in promoting gender parity in all the realms, and particularly in Science and Technology, began in the United States in the 1970´s (with the foundation of the *Association for Women in Science*, in 1971) and in Europe in the 1980´s[1]. Initiatives on the part of Scandinavian countries and the United Kingdom were followed by a general surge of awareness by the European Community that crested in 1999. As a result of the Conference "Woman and Science" celebrated in Brussels in 1998, the theme of gender was first incorporated into the history of EU research policy. The "Helsinki Group" was created to examine the situation of women scientists in 30 countries. The plan of action — to promote gender equality in Science and Technology— included the elaboration of the ETAN Report, published in the year 2000. Data therein reflected that women researchers were under-represented in the key positions of the 30 countries involved, a discrimination traced to multiple factors. Since then, slow advancements have taken place, yet more in the legislative or normative realm than in social reality overall.

The national Institute of Statistics (*Instituto Nacional de Estadística, INE*) includes among its data some statistics broken down by sex. According to this information, the number of female students registered in Spanish universities comes to some 54% of the total, although this percentage is much lower in the studies of Architecture and Engineering, where women represent only 30% of the total

[1]. The study "Mujer y Ciencia: La situación de las mujeres investigadoras en el sistema español de ciencia y tecnología" Fecyt, 2005, presents a panorama of the gender variable from its origins.

students registered. In Doctoral programs, the percentage of students registered is quite even, with women making up 51%; yet when the dissertations are finally read, only 47% pertain to women students. Women make up just 35% of all Spanish University professors, and only 13% of the Department Heads in these universities are female. According to these data, a high percentage of women scientists are seen to "drop out" of their research endeavours, leaving research as a principally masculine undertaking. At the same time, we can see inequality of gender in those employed in R+D activities in the different sectors of execution: over 60% of contracted personnel are male, their presence being greater in the private sector and lesser in non-profit Public Institutions and Administrations.

Despite these figures, Spain is not one of the worst situated countries insofar as the female involvement in science and technology is concerned: according to the report *She Figures 2006*, based on data from the Office of Community Statistics (Eurostat), the European mean for women researchers revolves around 29%, whereas for Spanish women it reaches 36%, in addition to evidencing higher growth amongst women on the national level (11% in the period 99-03) than internationally (4%). At the European level, half of the persons who work in science- or technology-related activities are women, a figure that has risen 4% in the period 1998-2004, nearly twice the increase undergone by men, at 2.2%. The same report confirms that women make up 43% of the total Ph.D. degree holders in the European Union, although Spain surpasses this figure, with 45%. However, the growth of women in science during the period 1998-2004 was greater on the European level, with a 7% increase, as opposed to the 5% growth seen in Spain; in contrast, the body of male scientists grew 4% nationally, but just 2% at the international level.

Studies on Scientific – Technological Output

Few are the studies on scientific production by gender, mainly due to the lack of availability of data broken down by sex. Aware of this difficulty, the European Union, in 1993, dictated recommendations as to the retrieval and comparison of statistics on gender in science and technology. In 1998 it again insisted on this point, yet it was not until the year 2003 when this type of information finally saw the light in the report "*She Figures*". Organizations such as the Helsinki Group sought to promote the inclusion of these data in studies carried out on either a national or an international level, in order to compare them and determine the factors influencing under-representation in certain fields, as well as the scarce presence of women in positions of leadership.

At present, desegregation by gender cannot be considered fully extended: for example, some authors underline the lack of attention conceded in bibliometric studies (Webster, 2001). In large bibliographic databases, such as that of Thomson Scientific, the information regarding authors may be incomplete or erroneous, with authors having more than one entry for their persona, or with only the initials of authors´ first names indicated, making gender distinction impossible. In the science database of China, however, 50% of the journals indicate this information, along with the age and the academic degree of the undersigning authors. Other databases, such as Scopus, with a greater coverage than the ISI (Moya, Chinchilla, et al., 2007) feature registers and tools (*Author Profile*) with author information where the full first name and middle initial appear as the norm..

The alternative is to dispose of lists of research communities classified by specialty, institutional affiliation, geographical base, or the means of financing. Thus we encounter studies based on lists of doctoral candidates (Goel, 2002), censuses (Lemoine, 1992) and institutional directories (Gupta, 1999) (Rusell, 2003) (Bordons and Mauleón, 2004). Meanwhile, indicators of technological activity would be easier to obtain, as patents must include the full name of the inventors and the persons who register them, though there are no documented reports of such for Spain. Studies relative to entrepreneurial environs are practically non-existent, except for the ETAN Report and the reflections gathered up in the EU report on "*Women in Industrial Research*".

Whichever the source, studies of gender and scientific output have been denouncing vertical discrimination (Bordons and Mauleón, 2004), horizontal bias (Stack, 2002) and categorical differences in salary. Generally, these studies evidence lower levels of production, giving rise to reports aimed to solve the so-called “puzzle of productivity” or *productivity gap* (Cole and Zuckerman, 1984). Being left out of the mainstream of research (Davenport and Zinder, 1995) can accompany lower levels of participation, position, and recognition (Long and Fox, 1995), limited representation as a human resource in science, and a discrepancy between the number of graduates with scientific degrees and the number of women actually active in research (Prpic, 2002) as well as the orientation of a publication through national networks (Webster, 2001) (Lemoine, 2002). Differences like these are lesser when they are seen in light of other influential factors such as professional category or age.

Some authors point out a “discipline effect” with regards to the relative differences in output between male and female researchers; that is, a horizontal segregation owing to factors such as educational stereotypes. In fields like sociology, with a high proportion of women, the traditional barriers for these researchers to overcome may be weak or non-existent (Snack, 2002). And it would appear that family obligations do not affect yield (Cole, 1979) (Cole and Zuckerman, 1987). The ETAN report affirms (p.42):

> In this study, there was no relationship between academic productivity and family structure – those women with children did not produce less than their childfree colleagues. Indeed previous studies have shown that married women, as a rule, produce more scientific papers per year than single women - and those with children have equal or higher productivity than those without children (Cole and Zuckerman, 1987; Luukkonen-Gronow and Stolte-Heiskanen, 1983; Kyvik, 1988). Career breaks and childcare are important issues nevertheless and taken up elsewhere in this report.

Another issue is the apparent finding that women are less productive in terms of the number of publications, but that their works are of high quality (Garfield, 1981) (Garfield, 1983) (Zuckerman, 1997) (Schiebinger, 1999) (Nilsson, 1997; Feller, 2004). Certain studies show women to publish more information per document than men (Long, 1992). While they publish fewer *papers*, they are cited more often (Sonnert and Holten, 1995a, 1995b, 1996). Notwithstanding, other studies do not reflect such differences (Lewison, 2001). In fields such as Astrophysics, citation analysis suggests that a publication is more likely to be cited if the author is a man, with women at a comparative disadvantage for gaining acknowledgement and funding (Rusell, 2003).

Generally speaking, there is little information about the size of research groups of men and women. Long shows that the work position does not depend on output, but rather that output depends on one´s position, from the relationship between the size of research groups and their productivity (Long, 1978). Some studies show that females are more likely to work in collaboration, but not at the international level, which in turn means a reduced participation in international congresses, key for establishing future scientific contacts.

When the predominant factor for seeking a position of influence in the hierarchy of the scientific community is related with high indexes of output in quality journals, the importance of indicators of scientific output according to gender becomes clear. Without such information, any attempt to explain the minor ladder of women in scientific communities will suffer from the lack of substantive foundations, and its validity will be questioned (Rusell, 2003).

In Spain, the *Fundación Española de Ciencia y Tecnología* features a line of work and reflection on “The role of women in scientific and technological activities”. Its objective is to “help identify and analyze the factors and circumstances related with their low participation and leadership in the scientific research system, in the development of technology, and industrial innovation”. In April of 2005, the monograph “Women and science: the situation of women researchers in the Spanish system of science and technology” (*Mujer y Ciencia: La situación de las mujeres investigadoras en el sistema español de ciencia y tecnología*) came out. Spain´s Higher Council for Scientific Research (*Consejo Superior de Investigación Científica*, CSIC), at the urging of the commission for Women and Science, published a study about the topic. In the *Centro de Información y Documentación Científica* or CINDOC, a project now underway, "Incorporación de la dimensión del género a los estudios bibliométricos", is being financed by the Spanish *Instituto de la Mujer*.

Material and Methods

An *ad hoc* database was created, to which a portion of the documents extracted from the Thomson-ISI database was exported. The selection of the source can be justified on the basis of its use by the National Evaluating Commission (*Comisión Nacional Evaluadora de la Actividad Investigadora*, CNEAI) as the source of reference for the evaluative processes for the concession of research incentives. The documents were selected among the 35,790 documents with international projection published in the year 2004 and having at least one author belonging to a Spanish institution.

Selection of the sample

In order to attain a significant simple of Spain´s scientific output, we calculated the number of ISI categories in each one of the scientific areas established by the *Agencia Nacional de Evaluación y Prospectiva* (ANEP), previously associated with the different ISI categories in order to determine which area each study pertained to. The selection involved 25% of these, representing 25% of the output for that area. The documents were chosen at random. Then, a table with a register for each author was created, and a field for information on gender was inserted, along with another field for the documents not located. These tables were used to establish the percentage of women per subject matter in each one of the sample categories. Such a representative sample, made up of 9,292 documents (25.96% of the total), may entail bias in very small conglomerates, such as Law or the technological areas, where the data volume may not have been statistically significant.

At this point, each one of the authors of every document was identified. The search process was initiated in different referential sources, and was carried on in sources that give full-text access to the document (ISI, Scopus, Scyrus, Google Scholar, Sciencedirect, etc.) Upon locating each document constituting the sample, the new information was incorporated into the fields mentioned above. There was a small percentage of documents for which one or more authors could not be located despite subjecting them to exhaustive search processes. In these cases the document was extracted from the sample and in its place another study was randomly included. In this manner, after identifying and modifying all the authors of each one of the documents, we proceeded to carry out the corresponding consultation in the database, so as to elaborate tables and graphs for our results.

The indicators analyzed are:

- Total output (ndoc): number of documents
- Primary output (ndocc): only articles appearing in journals, be they with or without Impact Factor, and including contributions in Art and Humanities (A&H)
- Citable output (ncit): articles in journals with an Impact Factor registered in the Journal Citation Report (JCR), but limited to Sciences (SCI) and Social Sciences (SSCI)
- Normalized Impact Factor (FINP): that of the respective journals of publication, with each document "inheriting" the IF corresponding to the journal in which it is published, which is therefore recorded in the Journal Citation Report for the year of publication of the document; and when this information is missing, it is assigned the IF for the nearest year known. Then it is transformed by means of a procedure of normalization based on typification or standardization that allows us to work with it in comparative terms, following other authors (Braun, Glänzel and Schubert, 1985) (Rousseau, 1988), in order to generate IF values that conserve variability, while at the same time making the scales of the different categories compatible and comparable. This normalization process marks a point of reference when situating the position of the domain in question, unlike other calculations in which the resulting value is placed within a range. Thus, the typified impact factor (TIF) is calculated using the formula:

$$tif_{jc} = \frac{if_{jc} - \overline{if_c}}{\sigma if_c}$$

Where *if* stands for the Impact Factor of a journal j, in a category c, of the JCR; and tif is the normalized IF of a journal j in a category c of the JCR. The resulting values can be positive or negative, and allow us to make comparisons among diverse categories. Yet this value can be difficult to comprehend and utilize in a cumulative sense when it is negative; and so, for this purpose, we propose the scale corrector: $fin_{jc} = m+(TIF_{jc} / k)$. Hence, we may adopt m and k as two constant values that give rise to positive numerals, adequate for the objectives of analysis. In our case we used $m = 1$ and $k = 3$. Thus, we manage to generate values that conserve their variability, are positive, allow for comparison among different categories, and ultimately make it possible to normalize the mean IF of a category having a value of 1, which is therefore assigned to each of the documents therein. However, upon comparison of the impact factors achieved by a given collective with respect to another (greater) one, within a thematic area that includes several different JCR categories, certain lacks of adjustment may occur as a consequence of the different weights that each category bears in the production of each group, and of the different habits of citation within each category. In order to solve this problem, a weighted normalized impact factor is introduced, to measure the mean weighted citation expected for a set of publications pertaining to a specific community or thematic level of aggregation, and to indirectly indicate the possibility of a greater audience on the part of the scientific community (Moya, et.al., 2004) (Chinchilla y Moya, 2007). Its formula is:

$$finp = \frac{(\sum NDocc * fin)}{\sum NDocc}$$

- Patterns of behaviour: the language of publication and type of document
- Patterns of coauthorship: coauthorship index (number of authors per document) and order of the signing authors and patterns of collaboration in which we distinguish: No Collaboration (documents signed by a single institution, regardless of the number of institutional departments participating in the research; National Collaboration (documents signed by authors from more than one Spanish Institution); Interregional Collaboration (documents signed by researchers from more than one Autonomous Community of Spain); and International Collaboration (documents signed by authors from more than one country). In the computation of documents in collaboration, there may be some overlap due to the fact that a given document may pertain to more than one category (for instance, national collaboration may also entail interregional collaboration).

Results

Whereas over 95% of the output has at least one male author, women are authors or co-authors of just 65% of the publications studied. This is a considerable difference, though more so for those documents where the authors are all of the same sex: more than 30% are signed exclusively by men, and less than 5% of the publications have only female authors.

Table 1. Percentage of Ndoc, Ndocc and NdocCit by subject matter and gender of authors

		Ndoc				Ndocc				NdocCit			
Thematic Area	Abr.	Male	Female	Only Male	Only Female	Male	Female	Only Male	Only Female	Male	Female	Only Male	Only Female
AGRICULTURE	AGR	91,93	78,88	21,12	8,07	91,93	78,88	21,12	8,07	91,93	78,88	21,12	8,07
FOOD SCIENCE AND TECHNOLOGY	ALI	90,26	89,23	10,77	9,74	90,05	90,05	9,95	9,95	90,05	90,05	9,95	9,95
CIVIL ENGINEERING & ARCHITECTURE	CIV	93,94	42,42	57,58	6,06	93,94	42,42	57,58	6,06	93,94	42,42	57,58	6,06
COMPUTER SCIENCE & TECHNOLOGY	COM	98,17	43,22	56,78	1,83	98,48	43,56	56,44	1,52	98,48	43,56	56,44	1,52
SOCIAL SCIENCES	CSS	90,91	51,14	48,86	9,09	93,15	49,32	50,68	6,85	93,15	49,32	50,68	6,85
LAW	DER	100,00	100,00			100,00	100,00			100,00	100,00		
ECONOMY	ECO	82,67	42,67	57,33	17,33	84,72	41,67	58,33	15,28	84,72	41,67	58,33	15,28
ELECTRICAL, ELECTRONIC & AUTOMATED ENGINEERING	ELE	100,00	35,71	64,29		100,00	38,46	61,54		100,00	38,46	61,54	0,00
PHYSIOLOGY & PHARMACOLOGY	FAR	98,23	77,88	22,12	1,77	97,87	82,98	17,02	2,13	97,87	82,98	17,02	2,13
PHILOLOGY & PHILOSOPHY	FIL	70,00	37,50	62,50	30,00	70,00	36,67	63,33	30,00	73,68	36,84	63,16	26,32
PHYSICS & SPACE SCIENCES	FIS	98,94	51,46	48,54	1,06	98,91	51,91	48,09	1,09	98,91	51,91	48,09	1,09
LIVESTOCK & FISHING	GAN	96,77	82,26	17,74	3,23	96,49	82,46	17,54	3,51	96,49	82,46	17,54	3,51
HISTORY & ARTS	HIS	75,00	50,00	50,00	25,00	76,00	52,00	48,00	24,00	80,95	52,38	40,00	19,05
MATERIALS SCIENCE AND TECHNOLOGY	MAR	98,39	72,58	27,42	1,61	98,34	71,82	28,18	1,66	98,34	71,82	28,18	1,66
MATHEMATICS	MAT	95,36	41,06	58,94	4,64	95,21	41,78	58,22	4,79	95,21	41,78	58,22	4,79
MECHANICAL, NAVAL & AERONAUTIC ENGINEERING	MEC	99,07	31,48	68,52	0,93	99,06	32,08	67,92	0,94	99,06	32,08	67,92	0,94
MEDICINE	MED	95,86	77,04	22,96	4,14	96,05	78,20	21,80	3,95	96,05	78,20	21,80	3,95
MOLECULAR & CELLULAR BIOLOGY & GENETICS	MOL	96,64	77,87	22,13	3,36	97,41	77,18	22,82	2,59	97,41	77,18	22,82	2,59
PSYCHOLOGY & EDUCATIONAL SCIENCES	PSI	95,31	76,56	23,44	4,69	94,55	72,73	27,27	5,45	94,55	72,73	27,27	5,45
CHEMISTRY	QUI	94,65	79,68	20,32	5,35	94,39	80,19	19,81	5,61	94,39	80,19	19,81	5,61
ELECTRONIC & TELECOMMUNICATIONS TECHNOLOGY	TEC	100,00	31,71	68,29		100,00	31,58	68,42		100,00	31,58	68,42	
GEOSCIENCES	TIE	96,23	58,16	41,84	3,77	96,44	59,56	40,44	3,56	96,44	59,56	40,44	3,56
CHEMICAL TECHNOLOGY	TQU	93,90	70,73	29,27	6,10	93,83	71,60	28,40	6,17	93,83	71,60	28,40	6,17
PLANT & ANIMAL BIOLOGY, ECOLOGY	VEG	98,20	61,71	38,29	1,80	98,10	62,86	37,14	1,90	98,10	62,86	37,14	1,90

The difference is even greater in certain scientific areas where male participation is seen in over 90% of the documents in all areas (Table 1); only in Philology and Philosophy (FIL), History and Art (HIS), and Economics (ECO) is the percentage lower. On the other hand, female intervention ranges between the 31.48% seen in Mechanical, Naval and Aeronautic Engineering (MEC) and the 89.23% in Food Science and Technology (ALI). In primary production, the results do not vary: with respect to total documents, the publications turned out solely by men range from the 10.77% in Food Science and Technology (ALI) to 70% in the areas of Mechanical, Naval and Aeronautic Engineering (MEC) and Electronic and Communications Technology (TEC). The contributions by women are negligible in these categories, while they are highest in Philology and Philosophy (FIL) with 30%, and in History and Art, with a 25% share.

Table 1. Type of document and language of publication

Document Type	Male	Female	Only Male	Only Female
Art Exhibit Review		100,00		100,00
Article	95,76	66,39	33,61	4,24
Biographical-Item	100,00		100,00	
Book Review	78,57	21,43	78,57	21,43
Correction	100,00	60,00	40,00	
Editorial Material	87,50	56,25	43,75	12,50
Letter	96,83	60,32	39,68	3,17
Meeting Abstract	98,35	84,30	15,70	1,65
Review	96,88	67,19	32,81	3,13
Theater Review		100,00		100,00

Language	Male	Female	Only Male	Only Female
English	95,80	66,79	33,21	4,20
French	80,00	40,00	60,00	20,00
Spanish	69,57	56,52	43,48	30,43

Whereas 33% of the scientific *articles* published are signed exclusively by men, those authored solely by women stand for less than 5%. However if we calculate the percentage that these represent in view of the total documents signed only by women, they amount to over 83%, thus reducing the differences with respect to articles signed by men with respect to the total (88%).

Meanwhile, publications in the English language that are signed only by women make up under 5%, while those with only male authorship are over 30%. This is due to the fact that 98% of the studies published by men are in English. Of studies by women authors, 93% are in English and around 6% in Spanish; that is, the percentage of articles written in Spanish by women is higher than that of men.

Patterns of Co-authorship

The order of appearance of author names on a document is considered useful for determining their importance, as not all positions of author names have the same value; and their importance could furthermore depend to a great extent on the subject field.

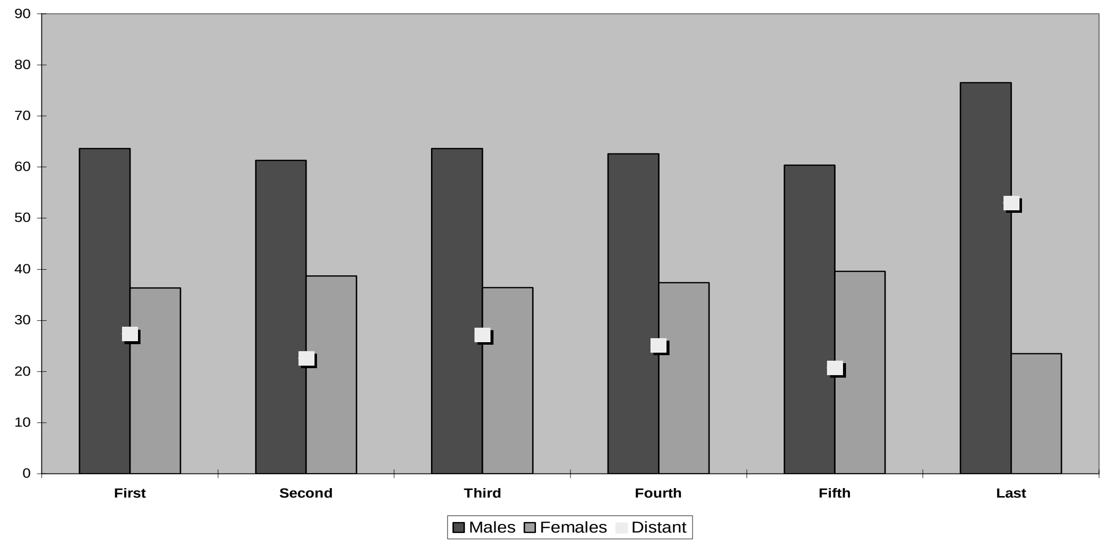


Figure 1. Percentage of documents by order of appearance of author names and gender

The usual finding is that the first and last positions are occupied by male names, related with the understanding that these positions bear a greater relevance on the work. In practice, authors themselves tend to reserve these two positions for contributors wielding a more important role. This hypothesis can be corroborated in the breakdown by gender. Yet the differences in the distances between the percentages reveal that the final position is most affected by this practice. Over 65% of the documents are signed in the first place by a male author (Figure 1), leaving the other 35% first positions for women as principal authors. As the position of the author name advances (to second, third, fourth or fifth place), the difference in this percentage decreases. However, the distance of the final position is very noteworthy: over 75% of the studies are signed in final place by a male.

With regards to distribution by subject matter, the documents featuring a woman as first signing author are the majority in Food Science and Technology (ALI) and Law (DER), where the importance of female contributions appears to be more relevant than male input, with women signing over 50% of production. Under this figure, yet over 40%, are the areas of Agriculture (AGR), Pharmacology and Pharmacy (FAR), History and Art (HIS), Materials Science and Technology (MAR), Molecular, Cellular and Genetic Biology (MOL), Psychology (PSI), Chemistry (QUI) and Chemical Technology (TQU), wherein the contribution of women scientists is seen to bear great importance. In the final author position, we see that only for the area of Food Science and Technology (ALI) are there female names on over 40% of the studies; and in Agriculture (AGR), Philology and Philosophy (FIL) Livestock and Fishing (GAN), History and Art (HIS) and Psychology (PSI) women authors sign lastly in over 30% of cases. There are areas in which women scientists sign below 30% of documents in first and last positions, and therefore, in these fields the relevance of their scientific contribution would be considered inferior to that of male colleagues.

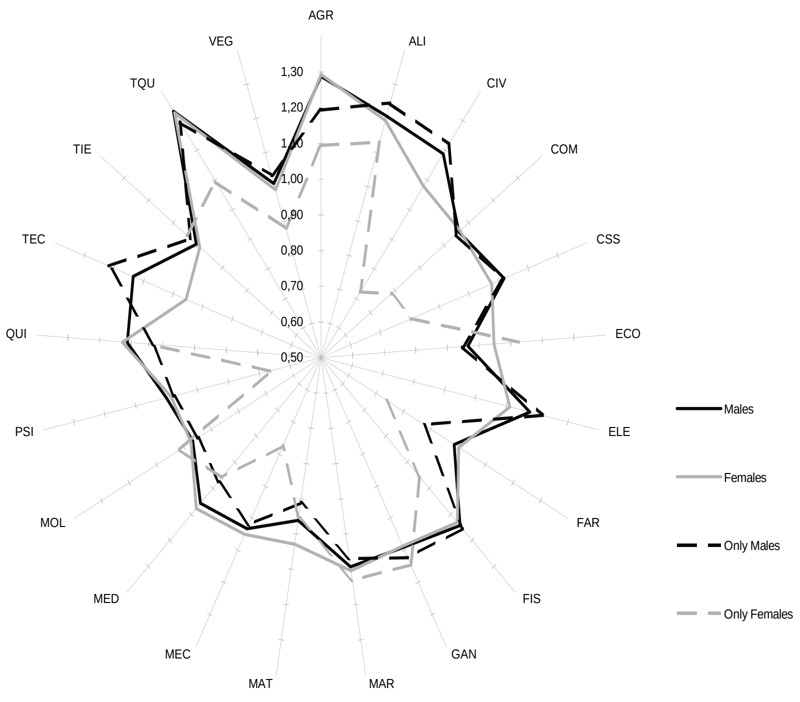


Figure 2. Standardized Impact Factor by ANEP area and gender

Although as a general rule, the documents signed only by male authors appear in journals with a higher Impact Factor, in some areas of science the opposite is true. Such is the case of Economics (ECO), Livestock and Fishing (GAN), Materials Science and Technology (MAR), Molecular, Cellular and Genetic Biology (MOL) and Earth Sciences (TIE).

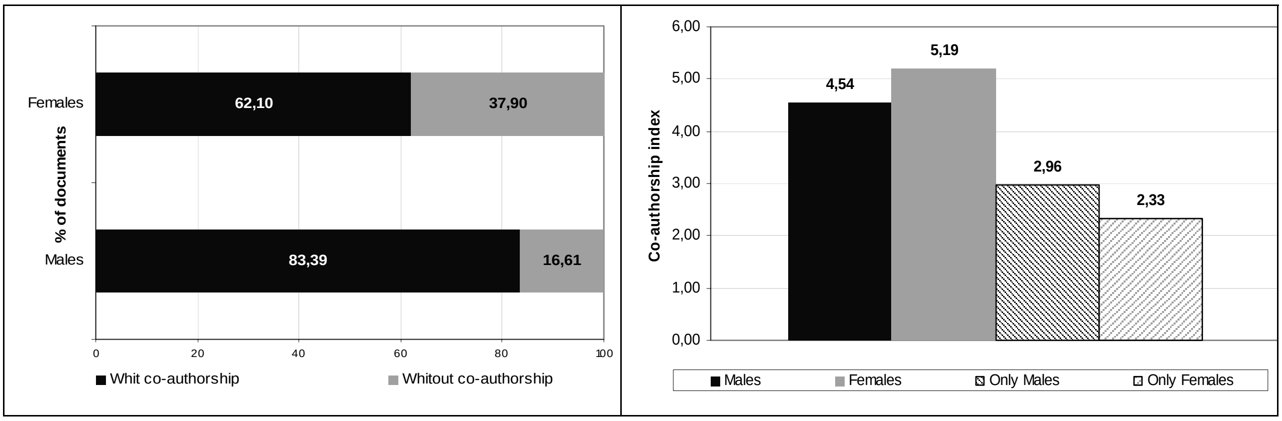


Figure 3. Percentage of documents by number of signing authors, coauthorship index and gender

Meanwhile, we see that of the documents signed only by men, over 80% are coauthored, whereas among women there is a lesser tendency toward coauthorship —some 40% of these are undersigned by a single female author (Figure 3). Out of all the coauthored documents, the ones signed solely by women stand for less than 3%, a very low figure in comparison with the 30% represented by only male coauthorship. This fact is reflected in the low index of collaborative authorship of the documents in whose elaboration only women intervene, with 2.33 authors per study. Yet the highest level of this index (5.19) is seen in conjunction with the documents having at least one woman author, meaning that in studies where men and women work together, the number of total authors is greater than in those produced by men alone. Figure 4 clearly illustrates how the more highly coauthored documents tend to show female collaboration. The fact that there are more studies involving women where three to four authors participate leads us to surmise that these belong to areas such as Biomedicine, where the pattern of coauthorship is high. Therefore, there would appear to be a more direct relationship between patterns of publication and collaboration depending on the thematic category, than gender bias *per se*.

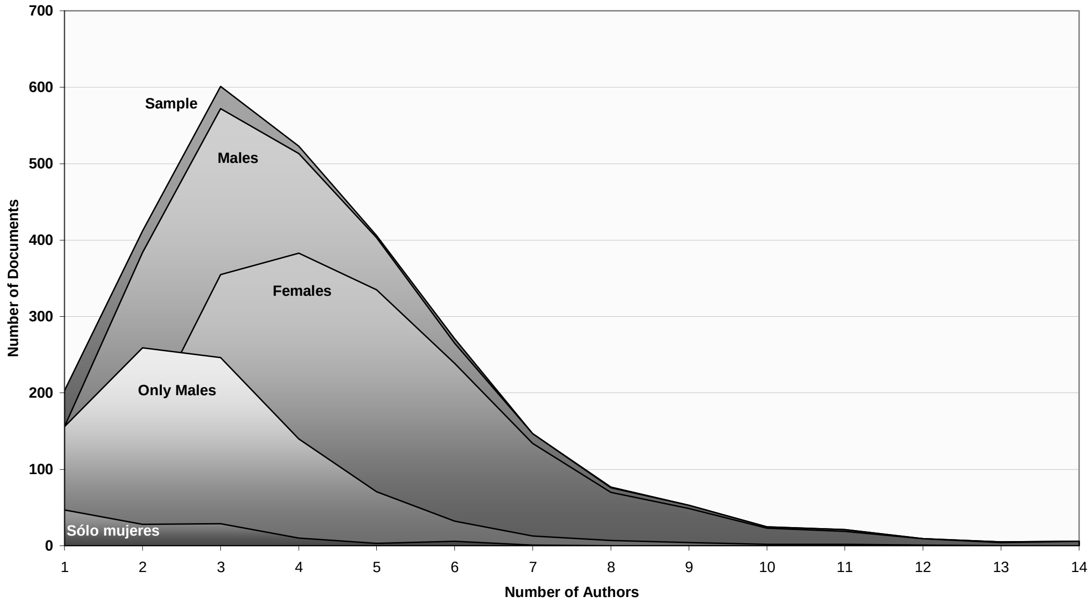


Figure 4. Patterns of coauthorship by gender

Finally, we observed an interesting network of coauthorship in the area of Agriculture within the University of Granada. This network consists of a total of 91 authors (nodes), of which 41 are men and 50 are women, making manifest the superiority (in number of participants) of female research in this category and time period. The relationships (links) between and among authors conform the different authorship networks, allowing us in some cases us to distinguish specialties for each.

From the structural standpoint, we can easily spot components or associations of authors, which implies that research is made up by fourteen nuclei of consolidated areas of investigation (regardless of some overlap). In most of the components there is a symbiosis of authors of both sexes, with a slight female predominance. There are three exceptions: a network of five authors and another of two authors, situated in the upper and lower right sectors of the figure, respectively made up uniquely by men; and another of three authors, in the lower right section, made up exclusively by women. In the rest of the networks, we can find at least one female author. Noteworthy are those components constituting five or more authors, in that the point of interconnection or *break point* of each is consistently represented by a female researcher. This suggests the significance, capacity of centralization and the prestige of each of the following women scientists: Urbano, G., Barrionuevo, M.,and DeLaSerrana, HLG.

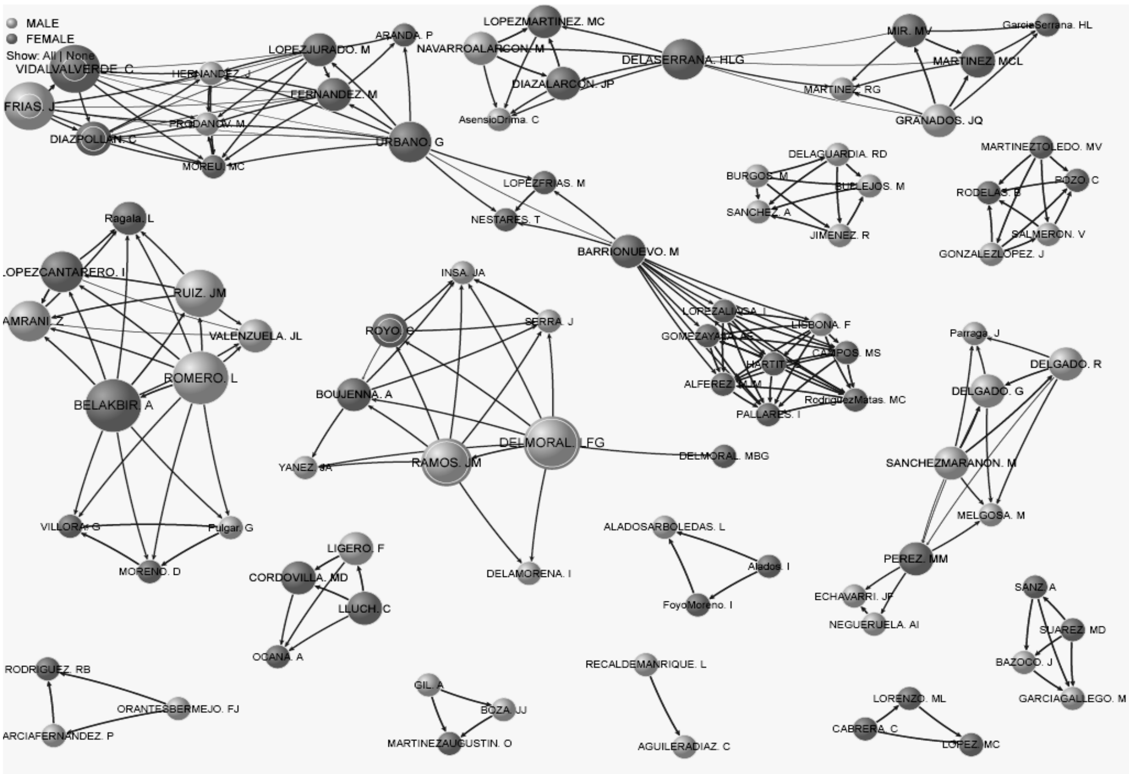
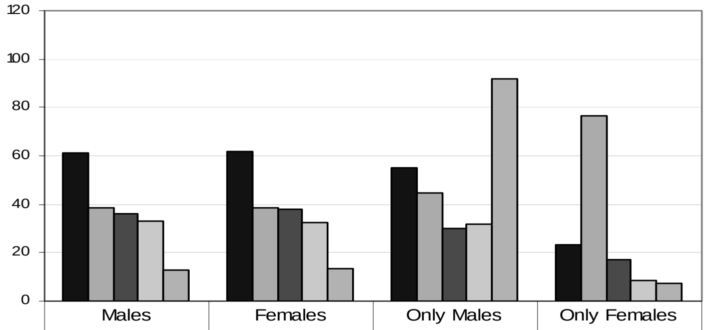


Figure 5. Network of Co-authorship, University of Granada. ANEP area: Agriculture

Patterns of institutional collaboration

Documents having exclusively male intervention account for 30% of the total in each type of collaboration, while works undersigned only by women do not surpass 3% in any type of collaboration. The patterns of collaboration (Figure 6) show that for men, the most habitual type of collaboration is interregional (more than 90% of their work), followed by international, at nearly 32%, and national, with just over 30%. On the other hand, as women hold a documental share of over 75% without institutional collaboration, the figures for collaboration are much lower. The 17% seen for national collaboration among women is followed by an 8% for international collaboration, and finally an interregional collaboration rate of 7%.



	Males	Females	Only Males	Only Females
%col	61,21	61,65	55,31	23,39
Without Institutional Collaboration	38,79	38,35	44,69	76,61
Domestic	36,09	37,76	30,23	16,94
International	33,32	32,38	31,94	8,87
Inter-regional	13,16	13,23	91,94	7,26

Figure 6. Patterns of collaboration

Table 2. Percentage of documents and form of collaboration by areas and gender (*)

Thematic Area	Whitout Institutional Collaboration				Domestic Collaboration				International Collaboration				Inter-regional Collaboration			
	Males	Females	Only Males	Only Females	Males	Females	Only Males	Only Females	Males	Females	Only Males	Only Females	Males	Females	Only Males	Only Females
AGR	41,61	39,13	8,70	6,21	60,25	51,55	14,91	1,86	24,84	17,39	8,07	0,62	12,42	10,56	2,48	0,62
ALI	48,72	52,82	3,59	7,69	64,10	65,64	7,18	1,03	18,97	15,90	4,62	1,54	7,18	6,15	1,03	
CIV	57,58	24,24	39,39	6,06	72,73	36,36	42,42		15,15	12,12	3,03		6,06		6,06	
COM	48,35	17,95	31,50	1,10	69,60	30,04	40,66	0,73	26,01	13,92	12,09		10,99	4,40	7,33	0,73
CSS	40,91	20,45	26,14	5,68	63,64	32,95	36,36	3,41	28,41	14,77	13,64		12,50	6,82	7,95	2,27
DER	100,00	100,00			100,00	100,00				0,00	0,00		0,00			
ECO	44,00	28,00	30,67	14,67	62,67	33,33	44,00	2,67	24,00	5,33	18,67		17,33	6,67	12,00	1,33
ELE	39,29	17,86	21,43		67,86	21,43	46,43		46,43	10,71	35,71		10,71	3,57	7,14	
FAR	29,20	20,35	9,73	0,88	55,75	46,02	11,50		35,40	32,74	3,54	0,88	9,73	3,54	6,19	
FIL	40,00	27,50	37,50	25,00	50,00	27,50	47,50	2,50	12,50	2,50	10,00		5,00		5,00	
FIS	36,34	18,30	18,83	0,80	68,17	35,01	33,95	0,27	42,71	22,02	20,69		12,20	7,69	4,77	0,27
GAN	37,10	32,26	8,06	3,23	58,06	45,16	16,13		38,71	30,65	8,06		19,35	19,35		
HIS	35,71	28,57	28,57	21,43	46,43	32,14	35,71		10,71	3,57	7,14		17,86	14,29	3,57	
MAR	45,16	31,18	15,59	1,61	69,89	51,08	20,43		30,11	24,73	5,38		10,75	7,53	3,23	
MAT	46,36	18,54	31,13	3,31	70,20	31,13	43,05	0,66	30,46	13,91	17,22	0,66	12,58	2,65	10,60	0,66
MEC	49,07	12,04	37,04		75,93	22,22	53,70	0,93	29,63	10,19	19,44		9,26	2,78	7,41	0,93
MED	30,89	25,33	8,28	2,72	50,30	40,36	13,02	1,07	27,34	21,78	6,04	0,47	15,03	11,95	3,31	0,24
MOL	34,78	28,26	9,68	3,16	59,29	47,23	15,22	0,20	34,58	27,47	7,11		12,06	9,68	2,37	
PSI	50,00	42,19	10,94	3,13	70,31	57,81	17,19		26,56	21,88	6,25	1,56	3,13	1,56	1,56	
QUI	43,32	36,90	10,70	4,28	64,35	54,01	15,15	0,53	27,45	22,10	6,24	0,89	10,70	9,80	1,07	0,18
TEC	56,10	19,51	36,59		87,80	29,27	58,54		34,15	9,76	24,39		2,44		2,44	
TIE	29,71	17,57	14,64	2,51	67,36	38,49	31,38	1,26	48,54	28,87	20,08	0,42	15,06	9,21	6,69	0,84
TQU	41,46	30,49	14,63	3,66	63,41	48,78	20,73		26,83	20,73	8,54	2,44	12,20	9,76	2,44	
VEG	30,63	18,92	13,51	1,80	65,32	40,09	27,03		45,50	29,28	16,22		14,41	8,56	5,86	

(*)Percentages calculated with respect to total documents signed by men, women, only men or only women.

Conclusions

When considering the identification of authors of scientific articles, the information offered by data sources is very often incomplete, and sometimes erroneous. To alleviate this obstacle, authors should always sign with the exact same name, and whenever possible, Spanish or Hispanic authors should connect their two surnames with a hyphen. Otherwise, foreign language databases are likely to make mistakes when assigning them an entry.

A horizontal segregation can be perceived in our results, owing to the fact that in certain areas, an unequal development by gender might be attributed to stereotypes lodged in formative or professional expectations surrounding women. Yet it is vital to bear in mind that these differences are strongly influenced by the patterns of publication in the different subject areas. Therefore, it may be that gender differences are rooted not only in stereotypes, but also in the dynamics of different areas of scientific activity or research.

Similarly, the patterns of coauthorship seen here are more closely tied to the subject area than to author gender; and even though women are unevenly distributed in this sense, there are also areas with a high participation in terms of authors and institutions. For instance, Biomedicine has a very noteworthy female presence, whereas in the Humanities, the norm is solitary output, traditionally at the hands of more women than men. We cannot, then, state that women participate less in coauthored works. Simply, it depends on the specific area analyzed. Likewise, we are not able to conclude here, at least, that female researchers tend to resort to national journals for publication rather than international ones. The fact that the woman scientist publishes a greater percentage of studies in the Spanish language has more to do with the area of study, as female participation is traditionally greater in the humanities and social sciences.

Finally, this study will lead us in the near future to enlarge the sample, to dispose of data for total production in view of gender and elaborate in greater depth an analysis of the different subject areas, at different levels of thematic grouping, where bibliometric arguments and the weight of social structures can be evoked to help us comprehend the true role of women in science in each particular discipline. At the same time, further study will help us avoid the types of bias that may have been introduced here due to the limited volume of the data conglomerates.

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