

## French Research: Citation Analysis Indicates Trends Are More Than Just a Slip of the Tongue

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French articles published in 1978 and covered in the *Science Citation Index*® were studied. Citations to these "source" items from 1978 to 1982 were compiled. Results were compared to an earlier analysis for 1973 articles, which indicated that French research was declining. The new data indicate that significant changes have occurred. French researchers publish in English more than ever before. And concomitantly, they cite English (international) literature more extensively than heretofore. While French researchers recognize the importance of English as the *lingua franca*, French clinicians continue to rely on their local journals and other media for new information.

In 1976 an article I published in *La Recherche* proved to be somewhat of a *cause célèbre*. Using data from the *Science Citation Index*® (*SCI*®), I demonstrated through citation analysis that French science appeared to be "provincial," if not actually in decline.<sup>1</sup> At the time, a symptom of the "crisis" was the refusal of the French-language establishment to recognize the need to publish in English in order to reach an international audience.

French scientific literature was generally of low impact. By publishing their research solely in French, leading French researchers would possibly never attain the international recognition they deserved and could, in fact, risk oblivion. Publishing in English is necessary if researchers want their works to reach the largest number of researchers. However, publishing in the vernacular is important for reaching clinicians, some technicians, the public, and the media.

In 1978 another citation analysis of French literature appeared in *Current Contents*® that examined the citations to 1973 articles from 1973 to 1976. With a few exceptions, the best of French research was published outside of France and in English.<sup>2</sup>

As part of an overall country-by-country study, we obtained more up-to-date citation

data. Using that database, we examined the fate of 1978 French articles covered in the 1978 *SCI*. Citations to those articles from 1978 to 1982 were compiled. As before, we obtained our data from the *SCI*, so only articles and references that were cited in journals covered in the *SCI* were included. In 1978 the *SCI* covered approximately 2,600 journals, and, as readers know, these included significant, high-impact journals. But clearly, if we added more French-language journals, their absolute citation counts would be increased somewhat. However, this would not be significant for international comparisons.

As was the case in our recent study of Japanese science,<sup>3</sup> our analysis here is an aggregate analysis meant to show (1) where France stands in relation to the rest of the world; (2) who are citing the French and vice versa; (3) in what language(s) French researchers publish; and (4) how the situation has changed since our last report.

### France vs. the Rest of the World

In order to define the parameters of this study, an article was categorized as "French" if the first author's address was located in France. To avoid confusion, I will

**Table 1: Top seven countries, ranked by the number of source items in the 1978 *SCI*<sup>®</sup>.** Data represent 1978-1982 *SCI* citations to the 1978 *SCI* source items.

Country	1978 Items	Percent of 1978 Items	1978-1982 Citations	Percent of 1978-1982 Citations	Five- Year Impact	Cited Items	Percent Cited
US	171,231	44.1	975,632	52.6	5.7	95,541	55.8
UK	34,926	9.0	181,915	9.8	5.2	21,144	60.5
FRG	24,124	6.2	107,375	5.8	4.5	13,942	57.8
USSR	21,158	5.5	31,574	1.7	1.5	8,772	41.5
Japan	20,810	5.4	83,834	4.5	4.0	13,357	64.2
France	17,314	4.5	73,329	4.0	4.2	10,501	60.7
Canada	16,054	4.1	78,324	4.2	4.9	10,163	63.3
<i>SCI</i> Totals	388,276	100.0	1,856,836	100.0	4.8	222,699	57.4

use the terms "French-authored" to define such articles and "French-language" to differentiate articles written in French.

Using the above criteria, we found that of the nearly 389,000 source items in the 1978 *SCI*, 17,300 (4.5 percent) were French-authored (Table 1). Of these, approximately 61 percent (10,500) accounted for all of the citations (73,300) to French articles from 1978 to 1982, leaving 39 percent uncited.

US articles accounted for 171,230 (44 percent) of the 1978 file. Of these, only 95,540 (56 percent) were cited. (We have not analyzed here the many different types of source items.)

The UK was next, but not a close second, with nearly 35,000 (9 percent) of the 1978 *SCI* file. In terms of global comparisons, France ranked sixth in the number of citations received during 1978-1982. However, France was second in publications and citations for continental countries in Western Europe, with the Federal Republic of Germany being first (Table 2).

#### France's Strengths and Weaknesses

In the international research arena it is important to know not only national outputs but also the areas or disciplines in which countries excel in their research efforts. In what areas did France concentrate? Table 3 shows the annual output of French authors by discipline. Data were compiled from a series

of articles by Tibor Braun and colleagues, Information Science and Scientometric Research Unit, Library of the Hungarian Academy of Sciences, Budapest.<sup>4,6</sup> They based their studies on 1978-1980 *SCI* source data and 1979-1982 citation data.

Their methodology was explained in our analysis of Japan.<sup>3</sup> The "Percent Share" column in Table 3 represents the percentage of the world's papers in each field that France published. The three different citation rates are observed, or actual (Obs.); expected, or average for journals (Exp.); and relative (Rel.). A relative rate of 1.00 indicates that a group of articles was cited as often as would be expected, based on the impact factors of the journals containing these articles.

From 1978 to 1980 France published mainly in the life sciences (approximately 32,400 articles). Physics was second with nearly 10,800 articles. However, the average annual output in the life sciences declined by 1.08 percent during this period, while that for physics rose by 3.19 percent. Chemistry was third in output with just about 8,650 articles, which accounted for an annual decline of 0.47 percent in this field. Mathematics had the lowest output and showed the largest average annual decline (-30.52 percent). In all fields except mathematics, the observed citation rate was lower than the expected citation rate.

In light of recent developments, it will be interesting to observe whether these trends

**Table 2: The 1978 source items from continental Western Europe.** Continental countries in Western Europe, ranked by the number of source items in the 1978 *SCI*<sup>®</sup>.

Country	1978 Items	Percent of 1978 Items	1978-1982 Citations	Percent of 1978-1982 Citations	Five-Year Impact	Cited Items	Percent Cited
FRG	24,124	40.9	107,375	35.6	4.5	13,942	57.8
France	17,314	29.3	73,329	24.3	4.2	10,501	60.7
Italy	6,309	10.7	24,969	8.3	4.0	3,747	59.4
Switzerland	5,572	9.5	34,122	11.3	6.1	3,203	57.5
The Netherlands	5,327	9.0	32,568	10.8	6.1	3,445	64.7
Belgium	3,075	5.2	15,761	5.2	5.1	1,897	61.7
Austria	2,215	3.8	6,005	2.0	2.7	1,118	50.5
Spain	1,665	2.8	4,262	1.4	2.6	931	55.9
Ireland	692	1.2	1,613	0.5	2.3	351	50.7
Greece	504	0.9	1,268	0.4	2.5	329	65.3
Portugal	114	0.2	466	0.2	4.1	67	58.8
Monaco	11	0.0	68	0.0	6.2	9	81.8
Luxembourg	4	0.0	0	0.0	0.0	0	0.0
Liechtenstein	1	0.0	0	0.0	0.0	0	0.0
Totals for Western Europe	59,029	100.0	301,806	100.0	5.1	39,540	67.0

change. France is channeling significant new resources into AIDS research, an area just about unknown during this study period. In a report in *Nature*, Peter Coles, staff writer, disclosed that the National Center for Scientific Research (CNRS); the Health and Medical Research National Institute (INSERM); the Pasteur Institute, Paris; and several small groups were allocated 100 million French francs (approximately US\$17 million) by the French science ministry for AIDS research.<sup>7</sup> This boost in research funding and efforts should surely precipitate more papers in the life sciences. And the fact that Frenchman Jean-Marie Lehn, Louis Pasteur University, Strasbourg, and

College of France, Paris, shared the Nobel Prize in chemistry with Charles J. Pedersen, formerly of E.I. du Pont de Nemours and Company, Wilmington, Delaware, and Donald J. Cram, Department of Chemistry, University of California, Los Angeles, may have a positive effect on chemistry's position now that attention is drawn to this discipline. Lehn and his prizewinning work were the topic of a recent essay.<sup>8</sup>

#### Who Are Citing the French?

We next looked at citations to and from French-authored articles and the number of 1978 articles written by French authors pub-

**Table 3: Publication fields of French authors.** Field-by-field breakdown for 1978-1980 *SCI*<sup>®</sup> source items with primary author addresses in France. The three citation rates are: observed (actual), expected (average for journals), and relative (correlation between observed and expected). Data are derived from the two following years of 1978-1982 *SCI* citations to each source year. (The table is based on articles by T. Braun in *Scientometrics*.<sup>4,6</sup>)

Field(s)	1978-1980 Items	Percent Share	Citation Rates			Percent Annual Change in Productivity
			Obs.	Exp.	Rel.	
All	58,015	5.17	2.32	2.37	0.98	2.24
Chemistry	8,645	5.54	2.59	2.74	0.94	-0.47
Life Sci.	32,417	5.21	2.18	2.22	0.98	-1.08
Physics	10,779	5.97	2.97	3.07	0.97	3.19
Mathematics	1,641	5.66	0.71	0.67	1.06	-30.52

**Table 4: Citation patterns of French articles.** Countries that cited or were cited by articles with primary author addresses in France and the number of 1978 articles they published with primary author addresses in France. Data represent 1978-1982 *SCI*<sup>®</sup> citations to the 1978 *SCI* source items.

Country	Citations to French Articles	Percent of Total	Citations from French Articles	Percent of Total	1978 Items Published
France	28,708	39.2	28,708	30.3	7,338
US	17,393	23.7	35,494	37.4	4,082
UK	5,561	7.6	7,414	7.8	1,800
FRG	3,592	4.9	4,186	4.4	830
Japan	2,330	3.2	2,733	2.9	66
Canada	2,031	2.8	2,800	3.0	115
Italy	1,484	2.0	1,148	1.2	81
USSR	1,453	2.0	650	0.7	108
The Netherlands	1,176	1.6	1,446	1.5	1,540
Switzerland	1,024	1.4	1,576	1.7	646
Sweden	866	1.2	1,408	1.5	32
Belgium	803	1.1	893	0.9	65
Australia	797	1.1	1,118	1.2	19
Israel	523	0.7	792	0.8	16
Poland	504	0.7	312	0.3	12
Denmark	460	0.6	770	0.8	254
All Others	4,624	6.3	3,391	3.6	310
Totals	73,329	100.0	94,919	100.0	17,314

lished in each country (Table 4). (The last column is provided for comparative purposes. It breaks down the 17,300 or so articles according to the countries where the journals containing the articles were published.)

Not surprisingly, French authors cite French articles more than authors from any other country. But France only accounts for 39 percent of all citations to French-authored articles. Authors from the US are second in citing French-authored articles, with nearly 17,400 citations, which is about 24 percent of the 1978-1982 citations to these articles.

#### Whom Are the French Citing?

French authors cited more 1978 source items from the US than they did from France (35,500 compared to 28,700, respectively) (Table 4). In terms of percentages, US articles received about 37 percent of the nearly 95,000 citations from French authors while French articles received just over 30 percent. The number of citations to articles in English is not unusual if we consider the size

of the scientific population that can be cited. While the number of US articles accounts for nearly half of the 1978 coverage of the *SCI* (Table 1), French authors cite the US only one-third of the time. Indeed, while French-authored articles represent just about 5 percent of the 1978 file, they received about one-third of French citations (Table 4).

#### Following the Trends

Some interesting patterns are evident when language data are investigated.

**Table 5: Source languages.** Languages of 1978 *SCI*<sup>®</sup> source items and the percentage of citations each group received in the 1978-1982 *SCI*.

Language	Percent of Items	Percent of Citations	Five-Year Impact
English	88.5	96.4	5.2
Russian	3.9	1.0	1.2
German	3.8	1.5	1.9
French	2.6	1.0	1.8
Japanese	0.4	0.1	0.7
All Others	0.8	0.1	0.5

**Table 6: Languages used by French authors.** Languages of 1978 *SCI*<sup>®</sup> source items that had primary author addresses in France.

Language	Items	Items Cited	Percent Cited	1978-1982 Citations	Five-Year Cited Impact	Total Five-Year Impact
English	8,900	5,895	66.2	57,608	9.77	6.47
French	8,349	4,578	54.8	15,636	3.42	1.87
German	54	27	50.0	84	3.11	1.56
Russian	8	1	12.5	1	1.00	0.13
Spanish	3	0	0.0	0	0.00	0.00
Totals	17,314	10,501	60.7	73,329	6.98	4.24

French-language articles account for 2.6 percent of the 1978 *SCI* coverage, yet they received only 1 percent of the citations from 1978-1982 (Table 5). As Table 6 indicates, French authors published more articles in English (approximately 8,900) than they did in French (8,350). This is a major change from our last study.<sup>2</sup> In 1973 French authors published 13,000 articles in French and 4,400 articles in English. Expressed in percentages, 75 percent of the 17,400 French-authored papers published in 1973 were published in the French language and only 25 percent in English. In 1978 48 percent were published in French and 51 percent in English. As more recent data confirm, this trend has continued, as can be seen for 1982 and 1986 in Figure 1.

Similar trends were reported by Joan K. Swinburne, National Institute for Research in Dairying, Reading, UK, who analyzed citations from 1958 to 1980 to papers published by French and British researchers in endocrinology and the biochemistry of lactation and reproduction. Swinburne pointed out that in 1968 the French group published in French 100 percent of the time; in 1972, just four years later, only 27 percent of their papers were in French, with the rest in English!<sup>9</sup>

We next found that of the 8,900 French-authored 1978 articles written in English, 5,900 (66 percent) were cited, receiving approximately 57,600 citations. The five-year cited impact for these articles is 9.77. In contrast, of the 8,350 articles pub-

**Table 7: Citations to French authors.** The 1978-1982 *SCI*<sup>®</sup> citations to 1978 source items in French by citing author address.

Country	Citations	Percent of Total
France	9,767	54.5
US	2,025	11.3
UK	1,105	6.2
FRG	690	3.9
Belgium	528	3.0
Canada	475	2.7
Switzerland	401	2.2
Italy	362	2.0
USSR	290	1.6
Japan	278	1.6
The Netherlands	214	1.2
Spain	153	0.9
Sweden	151	0.8
Australia	124	0.7
Poland	114	0.6
All Others	1,232	6.9
Totals	17,909	100.0

lished in French, 4,600 (55 percent) were cited over the same five-year period and received 15,650 citations. The average five-year impact for these is 3.42, over one-third of the impact of the articles in English (Table 6).

It is not unexpected that French authors produced 54.5 percent of the citations to 1978 French-language articles (Table 7). It also comes as no surprise that French authors cite literature in English and other languages. However, it is surprising that the citation rate has reached nearly 90 percent (Table 8). Only 10 percent of citations from

**Table 8: Citations from French authors.** The 1978-1982 *SCI*<sup>®</sup> citations from items with primary author addresses in France to 1978 source items by language of cited articles.

Language	Citations
English	84,478
French	9,767
German	522
Russian	117
Japanese	18
Spanish	9
Italian	5
Czech	1
Hungarian	1
Polish	1
Totals	94,919

French authors were to French-language articles.

In an editorial in *Journal des Maladies Vasculaires*, editor-in-chief C. Olivier recalls counting the number of references in an issue of *Journal des Maladies Vasculaires*. Of 371 references, only 79 (21 percent) were in French; 270 (73 percent) were in English. But Olivier does not applaud this recent development. Rather, he warns French readers that "This suicidal attitude towards medical research in our country [France] must be done away with."<sup>10</sup> It is not clear whether he believes French researchers are delinquent in citing French colleagues or is unaware that it is inevitable that research of multinational relevance must cite work outside of France. Without considering the microstructure of French biomedical research, 21 percent would be high unless the French emphasize vascular disease more than other countries' researchers.

### Publication Output

Although France's publication productivity declined by 2 percent from 1973 to 1978, it rose by 20 percent from 1978 to 1982 (Table 9). In Figure 1 we have provided a comparison of French papers for three years (1978, 1982, and 1986) in the *SCI* database.

The cross-hatched area of each bar shows the number of papers published by French authors in French. This has remained relatively constant for the last decade.

Several different trends are evident from the graph, however. First, the number of papers coming from France seems to be increasing at a steady rate. More French authors are publishing their papers in non-French (mainly English) languages (11,454, 16,165, and 22,190 for 1978, 1982, and 1986, respectively). The number of papers published in French from non-French authors (those with addresses outside France) is decreasing (from nearly 5,450 in 1978 to 3,900 in 1986).

These trends are particularly interesting considering that in 1982 Jean-Pierre Chevènement, Minister of State for Science and Industry, while acknowledging that it is advantageous to use English in international communications, wrote to the leading French scientific organizations and asked that their members "systematically" publish in French. He argued that "French scientific culture must be based on the French language."<sup>11</sup>

Reactions among French scientists to Chevènement's request were mixed. Although Alfred Kastler, 1966 Nobel Prize winner in physics, agreed with Chevènement in theory, he pointed out that if French scientists published in French, then they must accept the fact that their works would not be read by the international scientific community.<sup>11</sup> As Bernard Dixon, European editor of *THE SCIENTIST*<sup>®</sup>, recalls, apart from the obvious handicap of the reduced likelihood of citations, French scientists indicated that there was often no obvious French equivalent to technical terms coined by US scientists. As a result, the French were encouraged to use terms such as *le logiciel* in place of *le software*, and *le matériel* in place of *le hardware*.<sup>12</sup>

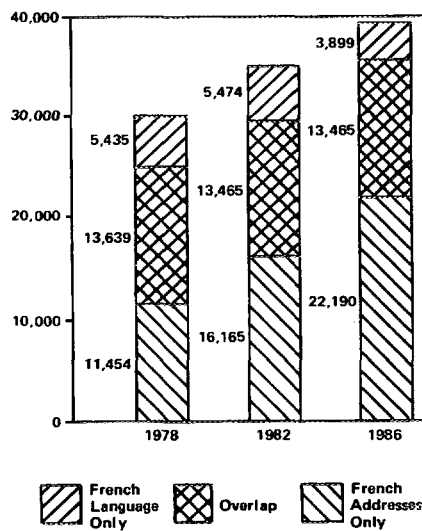
While France's productivity decreased during 1973-1978, the 20 percent increase during 1978-1982 (see Table 9) exceeded the average *SCI* 1978-1982 increase of 14 per-

**Table 9: National publication productivity.** National publication productivity, 1973-1978 and 1978-1982, by primary author address of *SCI*<sup>®</sup> source items.

Country	1973 Items	1978 Items	Percent of Change, 1973-1978	1982 Items	Percent of Change, 1978-1982
US	151,939	171,231	13	181,450	6
UK	32,728	34,926	7	39,695	14
USSR	24,715	21,158	-14	23,403	11
FRG	20,137	24,124	20	27,900	16
France	17,707	17,314	-2	20,795	20
Japan	15,569	20,810	34	28,657	38
Canada	15,362	16,054	5	17,200	7
Totals	353,248	388,276	10	443,755	14

cent. During this same period, there was a 20 percent increase in French articles in the *SCI* database. This is particularly important since the coverage of French journals in the *SCI* from 1978 to 1982 decreased from 140 to 119 (-15 percent). Although the journal coverage from 1973 to 1978 had increased by 9 percent, article output had decreased by 2 percent (Table 9).

**Figure 1: French papers in the *SCI*<sup>®</sup> database.** The overlap of source items in French with source items with author addresses in France is illustrated for three different years.



### Have Things Changed?

The picture is indeed different from that in my last analysis. French scientists seem to have implicitly acknowledged that English is, in fact, now the international language of science, if not in other areas of international activity. In his editorial, Olivier states that "the English language, let us not forget, brings together not only those for whom it is the national language, but also all countries for which it represents the common language of medical expression."<sup>10</sup>

French authors are now publishing more articles in English than ever before. This is quite a significant change. Our 1973 data showed that we covered three times as many French-language articles as English-language articles published by French authors. Of the 17,400 French-authored 1973 *SCI* source items, 75 percent were published in French and 25 percent in English. Other languages were comparably negligible.

In 1978 48 percent were in French while 51 percent were in English. Figure 1 substantiates this trend for current years. The number of French-language articles by French authors has remained relatively constant while the number of non-French-language articles by these authors continues to increase over the years. That nearly 90 percent of the citations from French authors were to English articles is also a dramatic change from our previous study.

The French may indeed be trying to change some of these trends, however. The following quotations from "Instructions to authors" (effective June 1, 1987), published in English and French for *Comptes Rendus de l'Académie des Sciences*, illustrate the point. Under the section "Languages used and presentation," it states:

Notes for the *Comptes Rendus* are usually published in French.... However, a "Note" may be *bilingual* and include an "Abridged English Version" of at least one but not more than two printed pages, which refers to the figures, tables and bibliographical entries.... Foreign authors may submit a "Note" written in English (other languages using latin characters may be accepted upon request), on condition that they include an Abridged French Version of at least one page, which refers to the figures, tables and bibliographic entries....<sup>13</sup>

It seems as though the editors of *Comptes Rendus* are trying to encourage French scientists to publish their research in English. Guy Ourisson, professor of chemistry and former president, Louis Pasteur University, and an active member of the Académie des Sciences, points out that although the "impact is still negligible on *Comptes Rendus*...surely this is in the right direction."<sup>14</sup>

#### How Things Stand Now

While it is obvious that French researchers are changing the language of their research, what about the research itself? The need to publish research in English certainly does not overshadow the need for high-quality research to report. What kind of research is coming out of France?

Chemist Pierre Piganiol, who was the first delegate general for scientific and technological research under Charles de Gaulle, paints a picture of French research in his book *La Recherche Mal Menée*,<sup>15</sup> which was reviewed in *THE SCIENTIST* by Alexander Dorozynski, science writer and editor,

Paris.<sup>16</sup> Piganiol claims that the creativity of French research is declining because state-supported research has become too isolated from industry and too centralized. Researchers are discouraged from physical and intellectual mobility. Piganiol fears that much of the French government's research budget will be directed to a few spectacular projects.

However, Ourisson contends that only part of what Piganiol claims is correct. Ourisson agrees wholeheartedly with Piganiol in saying that French research is too centralized. However, he argues that the claim that research is too isolated from industry is no longer true, and actually has not been the case for the past 10 years.<sup>14</sup>

Ourisson contends that

The *major* visible change in the everyday life of a biologist, a chemist, [or] a physicist in France has been, in the last ten years, that he now knows his industrial counterparts, cooperates with them, gets contracts, places his students in their [industry's] labs, [and] even works in "mixed labs," with industrial groups localized in university/CNRS buildings, or with CNRS researchers localized in industrial research labs. Consultantships are extremely widespread. In many institutes, cooperation with French, European, US, or Japanese industry is thriving.<sup>14</sup>

He cites as a cogent example his personal involvement as chairman of the Scientific Committee of the Rhône-Poulenc Group, in which such well-known academic chemists as Jean Rouxel, Pierre-Gilles de Gennes, Claude Helene, and Lehn act as scientific directors.<sup>14</sup>

Coles, like Piganiol, claims that efforts in French science are geared toward "keeping up appearances" by becoming involved in expensive, European, big-science projects without being financially prepared for such commitments. Coles pointed out that the inside picture of France is really one involving "political turmoil, cuts in basic science and budgetary sleight of hand."<sup>17</sup> Like many other European countries, France rec-



ognizes the dominance of the US and Japan and realizes that it must invest in research and development if it is to remain a competitor.

The situation is not all bad, however. There is one encouraging sign. Industrial research in France has been increasing annually by 6.5 percent for the past few years.<sup>16</sup>

So we see that things have changed in the French research scene and are continuing to do so. Future analyses will show how the

picture is progressing. Our next report will cover the literature for 1983 and draw upon the *SCI* data for 1983-1987.

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