

INTERNATIONAL CONTACT AND RESEARCH PERFORMANCE

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The scope of this article is to illuminate the relationship between degree of international contact and research performance among researchers in small countries. Comparisons are done between the natural, medical and social sciences, technology and the humanities. Three indicators on international contact are used: a) an index on contact frequency, b) type of conference attendance, and c) long-term research stays abroad. There is a relatively strong correlation between contact frequency and international publishing activity in all fields of learning. Researchers who were invited to present a paper by conference organizers were considerably more productive than those who gave a paper on their own initiative, and this latter group was in turn much more productive than those researchers who attended without papers. Contrary to other forms of contact, long-term research stays abroad have a very small independent effect on international publishing.

Introduction

Science per se is international, and contact between scientists across national borders has become an increasingly important part of research work. As *Stolte-Heiskanen*¹ has emphasized, "internationality" is, however, typically the concern of the scientific communities on the periphery, and the so-called international science is to a great extent the national science of the centers. *Ben-David*² has claimed that most of the research done in a small country must necessarily be mediocre. When small countries with limited intellectual resources try to cover all areas of research, one can not expect that they will be able to perform well in all these fields. He states, however, that mediocrity only becomes detrimental for a scientific system if countries with limited intellectual resources are isolated from the scientific centers. If they try to become autarchic in their research, they will inevitably drift towards dangerous mediocrity. The only way for small countries to avoid provinciality is to accept the fact that they are scientific provinces, and to make the best of this by attaching themselves closely to scientific centers.

In accordance with Ben-David's line of reasoning, in small countries close contacts with foreign scientists are regarded as more or less a prerequisite for doing good research. Informal contacts with colleagues in other countries give access to new information, results and ideas before they originate in print in journal articles or books. Especially in those disciplines where scientific developments are rapid, it is important to have access to information from fellow colleagues in order to cope with the research done at the frontiers.

So far, we have confined our discussion of internationality to *informal* scientific communication. It is, on the other hand worth noting that *formal* communication, writing and reading scientific literature, is the most important way to exchange ideas and results. Several studies show that scientists rank reading literature above personal contacts and conference attendance as a means to keep up to date with research.^{3,4} Do these results imply that the assumed importance of international contacts on an informal level is overestimated? This is not likely. While scientists have more or less equal opportunities to keep abreast with the published literature, important informal communication channels are much more restricted to certain groups within the scientific community. In addition, "membership" in informal research networks, so-called "invisible colleges" where information is exchanged through personal letters, telephone calls, electronic mail, informal meetings, and preprints, is supposed to have a stimulating effect on an individual scientist's performance level. A number of studies have also found that, in general, scientists who have broad contacts with fellow colleagues are more productive in scientific publishing than other researchers.⁵⁻¹¹

It is, however, not easy to ascertain to what extent research performance is affected by good and frequent communication with scientists abroad, or whether it is the prolific researchers who seek out and make contacts internationally. Two pairs of concepts may be fruitful in order to better understand the processes involved.

Cole and *Cole*¹² have used the concepts *awareness* and *visibility* to analyze the process of scientific communication. This involves the exchange of information between the producers of discoveries and an audience consisting of other scientists working in the field. Some scientists are more aware of or have a broader knowledge of important research and scientific networks and how to get in touch with them than others. Similarly, some researchers are more visible in the scientific community than are others due to their scientific achievements and location in the research system.

Olsen and *Svaasand*¹³ have used the concepts *motivation* and *attractiveness* to illustrate this process. In order to get information and contact with colleagues in

other research environments one condition is the motivation to seek such contacts. Another condition which has to be fulfilled is that one has to be attractive to other researchers in order to develop close relationships. The scientists involved need to have mutual interests to collaborate.

Awareness and motivation are related concepts as are visibility and attractiveness. However, motivation and attractiveness imply a more active process of communication than the other pair of concepts. Awareness is a basic condition for scientific communication, but the researcher in question must also be motivated to actively seek contact with colleagues. Furthermore, visibility is a basic condition for being potentially interesting to other scientists, but one also has to be attractive in order to be actively sought out by others.

Another important aspect of scientific communication is that much of the information which is exchanged seems to be unexpected for the receiver. Menzel¹⁴ has introduced the distinction between *planned* and *unplanned* communication in order to describe this process. In a study of American natural scientists he found that new ideas and results which come to the attention of researchers are not restricted to the information obtained when they intentionally gather information. Parts of it come to their attention in unplanned and unexpected ways during activities undertaken and on occasions sought out for quite different purposes. This aspect of informal scientific communication may also contribute to a better understanding of why participation in scientific networks seems to promote productivity in research.

The scope of this article is to illuminate the relationship between degree of international contacts and research performance among individual scientists in small countries. An important part of the study is to examine whether there are any differences between fields of learning in this respect by comparing the natural sciences, the medical sciences, the social sciences, technology, and the humanities.

On the basis of the preceding discussion we assume that the relationship between international contact and research performance is reciprocal. Awareness of research done at other locations, knowledge of scientific networks, and motivation, are prerequisites for the establishment of external communication, but visibility and attractiveness are equally important for the possibility of establishing close research relationships. In a way, this study is therefore also an inquiry of the relationship between formal and informal communication in science.

Data and methodology

The data are drawn from a 1992 questionnaire study among all faculty members of the rank of assistant professor or higher at Norway's four universities. The response rate was 69 percent. The field classification is done according to the guidelines for research statistics suggested by UNESCO.¹⁵

As an indicator on research performance we have used the number of scientific and scholarly publications, and as indicators on international contact an additive index of contact frequency, conference attendance, and long-term research stays abroad.

Number of scientific publications

In the questionnaire faculty members were requested to specify the number of publications in the three-year period 1989–91 on four categories;

- articles in scientific and scholarly journals,
- articles in research books, text books and conference proceedings,
- research books and text books,
- reports.

Faculty were instructed not to include abstracts, book reviews and articles in encyclopedias. Reports should only be included if they were part of a publication series.

In order to adjust for the effect of multiple authorship on the output variable, and to enable comparisons of productivity patterns across fields of learning and between individual researchers, a productivity index which takes account of type of publication and co-authorship was developed. All publications have been regarded as article equivalents. An article in a journal or book was given the value of 1, a book the value of 4, while a report received 1 point. In cases of co-authorship, the number of points according to whether the publication is an article, a book or a report has been divided by 2, irrespective of number of authors. To give full credit to all authors would have meant overestimating the productivity of researchers in those disciplines where joint authorship is normal, and would have distorted the pure effect of teamwork on scientific output.

The index thus measures the number of article equivalents produced during the three-year period 1989–91. Two measures of productivity have been applied: a) number of total article equivalents, and b) number of article equivalents published in a non-Scandinavian language. This has been done because we expect that

international contact has a greater effect on international than on domestic publishing.

Index of contact frequency

In order to have a uniform measure of international contact, we constructed an additive index of contact frequency. Through the questionnaire, data of the following forms of contact in 1991 were obtained:

- Conference attendance abroad;
- Study or research periods abroad;
- Guest lectures abroad;
- Evaluation work abroad;
- Research collaboration with foreign scientists.

Those who attended one conference or seminar abroad in 1991 were given one point, those who attended two were given two points, and those who attended three or more were given three points. The same procedure was followed with regard to the four other forms of contact.

Those researchers who score high on this index are assumed to have an extensive degree of scientific communication with colleagues in other countries, while those who score low are assumed to have little contact with researchers abroad. A methodological problem with this index is, however, that the variables included refer to the year 1991, while the publication data are from 1989–91. This means that the publications can not have been motivated by contact patterns in 1991. We assume however that international scientific communication is a relatively stable activity and that the pattern in 1991 is representative of a longer period of time.

Another weakness with this index is that it does not measure the quality of the various forms of international contacts, only the quantity. Communication can take place on a superficial basis or be a close working relationship between colleagues, and the ultimate consequences for productivity in publishing may be very different.

Conference attendance

The other indicator is conference attendance abroad in 1991. We have distinguished between two categories of scientists, "locals" and "cosmopolitans". "Locals" can be said to have the Norwegian scientific community as their audience, while "cosmopolitans" take the values and standards of the international scholarly community as a comparative frame of reference. "Cosmopolitans" can in turn be

divided into three groups; scientists who attend without presenting papers ("the tourists"), scientists who give papers on their own initiative ("the motivated"), and scientists who are invited to present papers by the conference organizers ("the attractive").

The variable conference attendance is thus given four values: 1) "the locals", 2) "the tourists", 3) "the motivated", and 4) "the attractive". The reason for this categorization is that we expect an increasing degree of international publishing going from group one to group four.

Long-term research stays abroad

Finally, we want to examine whether those scientists who have had at least one long-term research stay abroad (one term or more) during the period 1982–91 have a higher publishing activity than their colleagues without such a sojourn.

Results

International contact frequency and productivity

There is a clear correlation between number of contacts abroad and productivity in scientific publishing (Table 1), and this relationship gets even stronger when it comes to publishing in a non-Scandinavian language. This finding also holds for various age groups. There are surprisingly small differences between fields of learning, considering that faculty in the humanities and the social sciences publish most of their work in Norwegian.

Communication with researchers abroad is, as expected, much more important for international than for domestic publishing. In the natural sciences and technology there is no significant relationship between degree of international contact and publishing in Norwegian.

Conference attendance and productivity

The relationship between conference attendance abroad and scientific publishing is displayed in Fig. 1. The figure shows that those researchers who were invited to present papers by the organizers were considerably more productive than those who gave papers on their own initiative, and this latter group was in turn much more productive than those who attended without papers. This pattern holds for both total publishing activity as well as for international publishing, and for different age groups.

Table 1
The relationship between international contact and productivity, by field of learning (Pearson's r)

	Humanities	Social sciences	Natural sciences	Medical sciences	Technology	Total
Total number of article equivalents	0.37	0.42	0.33	0.39	0.43	0.35
Number of article equivalents in a non-Scandinavian language	0.40	0.46	0.35	0.44	0.56	0.42
Number of article equivalents in a Scandinavian language	0.20	0.23	0.03*	0.15	-0.01*	0.09
(N)	(316)	(267)	(567)	(292)	(148)	(1590)

* Not significant at the 0.05 level.

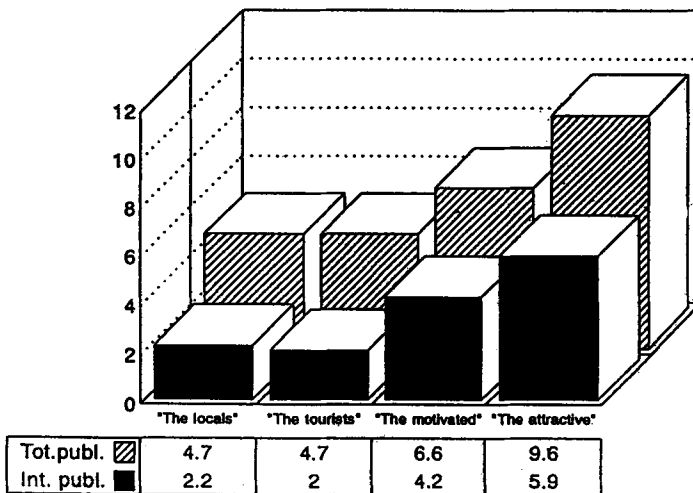


Fig. 1. Number of article equivalents per faculty member during the period 1989-91 by type of attendance in 1991

This difference could be expected considering that conference papers are often preliminary manuscripts which will later appear in print. Papers presented at conferences in 1991 can, on the other hand, not have been included to any substantial degree in the productivity measure which encompasses publications in the period 1989–91, because the printing time is often long, even for conference proceedings. Participation with papers at conferences in the year 1991 must, therefore, be taken as an indicator of a relatively stable and active international orientation.

Figure 2 displays the relationship between conference attendance abroad and international publishing by field of learning. We see that in all fields "the attractive" are more productive than "the motivated", who in turn publish more than "the tourists". However, in the social, natural, and medical sciences "the locals" publish more internationally than "the tourists".

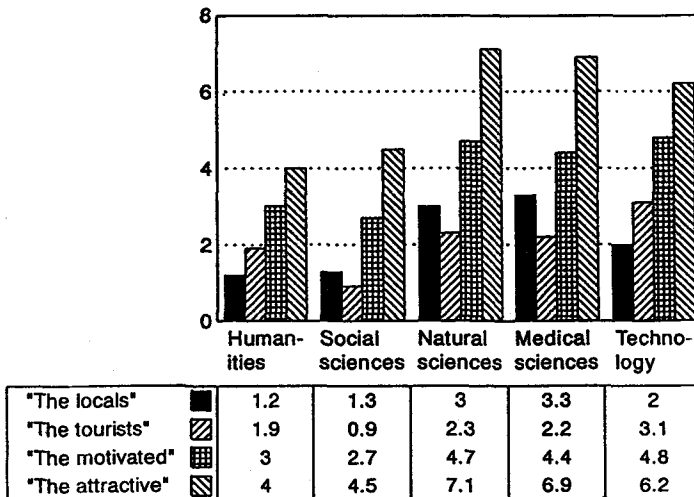


Fig. 2. Number of article equivalents in a non-Scandinavian language per faculty member during the period 1989–91 by type of attendance and field of learning

Table 2
 Number of article equivalents per faculty member during the period 1989-91 by field of learning and long-term research stay abroad or not during the period 1982-91

	Humanities		Social sciences		Natural sciences		Medical sciences		Technology		Total	
	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Stay abroad?												
Total number of article equivalents	6.3	8.2	6.3	8.2	5.1	5.9	7.3	7.9	4.8	6.4	6.1	7.0
Total number of article equivalents in a non-Scandinavian language	1.5	3.1	1.8	3.2	3.4	5.1	3.8	5.3	3.2	4.7	2.7	4.4
(N)	(150)	(166)	(130)	(137)	(176)	(391)	(147)	(145)	(53)	(95)	(656)	(934)

Long-term research stays and productivity

The evidence of a positive relationship between international contact and scientific productivity is strengthened when looking at the effect of long-term research stays abroad. The differences in performance level between those who have had such a sojourn and those who have not are, however, less than we found with respect to conference attendance. If we assume a causal relationship between research stays abroad and productivity, the effect is very small on the total output of publications, but strong on international publishing (Table 2). This tendency holds for different age groups as well as for the various fields of learning. However, the effect of research stays abroad on international publishing is somewhat stronger in the humanities and the social sciences than in the natural and medical sciences and technology.

Research stays, international contact and productivity

To what degree then do we find a relationship between research stays abroad, international contact, and productivity? Not unexpectedly, those who have had a long-term professional stay in a foreign country have a broader contact pattern with colleagues abroad than do those who have not had such a stay. The bivariate correlation between long-term research stays and international publishing is 0.19. When we control for degree of international contact, we find only a weak partial correlation (0.10) between research stay abroad and publishing in a non-Scandinavian language. There are only minor differences between the various fields of learning. On the other hand, we find a relatively strong partial correlation (0.39) between degree of international contact and publishing in a foreign language controlled for research stay abroad. (The bivariate relationship between international contact and publishing in a non-Scandinavian language is 0.42). This tendency holds for all fields of learning. This means that long term professional stays in foreign countries have a very small independent effect on productivity in international publishing. If such stays are not followed up by keeping in touch with foreign colleagues, there are virtually no differences in productivity between those with stays abroad and those who have spent their careers exclusively at Norwegian universities.

Discussion

Our study shows that there is a relatively strong correlation between contact frequency, active conference participation and international publishing in all fields of learning. There are, however, some differences between the humanities and the social sciences on the one hand, and the natural and medical sciences and technology on the other. First, differences in degree of international publishing between "the locals" and "the attractive" are larger in the former than in the latter fields. Second, the effect of research stays abroad on publishing in a non-Scandinavian language is somewhat stronger in the humanities and the social sciences than in the natural and medical sciences and technology.

These differences between fields can be explained by the fact that the three latter fields are more cosmopolitan than the former ones. In the natural and medical sciences and technology, publishing in international journals is the norm, while in the humanities and the social sciences local orientation and publishing in Norwegian is common. It could, therefore, be expected that in these two fields it is much more difficult and less motivating to publish in an international language for those who have spent their entire academic life at Norwegian universities, and who in addition do not participate actively at international conferences. One reason could be greater language problems due to the essayistic style of articles in these fields, but probably more important is that a long-term research stay abroad and conference participation make it easier to establish contacts with foreign researchers and thus have the international research community as a reference group. Though this is also important in the natural and medical sciences and technology, we would assume that it is a greater challenge for a researcher in the humanities and the social sciences, who has not had a professional stay in another country, to start publishing in a foreign language, than it is for their colleagues in other fields.

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