UNEVEN WRITING SPACES IN ACADEMIC PUBLISHING:

A Case Study on Internationalisation in the Disciplines of Biochemistry and Molecular
Biology

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Abstract

More than 70% of the output of the highest impact international journals is produced by American and British scholars in the disciplines of Human Geography and Marketing (Gutierrez and Lopez-Nieva, 2001; Rosenstreich and Wooliscroft, 2006; Baski and Ferenc, 2013). Additionally, 85.3% of the editorial board members of international Marketing journals are based in the US (Rosenstreich and Wooliscroft, 2006). Furthermore, 95% of the journals in the Web of Science database use English as their language of publication (Paasi, 2015). These empirical data seem to indicate that international publication spaces are dominated by US and UK-based research (Paasi, 2015). In this context, this research seeks to deepen the debate by focusing on a new research unit: references. Through case studies on the referencing of the three higher impact journals in the disciplines of Biochemistry and Molecular Biology (*PLoS Biology*, *Cell*, and *Reviews of Biochemistry*) it was possible to identify, describe and visually represent the spatial patterns of knowledge production. The main findings support previous literature; 74.9% of the references surveyed had at least one author from either the US or the UK. Moreover, there was a notable predominance of authors from the US (69.9%). Furthermore, there was a high preponderance of authors from English-speaking countries (88.32%). Finally, it was determined that there is an uneven writing space created by three factors: marginalization, governmental and institutional evaluation practices and the use of English. As a conclusion, a series of managerial and linguistic suggestions for academic publishers is provided in order to promote ethnic diversity and genuinely global journal publishing spaces.

Declaration

I have read and understood the College and Departmental statements and guidelines concerning plagiarism. I declare that: This submission is entirely my own original work.

Wherever published, unpublished, printed, electronic or other information sources have been used as a contribution or component of this work, these are explicitly, clearly and individually acknowledged by appropriate use of quotation marks, citations, references and statements in the text. It is 10,059 words in length.

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List of Abbreviations

EU European Union

IF Impact Factor

JCR Journal Citation Report

OA Open Access

OECD Organization for Economic Co-operation and Development

UK United Kingdom

US United States

WoS Web of Science

1. Introduction

The consequences derived from the Third Industrial Revolution –new technologies – have changed dynamics within society (Unesco, 2005). These developments have resulted in what is conceptualised as the knowledge society. Within this society, “knowledge becomes the essential element of the productive economic and other social processes” (Rek, Makarovi and Škabar, 2015).

In an ideal context, knowledge society should generate equal access to technology and fill the knowledge gaps between nations (Färber, 2015). Nevertheless, knowledge society itself carries exclusion potential and knowledge gaps that create disparities in distribution and value (Unesco, 2005). This tension has resolved in a division “between those whose have access to knowledge and participate in knowledge-sharing, and the others, those relegated to the side-lines of knowledge societies” (Unesco, 2005, p. 160). Within knowledge production, these differences resulted into the creation of uneven social spaces of academic work and writing, which are reinforced by unequal structural features in academic publishing (Paasi, 2015).

Furthermore, empirical research has demonstrated that in disciplines such as Human Geography and Marketing, the ‘international’ journal space –and the idea of international publishing– is dominated by authors from the US and the UK (Gutierrez and Lopez-Nieva, 2001; Paasi, 2005, 2015; Rosenstreich and Wooliscroft, 2006; Ba ski and Ferenc, 2013, Paasi, 2015). This conclusion is reached by analysing the affiliation of authors published in ‘international’ journals, and by classifying the members of editorial boards according to nationality.

Considering the context described above, the question that guides the research is: Are the references used by authors published in international Biochemistry and Molecular Biology journals really international?

In order to answer this question, it is necessary to identify and describe spatial patterns of knowledge production within these disciplines. These spatial patterns of knowledge production will be represented visually in order to provide a clear framework for understanding. In the interest of achieving the aims, the nationality of the authors of 1,040 references belonging to six research and review articles from the top 'international' journals *Annual Review of Biochemistry*, *Cell*, and *PLoS Biology* will be recorded and analysed.

This investigation will further the understanding of the phenomenon of uneven writing spaces (Paasi, 2015). This will be achieved by analysing the references of international journal articles, and by determining the influence of academic publishing in the phenomenon.

This dissertation is organised as follows. Firstly, the Literature Review chapter defines and explores concepts such as knowledge society, academic capitalism, scholarly subjectivity, spatial disparities in knowledge production, and academic publishing among other topics in order to provide a context for the findings. Secondly, the Research Methods chapter contains the details of the research strategy and data collection techniques that are used to extract empirical data. Thirdly, the Case study findings chapter presents the results of the empirical analysis and contrast them with existing literature in order to generate new knowledge. In the Conclusions chapter, the research question is answered and recommendations for academic publishers are presented.

Finally, it is important to highlight that the acknowledgment and portrayal of uneven writing spaces along with the formulation of recommendations for academic publishers could

contribute to the development of truly global discourse that embraces a multidirectional flow of ideas (Bański and Ferenc, 2013; Paasi, 2015).

2. Literature Review

2.1 The influence of the knowledge society on scientific production

2.1.1 Globalised science in the context of knowledge society

Information and communication technologies in the late modernity have generated the conditions for the emergence of a knowledge society (Unesco, 2005; Rek et al., 2015). This is characterized by the identification, production, process, transformation, dissemination, and use of information to build and apply knowledge for human development (Unesco, 2005). Likewise, Castells (1996) describes this period as an informational mode of development, in which the main source of productivity is the action of knowledge upon knowledge itself.

Furthermore, knowledge is transformed into a crucial global commodity “that shapes the economic and social progress of nations and their strategic position” (Teferra, 2004, p. 159). Moreover, it is “the object of huge economic, political and cultural stakes, to the point of justifiably qualifying the societies currently emerging” (Unesco, 2005, p.5). Within this logic, the production of science and knowledge are fundamental to economic and cultural progress. In other words, knowledge society is a framework of reflection and action around the world; which defines research, education, policies, and shapes international standards for academic work (Unesco, 2005; Paasi, 2015).

In this context, the dynamics of science have reached a state of globalization, which means that borders and national systems are not clear and could possibly disappear (Teichler, 2004). The foundation of the current Western-science-focused global practices was set during the geopolitical context of the North American Cold War (Paasi, 2005, 2015). During this time, there was a combination between high interest in science with the purpose of controlling the

flows of knowledge, and a culture of freedom, individual innovation, and entrepreneurialism (Castells, 1996). Within this political context, institutions such as the Organisation for Economic Co-operation and Development (OECD) and Unesco encouraged many countries to follow American models in their own science policies (Paasi, 2005). Moreover, in the present days, the trend of international consultation and policy transfer has furthered the legitimisation of some knowledge practices over others (Paasi, 2015).

There is a presumed ideal that information and specialized knowledge can travel easily and that scientific communication across borders –at least from a technological point of view- is possible (Unesco, 2005; Stehr, 2010). Nevertheless, this vision is questioned by structural components of knowledge society itself. In fact, knowledge society carries an exclusion potential and knowledge gap disparities on distribution and value (Unesco, 2005). Therefore, knowledge is determined by the place in which it is generated. In other words: “generation of knowledge takes place in distinct places and under special circumstances. The spaces and circumstances touch the substance of what is produced” (Stehr, 2010, p. 24). In addition, “language and context are decisively related in the construction of scientific accounts” (Paasi, 2013, p. 3).

As a consequence, there is a tension between the concept of globalised science and spatial disparities in knowledge production, legitimisation and dissemination. This tension has resolved itself in the development of differentiated knowledge production conditions. These are determined by homogenised scientific practices, standardised publishing practices, the creation of uneven power relationships in the publishing business, evaluation cultures where rankings and metrics are used to assess the quality of performance, and restricted access to

knowledge in the case of development countries, among other phenomena (Lillis and Curry, 2010; Paasi, 2015).

2.1.2. The impact of academic capitalism in higher education and knowledge production

Higher education institutions play a fundamental role within knowledge society (Slaughter and Rhoades, 2004). For example, they are a major participant in the cultivation of the intellect, teaching and the search for knowledge (Rubins, 2007). In this context, Clark (2000, as cited in Rubins, 2007) identifies four expectations and pressures that society places on universities. Firstly, an overall demand for participation which changed student entry from elite to mass to universal. Secondly, the job market request for new kinds of knowledge which are no longer provided by first education. Thirdly, the government and private sector exhort universities to help them in solving problems as broad as poverty and technological progress. Finally, there exist a general obligation towards the generation of knowledge and advancement.

It could be argued that these pressures have changed the relationship between higher education institutions and society in America; generating the phenomenon called academic capitalism (Slaughter and Rhoades, 2004). Within this, the authors identify “new circuits of knowledge that link higher education institutions to the new economy” (Slaughter and Rhodes, 2004, p. 1). These circuits are mainly based on the conception of knowledge as a private good rather than a public good (Rubins, 2007).

In this context, universities have a double economic role: “generating revenue for academic institutions” and “producing knowledge and wealth to boost the global competitiveness of corporations” (Rhoades, 2005, p. 38). Overall, this resulted in the increase in focus on

external revenue through contracts, generation of intellectual property, services, teaching materials and donations, among other activities. For example, in fields such as Health and Technology, academic capitalism has translated into the generation of patents, licenses or high technology products (Slaughter and Rhoades, 2004; Rubins, 2007).

Under the academic capitalism logic, scholars have to create attractive projects in order to obtain grants that allow them to further their research. Therefore, the dependence of universities on external resources can lead to a ‘harmonisation’ of research practices and topics (Paasi, 2005). This subordination to external funding has generated a culture where most research is conducted on short-term projects. This affects the continuity and working conditions of individual researchers, and the quality of science itself. As a consequence, “researchers often have to hurry from one project to the next without being able to concentrate properly on the topic and utilize all of the intellectual potential they have” (Ylijoki, 2003, p. 329).

Nevertheless, academic capitalism practices are not mechanical. They acquire various adaptations in different discipline environments, which means that not all disciplines engage in academic capitalism in the same way. For example, the Technological and Health fields have closer links to commercial product development than the Humanities (Ylijoki, 2003).

2.1.3. Scholarly subjectivity in academic capitalism

Academic capitalism rationally assesses competition over productivity in scholarly practices (Paasi, 2013). This often means that researchers are forced to give up activities such as advising students or participating in university governance because they take away time for production, and do not generate measurable results (Rhoades, 2005). As a consequence, the

focus on academic competition over symbolic capital has translated to a complex neoliberal rationality around scholarship practices (Paasi, 2015).

In this context, academic productivity means publishing articles in English, specifically in ‘international’ high impact journals (Paasi, 2013). Under this logic, scholars are valuable to their institution as long as they produce certain knowledge output, which should be published in certain journals. In this sense, “for a department or research school, more publications in English means more funding; for an individual researcher, more publications in English can mean continuation of a contract or even a promotion” (Aalbers, 2004, p. 321).

Other factors that determine scholarly subjectivity are the evaluation of performance by publication metrics, the declining number of tenure positions and the rapidly evolving nature of scholarly communication (Alvarez, Bonnet and Kahn, 2014). Moreover, scholars perform a myriad of activities within higher education institutions. For example, carry out high quality research, teach students, generate external funds, fill out evaluation forms, write applications, and work to comply with funding criteria, among other assignments (Ylijoki, 2003). As a consequence, some scholars in the modern day work more than sixty hours a week, and can suffer from anxiety (Paasi, 2013; Matthews, 2016).

Furthermore, Tienari (2012, p. 252) compares scholars with investors:

As individuals, we engage in speculative behaviours that (may) offer opportunities to shine in the eyes of academic gatekeepers and to score points in assessment exercises [...] As a result, we get excited and opportunistic about the same ideas and investment targets, and mimic each other in our attempts to maximize the value of our own investments.

Nevertheless, academics have a responsibility in the construction of their own subjectivity. In this sense, scholars “are not mere objects of external steering but active actors who monitor their behaviour in accordance with their values, interests, aims and traditions” (Ylijoki, 2003,

p. 328). Therefore, researchers have developed strategies to either operate under the market-like practices or to resist them (Paasi, 2015).

2.2. The impact of an international academia on publishing practices

2.2.1. ‘International’ science and academic publishing

In the higher education context, internationalisation of science – and not globalisation of science - “address[es] an increase of border-crossing activities amidst a more or less persistence of national systems of higher education” (Teichler, 2004, p. 7). The concept is discussed in terms of physical mobility and academic knowledge transfer. In this sense, the debate around internationalisation has two perspectives; one considers internationalisation as a positive phenomenon, while the other maintains a critical approach. In the former, concepts such as an international focus and cooperation are associated with high quality and knowledge advancement (Teichler, 2004). In the latter perspective of the internationalisation phenomenon, Paasi (2015) recognises that borders are being crossed, but in uneven ways.

The author identifies the factors that contribute inequality (2013, p.2):

(hegemonic)languages, national academic cultures and contexts, the power of publishing houses in marketing and promoting journals, editorial policies and gate keeping, and the power of indexing and ranking such journals into various data sets (like Scopus and/or Web of Science).

Taking a broader science perspective, Paasi (2005) analysed the volumes and spatial patterns of global journal publishing. Based on data retrieved from the Science, Arts and Humanities, and the Social Sciences indexes of Web of Science (WoS), the author identified a global asymmetry favouring representation of English-speaking countries. He concludes that ‘internationalism’ represented by this database has its limits (Paasi, 2005). Moreover, Lillis and Curry (2010), based on National Science Foundation data from 2007, have identified that

the US -wide share of global research output was 34%, and the share of the European Union (EU) was 31%.

On a discipline-based level, empirical research revealed that in Human Geography editors and members of international advisory boards were often represented by Anglophone departments (Gutierrez and Lopez-Nieva, 2001). In the case of the journal output, 73.4% of the authors were based on the United States (US) or the United Kingdom (UK). Even so, more than ten years later Baski and Ferenc (2013) confirmed that the situation in this discipline has not changed. Still, over 70% of the articles published in the most respected ‘international’ journals are written by American or British authors.

A similar phenomenon occurs in the Marketing discipline. Rosenstreich and Wooliscroft (2006) discovered that within the top ten ‘international’ marketing journals, there are low levels of international involvement and high proportions of US authors and content (84.4%), and a majority of experts of this nationality in editorial boards.

As a consequence, the concept of ‘international’ science is limited to a Western way of knowledge production practices (Lillis and Curry, 2010; Paasi, 2015). In other words, “the ongoing internationalisation has not meant academic interaction and exchange of knowledge, but the dominance of the leading Anglophone journals in which international debate occurs and gains recognition” (Minca, 2013, p. 8). Thus, the concept of ‘international’ science needs to be understood beyond the noble ideal of a borderless academy or free travelling ideas (Paasi, 2015).

However, this phenomenon contrasts with the international knowledge production practices of American science and engineering scholars. In the last thirty years, these disciplines have had an increase of international co-authorship. Statistics show that in 1988 only 8% of the

world's articles had international co-authors while in 2009 this share had grown to 23% (National Science Board, 2012). Especially, the international participation of Asia-based authors has arisen considerable, specifically in the cases of China, Japan, South Korea, Singapore, and Taiwan (National Science Board, 2012).

Within academic publishing, practices are diverse. On one side, some publishers diminish the concept of international by developing strategies limited to sales and marketing departments. They reduce international publishing to translation, VAT, and other tax laws, licensing and copyright laws (Michael, 2014). On the other side, there are companies with a broader perspective on international academic publishing. They believe that international editorial boards are necessary because they make editors “aware of regional and cultural differences that exist among practitioners ostensibly in the same field” (Michael, 2014). Likewise, Michael Clarke understands that international publishing should cultivate a truly global community of editorial board members, reviewers, readers, and authors. Moreover, Judy Luther states that in order to achieve full global impact, publishers should support the publication of new titles in other languages and help to attract audiences to international authors (Michael, 2014).

In summary, the concept of ‘international’ regarding higher education, knowledge production, and academic publishing practices is still debatable. In the words of Kent Anderson: “international represents the start of a conversation. But pretty soon after using the word, you have to start getting to what you’re really talking about” (Michael, 2014).

2.2.2. English as a *lingua franca* in knowledge production

Currently, English is the dominant language involved in the production, reproduction, and circulation of knowledge (Paasi, 2015; Hwang, 2005; Short, Boniche, Kim and Li Li, 2001).

This phenomenon could be explained by the acceleration of transnational competition and cooperation in science and technology, together with globalisation and internationalisation of knowledge (Hwang, 2005).

The predominance of English in academic production is reinforced by the institutional accountability demands around publishing (Hwang, 2005). University and governments have been establishing formal requirements or monetary reward systems that oblige scholars – especially in the case of non-native English-speakers - to publish in the highest impact ‘international’ journals which have English as their publication language (Paasi, 2015).

This imposition has an impact upon the daily science production practices of non-native English-speaking scholars’ day-to-day production of science practices. They are forced to spend a part of their budget on translation and correction; in addition to time and effort invested on subsequent corrections. These conditions transform publication in English into a burden (Aalbers, 2004; Hwang, 2005). In the case of the Taiwanese applied linguist, Min (2014) identifies two challenges they face when attempting to publish in international journals; first, a lack of confidence in English language use for academic purpose, and second, a perceived bias towards the use of American/British English at a native speaker level.

In this context, the phenomenon of English as a *lingua franca* should not be seen just as a technical matter. Canagarajah (2002) concludes that there are forms of hegemony emerging from this linguistic dominance. Similarly, Short et al. (2001) ponder that linguistic hegemony empowers some while disempowering others. In other words, the use of English reflects the various positions of language users and acts as an invisible, hegemonic force that has a strong

impact on the framing and ordering of the global world and organizations (Hwang, 2005; Tietze and Dick, 2009, as cited in Paasi, 2015).

As a consequence, English hegemony has created asymmetric writing spaces by strengthening the power of Anglophone publishing (Paasi, 2015). Moreover, English language journals are over-represented in the Science Citation Index (Larsen and von Ins, 2010). On a discipline level, research shows that more than 95% of the Natural Science journals indexed in WoS, as well as 90% of the Social Science are either fully or partially English language (Lillis and Curry, 2010).

On another perspective, the use of English is beneficial for small linguistic communities (Hwang, 2005; Paasi, 2013). In fact, in some non-native English-speaking countries there has been a conscious adoption of English as a second language (Short et al., 2001). In this sense, “English has become a form of cultural capital for both national governments seeking to produce an English competent workforce and individuals eager to achieve a better position in a globalizing world” (Short et al., 2001, p. 3).

2.2.3. Spatial disparities in knowledge production

The concept of spatial disparities in knowledge production has been ample described (Unesco, 2005; Paasi, 2015; Hwang, 2005; Lillis and Curry, 2010). One approach positions certain regions on the core or centre of knowledge production in contrast with the periphery. This division is based on differing material conditions and dependency relations between regions of the world (Lillis and Curry, 2010). This means that there are practitioners and audiences of scientific knowledge; and that American and European located science is more meritorious than science generated on the periphery (Paasi, 2015).

As a result, science institutions in the periphery shape their criteria for excellence based on core science, in order to be viewed as part of it (Hwang, 2005). Whereas UK and US-based scholars hardly consider the periphery science to be relevant (Yeung, 2001). “Native English speakers not only ignore the non-English literature (Pénot and Agnew, 1998), they often even neglect pieces from authors outside the UK and US when they are written in English” (Aalbers, 2004, p. 320).

The second approach challenges the core-periphery dichotomy because it considers it as a simplistic vision on a rather complex phenomenon (Hwang, 2005; Unesco, 2005; Muniz, Ariza-Montes and Molina, 2015; Paasi, 2015). In fact, the concept of Western-hegemony (Paasi, 2015) recognises divisions among Europe-Mediterranean countries and the UK, and even within universities themselves (Garcia-Ramon, 2003; Muniz et al., 2015). In this sense, the hegemony approach describes the phenomenon as an experience marked by marginalisation and even discrimination in two specific areas. First, regarding the use of English language; secondly, the consideration that the knowledge generated in non-Anglophone social spaces is inferior, irrelevant, incorrect or ‘exotic’ (Paasi, 2015).

2.3. Academic Publishing: journals and the Impact Factor

2.3.1. Academic publishing

Academic or scholarly publishing is “based on research from academic institutions [...] also it encompasses material produced by research institutions, governmental or private sector research organisations, as well as companies such as those operating in the pharmaceutical sector” (Hall, 2014, p. 61). This field “is defined by the distinctive relation between publishing organizations, on the one hand, and the institutions and activities of scholarly and

scientific research, on the other” (Thompson, 2005, p. 81). Also, it is highly determined by higher education institutions, governmental and funding policies, and trends among some research areas (Smith, 2012).

It is important to highlight that academic publishing is a key part of the overall scholarly communication system (Thompson, 2005). Unesco in its *Towards Knowledge Society* report (2005, p. 114) recognises its significance:

Thanks to publication, what was informal knowledge, confined to a laboratory, is validated by the peer group and enters the realm of public discussion for examination and debate. Because it ensures transmission and validation of research findings, publication is part and parcel of the knowledge creation process.

Based on these ideas, the main function of scholarly publishing is dissemination and certification. The former involves making results available in spaces where the work can be noticed by the right audience (Thompson, 2005). The latter involves “a degree of legitimacy or symbolic value on the output, and thereby gives the output a standing which it would not have if it were simply made available by the researcher as an unpublished paper” (Thompson, 2005, pp. 82-83). This legitimisation process is mainly funded in the peer review process.

Regarding the audience for this area of publishing, it is relevant to differentiate between buyer and user. On one hand, the buyers are libraries that have a limited acquisition budget (Thompson, 2005). On the other hand, the users are scholars which engage with academic publishing in two roles; as readers when they need a valid source to develop a new research, and as writers when they look to place the new findings among the discipline landscape (Hall, 2013).

Regarding the business aspect of academic publishing, for the past two decades, the advancement of technology has provided new opportunities for the creation of new fields of

enquiry, novel methodologies and research tools (Unesco, 2005; Anders and Elvidge, 2013). These changes had impacted in the economic aspect of academic publishing which has been characterised by mergers and high profit margins. In 2012, Elsevier had 38% revenues (US\$3.2 billion) followed by Springer with US\$1.1 billion in sales (Cope and Kaltantzis, 2015). Furthermore, the journal publishing market faces oligopolistic conditions with the five top publishers controlling more than 50% of all the papers published (Larivière, Haustein and Mongeon, 2015).

2.3.2. The supremacy of journal publishing

Currently, journals are the main medium that scholars use to disseminate their research (Mackenzie Owen, 2007; Lillis and Curry, 2010; Cope and Kalantzis, 2011; Larivière, Haustein and Mongeon, 2015). Furthermore, Crysler (2003) states that journals are relevant in the construction of authority, power, cultural capital and the boundaries of the spaces of knowledge.

For scholars, publishing in a high impact journal has benefits over other forms of publication. First, high-impact journals give visibility to the work, which could ‘ideally’ lead to a citation. Secondly, institutional and governmental evaluation systems use journal-based metrics to assess scientific production (Lillis and Curry, 2010). Therefore, the credit awarded for publishing in a journal allows scholars to progress in their career, achieve degrees and win research grants (Phillips and Cope, 2011; Paasi, 2015).

In this context, it is important to highlight that even though the process of publication is a key part of knowledge production (Unesco, 2005), the supremacy of a certain medium has consequences. On a linguistic level, the research and review article genre leaves out other forms of scholarly discourse such as monographs, books and conference proceedings (Paasi,

2005). In terms of research practices, it leads to a phenomenon known as ‘fast-food’ research in which academics “deliberately begin to avoid substantial, complicated and time-consuming research themes and instead concentrate on relatively small, focused, ‘sexy’ topics” (Paasi, 2013, p. 3).

Nevertheless, there have been changes in the publishing journal industry in the past years. New business models such as Open Access (OA) and hybrid journals have surfaced. New types of publications such as cascades and mega journals have also arisen. Moreover, academic technological platforms that foster collaboration and allow for experimentation with instant publication and post-publication peer review are now available. These developments should be interpreted as “symptoms of, and catalysts for, transformations that are underway in contemporary knowledge ecologies” (Cope and Kalantzis, 2014, p. 10)

2.3.3. The relevance of Impact Factor (IF)

WoS defines the Journal Citation Report (JCR) as “a systematic, objective means to critically evaluate the world's leading journals, with quantifiable, statistical information based on citation data...JCR helps to measure research influence and impact at the journal and category levels” (WoS, 2016).

This metric has become “the chief quantitative measure of the quality of a journal, its research papers, the researchers who wrote those papers, and even the institution they work in” (Amin and Mabe, 2010, p. 1). The IF is used by governments, funding agencies and university administrators to assess quality and to evaluate the production rates of individual academics and departments (Paasi, 2005, 2013, 2015).

As a consequence, some researchers aim to publish in journals with high IF instead of those with suitable audiences (Rawat, 2014). Scholars see articles as investments which could lead to better job positions, and continuous funding, among other benefits. With this choices, academics “sustain the hegemonic system driven by publications in the right places –by apparent consent, rather than by coercion- and reproduce its metrics and values as legitimate and self-evident” (Tienari, 2012, p. 251).

The use of IF as a metric to evaluate the quality of science production has been amply criticised (Rhoades, 2005; Lillis and Curry, 2010; Cope and Kalantzis, 2014; Paasi, 2015). First, faculty productivity and efficiency is evaluated in narrow terms (Rhoades, 2005). Second, the IF metric is not appropriate to evaluate quality, because citations are not an adequate measure of epistemic impact and value (Cope and Kalantzis, 2014). Third, the IF is based on the WoS database which has been questioned for its lack of diversity (Cope and Kalantzis, 2014; Paasi, 2015). In 2005, Unesco reported that WoS only covers a thin sample of journals which are actually located in two major poles: Europe (EU, UK, Ireland, Norway and Switzerland) and North America (US and Canada) with 38.6% and 37.6% of all the citations respectively. Furthermore, 95% of the journals are published in English, which makes the index not only spatially but also linguistically uneven (Paasi, 2015).

3. Research methods

In chapter two, the lack of geographical diversity in the top ‘international’ Marketing and Human Geography journals was presented (Gutierrez and Lopez-Nieva, 2001; Paasi, 2005; Rosenstreich and Wooliscroft, 2006; Baski and Ferenc, 2013). In this regard, spatial disparities in knowledge production have been conceptualized either as a centre-periphery division (Hwang, 2005; Unesco, 2005) or a Western-hegemony (Paasi, 2015). Empirical research has contributed to the debate, although it has concentrated on Social Science disciplines and on the degree of internationalisation of the journals’ output and the ethnic diversity of the editorial boards.

This research will attempt to delve deeply into the spatial patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology by implementing a multiple descriptive case study strategy. It is hoped that the results of this research could further the description of the uneven writing space phenomenon (Paasi, 2015), and enrich the understanding of research practices in the disciplines of Biochemistry and Molecular Biology.

This section will provide details of the research strategy adopted to address the objectives. It also will state the methods used for data collection – sample selection and analysis approach – and the framework for data analysis. Finally, the topic of potential limitations will be discussed.

3.1. Objectives

This study had two interrelated objectives and a question that guided the research process:

1. Identify and describe spatial patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology.
2. Visually represent patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology.

These objectives aimed to answer the following research question: Are the references used by authors published in international Biochemistry and Molecular Biology journals really international?

3.2. Research Strategy

A multiple descriptive case study strategy meets the needs of this research as it provides an in-depth and insightful description of the phenomenon, and it allows understanding the complexity of the context where the patterns occur (Yin, 2012; Biggam, 2015).

Regarding the analysis, it is primarily qualitative in nature because it is concerned with the description and understanding of a single case (or a few cases) as ends in themselves (Singh, 2011). Nevertheless, there is also a quantitative aspect which “has a mechanistic, non-judgemental component in the form of statistical inference” (Howe, 1998, as cited in Robson, 2011, p. 163). Therefore, a sequential transformative design is used. This type of mixed method is guided by a theoretical perspective and integrates results –qualitative and quantitative– in the interpretation phase (Robson, 2011). Mixed methods are therefore suitable for this research due their capacity to complete a comprehensive picture of the topic, their ability to deal with complex phenomena and situations, and their capacity to illustrate data in a more comprehensible way (Robson, 2011).

3.3. Data Collection: sample selection and techniques

The data used in this multiple descriptive case study were the references of six research and review articles belonging to three ‘international’ journals with highest IF in the disciplines of Biochemistry and Molecular Biology. Each of these publications had different business models –subscription, hybrid, and OA. As a result, 1040 references of the journals *PLoS Biology*, *Cell* and *Annual Reviews of Biochemistry* were analysed.

The rationale behind the selection of the Biochemistry and Molecular Biology disciplines is their translatable nature. This means that these fields have higher levels of collaboration and even physical mobility of scientists due to their global approach, worldwide topics and the wide adoption of English in knowledge production and communication (Unesco, 2005; Paasi, 2005; Sonnenwald, 2007).

In order to select the journals and articles, convenience sampling was used. This non-probability approach was selected due to the time frame to retrieve and analyse data. It is also consistent with the case study research strategy, which demands a small amount of cases to perform a focused and achievable approach (Biggam, 2015). The data extraction process was performed through the journal’s website. In some journals, the articles had a direct link to the reference, and in the case the journals did not provide a direct link, the UCL Library website was used to locate the reference. Google was used as a final resource for locating the reference.

The criteria to determine the sample was established considering the objectives of this research. First, to determine the most influential journals in the discipline, the 2015 JCR for Biochemistry and Molecular Biology was consulted. The rationale behind this decision was

the ample use of this metric to determine quality and impact in knowledge production (Hwang, 2005; Paasi, 2013). Secondly, in order to establish if the journal was international, the text in the “About the journal” section of each publication was consulted. In the case that the journal stated it was international or had a broad audience, it was considered as an international journal. Thirdly, the two highest cited research and review articles were chosen in each journal using WoS database. This selection was based on the grounds of (a) describing the citation patterns of the output with the highest impact in the discipline; and (b) genres considered for the JCR.

Regarding data extraction, content analysis was performed. This research technique allows the generation of valid inferences about data directly from the context of use (Drisko and Maschi, 2015). Content analysis was chosen due to its ability to simplify a large amount of data into a short description of the data’s features (Bauer, 2000). Also, it allows “constructing indicators of worldviews, values, attitudes, opinions, prejudices and stereotypes, and compare these across communities” (Bauer, 2000, p. 3); which is relevant to characterise uneven writing spaces.

Data retraction was performed manually for each reference and collected on a Microsoft Excel sheet. A coding frame (Figure 1) was established in order to achieve a thorough description of the spatial patterns of knowledge production.

	Journal	Plos Biology			Cell		Annual Reviews of Biochem	
	Article	Plos Biology	Different Levels		Fat	Microbiota	Genome	The Scanning
	Genre	Research article	Research article		Review	Research article	Reviews	
	Country	France	Belgium; US		US	France;Sweden;Denmark	US	US
		Quantity	%		Quantity	%	Quantity	%
1	Argentina							
2	Australia							
3	Austria							
4	Belgium							
5	Brazil							
6	canada							
7	China							
8	Czech Republic							
9	Denmark							
10	Finland							
11	France							
12	Germany							
13	Greece							
14	India							
15	Ireland							
16	Israel							
17	Italy							
18	Japan							
19	Kenya							
20	Korea							
21	Mexico							
22	Netherlands							
23	New Zealand							
24	Norway							
25	Panama							
26	Portugal							
27	Romania							
28	Russia							
29	Saudi Arabia							
30	Slovenia							
31	Singapore							
32	Slovakia							
33	South Africa							
34	South Korea							
35	Spain							
36	Sweden							
37	Switzerland							
38	Turkey							
39	UK							
40	US							

Figure 1. Coding frame used for data retraction

3.4. Framework for data analysis

First, basic statistical procedures such as summary statistics and graphics were applied in order to obtain quantitative data. Secondly, the geographical affiliation of the author was

visually represented on a map using the Tableau software. Both procedures were chosen considering the objectives that guided the research.

3.5. Limitation and potential problems

It is relevant to recognise that the case study approach has its own limitations. The most important one is that it does not allow making generalisations (Yin, 2012). Although, in this research selecting and describing a small number output based on the convenience sample technique did never pretence to describe the overall spatial knowledge production patterns of the disciplines (Biggam, 2015). In other words, the present results are not comparative, but comparable (Singh, 2011).

Secondly, the use of content analysis is appropriate and relevant because it has the potentiality to be adapted to each case (Drisko and Maschi, 2015). Finally, the manual extraction of data could lead to a question of reliability. Nonetheless, Bauer (2000, p. 10) considers that regarding content analysis “automatic and computerized coding has shown its limitations, and the human coder/interpreter is far from obsolete”. Also, the accurate and detailed description and justification of the procedure prove the empirical research was performed with care and fairness.

4. Case study findings: description and analysis

This section presents the findings of the multiple descriptive case study presented in chapter three. The research aims are to identify, describe and visually represent spatial patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology. In order to accomplish these objectives, 1,040 references contained in six research and review articles within three high impact journals –*PloS Biology*, *Cell* and *Annual Reviews of Biochemistry*– were analysed.

It is important to clarify that the theoretical and methodological frameworks used to analyse the present findings belong to the discipline of Geography. The rationale behind this decision is that this critical approach to internationalisation has been developed over the course of twenty years of research. Furthermore, the field of publishing has not yet developed discipline-based theoretical and methodological tools to analyse the phenomenon. Although, the relevant role that publishing has within internationalisation is taken into consideration in the present and following chapters.

Furthermore, the empirical research presented in chapter two focuses on the fields of Human Geography and Marketing. The research unit studied in these disciplines were the affiliation of the authors of the articles published in ‘international’ journals, the nationality of the members of the editorial board, and interviews with an expert panel of senior academics. However, the research unit analysed in this investigation are the references used in published research and review articles. Nevertheless, all of the named research units help to explain the complex phenomenon of internationalisation within journal publishing.

In this context, it is important to clarify, that percentages do not sum up a 100% because most of the references analysed have more than one author. For example, in the case of the US, in 724 references there was at least one author from that country.

Also, it is important to highlight that knowledge production practices are complex and that the above is not an attempt to explain the overall phenomenon in the disciplines of Biochemistry and Molecular Biology.

Finally, the structure of this chapter is guided by the research objectives. At first, spatial knowledge production patterns are identified and described. Secondly, the visual representation of the knowledge production patterns is discussed with the literature presented in chapter two. Within the latter objective, three elements that constitute the uneven writing space of publication are identified and explained.

4.1. Identification and description of geographical patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology

A multiple descriptive case study of the top three Biochemistry and Molecular Biology journals—with different business models— has revealed that the vast majority of the articles referenced (74.9%) are written by at least one American or British author. Within these results, there is a clear dominance of American scholars, with 69.9% of the references containing at least one author from the country. This is followed by the UK with 9.6%.

In Table 1 the percentages of the most referenced countries in each journal are revealed. It is important to clarify that considering the topic of internationalisation the focus is centred on the disciplines rather than the journals.

	US	UK	France	Germany	Canada
PLoS Biology	64.9%	16.6%	3.3%	6.6%	13.9%
Cell	68.3%	9.1%	9.1%	6.2%	3.7%
Annual Reviews of Biochemistry	72.4%	7.9%	6%	6%	4.3%
Disciplines total	69.9%	9.6%	6.7%	6.2%	5.5%

Table 1. Percentages of the countries with most references in PLoS Biology, Cell and Annual Reviews of Biochemistry and in the overall disciplines of Biochemistry and Molecular Biology

As it can be seen in Table 1, *PLoS Biology* has the highest contribution of US and UK authors (81.5%), closely followed by *Annual Reviews of Biochemistry* (80.3%) and finally, *Cell*, with 77.3%. Considering that the US and the EU make the largest investments in research (Lillis and Curry, 2010), it is plausible to assume that scientists from this spaces have the financial means to access the technology necessary to produce high-quality science, hire qualified scientists, and access high priced sources of scientific knowledge.

Also, there is a noticeable and constant predominance of references with at least one author from the US in all of the journals and in the overall disciplines. However, the percentages of references from the UK are not as consistent. *Annual Reviews of Biochemistry* has 7.9% of UK references with at least one author from the UK, while *PLoS Biology* more than double: 16.6%.

Moreover, in the overall discipline France (6.7%), Germany (6.2%) and Canada (5.5%) are part of the countries with more references; despite the vast gap between them and the US.

Table 2 shows the percentages of the least referenced countries: Kenya, Mexico, Panama, Romania, Slovenia, Slovakia, and Turkey. As in Table 1, the results are differentiated by journal and the percentages for the overall disciplines are also presented.

	Kenya	Mexico	Panama	Romania	Slovenia	Slovakia	Turkey
PLoS Biology	0%	0.7%	0.7%	0%	0.7%	0.7%	0%
Cell	0.3%	0%	0%	0.3%	0%	0%	0.3%
Annual Reviews of Biochemistry	0%	0%	0%	0%	0%	0%	0%
Disciplines total	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%

Table 2. Percentages of the countries with least references in PLoS Biology, Cell and Annual Reviews of Biochemistry and in the overall disciplines of Biochemistry and Molecular Biology

Furthermore, it is important to highlight that only 40 of a total of 196 countries in the world (Rosenberg, 2016) are referenced in the disciplines of Biochemistry and Molecular Biology, which are 20.4% of the nations. This means that 79.6% of the countries are not represented in knowledge production practices of the disciplines of Biochemistry and Molecular Biology. It is important to highlight that most of the countries belong to regions such as Central and South America, Asia and Africa.

4.2. Visual representation of geographical patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology

As it was explained in chapter three, the program Tableau was used to visually represent the spatial patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology. Additionally, the findings will be discussed using Geography's theoretical framework together with the empirical research presented in chapter two.

Figure 2 visually represents the spatial patterns of knowledge production within the disciplines of Biochemistry and Molecular Biology. This is based on the analysis of the

affiliation of 1,040 references belonging to six research and review articles. Furthermore, in Table 2, the quantity of references by each country is shown. It is important to indicate that the affiliations of the authors of the six research and review articles analysed are: US, Belgium, France, Denmark, and Sweden.

Figure 2. Visual representation of spatial patterns of knowledge production in Biochemistry and Molecular Biology

Figure 2 contains two graphical representations of the quantities of references. Firstly, there is a colour gradient; red referring to greater amount of references and blue referring to a lower amount of references. Secondly, the size of the circles allocated on top of each country indicates the range of the number of references. Considering the big range between the highest referenced country (724) and the least referenced nation (just 1); the data needed to be organised around five ranges which are presented in the right and above corner of Figure 2.

It is clear how the patterns of knowledge production in Figure 2 visually represent Western hegemony within the references used in the disciplines of Biochemistry and Molecular Biology. In further detail, Figure 2 illustrates that authors published in high impact Biochemistry and Molecular Biology ‘international’ journals highly reference US-based authors (represented with a red dot in Figure 2). Furthermore, Figure 2, along with the quantitative information in Table 3, reveals an extensive gap between the two highest referenced countries: the US with 724 references and the UK with just 100.

Country	Quantity	Country	Quantity
US	724	Brazil	7
UK	100	Finland	6
France	69	Korea	5
Germany	64	Ireland	4
Canada	57	Greece	3
Japan	46	India	3
China	42	New Zealand	3
Sweden	35	Norway	3
Switzerland	35	Singapore	3
Italy	27	Argentina	2
Netherlands	24	Portugal	2
Spain	24	Saudi Arabia	2
Russia	21	South Korea	2
Denmark	16	Kenya	1
Belgium	13	Mexico	1
South Africa	13	Panama	1
Czech Republic	12	Romania	1
Australia	11	Slovakia	1
Israel	11	Slovenia	1
Austria	10	Turkey	1

Table 3. The amount of references for each country

Additionally, Figure 2 and the data provided in Table 3 evidence the important role of Western European countries in knowledge production in the disciplines of Biochemistry and Molecular Biology (Carter, 2005). Authors from countries such as France, Germany, Italy,

Switzerland, the UK, Netherlands, Denmark, Sweden, Greece, Spain, Norway, Austria and Belgium contribute with 423 references, which represent a 40.67% of the total of references. These findings confirm Western hegemony in knowledge production in the disciplines of Biochemistry and Molecular Biology.

Moreover, the findings indicate that the knowledge produced in regions such as Central and South America (11) and Africa (13) are almost symbolic for the authors published in the higher impact journals of Biochemistry and Molecular Biology. Only 2.2% of the references were authored by researchers of those regions. A hypothesis around the causes of this phenomenon would be explained further in the chapter.

Additionally, the authors of the six research and review articles reference their own countries on an average of 57.1%. In Table 4, the percentage of references of the own author's country are displayed per article.

Journal	Genre	Countries	Percentages
PLoS Biology	Research article	France	6,7%
	Research article	US and Belgium	71%
Cell	Research article 1	US	73,2%
	Review article	France, Sweden and Denmark	47,3%
Annual Reviews of Biochemistry	Review article	US	74,1%
	Review article	US	70,3%

Table 4. Percentage of references of the author's country displayed by article

In this sense, these findings reflect the direction of knowledge flows in the disciplines of Biochemistry and Molecular Biology. Western-based academics mainly reference Western-based authors, determining a homogenised concept of 'international' and quality science (Kitchin, 2005). Similarly, Tienari (2012, p. 253) observes that "the academic system serves particular interests; some actors benefit from the game and its rules, while others are positioned at a disadvantage".

Moreover, even though the visual representation of knowledge production in the disciplines of Biochemistry and Molecular Biology confirms Western hegemony, it is important to highlight an interesting phenomenon. Findings indicate that at least one Asian author from countries such as China, Japan, Korea, and Singapore was part of 96 references. This quantity is comparable with UK's amount of references (100).

However, the high number of references from Asian scholars does not contradict the Western hegemony theoretical approach, but rather reinforces it. Asian countries have developed national schemes to internationalise their higher education institutions through investments in Elite Research Centres. Also, in Asian universities, there are initiatives such as tenure-track and monetary reward systems to push their faculty to publish in high impact 'international' journals (Min, 2014). Furthermore, in the cases of Biochemistry and Molecular Biology, there is an uprising trend of collaboration between Chinese scientists and US-based scholars. Also, the number of Chinese articles published in 'international' journals rose annually by 10% from 1999 to 2002 (He et al., 2005). This proves that Western hegemony is not a geographical division, but a concept that validates the idea that there is only one way to produce science (Paasi, 2015).

In summary, the findings described above indicate that the references used by authors of high-impact 'international' Biochemistry and Molecular Biology journals are not, in fact international. The high predominance of US and UK authors in the references (79.4%) contradicts the traits of internationalisation declared in the Scope of the three journals analysed. For example, "Our audience is the international scientific community as well as educators, policy makers, patient advocacy groups, and interested members of the public around the world" (PLoS Biology, 2016); or *Cell*'s "broad readership" (Cell, 2016), and

Annual Reviews' mission "to provide the worldwide scientific community with a useful and intelligent synthesis of the primary research literature" (Annual Reviews, 2016). In this context, it is interesting to highlight two facts. Firstly, the journals used ambiguous language to name the actors that benefit from internationalisation; 'audience' could refer to readers or authors. Secondly, internationalisation seems mostly focused on the readers' end, and not on the journal's output.

In this context, the present findings –79.4% of the references with at least one author allocated in US and UK–supports empirical research on the degree of internationalisation in Geography and Marketing journals (Gutierrez and Lopez-Nieva, 2001; Short et al., 2001; Rosenstreich and Wooliscroft, 2013; Baksy and Ferenc, 2013; Paasi, 2015). In the discipline of Geography, Gutierrez and Lopez-Nieva (2001) conclude that American and British authors contributed with 73.4% of the articles published in 'international' journals. More than ten years later, Baksy and Ferenc (2013) findings prove that this phenomenon has not changed. Still over 70% of the output in Geography journals is dominated by the UK and the US, with 39.9% and 34.5% respectively.

In the case of Marketing, Rosenstreich and Wooliscroft (2006) focused in US dominance in the top ten 'international' journals. The authors discovered that 84.4% of all the articles published had at least one author from the US. This correlates with the findings of the present research in which 69.9% of the references had at least one author from the US.

Considering the objectives of this research, the findings will be analysed from a critical theoretical perspective: the inequality of the writing spaces (Paasi, 2015). Furthermore, based on the literature review revision and the present findings three elements that establish the

uneven writing space will be recognised: marginalisation, evaluation practices and the prevalence of English in text production. These factors will be explained next.

4.2.1. Constitution of uneven writing spaces through marginalisation

The first element that constitutes the uneven space is marginalisation (Aalbers, 2004; Paasi, 2015). Firstly, in order to understand the phenomenon, it is necessary to define the concept of referencing. This is “the use of a source of information in order to ascertain something” (Oxford Dictionary, 2016). In this sense, “all research takes place in a context which is shaped in part by previous research and reflection, and it is an accepted part of scientific and scholarly practices that researchers should take account of the results of previous research as expressed in outputs of various kinds” (Thompson, 2005, p. 82). Moreover, scholars interconnect their ideas with others and create representational designs that “are the fundamental basis of all academic and scholarly knowledge work. They give tangible form to fields of interest. They are found objects that precede all new intellectual work and new knowledge representation” (Cope and Kalantzis, 2014, pp. 11-12).

In this context, the hegemony of references with at least one author from the US or the UK could be interpreted as the validation of science produced in certain places in the world against others (Aalbers, 2004; Minca, 2013). Furthermore, Paasi (2015, p. 515) states that Anglophone scholars consider non-Anglophone science “irrelevant or incorrect, or, at best, was regarded as exotic, [and] local case studies incapable of producing innovative theory or of framing the epistemological boundaries of disciplinary practices”. Moreover, Simonsen (2004) deemed that none-Anglophone Geography authors are expected to submit only descriptive or analytical research based on case studies; which later will become empirical material for American and British scholars. Another experience of marginalisation is the

physical one, which Timár (2004) identifies as ‘ghettoisation’. East Central European scholars –especially Hungarian–do not have the financial means to attend conferences and discuss their results, which leaves them partially excluded from the discipline’s main topics of discussion.

Regarding marginalisation practices in the disciplines of Biochemistry and Molecular Biology, Chinese authors believe that by submitting important findings to high impact international journals, the country’s influence in the field will increase (He et al, 2005). These findings prove that forms of Western hegemony not only take place in Geography and Marketing but also in the analysed fields.

4.2.2. Constitution of uneven writing spaces through evaluation practices

The second element that establishes the unevenness of writing spaces is the evaluation practices or the geopolitical dimension of academic text production. These are “the policies influencing research and evaluation systems at local, national and supranational levels” (Lillis and Curry, 2010, p. 5).

Currently, governments, universities, and funding institutions are using metrics to evaluate scholars, IF being the most popular. Therefore, a ‘good scholar’ is the one who publishes in the highest impact journals, which could potentially grant prestige, career advancement, and research funds.

As a consequence, scholars apply different strategies in order to get published in the highest impact journals (Paasi, 2005, 2013, 2015; Tienari, 2012). Even though some of these practices are looked upon, research has demonstrated that authors are asked by referees to reference previous papers that appeared in the journal or to reference often cited authors

(Aalbers, 2004, Ba ksi and Ferenc, 2013). Thus “the author often ends up summarising the US and UK literature and then ‘testing’ it for another country” (Aalbers, 2004, p. 320).

Even though it is impossible to establish whether the authors’ choice of references in the disciplines of Biochemistry and Molecular Biology was a strategy in order to get published, the fact that they referenced certain regions reinforces the uneven writing spaces in journal publication.

4.2.3. Constitution of uneven writing spaces through the supremacy of English in knowledge production

The third element that contributes to the uneven writing space is the high predominance of the use of English in knowledge production or the geolinguistic dimension of academic text production. In fact, more than 95% of the Natural Science journals and 90% of the Social Science journals indexed in WoS are totally or partially in English (Lillis and Curry, 2010). Similarly, Paasi (2015) conclude that 95% of the journals in the WoS database are published in English. Furthermore, Short et al. (2001) conclude that English has become the language of Geography.

The present findings confirm the predominance -88.32%- of authors from English-speaking countries in the references of the six research and review articles in the disciplines of Biochemistry and Molecular Biology. These findings support the conception of English as the *lingua franca* of science (Aalbers, 2004).

Authors with languages other than English such as French, German, Spanish, Romanian, Slovene, Slovak, Turkish and Swahili were found in 47.39% of the references. This is 46.1% less than English-speaking countries. One reason that could explain the lower percentage of

non English-speaking authors compared to English-speaking authors is the pragmatic implications of writing in this language for the former scholars. In this context, there is a tension between institutional and governmental publication requirements –to publish in high impact journals–and the practical implications of writing in English – extra expenditure, more effort and a time-consuming activity. As a consequence, publication becomes a burden for scholars (Aalbers, 2004, Hwang, 2005; Bánksi and Ferenc, 2013).

In Graph 1 there is a visualisation of the linguistic distribution in the references. In order to determine English-speaking countries, the theory of Inner and Outer circle was used (Lillis and Curry, 2010). The Inner circle include nations such as the US, the UK, and Australia; and the latter are the former colonies where English is a second official language.

Graph 1. Distribution of authors from English-speaking countries and no English-speaking countries in the refernecs of Biochemistry and Molecular Biology

Although the use of one language allows global communication in science, it is important to recognise that “linguistic hegemony is a form of power that empowers some while

disempowering others” (Short et al. 2001, p.1). Furthermore, the use of English reflects the various positions of the people who speak it (Hwang, 2005).

In consequence, the predominant use of English either in knowledge production –publication output or references—together with the preponderance of American and British members of editorial boards constitute a writing space where power is held by English-speaking scholars.

Finally, Western hegemony in knowledge production is not just a theoretical matter, but it materialises in actual scientific practices. In the area of science and engineering Korean scholars declare that the country is limited to consume and adapt core knowledge to local practices (Hwang, 2005). In the case of Geography, Timár (2004) identified cases of exploitation of knowledge in post-socialist Hungary. In this context, companies with expertise in the EU accessed Hungarian knowledge for free; making scientists believe that what actually was cheap labour was a promotion.

5. Conclusion

The research question that guided the investigation was: Are the references used by authors of international journals in Biochemistry and Molecular Biology really international? In order to answer it the following aims were established:

1. Identify and describe spatial patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology.
2. Visually represent patterns of knowledge production in the disciplines of Biochemistry and Molecular Biology.

In this chapter, the main findings will be presented and conclusions will be offered that consider the findings alongside the investigated literature. Also, suggestions for changes in academic publishing practices will be displayed. Additionally, the contribution of this research to the description of spatial patterns of knowledge production will be addressed. Finally, some recommendations for future research will be laid out.

Firstly, it is important to declare that the aims that guided this research were met and the question was answered. By analysing the affiliation of the authors of 1,040 references it was possible to identify, describe and visually represent the spatial knowledge production patterns of the disciplines of Biochemistry and Molecular Biology. As is the case with the output of Geography and Marketing 'international' journals (Gutierrez and Lopez-Nieva, 2001; Baksi and Ferenc, 2013; Rosenstreich and Wooliscroft, 2006; Paasi, 2015), the affiliation of the authors of the references are highly dominated by US and UK authors (74.9%) and English-speaking countries (88.32%). Moreover, the authors who published in the highest impact journals of the disciplines of Biochemistry and Molecular Biology have a high preference for

science produced in their own country (57.1%). Furthermore, there is a low geographical diversity: only 40 countries were used in the references. Even so, there is marginalisation or absence of science produced in regions such as Central and South America and Africa (2.2%)

Secondly, the visual representation of spatial knowledge production patterns in the disciplines of Biochemistry and Molecular Biology confirm the existence of an uneven writing space (Paasi, 20015) within the disciplines of Biochemistry and Molecular Biology. Three elements that constitute this phenomenon were recognised: marginalisation, governmental and institutional evaluation practices and the supremacy of English as a *lingua franca* in knowledge production and distribution.

In summary, this case study, together with an extensive review of related literature, question the degree of internationalisation of high impact international journals of Biochemistry and Molecular Biology. Considering that ‘international’ journals of these disciplines do not highly reference international sources, the concept of ‘international’ is a misrepresentation in the case of these journals. In this sense, “‘international’ in the context of academic publishing is, rather, often used as a proxy for ‘English medium’, and together ‘English’ and ‘international’ constitute an important indexical cluster used to signal ‘high quality’” (Lillis and Curry, 2010, p. 6). Moreover, the monopolisation of the idea of ‘international’ science by US and UK-located scholars (Paasi, 2015) create narrow ‘international’ forums, dismiss alternative approaches and methodologies and generate a monothematic and Anglo-focused topical conversation (Hwang, 2005; Baski and Fernec, 2013). On the other hand, an ethnical diverse publication space could raise awareness of cross-cultural issues, provide objectivity from outsider perspectives, test and apply theories in other contexts, and inform about new issues or provide a new perspective on old ones (Flowerdew, 2001).

In this context, the crucial role of academic publishing within knowledge production should not be underestimated (Unesco, 2005). For this reason, several suggestions will be provided with the aim of reshaping the international journal publication space. These propositions derived from the investigation performed in the literature review and are classified in two main areas: management and language.

With reference to managerial practices, the first recommendation to be made is naming non-native English editors (Paasi, 2015). The second one is to increase the ethnic diversity of editorial boards by including scholars with different nationalities and linguistic origins. Both suggestions will diversify and open the networks of referees and the topics that the journal could cover. Thirdly, peer reviewers should be carefully chosen and they must construct clear and constructive communication with nonEnglish-speaking authors (Belcher, 2007).

Regarding language, the first recommendation is to translate books and articles into English as well as the other way around (Garcia-Ramon, 2003). The second suggestion is accepting the use of World English in papers, this means that “gatekeepers should accommodate towards linguistic, rhetorical, cultural, and geopolitical varieties” of the English language (Min 2014, p. 198). Even though language related suggestions will call for big economic investments, the impact of breaking linguistic barriers in both ends is invaluable for knowledge.

Finally, this research contributes to knowledge because it deepens the understanding of uneven writing spaces by analysing a new variable: references. To date, the empirical research produced is based solely on the affiliation of the authors of published articles, the ethnic diversity of editorial boards, or the opinion of influential scholars in the area. In addition, the present findings contribute to the description of the research and publishing

practices in the disciplines of Biochemistry and Molecular Biology. Furthermore, the recommendations to academic publishers encapsulate feasible measures that could have a real impact on diversifying the uneven publication space.

Although thorough research has been conducted, the phenomenon of uneven writing spaces is not completely described. This is because the elements that constitute them are multivariate: geographical, political, economic, linguistic, educational and philosophical, among others. Further research could analyse scholars' representation of knowledge within the disciplines, in short, what they consider to be valid science. Also, new investigations could increase the sample of international journals; interview the perspective of stakeholders such as non-English-speaking scholars that have attempted -or successfully been published- in high impact international journals and the editors of high and low impact 'international' journals.

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