Sustained Collaboration Between Researchers in Mexico and France in the Field of Chemistry

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Abstract
We analyse the co-authorship and publication patterns of 863 mainstream WoS papers in the field of Chemistry co-authored between Mexican and French institutions from 1984 to 2013 with the purpose of identifying and characterizing the dynamics of sustained collaborative research partnerships in the field between the two countries. From a normalized set of the most productive authors with ≥ 5 co-authorships we selected three Mexican scientists for a detailed analysis of their co-authorship network visualized using Gephi software and its development over time. The first was the most productive Mexican author from the main national university whose collaboration with France spanned the period from 1987-2012, while the second and third researchers work in provincial universities and whose collaboration with France is more recent but lasting 10 and 15 years respectively, and also continues up to the present day. Preliminary results suggest that sustained partnerships are driven by a strong central bond between the Mexican researcher and their foreign partner. In the first two cases, the bond is with directly with a French scientist but in the third, is stronger with an Italian rather than with the French counterpart.

Conference Topic
Country level studies

Introduction
A recent paper examining the main research thrusts and future challenges facing research into scientific collaboration mentions the need to characterize the factors underpinning successful collaborations and to ascertain how collaboration can benefit scientific development in the less developed countries (González Alcaide & Gómez Ferri, 2014). International collaboration is known to be especially important for countries whose scientific infrastructure and capacity can benefit from forging alliances with researchers from institutions abroad. Colombian researchers for instance were found to increase team output by almost 40% by co-authoring with overseas partners (Ordóñez-Matamoros, Cozzens & García, 2010).

We know little about the duration of international research collaboration between individual researchers in terms of the number and timeline of co-authored papers. Two decades ago a study looked at the production and duration of collaboration between researchers from institutions in Mexico and France in all scientific areas (Narvaez-Berthelemot & Russell, 1996). Chemistry was the subject of the greatest number of bilateral publications as well as having the highest continuity index defined as the number of articles (>2) in a given period, in this case 1980-1989, that were co-authored by the same groups. More recently an analysis of co-publications between the two countries from 1984 to 2010, showed that Chemistry gradually lost ground with respect to other disciplines notably Physics, even though the number of papers increased with time (Ainsworth et al., 2014).

The present research in progress sets out to characterize the publication dynamics of sustained collaborative research partnerships between Mexico and France in Chemistry in the period 1984-2013. We take as our starting point, the most productive authors in papers with at least

one author from both Mexico and France. Considering that interpersonal links are the key drivers of collaboration (Gaillard et al., 2013) we are also interested in analysing the relationship between co-authors and tracing the development of their networks over time. Another aspect of the collaboration we consider is the level of importance of the relationship with Mexico in the case of the French scientists or France for the Mexicans, for the total body of work of the key players during the same period and who might be the senior partner in the bilateral relationship. We adopt two approaches when analysing our publication and co-authorships data based on the following assumptions: 1. Sustained collaboration is characterized by a central relationship established between one Mexican and one French scientist. 2. Sustained collaboration between the two countries is characterized by a series of relationships forged with different French scientists and institutions.

Data source and methods

Data source was the Web of Science searching France and Mexico in the country field, covering the period 1984-2013, in the discipline of Chemistry. WoS journal subject categories were adapted to the RFCD classification scheme for the assignment of the discipline (Butler, Henadeera y Biglia, 2006). Records were downloaded to a local MySQL database. Author names with ≥ 5 co-authorships were normalized and assigned (often several) Scopus author ids and affiliations, given that author identification in WoS proved less than adequate for our purpose. Case studies were selected from the group of the most prolific Mexican authors with bilateral France-Mexico collaboration. For this preliminary presentation of results we have selected three case studies based on our initial analysis of their collaboration dynamics. These include the most prolific Mexican researcher and two other productive researchers from established groups with substantial French collaboration from two provincial state universities, namely Cecilio Álvarez y Toledano from the Institute of Chemistry at the big national Mexican university, Universidad Nacional Autónoma de México (UNAM), Ricardo Navarro-Mendoza from the Universidad de Guanajuato (UG) and Claudio Marcelo Zicovich-Wilson from the Universidad Autónoma del Estado de Morelos (UAEM).

The interactive visualization open source software Gephi was used to select and represent these collaborations and to show sub-networks within clusters. Co-authors involved in each of the papers were examined to characterize the temporal collaboration, and separately the normalized author information from Scopus was used to represent the importance of the Mexico-France collaboration in the main authors' output. The corresponding author of each paper was also identified.

Overall panorama of Mexico-France co-authorship in Chemistry

The number of co-authored papers in Chemistry between Mexico and France showed a steady rise from a mere two in 1984 to 54 in 2013 (Figure 1). Social network graphs (not shown here) show an increasing dense and complex series of relationships when comparing the first 15 years (1984-1993) with the second period (1994-2013).

Publication dynamics of sustained partnerships

Figure 2, divided into three decades, shows the dense network of co-authorships of Cecilio Álvarez y Toledano with French institutions during our period of study. The strongest link is with Henri Rudler of the Université Pierre et Marie Curie, Institut Parisien de Chimie Moléculaire starting in 1987, and to a lesser extent with Andrée Parlier of the same laboratory except during the middle period 1994-2003. Rubén Alfredo Toscano works in the same institute as Cecilio Álvarez y Toledano as a highly specialized technician and is a regular co-author. Of the 29 papers of Álvarez y Toledano in co-authorship with a French institution, 23 were published in co-authorship with Rudler. There was a notable pause in their collaboration

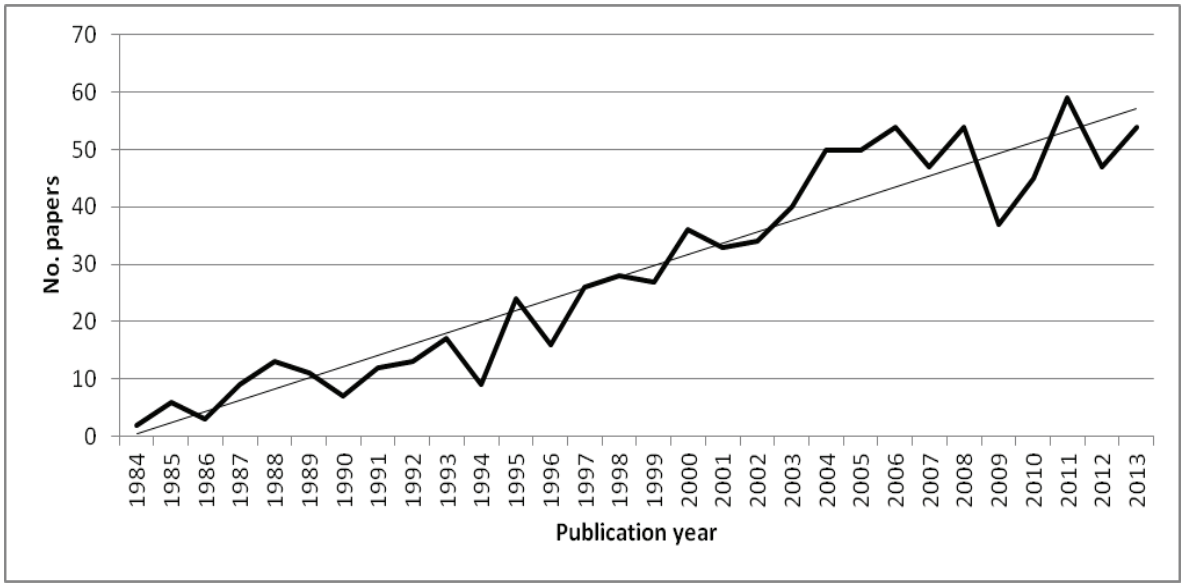

Figure 1. Papers in collaboration between Mexico and France in Chemistry 1984-2013.

from 1996 to 2004 when Álvarez y Toledano co-authored two papers with two other French authors, Henri Arzoumanian, Aix-Marseille Université, and Bruno Donnadieu now of the newly formed Université de Montpellier but at the time of the Universite Montpellier 2, respectively and involving a different set of co-authors. Nonetheless, Andrée Parlier and Henri Rudler continued their collaboration without Álvarez and Toledano during this period, together with Jacqueline Vaissermann, also from the same laboratory.

During the first two periods four clusters of co-authors are apparent, while in the most recent period 2004-2013, co-authorships are concentrated in two with Rudler and Parlier at the centre, respectively. A strong central bond with Henri Rudler is evident in the collaboration of Álvarez y Toledano over the whole period suggesting that this bilateral partnership is the motor driving this example of sustained co-authorship between Mexico and France.

Data taken from Scopus using the author id field for papers co-authored by Rudler and Álvarez-Toledano in Chemistry show Rudler to be senior (corresponding) author in 11 of these 29 papers as compared to 6 in the case of Álvarez-Toledano, which would seem to show that Rudler is the senior partner in this collaboration. The issues of authorship order are discipline-specific, but in many scientific areas it is accepted that the principal investigator is named as the corresponding author (Frandsen & Nicolaisen, 2010). These 29 papers represent 26% of all Rudler's papers as represented in Scopus, compared to 20% of those of Álvarez-Toledano suggesting that the bilateral partnership is of significance for the output in Chemistry for both researchers.

The network of collaboration with French institutions starting in 1998 around Ricardo Navarro Mendoza from the Universidad de Guanajuato appear in Figure 3 with strong links to Eric Guibal from the École des Mines d'Alès. Fourteen of the 15 papers published from 1998-2012 appear with both authors. Imelda Saucedo Medina, also from the Universidad de Guanajuato, is a co-author in 11 of these papers. In one article at the beginning of the period in 1998, there is a collaboration with other French authors, Denise Bauer and Gérard Cote, both from the École Nationale Supérieure de Chimie de Paris, and in two articles, 2000 and 2001 with Thierry Vincent from École des Mines d'Alès.

This suggests a consolidated partnership, though perhaps also an unequal one. Scopus data for papers co-authored by author Ricardo Navarro Mendoza and Eric Guibal in Chemistry show Navarro-Mendoza to be corresponding author in 8 of the 11 instances, compared to 3 for

Guibal. This would suggest that in this case the Mexican is the senior partner. These 11 papers represent 33% of all Navarro Mendoza's papers in Scopus, but only 7% of Guibal's.

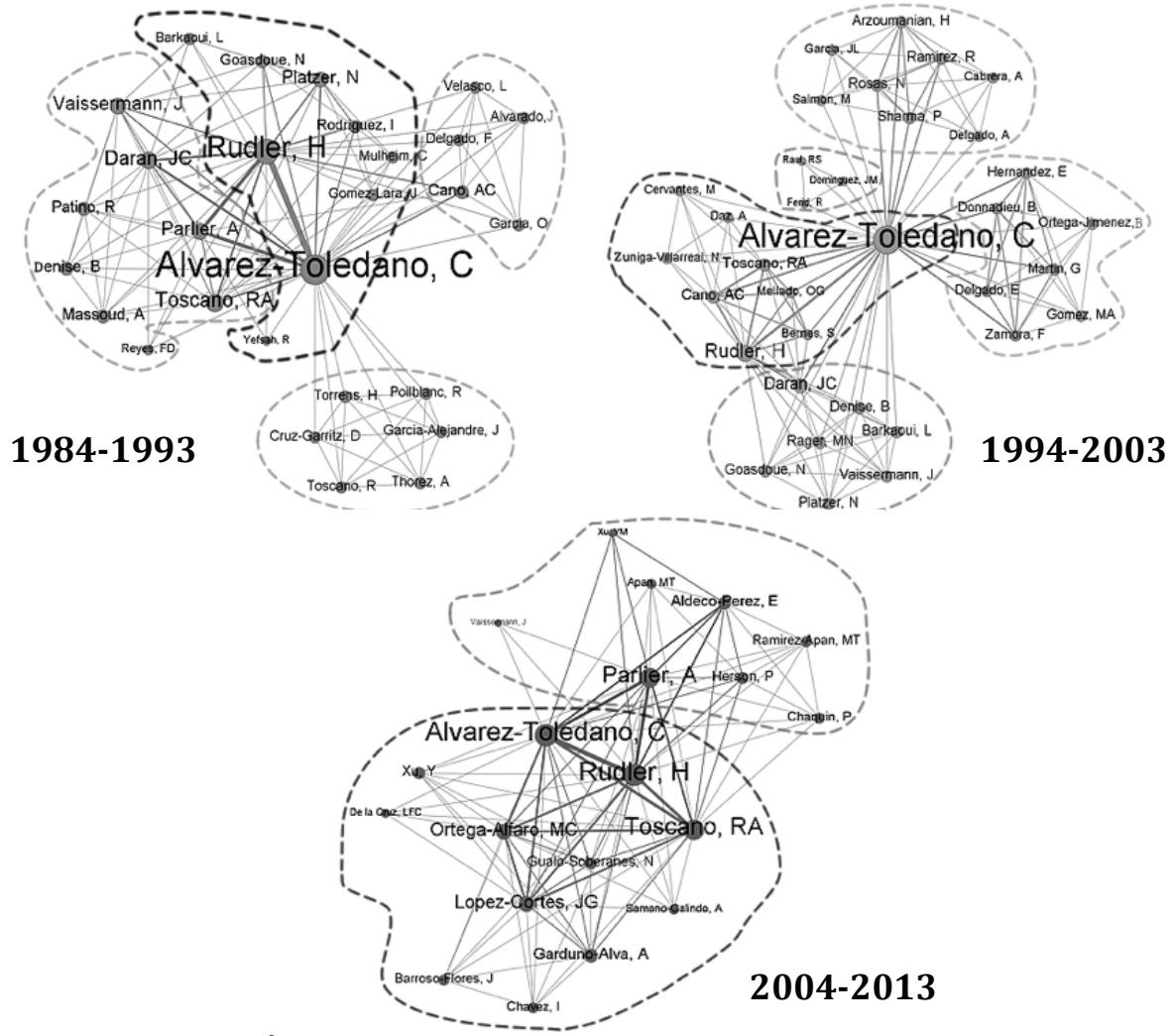

Figure 2. Álvarez y Toledano: Network of ≥ 3 co-authorships 1984-2013.

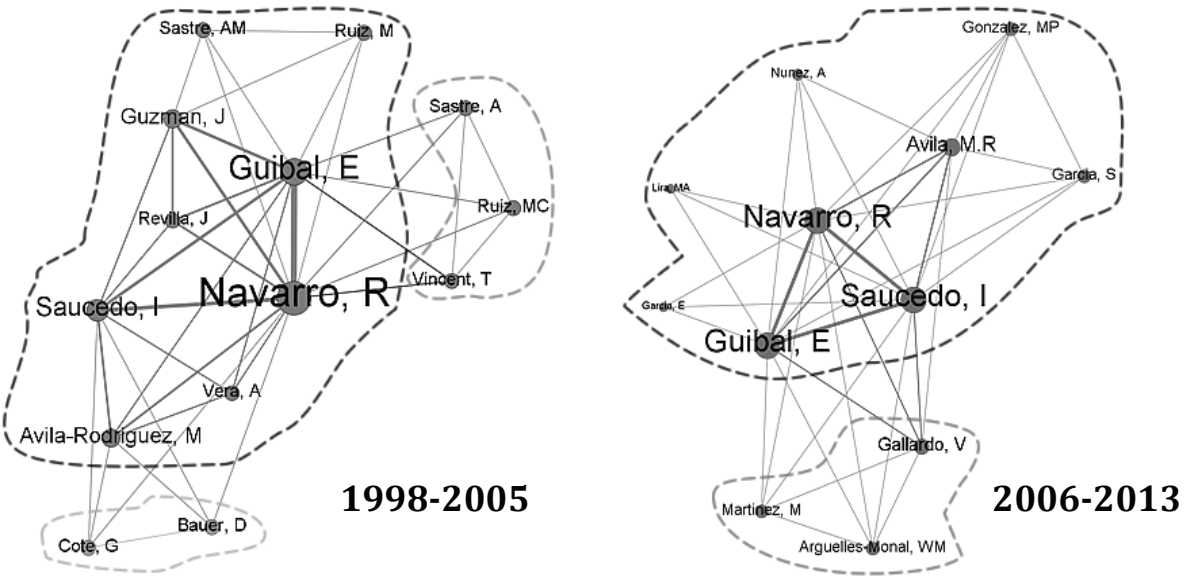

Figure 3. Navarro Mendoza: Network of ≥ 3 co-authorships 1998-2013.

The co-authorship of Claudio Marcelo Zicovich Wilson from the Universidad Autónoma del Estado de Morelos with researchers from France that began in 2004, is reflected in Figure 4, as is also the importance of a group of Italian authors for this collaboration. Roberto Dovesi from the Universita degli Studi di Torino appears as co-author in 13 of the 16 papers of Zicovich Wilson where there are also authors from French institutions in the period 2004-2013. Other researchers from the same Italian institution such as Roberto Orlando (6 papers), Piero Ugliengo (4 papers) Loredana Valenzano (3 papers 2006-2008) and Raffaella Demichelis (also 3) appear together with Dovesi, the latter co-author during 2010-2011. The predominant French author is Fabien de Pascale, at the time of Université Henri Poincaré - Nancy I, who is a co-author in 8 of the 16 papers during 2004-2010, Yves Noël, CNRS Institut des Sciences de la Terre de Paris with 5 papers 2007 then 2010-2012, together with Michel Rérat, Université de Pau et des Pays de L'Adour form a separate French collaboration, albeit together with Roberto Dovesi. The central role of Roberto Dovesi in the Mexico-France collaboration seems evident from the data taken from WoS. Data from Scopus for papers in Chemistry co-authored by Zicovich Wilson and Pascale reveal that the Mexican is corresponding author in only one of these, and Pascale not in any of them. (Pascale appears as first author in three of them.) The role of Roberto Dovesi in this collaboration seems to be confirmed in that he is corresponding author in 6 of these 10 papers. These papers correspond to 9% of all Zicovich Wilson's papers, 40% of Pascale's but only 4% of those of Dovesi. These data imply that Pascale is the junior partner here.

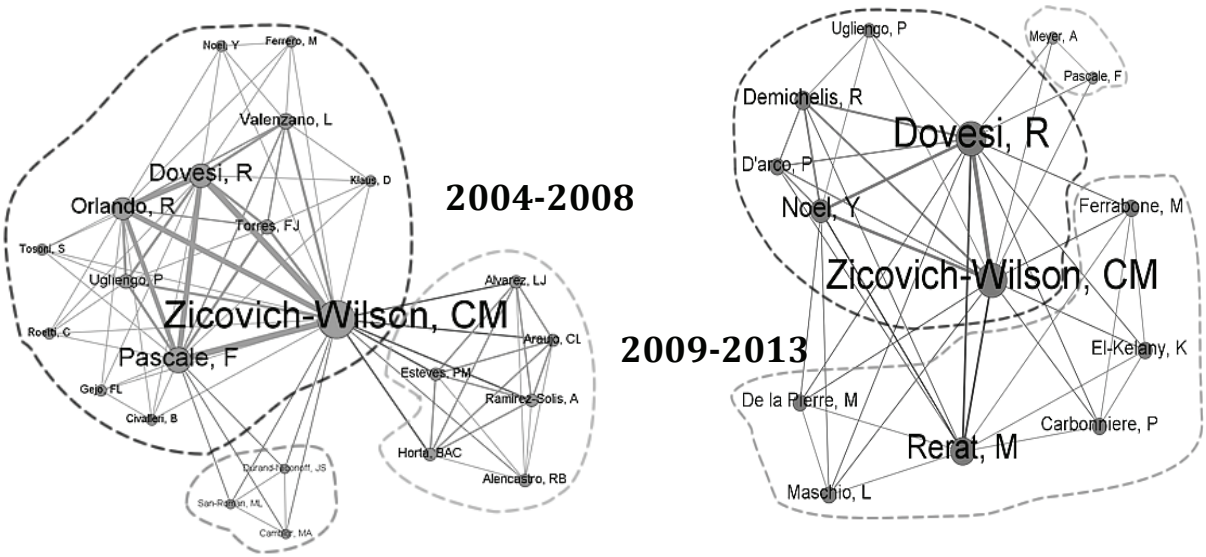

Figure 4. Zicovich Wilson: Network of ≥ 3 co-authorships 2004-2013

Preliminary Conclusions

Our detailed analyses of the co-authorship networks of three Mexican scientists, one from the large national university located in Mexico City where the national scientific research effort is centred and two from provincial universities, with ≥ 5 co-authorships with France in mainstream Chemistry journals during our period of study, lend support to our initial assumption that sustained collaboration is characterized by a central relationship established between two individual scientists but not necessarily directly between a Mexican and a French scientist. In the first two cases the bond is with a French scientist but in the third, is stronger with an Italian rather than with the French co-author. These central relationships are

strengthened and supported by frequent co-authorship from both Mexican and French groups in the first two cases and in the third, by the Italian group. A substantial number of one-time co-authors was evident in all three cases. We found differences with respect to the importance of the bilateral collaboration for the Mexican and French authors and with respect to which of the two could be considered the senior author. These preliminary conclusions will be tested by analysing further case studies of sustained partnerships between Mexican and French chemists.

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