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Research production in high-impact journals of contemporary neuroscience: A gender analysis

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ABSTRACT

Neuroscience or Neural Science is a very active and interdisciplinary field that seeks to understand the brain and the nervous system. In spite of important advances made in recent decades, women are still underrepresented in neuroscience research output as a consequence of gender inequality in science overall. This study carries out a scientometric analysis of the 30 neuroscience journals (2009–2010) with the highest impact in the Web of Science database (Thomson Reuters) in order to quantitatively examine the current contribution of women in neuroscientific production, their pattern of research collaboration, scientific content, and the analysis of scientific impact from a gender perspective. From a total of 66,937 authorships, gender could be identified in 53,351 (79.7%) of them. Results revealed that 67.1% of the authorships corresponded to men and 32.9% to women. In relative terms, women tend to be concentrated in the first position of the authorship by-line (which could be a reflection of new female incorporations into neuroscience research publishing their first studies), and much less in the last (senior) position. This double pattern suggests that age probably plays a role in (partly) explaining gender asymmetry, both in science in general and in neuroscience in particular.

1. Introduction

Despite progress in recent decades, women are still underrepresented in science. Large-scale analyses reveal that global gender disparities persist in different scientific fields. Recently, Larivière, Ni, Gingras, Cronin and Sugimoto (2013) presented a worldwide bibliometric analysis of more than 5 million research and review articles, including more than 27 million authorships, and they found that, globally, women represent fewer than 30% of scientific authorships. West, Jacquet, King, Correll and Bergstrom (2013) carried out an analysis based on the JSTOR corpus, which comprises more than 8 million scientific documents, and they again revealed that important gender inequities remain in the current research production. Official reports from international organizations reach similar conclusions. The UNESCO Science Report (UNESCO, 2015) states that worldwide only 28% of researchers are women. The last issue of She Figures (European Commission, 2016), the official report on gender equality in research and innovation in Europe, recently concluded that we are far from achieving gender parity, and that women represent only one third of European researchers. In the foreword of a previous issue, Marie Geoghecan-Quin, the European Commissioner for Research, Innovation and Science, stated, "the figures do show us that some

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gaps have been reducing slowly over recent years, but gender imbalance in research is not a self-correcting phenomenon and so we must redouble our efforts" (European Commission, 2013, p. 3).

Empirical evidence shows that gender inequality is not confined to research output. Although in many countries the proportion of female undergraduates is equal to or higher than that of male undergraduates (OECD, 2015a; UNESCO 2015), women occupy fewer positions as full professors, and there is an imbalance in hiring, promotion, earnings and grant funding (for a review see e.g. Shen, 2013; UNESCO, 2015). The causes of this imbalance are probably complex, and they do not respond to a single reason, but we cannot discard the existence of certain (sometimes subtle) gender biases within science and academia. In an elegant double-blind experiment, Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman (2012) identified faculty's subtle gender biases toward female students. The authors asked 127 professors from six American research-intensive universities to review a job application for a laboratory manager position. The application was identical for all professors, and it was randomly assigned the name of a (fictitious) male or female student. Results demonstrated that the "male" applicants were rated as more competent and hireable than the identical "female" applicants, and they were offered a higher salary and more career mentoring. A mediation analysis revealed that the female student was less likely to be hired because she was perceived as less competent. Interestingly, the gender of the professors was unrelated to the judgments, and women exhibited the same gender bias as their male colleagues.

In addition to large-scale studies about global gender inequality in science, recent work has focused the gender analysis on specific fields, such as nanoscience and nanotechnology (Sotudeh & Khoshian, 2014), computing research (Cavero, Vela, Cáceres, Cuesta, & Sierra-Alonso, 2015), software engineering (Vela, Cáceres, & Cavero, 2012), materials science (Mauleón & Bordon, 2006), medical literature (Jagsi et al., 2006), or psychology (Barrios, Villarroya, & Borrego, 2013). Neuroscience, or the scientific study of the brain and nervous system, is a very active and expanding research field that, according to the category description from Web of Science, "covers resources on all areas of basic research on the brain, neural physiology, and function in health and disease. The areas of focus include neurotransmitters, neuropeptides, neurochemistry, neural development, and neural behavior. Coverage also includes resources in neuro-endocrine and neuro-immune systems, somatosensory system, motor system and sensory motor integration, autonomic system as well as diseases of the nervous system" (Web of Science, Science Citation Index Expanded, Scope notes, 2014). It is therefore an interdisciplinary field that collaborates with many other areas and has an increasing impact on contemporary science and human society. Several scientometric analyses without gender distinctions have focused on the study of neuroscience production in different countries, such as India, Italy, Sweden or China, (e.g., Bala & Gupta, 2010; Berardelli, Defazio, Mancardi, & Messina, 2005; Glänzel et al., Danell, & Person, 2003; Xu, Chen, & Shen, 2008), but to our knowledge no publication has performed a quantitative analysis of women's participation in contemporary neuroscience.

For decades, women have contributed in a significant way to the development of neurosciences (Finger, 2002), but a significant gender gap still persists today. In 2006, an editorial of the influential journal *Nature Neuroscience* complained that only one in every five papers published in its pages had a female corresponding author, and the authors of the editorial wondered if this asymmetry was simply a reflection of reality or if "it could also contribute to perpetuating the problem" (Nature Neuroscience, 2006). Since the creation of Women in Neuroscience (WIN) in 1980, an international organization "whose major goal is to promote the professional advancement of women neuroscientists" (Haak, 2002; p.70), there has been a strong interest in fostering their contribution to today's neuroscience. The Society for Neuroscience considers this goal a priority, and it currently devotes efforts and additional resources to increasing women's participation in neuroscience, both in research and academia.

Given the importance of knowing what women's representation is within the brain sciences, we present a bibliometric analysis of the most influential neuroscience journals in order to quantitatively examine the current participation of women in scientific production in this research field. To accomplish this objective, the scientific production, the pattern of research collaboration, the content, and the scientific impact (or the number of citations a paper receives) are analyzed from a gender perspective.

2. Methodology

2.1. Databases and gender identification

This study was based on Thomson Reuters' Web of Science database. The 30 journals with the highest impact factor in the NEUROSCIENCES subject category were selected from the Journal Citation Reports (Journal Citation Reports (JCR) Edition, 2014) (see Table 1). The impact factor of a scientific journal is a measure that indicates the average number of citations received by studies published in that journal, and it reflects the relative importance of journals within its field. Despite its criticisms, the citation frequency reveals a journal's relevance to its end users, particularly when the readers are primarily researchers (Saha, Saint, & Christakis, 2003). In the biomedical field, the correlation between impact factor and journal quality rated by field researchers is strong (Saha et al., 2003). Consequently, our sample included a broad selection of the most important and influential journals of the neuroscience field. All the articles and reviews from 2009 to 2010 were extracted in text format and preprocessed through the BibExcel software (Persson, Danell, & Wiborg-Schneider, 2009) in order to perform the subsequent bibliometric analyses with the BIbExcel and Microsoft Excel 2010 programs. We chose these two years because they are relatively recent and, at the same time, far enough in the past to allow us to study the citations received by papers published in that time period. Records from one journal (Molecular Psychiatry) were subsequently