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International Scientific Collaborations: A Key to Scientific Success

*Joseph S. Francisco**

Joseph S. Francisco
Dean of the College of Arts and Sciences, University of Nebraska-Lincoln, Past President of the American Chemical Society, Member of the International Advisory Board, Alexander von Humboldt Foundation

After my plenary talk at the 15th Winter Fluorine Conference in 2001 on radical intermediates resulting from the oxidation of chlorofluorocarbons, a colleague, Professor Helge Willner from the Universität Duisburg-Essen, approached me to discuss the opportunity for our laboratories to collaborate on further experimental and theoretical characterizations of these species. Our approach was from a gas-phase perspective and his from a matrix-isolation one, the two being complementary. We successfully applied for a Humboldt Research Award, which led to a sabbatical leave in Germany. Not only did I acquire knowledge about a new technique, but the two of us brainstormed new projects and germinated plans for student exchanges. After giving presentations at several institutions in Germany on the collaboration of the two laboratories, several other potential research partners approached me. Going abroad thus opened up new research opportunities that contributed immensely to the productivity of my research. A collaboration that had begun modestly continues to offer new perspectives.

Today, more than ever, research is of an international character, and "globalization" of science research is proceeding rapidly. This has important implications for the chemical sciences. The conditions for science research around the world are continually improving, and thus international collaborations and partnerships can provide rich opportunities to enhance research and training. Diverse views and experiences give internationally connected research groups a significant competitive advantage over geographically limited ones; this is because the integration of different approaches enables much more creativity. Many of the world's most pressing problems call for international cooperation, and chemistry plays a key role in solving many of them, such as climate change, food security, public health, infectious diseases, or resource conservation and environmental sustainability.

An increasing number of research organizations and universities are realizing the benefits of international scientific collaboration. International research not only leads to economic growth and employment, but can also lead to a significant boost in the development of newly established institutions. Also, research collaborations across borders will become natural for the next generation of academics, as sharing of facilities will make it easier for them to be more productive.

Benefits of International Collaboration in Research

International collaborations are driven by a desire of scientists to find the best peers around the globe, and geographic boundaries are not an issue. By collaborating with one another, researchers can learn new techniques and come up with new ideas. The "transfer of skills" is an important and primary benefit of research collaboration. Other benefits of international collaboration include: 1) impact and visibility; 2) greater capacity to carry out research; and 3) benefits to young investigators.

Regarding impact and visibility, a study by the Royal Society[1] showed that countries engaged in international collaborations experienced more than a threefold increase in their publication citations by collaborating with one or more researchers from partner countries. This increase could be either an indicator of how useful the work may be, or due to the broader dissemination of the work because of the diversity of countries from which the research partners are involved. Additionally, international authorship can lead to an increase in a paper's citations, provided there are not more than ten authors. A study by Matthews et al. raised the question of what a scientist in the area of stem-cell research gains from international research collaborations.[2] Although the study was limited to collaborations between researchers in the United States and the United Kingdom, they found that UK researchers engaged in more international collaboration than did US investigators. The research from the UK and US international collaborations was cited significantly more often than those generated solely by UK or US researchers. A more recent study analyzed 1.25 million science papers published between 1996 to 2012 in eight disciplines including chemistry.[3] Results from this study found that international collaboration is correlated with journal place-

[*] Prof. J. S. Francisco
College of Arts and Sciences
and
Department of Chemistry
University of Nebraska-Lincoln
1223 Oldfather Hall
Lincoln, NE 68588-0312 (USA)
E-mail: jfrancisco3@unl.edu

ment and more citations. The authors found that chances of getting papers into top journals were much higher if authors collaborate across nations. They also found that publications from international collaborations are more frequently cited by other scientists. In any case, all the above studies show that collaboration across national borders has broadened the value of science research articles.

Global collaboration allows scientists to build their capacity to conduct research by leveraging the resources of partners in other countries. For example, they can use facilities and instruments that may not be available locally. An excellent example is the way in which the European Union is encouraging scientific collaboration between its member countries to strengthen the European research environment. A consequence of this strategy is an increase in the number of articles with co-authors from several European countries.

Taking Cultural Differences Seriously

Numerous obstacles can impede meaningful and successful international collaborations. Productive engagement requires recognition of differences in culture and language barriers. Collaborations must navigate funding challenges across different national or international agencies. For faculty, the challenges are finding time to productively engage in transnational projects and—the biggest challenge of all—finding a complementary research partner. Sabbatical leave is very helpful, as are communications technologies that make collaborations efficient and effective, however, these tools are never a replacement for face-to-face meetings, which are essential for the creation of trust between individuals. Once trust has been established, only then can communication technologies, such as the internet, facilitate genuine collaboration. Scientific research is indeed a social enterprise involving people working and communicating together.

While individual faculty members may pursue projects abroad, they often lack institutional support. Universities should create incentives to promote more international collaboration in science research. Setting aside funding for international collaboration projects is one approach. Another approach might link research funding for collaboration with researchers in other countries. Mechanisms should be put in place to allow researchers sufficient freedom to pilot new ideas. Universities could host intramural annual forums for faculty members, bringing those experienced in the international context and international newcomers together to network at their own institution. All these approaches are important to facilitating international collaborations, which in turn can help enhance the excellence and productivity of research.

It Is People, and not Institutions, Who Work Together

In the end, collaboration occurs between people and not between institutions. Culture influences how people perceive the world, how they interpret what they see, and how they respond to the world as they see it. It is important to recognize, understand, and appreciate differences and commonalities of cultures. Nothing replaces immersion in other societies and cultures, for which longer-term international research stays are required. The development of faculty members becomes important in this context. Cultural factors shape the success or failure of international collaborations. People should be aware of the rules of politeness and etiquette, open approaches to information sharing, relationship, and trust building, and be willing to experience new things.

Cross-cultural collaboration, when it works, is synergistic, and brings understanding between partners that neither is likely to be able to develop alone. There are important habits that help make cross-cultural collaborations endure and thrive. These include flexibility, the ability to ask good questions, openness to others lines of thought, and to new information, curiosity, and the ability to discern patterns.

In the end, a lesson learned from my experience with international collaborations is that there are people in the world that know something, but nobody knows everything. International collaborations in science bring together and capitalize on the dispersal of knowledge and resources across the globe, and the human desire to advance knowledge.

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