

# Mapping the Literature in Forensic Sciences: A Bibliometric Study of North-American Journals from 1980 to 2005

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**Abstract:** The present study was designed to describe the evolution of forensic literature in North-American journals over more than 25 years. From 1980 to 2005, the number of articles per year and the average number of authors per article have both increased almost twofold, while the relative contribution of other countries in comparison to the United States has increased from 19.2% to 61.0%. The contributions to the forensic literature of anthropology and biology/DNA have significantly increased, while the contribution of questioned documents and ballistics decreased. Finally, the number of studies using the scientific method has significantly increased through the years, passing from 10.5% to 40.7%. This better knowledge of our body of literature as a whole could help us assess our strengths and weaknesses, and help us to position ourselves on literature ethical issues.

**Keywords:** Literature, bibliometrics, north-america, forensic sciences, ethics, authorship.

## INTRODUCTION

Bibliometric studies have increasingly been used over the last few years [1]. These studies are useful to understand the evolution of literature or trends in particular fields [2-9] or within a geographical area [10-18]. However, in forensic sciences, bibliometry has barely been used yet. As a matter of fact, Jones is the only author to have worked on bibliometric analysis of forensic science literature [19-21]. His interesting work was mainly focused on most highly cited articles, most prolific authors and impact factors.

The present study was designed to describe the evolution of forensic literature in North-American journals over more than twenty-five years. More precisely, it will draw a picture of our literature and describe developments and trends regarding numbers of authors per article, represented countries and international collaborations, fields of forensic sciences, types of articles and use of the scientific method. This improved knowledge of our body of literature as a whole could help us assess our strengths and weaknesses, and help us to position ourselves on literature ethical issues.

## MATERIALS AND METHOD

The two North-American leading journals in forensic sciences were selected: the Journal of Forensic Sciences and the American Journal of Forensic Medicine and Pathology. All articles published in these journals over 5-year intervals from 1980 to 2005 were retrospectively analyzed, excluding editorials, guest editorials, tributes and book reviews. For each article, the following features were compiled: number of authors, author's country and international collaboration, related field of forensic sciences and type of article.

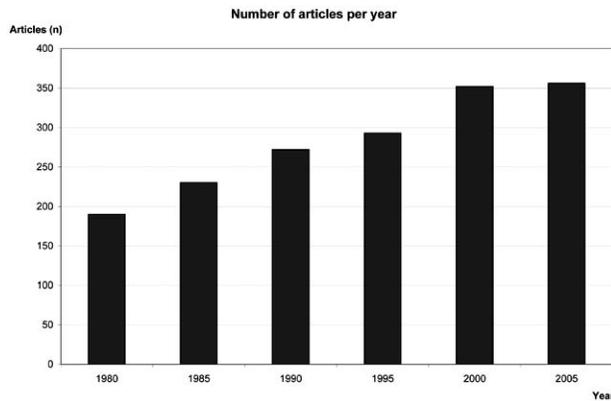
Furthermore, it was assessed if the article was using or not the scientific method, with testing of hypotheses by statistical analysis.

A total of 1693 articles were examined: 1252 articles from the Journal of Forensic Sciences and 441 articles from the American Journal of Forensic Medicine and Pathology. One article was excluded from the evaluation of the number of authors because it was written by a corporation. For the author's country, articles written by authors from two different countries were counted as belonging to both countries. In some rare cases, the author's country was not mentioned, the latter articles being excluded for this feature. Related fields of forensic sciences were classified into 10 categories: anthropology, ballistic and forensic firearms examination, biology/DNA, chemistry, pathology and legal medicine, psychiatry and psychology, odontology, questioned documents, toxicology and others. As for article type, this was classified into 8 categories: case report, case series, historical overview, letter to the editor, original study, review article, technical note and others. For the purpose of this study, it was decided that case reports were reports of a single case, while reports of two or more cases were considered to represent case series. Finally, an article was considered to use the scientific method if we could find hypotheses tested by statistical analyses, with a degree of statistical significance (such as Student's t-test, ANOVA, Chi-square test, linear regression). The SPSS 15.0 software was used to perform statistical analyses at a threshold of significance of 5%. Mean values were compared using analysis of variance, while proportions were compared through Chi-square tests.

## RESULTS

The number of articles per year has progressively increased in both North-American journals (Fig. 1). From 190 articles in 1980, the number of articles per year has

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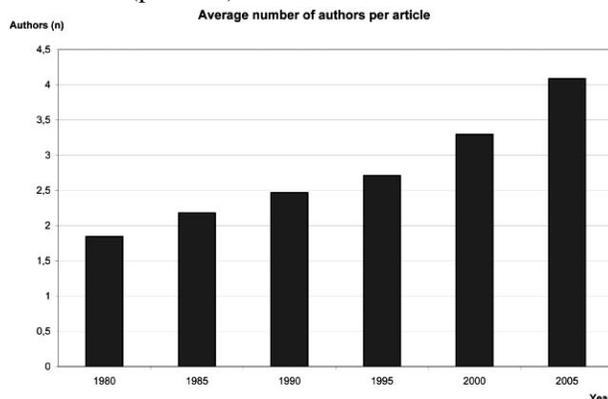


**Fig. (1).** The number of articles per year from 1980 to 2005.

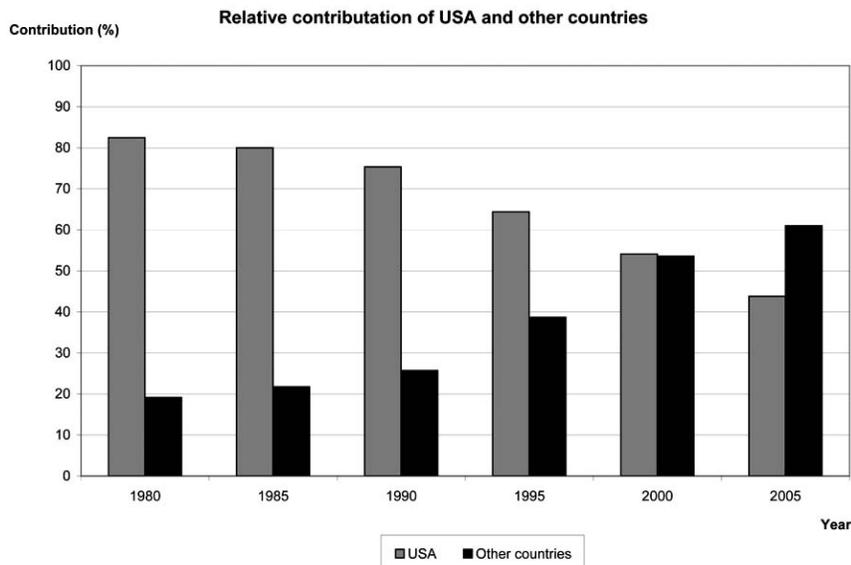
reached 356 in 2005. Therefore, over the 25-year interval, the number of articles per year increased almost twofold.

### Number of Authors

The average number of authors per article has progressively increased over the last twenty-five years (Fig. 2). As a matter of fact, the average number of authors has passed from 1.9 in 1980 to 4.1 in 2005, increasing by more than twofold ( $p < 0.001$ ).



**Fig. (2).** The average number of authors per article from 1980 to 2005.



**Fig. (3).** The relative contribution of other countries in comparison to the United States from 1980 to 2005.

### Author's Countries

In terms of author's countries, the relative contribution of other countries in comparison to the United States has increased through the years (Fig. 3). Indeed, from 1980 to 2005, the relative contribution of other countries has significantly increased from 19.2% to 61.0% ( $p < 0.001$ ). The contribution over the years of the 10 most active countries apart from United States is further analyzed in Table 1. Three countries are particularly active in their contribution to the North-American literature, producing on average more than 10 papers per year since the nineties: United Kingdom, Canada and Japan. Those active countries were joined in 1995 by two others: Australia and Germany. These latter countries are also producing more than 10 papers per year since the mid nineties. However, in the last years, a new player has surpassed all other countries. China is now a major contributor to our literature, producing 45 papers in 2005.

### International Collaborations

More often than not, articles published in the study period were written without international collaboration. Nevertheless, as presented in Fig. (4), the percentage of articles written with some form of international collaboration has significantly increased from 1.6% to 10.4% from 1980 to 2005 ( $p < 0.001$ ).

### Fields of Forensic Sciences

The evolution of the contribution of each individual field to the forensic literature over time is presented in Table 2. While biology/DNA and anthropology have significantly increased their contribution to the forensic literature over the years ( $p < 0.05$ ), ballistics and questioned documents significantly decreased theirs ( $p < 0.05$ ). As for chemistry, odontology, pathology and legal medicine, toxicology, psychiatry and psychology, their contribution to the forensic literature stayed relatively stable.

### Types of Article

The evolution of the types of articles over time is presented in Table 3. Technical note was the only type of

**Table 1. The Contribution Over the Years of the 10 Most Active Countries Apart from United States**

	1980	1985	1990	1995	2000	2005	Average
<i>United Kingdom</i>	7	5	10	14	21	18	12
<i>Canada</i>	4	5	12	14	21	18	12
<i>Japan</i>	3	7	14	11	15	13	10
<i>Australia</i>	0	4	6	14	20	16	10
<i>Germany</i>	1	2	5	11	13	17	8
<i>Italy</i>	0	4	6	4	16	19	8
<i>China</i>	0	0	3	0	2	45	8
<i>Israel</i>	7	1	0	4	12	5	5
<i>Spain</i>	0	2	3	7	11	9	5
<i>France</i>	0	1	4	6	9	6	4

articles showing a significant increase from 1980 to 2005 ( $p < 0.05$ ). On the other hand, historical overviews, letters to the editor and review articles demonstrated a significant decrease ( $p < 0.05$ ). No statistical differences were observed for case reports, case series and original studies ( $p > 0.05$ ).

#### Scientific Method

The number of studies using the scientific method has also significantly increased through the years (Fig. 5). Indeed, articles using the scientific method has passed from 10.5% to 40.7% from 1980 to 2005 ( $p < 0.001$ ).

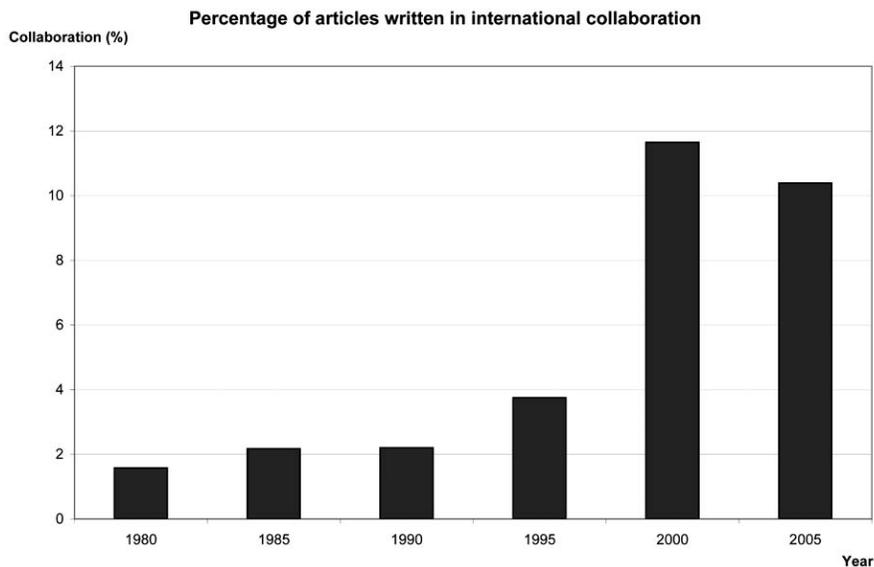
#### Study Limitations

This study is limited to two North-American leading journals in forensic sciences: the Journal of Forensic Sciences and the American Journal of Forensic Medicine and Pathology. Papers published in other journals are not compiled here.

#### DISCUSSION

On the 25-year interval covered in this study, the number of articles per year in forensic sciences in leading North-American journals increased almost twofold. This could be considered a good indicator of research vitality. Another indicator of the increasing vitality and quality of research in forensic sciences is the significant augmentation of the number of papers using the scientific method.

Particularly active contributors to our literature are biology/DNA (35.7% of papers in 2005), pathology and legal medicine (25%) and toxicology (10.7%). Coming to no surprise, while contribution of pathology and legal medicine as well as toxicology stayed relatively stable over time from 1980 to 2005, the contribution of biology/DNA increased, passing from 8.4% in 1980 to 35.7% in 2005. This expansion of the number of papers in biology/DNA is certainly to correlates with the tremendous growth in the use of DNA evidence in crime scene investigation over the same period.



**Fig. (4).** The percentage of articles written in collaboration from 1980 to 2005.

**Table 2. Evolution of Individual Fields in the Forensic Literature from 1980 to 2005**

Fields	1980	1985	1990	1995	2000	2005	<i>p</i> -value	Increase / Decrease
	%	%	%	%	%	%		
Biology/ DNA	8.4	9.1	12.5	16.0	25.0	35.7	<0.05	
Anthropology	2.6	4.8	4.0	7.5	4.3	8.4	<0.05	
Chemistry	7.9	7.0	9.2	6.1	2.8	5.3	>0.05	=
Odontology	2.1	3.9	4.0	2.0	1.4	1.7	>0.05	=
Pathology and Legal Medicine	28.9	36.1	32.0	31.7	32.7	25.0	>0.05	=
Toxicology	15.8	19.1	21.3	17.1	17.0	10.7	>0.05	=
Psychiatry and psychology	3.7	6.1	1.5	4.4	5.1	2.2	>0.05	=
Ballistic	4.7	1.7	4.8	4.1	4.5	1.7	<0.05	↓
Questioned Documents	7.4	3.0	2.2	2.4	0.6	3.1	<0.05	↓
Other	18.4	9.1	8.5	8.5	6.5	6.2	<0.05	↓

**Table 3. Evolution of Types of Articles from 1980 to 2005**

Types	1980	1985	1990	1995	2000	2005	<i>p</i> -value	Increase / Decrease
	%	%	%	%	%	%		
Technical Note	28.4	22.6	23.2	29.7	35.2	49.7	<0.05	
Original Study	20.0	23.9	20.2	22.9	18.8	24.2	>0.05	=
Case Report	11.6	22.6	20.6	22.2	17.9	13.8	>0.05	=
Case Series	4.7	8.3	7.0	5.5	10.8	4.8	>0.05	=
Historical Overview	8.9	3.0	0.7	0.7	1.1	0.6	<0.05	↓
Letter to the Editor	8.4	10.0	16.5	10.2	9.7	3.4	<0.05	↓
Review Article	8.4	8.7	11.0	6.8	3.7	3.1	<0.05	↓
Other	9.5	0.9	0.7	2.0	2.8	0.6	<0.05	↓

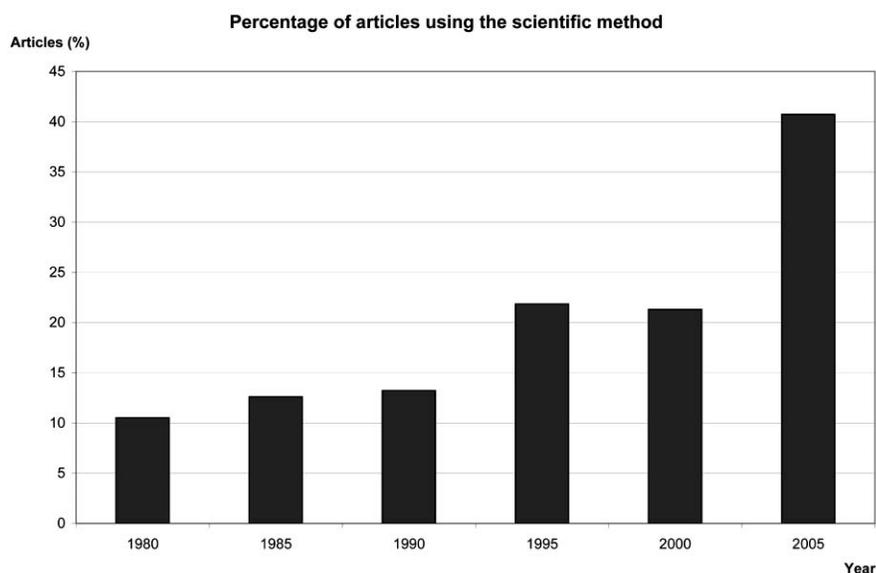
Interestingly, anthropology also significantly increased their contribution, almost reaching the level of toxicology. However, ballistic and questioned documents seem to be, nowadays, less active players in the forensic literature. For those two fields of forensics, this may be a warning sign. Without research work, a science is in danger of becoming a technique.

In the last 25-years, not only the relative contribution of countries outside United States to the North American forensic literature has tripled, but the percentage of articles issued from international collaboration has increased more than sixfold. This increase in international collaboration could also be considered a good indicator of research vitality. As a matter of fact, international scientific collaboration has been proven to be an efficient mean to advance research and to enhance publication capacity [4, 22]. It has been proposed that there are two types of co-authors: the globals and the locals. The globals, who appear

to co-author with individuals outside their own group, are a small group of highly productive scientists. The locals, on the other hand, constitute the larger group of lower-rank authors who are limited in their formal collaboration [22]. Therefore, international scientific collaboration may not only advance research but also serve as a mechanism to increase visibility and authorship of the highly productive [22].

The participation of China to the North-American forensic literature has increased tremendously in the recent years. From less than 5 articles per year before 2000, China has produced 45 papers in 2005. This new importance of China in the forensic literature is in keeping with the new economical and political position of this emerging country.

In the last 25-year, the average number of authors per article has doubled in North-American forensic science. This significant augmentation in the average number of authors per article is not specific to our field and was also observed in other fields such as physiology [23], dermatology [24] and



**Fig. (5).** The number of studies using the scientific method from 1980 to 2005.

obstetrics and gynecology [25]. In fact, this seems to be a generalized trend in science, as demonstrated by Shaban in a study of authorship in prestigious journals from 1950 to 2005: number of authors per article increased over time in a linear fashion while the number of single-author articles decreased [26]. Several authors have discussed the authorship ethical issues related to this situation [23, 27]. The worth of authorship was questioned [27-33] and groups such as the International Committee of Medical Journal Editors have deliberated on the qualifications and contributions necessary to be listed as an author [34]: "Authorship credit should be based on: 1) substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) drafting the article or revising it critically for important intellectual content; and 3) final approval of the version to be published. An author should meet conditions 1, 2, and 3."

Establishing authorship requirements is an important step in the fight against the dubious practice of gift authorship. Gift authorship correspond to a senior researcher or colleague included among the authors without significant contribution to the experiments or the writing of the manuscript [27, 35].

However, though we fully agree with the importance to avoid gift authorship, we think that the augmentation of average number of authors per article could impart positive aspects. First of all, to work as a team may increase the productivity of research work. Furthermore, team work is a mandatory element of multidisciplinary work, an important aspect of forensic sciences. Also, an effort to reduce the number of authors per article could unfortunately mean a lesser recognition of student work. For example, on the present paper, only the first author has fulfilled all conditions of authorship as proposed by the International Committee of Medical Journal Editors [34]. The other two authors are summer research students that compiled data (condition 1 without conditions 2 and 3). However, though they don't have the scientific maturity to fulfill all the authorship conditions, I would not feel comfortable to dismiss their

work. Considering the amount of work implied, would it be fair to ignore their contribution? Would mentioning their name in an acknowledgment be enough? Personally, although I fully understand the importance to be cautious with the concept of authorship, I would not feel comfortable putting their work under my sole name, especially in the name of ethic.

Maybe a solution to this dilemma of avoiding gift authorship while allowing recognition of student's work would be to apply authorship requirements on a spectrum of progressive contribution over time. Therefore, the expected contribution of a senior author could be to fulfill all authorship conditions, while the contribution of a junior author could be restricted to one or two conditions.

## CONCLUSION

Study of forensic literature in leading North-American journals reveals good indicators of research vitality: an increase in the number of articles per year, in the number of papers using the scientific method, in the relative contribution of countries outside United-States to the North American forensic literature and finally, in the percentages of articles issued from international collaboration. However, the average number of authors per article has doubled in North-American forensic science in the last 25-year. This raises several ethical concerns.

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