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# Gender and science: An analysis of brazilian postgraduation

## *Gênero e ciência: uma análise na pós-graduação brasileira*

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### Abstract

Gender issues are present in different work environments, including the academic world. This secondary data research aimed to compare, by gender, distribution and scientific output of Brazilian faculty who are active in *stricto sensu* postgraduation. A collection protocol was developed to capture data made available by the Coordination of Improvement of Higher Education Personnel, in the quadrennium 2013-2016 (n = 50.533, 57.5% men). The results indicate no difference in production by gender, but the following gender disparities in the researchers' career were identified: (i) female prevalence in the areas of Health, Humanities and Linguistics and Arts, and male prevalence in the Exact and Earth Sciences, Engineering and Agrarian Sciences; (ii) gender differences in favor of men in the earning of research productivity scholarships. We conclude that a reduction in gender disparities in science is expected over time, although there is still a male predominance in the scientific field.

**Keywords:** Career mobility; Conflict (Psychology); Faculty; Gender identity.

### Resumo

*Questões de gênero estão presentes em diferentes ambientes de trabalho, inclusive no mundo acadêmico. Esta pesquisa de dados secundários objetivou comparar, por gênero, a distribuição e a produção científica de docentes brasileiros que atuam na pós-graduação stricto sensu. Construímos um protocolo de coleta para extrair dados disponibilizados pela Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, no quadriênio 2013-2016 (n = 50.533, 57,5% homens). Os resultados apontam ausência de diferença de produção por gênero, mas são identificadas as seguintes disparidades*

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de gênero na carreira de pesquisador: (i) prevalência feminina nas áreas da Saúde, Ciências Humanas e Linguística, Letras e Artes e prevalência masculina nas Ciências Exatas e da Terra, Engenharias e Agrárias; e (ii) diferenças de gênero a favor dos homens no recebimento de bolsas produtividade. Concluímos por uma redução das disparidades de gênero na ciência ao longo do tempo, embora ainda exista um predomínio masculino no campo científico.

**Palavras-chave:** Mobilidade ocupacional; Conflito (Psicologia); Docentes; Identidade de gênero.

Gender studies show that knowledge of interactions between women and men is fundamental for a review of social relations. In this study, we adopted the concept of gender brought by Scott (1995) that defines it as an antagonistic and hierarchical perception about the sexual differences between men and women, able to set boundaries in their roles and influence their relationships. The notion of gender does not disregard the differences in sexed bodies, but positions the disparities between women and men in the social dimension and in the historical context (Louro, 1999).

Thus, the concept of gender sets parameters for people's perceptions and evaluations of themselves and of others, referring to a set of social practices that create asymmetries between what is understood as feminine or masculine (Louro, 1999). Such parameters develop, throughout life, into stereotypes that establish norms of desirable behavior for each gender, including in terms of the spaces they should occupy and the type of education most appropriate for each one (Louro, 1999).

Gender inequalities throughout the world are present in the history of education; however, a movement of change, reflected in the presence of women in higher education, including in *stricto sensu* postgraduate teaching positions, can be observed. For many years, this was considered a male privilege (Grossi, Borja, Lopes, & Andalécio, 2016). In Brazil, women already outnumber men in enrollment at all levels of education. In 2015, they were the majority, even in relation to master's degrees (61%) and PhDs (55%) (Barros & Mourão, 2018). In *stricto sensu* postgraduate teaching, although women are still at a disadvantage (43% of Brazilian tenured academics) (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, 2018), gender equity has also increased, signaling a changing trend in the inequality scenario.

However, even with so many educational changes in favor of women, Brazil is still in the 94th position in the ranking that includes 160 countries considered for the calculation of the Gender Inequality Index (the indicator includes data such as education and performance rate in the labor market) (Programa das Nações Unidas para o Desenvolvimento, 2015). These asymmetries can be horizontal or vertical. Horizontal asymmetry occurs by the sexual division of tasks in which, for certain positions, careers and functions, characteristics attributed to men and masculinity are valued and, for others, characteristics attributed to women and to the female world (Silva & Ribeiro, 2014) are valued.

Discussions about female participation in predominantly male areas, such as Science, Technology, Engineering and Mathematics (STEM), are considered to be prestigious areas paying higher average salaries (Barros & Mourão, 2018). The inclusion of women in different areas of knowledge may cause a reduction of potential biases and in more robust solutions enhancing the quality of research outcomes (Charyton, Elliott, Rahman, Woodard, & Dedios, 2011).

This phenomenon should be reviewed taking into account the interaction of a series of factors inserted in the socialization process, such as social, cultural and gender norms, as well as the socioeconomic reality and the way they interact with family, parents, friends, teachers and the society as a whole (United Nations Educational, Scientific and Cultural Organization [Unesco], 2017). In this connection, surveys have shown that more than half of the Nobel laureates (52%) whose fathers or mothers, or both, were active in the same careers or fields of science (Rothenberg, 2005).

Exposing girls and women to prominent female models is considered as promoting an interest in STEM careers (Aguinis, Ji, & Joo, 2018). A survey of college students found that no student was able to list names

of female scientists who were awarded the Nobel Prize, but many students of both genders were able to remember male laureate names (Charyton et al., 2011).

Another study investigated Brazilian women and productivity scholarship holders from the *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq, National Council for Scientific and Technological Research and Development) of different levels, ages and areas of expertise. The respondents' comments showed that the lack of female models in decision-making instances in the Brazilian scientific framework, the invisibility of women in the production of knowledge and the historical gender distinction led some interviewees to actually question their own abilities (Barros & Mourão, 2019). Those statements corroborate findings from another study about a lower inclusion of women among high-performance researchers, especially as production levels rise (Aguinis et al., 2018). These two findings reveal the second pattern of gender disparities in science (vertical asymmetry), associated with the lower proportion of women in higher academic career positions.

Unesco's mapping about the leadership in Science, Technology, and Innovation areas around the world reveals that horizontal and vertical gender asymmetries are a global reality. Women are not equally represented in key science sectors, either as professionals or as decision makers. Although well represented in some scientific disciplines - such as health, agriculture and environmental management – they are a minority in other fields that will be vital for the transition to sustainable development –, such as energy, engineering and IT (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015).

A study with female Brazilian researchers revealed that, for them, the conciliation of research activities with family tasks is one of the greatest difficulties encountered in their careers (Prado & Fleith, 2012). Another national study compared personal and professional life issues of researchers and research fellows at CNPq. The findings revealed that female grantees are older, enter the productivity scholarship system later and have children when they are still younger than male grantees, suggesting that women dedicate to maternity issues before investing in their careers (Barros & Mourão, 2019). Findings by Charyton et al. (2011), in turn, show that women who win important scientific awards tend not to have or have fewer children than men; in addition they have a lower marriages rate.

Within such framework, the objective of this study is to compare, by gender, the distribution and scientific output of Brazilian professors who are active in *stricto sensu* postgraduate studies. Our aim is to foster discussions around gender biases based on the androcentric feature in which science was historically established, acknowledging gaps to be addressed by future research. The advances of this study in relation to those already available are due to the fact that all Brazilian tenured professors who worked in the period 2013-2016, will be covered as well as all areas of expertise.

For this purpose, reviews were made by sections of Capes Colleges and by career levels (CNPq productivity scholarships). The decision to review the distribution by CNPq productivity scholarships is because the latter is considered one of the most important fellowships in this country, geared to researchers who already enjoy academic recognition in their fields (Valle & Sakuray, 2014). However, it should be noted that, as this is a grant that requires voluntary application, we cannot disregard the fact that researchers of equal prominence may choose not to apply for such fellowships. Thus, we do not intend to establish a hierarchical discussion regarding research fellows and non-fellows.

## Method

### Participants

To participate in this study, we selected professors according to the following criteria: postgraduate *stricto sensu* performance evaluated by Capes in the 2013-2016 quadrennium, and who met two inclusion

criteria: (i) Brazilian nationality; and (ii) acting as tenured scholar during the four years of the evaluation. Our choice for Brazilian scholars aimed at restricting any potential social historical influences to a specific context, in order to reduce potential cultures and nationalities biases. Considering these criteria, the research universe totaled 50,533 tenured professors, being 57% men.

The analysis of teacher distribution shows a higher concentration in postgraduate programs of public institutions (86.3%), according to the distribution of *stricto sensu* postgraduate courses in this country. As for the region, there is a predominance in the Southeast (51.0%), followed by the South (19.0%) and Northeast (18.0%) and with lower numbers in the Midwest (7.0%) and North (5.0%).

Regarding the level of education, there is a predominance of insertion in programs that combine Master's and PhDs courses (68.0%), followed by those offering only academic (20.0%) or professional (11.0%) Masters' degrees courses and, finally, those that offer exclusively doctoral level courses (2.0%) (Table 1).

As for the work regime, 78% are exclusively dedicated to teaching, 17% full-time, and only 5% are part-time teachers. It may also be observed that 30% of the teachers analyzed are CNPq productivity fellows, with higher concentration in the initial scholarship extract corresponding to level Lower Level Productivity Scholarship (PQ2) (56%).

## Data collection

The research project was registered in the *Plataforma Brasil* and approved by a Research Ethics Committee (CAAE 55958816.6.0000.5289). This is a secondary data study and a collection protocol was developed to extract data from the 2013-2016 quadrennium evaluation worksheets available at the Capes website. The original data are presented grouped by knowledge area, totaling 49 spreadsheets. These spreadsheets were used to compose a single database.

Considering that the indicators shown in the Capes spreadsheets were different according to the areas, the criteria for selecting variables to be included in the database were: to be a scholar evaluation indicator, and be common to all 49 areas.

Table 1  
Distribution of tenured professors by colleges and major areas and gender

School	Big Area	Female		Male		Total	
		<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Life Sciences (38% Tenured Professors)	Biological Sciences	2.551	43	3.379	57	5.930	31
	Health Sciences	4.468	53	3.962	47	8.430	44
	Agrarian Sciences	1.528	33	3.137	67	4.665	25
Exact Sciences, Technological and Multidisciplinary (32% of Tenured Professors)	Exact and Earth Sciences	1.449	27	3.970	73	5.419	34
	Engineering	770	21	2.963	79	3.733	23
	Multidisciplinary	3.125	45	3.776	55	6.901	43
Humanities (30% of Tenured Professors)	Applied Social Sciences	2.021	39	3.221	61	5.242	34
	Humanities	3.765	52	3.514	48	7.279	47
	Liberal Arts	1.816	62	1.118	38	2.937	19

Source: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes, Higher Education Personnel Improvement Committee) (2017).

## Data Analyzes

Descriptive statistical analyzes and Student's t-tests were performed for independent samples (with Levene's assumption of variance test), in order to compare the means of teacher indicators in groups of women and men. Given the many areas of knowledge and the variables that make up the scholars' output, analysis of gender differences were performed considering the total sample and two different sample sections: the division by colleges and by large areas, according to Capes classification. The analyzes were performed with the aid of the IBM®SPSS® Statistics (version 21.0). After the tests were performed, effect size tests (Cohen's *d*) were performed, forming a common metric to compare results from different groups (Espírito-Santo & Daniel, 2015).

## Results

The analyzes considering different sections allowed the observation of the possible effects of gender in the output of Brazilian professors. The sample analyzed shows that for practically all variables (except for Professional Master's Degree in progress, completed Professional Master's Degree Guidance, Visiting Professor and Organization of Scientific Events), there were significant mean differences ( $p < 0.05$ ) between men and women.

If only the significant mean differences were analyzed, men would show higher averages in the following variables: funded research projects, Master's Degree advisor program in progress, PhD degree advisor program in progress, total advisor programs in progress, completed doctoral degree, total advisor programs, published articles and journal articles. In contrast, women showed higher averages than men in the following variables: monograph advisory programs, scientific advisory programs, undergraduate workload, published complete books, published book chapters, technical services provided, short term courses, presentation of papers, publishing and development of teaching material.

However, the literature of the area draws attention to the need to consider effect sizes when comparing the averages between two independent groups (Espírito-Santo & Daniel, 2015). This recommendation becomes more important by the fact that the database is composed of many cases, since the sample size interferes with the level of significance, overestimating possible differences between the means.

Thus, Cohen's test analysis showed that the effect sizes were low ( $d < 0.20$ ), indicating no relevant differences in the production averages of men and women acting as tenured professors. The only variable whose effect size met the minimum parameters was the presentation of papers, which is a type of output scarcely valued in most areas and, therefore, may have lower reliability in the information provided in the Capes system. Table 2 presents the male and female averages, and their relevant standard deviations, for the different scholars' evaluation indicators, as well as the results of the t tests for independent samples and Cohen's *d* Tests.

The same analyzes were performed, subdividing the database by colleges and large areas. Although t-tests comparing groups of women and men by colleges separately (Life Science, Exact Sciences, Technological, Multidisciplinary, and Humanities) showed significant differences ( $p < 0.05$ ), Cohen's test did not identify significant size effects. The exceptions appeared in the Exact Sciences, Technological and Multidisciplinary College, in two variables in which women had higher averages. They are: presentation of papers (Women:  $M = 6.26$ ;  $SD = 10.95$ ; Men:  $M = 3.72$ ;  $SD = 7.61$ ) with  $t = 17.10$  ( $p < 0.01$ ) and  $d = 0.27$  and book chapters (Women:  $M = 2.19$ ;  $SD = 4.43$ ; Men:  $M = 1.32$ ;  $SD = 3.10$ ) which had the values  $t = 14.42$  ( $p < 0, 01$ ) and  $d = 0.23$ . On the other hand, the analysis of Large Areas showed no discrepancies between male and female averages (if an effect size  $d > 0,20$  is considered).

Table 2  
Cohen's and *t* Tests in comparing female and male teachers' production

Variables	Female (N = 21.493)		Male (N = 29.040)		Total sample (N = 50.533)		
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>t</i>	Sig. (2-tailed)	<i>d</i> Cohen
Funded Research Projects	9.46	11.66	10.16	12.92	-6.341	0.00	0.006
Master's Degree Advisor (in progress)	7.12	5.97	7.43	7.16	-5.215	0.00	0.005
PhD Advisor (in progress)	6.36	7.69	6.97	8.52	-8.339	0.00	0.008
PMD Advisor (in progress)	1.25	4.21	1.30	4.89	-1.140	0.25	0.010
Total Advisory (in progress)	14.73	10.09	15.70	12.43	-9.425	0.00	0.009
Master's Degree Advisor (Completed)	3.11	2.74	3.14	2.97	-0.997	0.32	0.010
PhD Advisor (Completed)	1.19	1.86	1.29	1.96	-5.722	0.00	0.005
PMD Advisor (Completed)	0.48	1.75	0.51	2.04	-1.885	0.59	0.015
Total Advisory (Completed)	4.77	3.51	4.93	4.02	-4.584	0.00	0.004
Monograph Advisory Service	3.00	6.14	2.78	6.21	3.963	0.00	0.004
Expertise in Scientific Advising	4.67	6.85	3.87	6.21	13.621	0.00	0.012
Undergraduate Workload	550.20	580.75	534.98	575.71	2.927	0.03	0.003
Published Articles	12.11	13.59	12.52	14.84	-3.219	0.01	0.003
High Impact Journals	8.08	10.35	8.38	11.50	-2.950	0.03	0.003
Complete Published Books	0.99	2.34	0.86	2.17	15.868	0.00	0.006
Chapters of Published Books	3.04	5.00	2.37	4.43	10.182	0.00	0.014
Technical Services Provided	5.92	13.54	4.69	13.38	5.193	0.00	0.009
Short Duration Courses	1.08	2.77	0.93	3.36	22.331	0.00	0.005
Paper Presentations	8.53	13.18	6.14	10.84	5.284	0.00	0.020
Editorial	0.48	2.59	0.36	2.26	6.394	0.00	0.005
Teaching Material	0.23	1.85	2.48	4.24	14.119	0.00	0.006
Organization of Scientific Events	2.48	4.24	1.96	4.00	1.994	0.46	0.013

Note: *M*: Mean; PhD: Doctorate; PMD: Professional Master's Degree; *SD*: Standard Deviation; *t*: test.

Source: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes, Higher Education Personnel Improvement Committee) (2017).

We then divided the tenured faculty groups into those who have earned the CNPq productivity scholarship and those who have not. In the division by gender, the predominance of men who correspond to 63% of PQ scholarship holders became evident. Given this finding, we reviewed the distribution by gender of these productivity scholarship holders fellows in the different categories and levels of scholarship. The results pointed to a clear disparity between them, as men not only predominate at all levels, but this difference increases as the scholarship level raises, reaching the disparity that only 23% of women are at the highest career level (Table 3).

Then, we reviewed the distribution of scholars by PQ fellowship level and gender, considering the three Capes Colleges with view at verifying if the male percentages remained higher in all the Colleges. The data indicated a male predominance at all levels of PQ scholarship in the Life Sciences and Exact Sciences, Technological and Multidisciplinary Colleges. In these colleges, men constitute an absolute majority in the total number of fellow teachers with percentages of 59% and 75%, respectively. In contrast, the Humanities College presented different results, since besides the total number of women (51%) and men (49%) PQ scholarship holders being practically the same, with a slight female predominance, the distribution of scholars by PQ scholarship level is also better balanced. Although women remain a minority at levels 1A (44%), 1C (48%), 1D (49%) and 2 (49%), the difference is small, and they outnumber men at level 1B (54%). Table 4 details the distribution of PQ fellowship holders considering college and gender.



Table 3  
Distribution of tenured professors by productivity scholarship level and gender

Productivity Scholarship Level	Distribution by Level (100%)		Women (37%)		Men (63%)	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
PQ-2	8,503	56	3,390	40	5,113	60
PQ-1D	2,564	17	941	37	1,623	63
PQ-1C	1,404	10	496	35	908	65
PQ-1B	1,301	9	440	34	861	66
PQ-1A	1,288	8	301	23	987	77
Total	15,095		5,582		9,513	

Note: PQ: Productivity Scholarships Classification of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, National Council for Scientific and Technological Development) (2018).

Table 4  
Distribution of tenured professors by Capes colleges (departments), productivity scholarship level and gender

School	Gender	PQ Scholarships at College	Percentage Distribution by PQ Scholarship Level					Total
			1A	1B	1C	1D	2	
Life Sciences	Female	2,773	23	35	38	40	45	41
	Male	4,051	77	65	62	60	55	59
	Subtotal	6,824	421	444	479	873	3,022	100
Exact sciences, Technological and Multidisciplinary	Female	1,311	12	20	23	25	28	25
	Male	3,928	88	80	77	75	72	75
	Subtotal	5,239	277	287	303	480	1,395	100
Humanities	Female	1,484	44	54	48	49	49	49
	Male	1,513	56	46	52	51	51	51
	Subtotal	2,997	244	264	254	525	1,710	100
Total		15,060	942	995	1,036	1,878	6,127	26,038

Note: PQ: Productivity scholarships classification of the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, National Council for Scientific and Technological Development) (2018).

The breakdown by Capes Major Areas of Evaluation allowed a better understanding of the disparities identified. On the one hand, in the large Health Sciences area there is a slight female predominance in the number of PQ scholarship scholars (51%) and in PQ2 level scholars (57%). On the other hand, at the PQ1D level, the female percentage drops to 49% and is even lower at the following levels (PQ1C - 45%, PQ1B - 42% and PQ1A - 32%). In the large area of Biological Sciences, women represent 42% of all teachers with productivity scholarship. At the initial level (PQ2), they are 46%, i.e., slightly lower than the male percentage; however, at the highest level (PQ1A) female participation drops to 21%.

In the large Applied Social Sciences area, women predominate only at the PQ1B level (52%) and a slump in female representation occurs between the PQ2 level (42%) and the PQ1A level (32%). In the Humanities there is a percentage equality in the number of women and men in the PQ scholarships (50%) and in the distribution in the PQ2 level (50%). In the PQ1C and PQ1B levels, the female percentage exceeds the male percentage (52% and 53%, respectively); however, the female percentage falls at the PQ1A level (46%). In contrast, the results in Linguistics, Letters and Arts showed a predominance of women (60%) among the scholarship holders, as well as a greater representation of women at all levels of PQ scholarship.



Finally, the distributions of productivity scholarships teachers that reveal the largest discrepancies in female and male percentages are: Engineering, Exact Sciences and Earth Sciences, and Agricultural Sciences. Men represent more than 75% of the scholarship holders in these areas, reaching an 82% level in Engineering. In addition to the predominance in absolute terms, these areas also hold the largest differences in gender distribution and PQ scholarship level, especially at the PQ1A level, where they are 91% in Engineering, 88% in Exact and Earth Sciences and 85% in Agricultural Sciences (Table 5).

In summary, the results found in this study indicate that there are practically no gender differences in terms of current scientific production, but there are some inequalities in the distribution of CNPq productivity grants and in the distribution of researchers by Large Area. Possible explanations for these findings as well as their implications are discussed in the following section.

Table 5  
*Distribution of tenured professors by area, productivity scholarship level and gender*

Big Area	Gender	PQ Scholarships in Big Area (N)	Percentage Distribution by Productivity Scholarship Level					Total
			1A	1B	1C	1D	2	
Exact and Earth Sciences	Female	544	12	14	20	23	27	24
	Male	1,755	88	83	80	76	73	76
	Subtotal	2,299	198	218	243	357	1,283	100
Biological Sciences	Female	1,156	21	38	42	46	46	42
	Male	1,586	79	62	58	54	54	58
	Subtotal	2,742	277	287	303	480	1,395	100
Engineering	Female	278	9	14	19	18	21	18
	Male	1,231	91	86	81	82	79	82
	Subtotal	1,509	137	122	118	276	856	100
Health Sciences	Female	1,126	32	42	45	49	57	51
	Male	1,077	68	58	55	51	43	49
	Subtotal	2,203	197	188	193	356	1,269	100
Agrarian Sciences	Female	491	15	18	23	22	30	26
	Male	1,388	85	82	77	78	70	74
	Subtotal	1,879	149	118	175	330	1,107	100
Applied Social Sciences	Female	395	32	52	43	43	44	43
	Male	515	68	48	57	57	56	57
	Subtotal	910	69	62	69	159	551	100
Humanities	Female	792	46	52	53	47	50	50
	Male	803	54	48	47	53	50	50
	Subtotal	1,595	136	162	130	269	898	100
Linguistics, Letters and Arts	Female	297	61	67	60	65	57	60
	Male	195	39	33	40	35	43	40
	Subtotal	492	39	40	55	97	261	100
Multidisciplinary	Female	489	15	31	34	34	36	34
	Male	942	85	69	66	66	64	66
	Subtotal	1,431	86	104	118	240	883	100

## Discussion

The aim of this study was to compare, by gender, the distribution and scientific production of Brazilian scholars who are active in *stricto sensu* postgraduation. The data of the teachers' production point to few differences between women and men, either in the scientific production or in the formation of human resources in the *stricto sensu* post-graduate studies. However, if, on the one hand, this can be considered to indicate that there is a consolidated path of change; on the other hand, the variables of scientific production are a condition for academics to be included in these programs. Thus, the very decision to survey tenured professors already imposes a certain condition of gender equality, considering that many postgraduate programs adopt accreditation and disqualification criteria based on scientific output.

In addition to other gender issues that may be implicit, the results of the present study show that at the Exact Sciences, Technological, and Multidisciplinary College significant differences emerged in favor of women in scientific productions of paper presentations and writing of book chapters. The question remains whether, in the areas that make up this College, women would stand out in productions that would be less valued. It is noteworthy that, in a comparative study of the performance of women and men in Astronomy, Immunology and Oceanography, Leta (2014) found a lower female production in the Web of Science database. The author hypothesized that there could be a lower internationalization of women and, consequently, less collaboration with authors from other countries. However, in the same study, the results revealed no gender differences and that both tend to establish international partnerships in a similar way.

An important finding of the study concerns the distribution of scholars in the different Colleges and Major Areas, with significant differences between women and men, with male predominance in Engineering, Mathematics and Technologies while the female predominance is mainly in Humanities, Liberal Arts and Health Sciences. The results are in line with those obtained by other countries reviewed in the Unesco (2017) on the participation of female students in the so-called in the exact sciences. The survey points out that not only is female participation in STEM education and jobs lower, but the teachers' dropout rate is high. In addition, women tend to abandon STEM disciplines during the transition to the workplace and even throughout their careers.

Gender stereotypes may be a possible explanation for this phenomenon. A study by Leslie, Sarah-Jane, Cimpian, Meyer, and Freeland (2015) found less female identification with careers in which the belief that good performance is associated with innate talent and hostile behavior often attributed to men prevails. Another possible explanation may be the lack of female role models in these areas to promote greater self-confidence and interest in such careers in girls and women (Aguinis et al., 2018). In this connection, the educational level of parents has been pointed as likely to interfere with academic and professional selections. A national study with CNPq productivity fellows showed that 43% of the researchers had parents with completed college or graduate school; and 75% had mothers with only elementary or high school education. As female participation in academia is more recent, generational changes are needed to achieve greater gender equity.

Unesco (2017) suggests that interventions to change this scenario should be done on an individual level (by strengthening skills from childhood and developing positive STEM identities); family (promoting dialogue between caregivers and children and refuting misconceptions); and educational (improving challenges at the educational system level and recruiting teachers, excluding gender bias of the teaching materials). Interventions should also encompass social policies and legislation, promoting positive images of women in STEM in the media and building public-private partnerships.

Another noteworthy result is the comparison of scholars regarding the granting and distribution of CNPq productivity scholarships at all levels, especially the highest ones (PQ1A). They are 43% of the total faculty, 37% of the total productivity fellows and only 23% in the highest PQ scholarship level (PQ1A). Findings from other studies also with CNPq productivity fellows show the same phenomenon.

We cite as examples the findings of Weber et al. (2015) and Sacco et al. (2016) who show a female majority (63.0% in both studies) among psychology productivity fellows. In addition to these, Santos, Padoin, Lacerda, and Guetteres, (2015) found that, by adding the number of women in Psychology and Nursing (areas traditionally occupied by greater female percentage), they reach 94.6% of the scholarship holders. It should be observed that this phenomenon is not exclusive to Brazil either. Studies such as those of Aguinis et al. (2018) point out that most high-performance researchers are men and that this gender disproportion increases as production levels increase, i.e., they tend to be fewer among the Top 10.0%, Top 5.0% and Top 1.0% groups.

On the one hand, such results are probably associated with the fact that there is a larger number of Brazilian male scholars. On the other hand, even considering such differences, the disproportion between men and women indicates other causes. Possibly, the late entry of women in the academic world is one of the explanations for this phenomenon, since achieving the highest levels of productivity scholarship requires many years of dedication to the research career. The findings of Prado and Fleith (2012) show that women take, on average, three decades to reach the top of their career in productivity scholarship.

In this sense, the study by Guedes, Azevedo, and Ferreira (2015) shows a rejuvenation (in terms of age) of the productivity fellows in all areas, indicating a possibility of change in the distribution, by gender, in the different areas. This conclusion is due to the authors' finding that, in areas such as Chemistry, Chemical Engineering and Sanitary Engineering, often with male predominance, there was an increase in the number of female scholarship holders. However, the same study also shows that the Exact Sciences, Earth Sciences and Engineering, in addition to being the most favored by productivity scholarships, still benefit most the young men.

Another possible explanation that has been explored in national and international studies addressing the issue of gender and science are the characteristics of personal life, including the impact of marriage, the presence of children and the care of other family members, including the elderly (considering to population aging). Warrior (1997) suggests that the structure of scientific work alone would not be favorable to women since the period between 25 and 35 years of age is crucial for the consolidation and establishment of a good reputation in the area in which it operates. However, this is also the period in which formal education ends (including PhD and postdoctoral) and for which women experience the conflict: devoting themselves to motherhood or to a researcher career? The findings of Barros and Mourão (2019) suggest that among CNPq productivity grantees there seems to be dedication first to motherhood, and only then do women enter the PQ scholarship system.

In contrast, the study by Guedes et al. (2015) showed that most of those who reach the highest positions in the scientific career have children and are married. In this sense, the gender disparity in science goes beyond family aspects and is possibly associated with social practices that perceive these differences as being "natural", resuming the discussions around gender stereotypes. Thus, the divergence between the findings in different studies and contexts indicates the complexity of the investigation of the effect of female roles on their scientific and academic performance and shows that much remains to be investigated.

Given the above, gender studies are relevant to better understand how the categories of being male and female were conceived and how they may be affecting the world of science. The results obtained, although signaling a reduction in gender disparities in the researcher's career, confirm that the scientific field still has a male predominance in certain areas and at the highest levels of CNPq productivity scholarships – an important indicator of acknowledgment in the national scenario –, which corroborates a set of other national and foreign studies

Thus, we conclude that there are no differences in the productions of scholars of Brazilian post-graduate programs; however, there are still discrepancies in professional development, if we consider the

grant and progression in the productivity scholarship system as an indicator for such analyzes. As the academic hierarchy rises, the gap between women and men widens. Although the criteria for granting scholarships are objective (e.g., quantity and quality of scientific production, internationalization of production, training of new investigators, involvement with management activities and academic insertion), male predominance indicates a gender difference that requires further investigations.

The findings regarding comparison of the distribution of teachers of both genders in postgraduate studies, as well as their relevant scientific productions, with different sections, are more relevant because all Brazilian tenured professors who worked in the period 2013-2016 were considered. The reliability of these data can be considered high, as they are based on reports generated by post-graduate programs for their quadrennial evaluation, listing output properly recorded in scientific journals, books, Lattes curricula and/or other repositories.

Despite the reliability of the data used for this study and the fact that it includes a census of Brazilian tenured professors acting in postgraduation (eliminating possible biases of sample designs), the research has some limitations. One of them refers to the time frame restricted to a period of four years. Another limitation is that career advancement is exclusively measured by the achievement of productivity scholarship, when there are many other elements such as management and representation positions, hierarchical levels and other titles or indicators of success in the academic context (full professor, associate professor, H index factor, advisory activity of different instances in the university, among others).

Despite these limitations, the results contribute to discussions about the researcher's career, as well as to the definition of policies that discuss gender biases still present in the scientific world. In this connection, we suggest studies, especially those of a qualitative character, with variables that may influence the career of men and women, such as the presence and age of the children, the age of the investigators, the socioeconomic context in which they are inserted and were educated, support and the family and / or institutional influences that they had or not. We also suggest surveys to measure the numbers of women and men who compete for productivity scholarship but are unsuccessful in order to assess whether there are statistically significant differences between them, contributing towards new reflections on gender and science.

## Contributors

S.C.V. BARROS participated in the literature review, research design, data collection, results analysis and writing of the article. L. MOURÃO participated in the literature review, research design, results analysis and writing of the article.

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