

**BOOKS VS. JOURNAL ARTICLES: A DIACHRONIC
STUDY OF REFERENCING IN WRITTEN MEDICAL ENGLISH
PROSE (1810-1995)**

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Abstract

The objective of the present paper is to examine the qualitative and quantitative diachronic evolution of references made to books and journal articles and that of their linguistic origin over a 185 year-period. We analyzed a corpus of 162 medical articles published in 34 different British and American medical journals between 1810 and 1995. The results obtained were grouped according to the 4 distinct year-blocks identified in our previous study (Salager-Meyer, 1996a). Between-block comparisons were performed by means of Chi-square tests. Our global results showed that: a) English-written (E) sources were more frequently cited than sources written in other languages (NE); b) journal articles were also more frequently referred to than books, and c) E journals were more frequently cited than NE journals. The quantitative and qualitative differences put forward by our data are analyzed and discussed within a social-constructivist perspective. The diachronic evolution observed over the 185 years studied reflects how the birth and growth of medical specialties and sub-specialties have influenced referencing behavior as well as the changing role journals and books have played over time as knowledge sources.

Key-words: *references; sources; books; journal articles.*

Resumo

O objetivo do presente trabalho é examinar a evolução diacrônica qualitativa e quantitativa das referências feitas a livros e artigos publicados em revistas e sua origem lingüística, abrangendo um período de 185 anos. Analisamos um corpus de 162 artigos médicos publicados

*This research was supported by Grant N° M-565-96 from the Consejo de Desarrollo Científico, Humanístico y Tecnológico (CDCHT) of the Universidad de Los Andes (Mérida, Venezuela), and N° S1-95000878 from the Consejo Nacional de Investigaciones Científicas (CONICIT). A shorter version of this paper was presented at the V Latin American ESP Colloquium, Mérida, Venezuela, November 1996.

em 34 diferentes revistas britânicas e americanas entre 1810 e 1995. Os resultados obtidos foram agrupados em quatro blocos distintos, de acordo com o ano de publicação, identificados em estudo anterior (Salager-Meyer, 1996a). As comparações entre os blocos foram realizadas através de testes de chi-quadrado. Os resultados globais apontam que: a) fontes escritas em inglês (I) foram mais freqüentemente citadas do que fontes escritas em outras línguas (NI); b) artigos de revistas também foram referidos mais freqüentemente do que livros; e c) revistas I foram citadas mais freqüentemente do que revistas NI. As diferenças qualitativas e quantitativas apontadas por nossos dados são analisadas e discutidas com base em uma perspectiva socioconstrutivista. A evolução diacrônica verificada no período de 185 anos estudado é um reflexo de como o nascimento e crescimento de especialidades e sub-especialidades médicas têm influenciado o comportamento de se fazer referências, bem como o papel que as revistas e livros têm exercido como fontes de conhecimento através dos tempos.

Palavras-chave: referências; fontes; livros; artigos de revistas científicas.

1. Introduction

Two trends - which have drawn closer applied linguists and subject specialists - have characterized recent LSP studies and have been the focus of a growing body of research over the past decade. The first one is related to the increasing interest in contrastive rhetorics (e.g., Leki, 1991; Mauranen, 1993; Fox, 1994; Ventola and Mauranen, 1996; Mauranen, 1996; see also the special issue of ASp on *Langue de Spécialité et Culture* 1994), particularly as regards professional genres such as the research paper (Birch, 1994; Belcher and Braine, 1995; Berkenkotter and Huckin, 1995). The second trend is concerned with social aspects of the historical development of scientific discourse and is referred to as the "social-constructionist" or "constructivist" movement (cf. Giddens, 1979; Bazerman, 1988 and 1990; Latour, 1987; Myers, 1990; Swales, 1990; Berkenkotter et al., 1991), the fundamental tenets of which are 1) that societal development is a determining factor in the changing of textual patterns, and 2) that persistence and change in the social system are both reflected in the text and brought about by means of text. In other words, determining factors of linguistic change are intimately linked to and brought by the social, historical, cultural and economic context in which discourse is produced. As Swales and Feak put it (1995: 81): "...

scientific facts are not 'out there' to be collected, but are constructed via the consensus of particular communities." It can then be seen that the social-constructivist movement has clear similarities with the sociosemiotic theories put forward by Halliday (1977, 1978) according to which there exists a mutual determination between language and society in the sense that one system (language) redounds with the other (social context) and *vice versa*. In the words of Halliday and Martin (1993: 24): "... language construes, is construed by and (over time) reconstrues and is reconstrued by social context."

Among the most notable research that has been carried out within the above mentioned social constructivist movement and has been concerned with the diachronic development of *English* scientific discourse, we can cite the work of Bazerman (1984, 1988) who analyzed spectroscopic papers published between 1893 and 1980 in the *Physical Review* and articles published in *The Philosophical Transactions of the Royal Society of London* from its founding in 1665 to 1800; the research carried out by Atkinson (1992) in medical papers published in the *Edinburgh Medical Journal*; that of Dudley-Evans and Henderson (1993) who report on the heterogeneous textual development of economic articles published between 1891 and 1980 in the *Economic Journal*; that of Valle (1993) who studied the evolution of papers published between 1711 and 1870 in the *Philosophical Transactions of the Royal Society*, and that of Gläser (1994, 1995) who conducted a diachronic comparison between the presentation of 'normal science' (Kuhn, 1970) in the first edition of the *Encyclopaedia Britannica* (1771) and the reprinted issue of its fifteenth edition (1992).

Other research - mainly that carried out by the Research Group on Discourse in the Professions from the University of Uppsala in Sweden - deals with the diachronic evolution of English and Swedish literature in the fields of economics, medicine and technology (Melander, 1992 and 1994; Melander and Näslund, 1993; Gunnarsson, 1988, 1991, 1992, 1994, to cite just a few). Others (e.g., Ylönen, 1993) have characterized German medical research reports from 1884 to 1989 as a paradigm-and media-dependent activity.

Despite this increasing interest in the history of scientific rhetoric, diachronic changes in intertextual referencing - itself a strong indicator of a text's reliance on background knowledge - has not been dealt with in a systematic fashion. This is despite the fact that, as Valle

(1995) expresses, citation behavior is a pragmatic feature central to the modern academic world and to the scientific enterprise (scientists need to refer to previously published texts in order to present their claims and discuss scientific knowledge), and a useful tool for the historian of a particular discipline (Swales, 1986)¹. We must, however, give credence to the diachronic LSP studies mentioned in the previous paragraph, most of which indeed mention the question of intertextuality, but do so either on a very general level or by studying a corpus drawn from a single source. As far as I am aware, two papers only deal *exclusively* with the problem of intertextuality from a diachronic standpoint. I am firstly referring to Ellen Valle's study (1995) which examined that specific issue in articles published between 1710 and 1870 in *The Philosophical Transactions of the Royal Society of London*, and secondly to our own research of the quantitative and qualitative evolution of intertextuality and referential behavior in medical English and French papers published between 1810 and 1995. Broadly speaking, the results of our study showed that: a) on the basis of the frequency of reference citing, the 185 years studied could be divided into 4 distinct year-blocks, viz., 1810-1859; 1860-1909; 1910-1949 and 1950-1995 (Salager-Meyer, 1996a)²; b) it is in the early 1950's that the most striking and dramatic increase in reference frequency occurred, and c) referential patterns used and favored in 19th century papers both quantitatively and qualitatively differ from those used and favored in 20th century medical discourse (Salager-Meyer, 1996b).

2. Purpose

The data reported here were gathered as part of the larger above mentioned study on the diachronic evolution of English and French written medical discourse. The objective of the present paper is to analyze, over a 185 year-period, the quantitative and qualitative evolution

¹ There is a large body of knowledge on citation analysis, but it mainly refers to *modern* scientific writing. We can cite, for example, the works of sociologists of science (Meadows 1974, Meadows and O'Connor 1971, Gilbert 1977, Myers 1990), applied linguists (Dubois 1987, Swales 1986 and 1990, Banks 1994), psychologists (Bavelas 1978) and information scientists (Cronin 1981).

² It is important to bear in mind that these 4 blocks had **not** been pre-established before undertaking the mentioned study (Salager-Meyer 1996a), but had been determined *a posteriori* by the results obtained.

of references made to books and journal articles as well as the development of their linguistic origin (or language of publication) - i.e., whether the sources referred to were originally written in English (E) or in languages other than English (NE). These questions will be examined and discussed within the social-constructivist perspective, the basic characteristics of which I mentioned earlier. It is my contention indeed that a meticulous examination of the evolution of references made to books and journals in English medical prose as well as the study of their language of publication will reveal important features about the structural development of medical science and of the medical community at large. As Bazerman (1988: 154) indeed suggests: "Studies of 19th century scientific writing would do well to take on the question of changing institutions of intertextuality". Furthermore, I believe that, because of the characteristics of its corpus (see Section IV below), the present research will complement and expand the diachronic studies mentioned in the Introduction of the present paper.

The first hypothesis on which this research is based is that important quantitative and qualitative differences in the frequency of references made to books *vs.* journal articles and in the linguistic origin of the sources cited will be evidenced over the 185 years studied. It is also assumed that the evolution observed (if any) will be relatively "smooth" and gradual, this surmise being based on the fact that both Fye (1987) and Atkinson (1992) claim that, although it is undeniable that the literature of medicine has evolved through the centuries, many features of that literature have remained remarkably stable for decades.

3. Corpus and methods

Because medical journalism has exercised a strong influence for the advancement of medical science and education (Fye, 1987), we decided to select journal articles (and not textbook sections) as our primary source materials. The characterization presented in the following *Results and Discussion* section is then based on the analysis of 162 randomly chosen articles written in English and published in 34 different medical journals from 1810 to 1995. Articles were taken from 1810 and thereafter at 10 year-intervals up to 1995 (the last period, 1980-1995, covers 15 years), each decade being made up of 9 articles. The articles chosen in this manner totalled 297,535 running words. Although the question of how many articles to include in studies of this kind is always a difficult one, I consider that the corpus under study is large enough to

reveal major trends. Finally, in order to have an accurate representation of the data distribution, it was decided to use full length papers (instead of a given length of text) as our basic unit of analysis.

The following text-types were included in the linguistic sample under study:

1. Medical articles typical of 19th century medical discourse, such as:

1.a. Narratives of single cases or disease that were then called "extracts from a letter to ...", "clinical lectures and remarks on ...", "clinical illustrations of ...", or "cases of ...". All these were somewhat similar in function to present day "case reports", the "quintessential medical portrait," as Reiser (1991: 984) puts it (cf. also Salager-Meyer, 1992).

1.b. Summation of knowledge about specific conditions that, according to the journals, were entitled "annual addresses" or "annual speeches", "Gulstonian" or "Croonian" lectures or simply "lectures" or "courses of lectures on ...". These papers were quite similar in communicative function to present-day review papers.

1.c. Experimental reports which started appearing in the closing years of the 19th century.

2. Medical articles more typical of 20th century medical literature, e.g.:

2.a. Original research papers;

2.b. Survey articles or review papers;

2.c. Editorials and

2.d. Case reports.

Book reviews and journal articles such as discussions of ethical and/or sociological aspects of medical practice, of salary and work conditions, etc. were excluded. The source journals, both American and British, were in the main generalist rather than specialist medical periodicals. Here are a few titles of 19th century medical journals: *The New England Journal of Medicine and Surgery and the Collateral Branches of Science conducted by a number of Physicians*, *The Lancet*, *New Orleans Surgical and Medical Journal*, *Transactions of the Medical Society of the State of New York*, *The Edinburgh Medical and Surgical*

Journal, Society Proceedings, Boston Medical and Surgical Journal, New England Medical Gazette. Among the 20th century medical periodicals, we can cite: *The Journal of the American Medical Association (JAMA), Archives of Internal Medicine, Annals of Internal Medicine, International Medical Digest, The Lancet, The British Medical Journal.*³

The total number of references to journal articles and books was recorded in each article along with the respective language of publication (E vs. NE) of the works referred to. When it was not possible, because of lack of information, to determine either the linguistic origin or the nature of the sources cited (i.e., whether it was a book or a journal article), the reference was labeled "undocumented reference" (UnR). Table 1 provides examples of such vague and undocumented allusions to fellow physicians/scientists. These were cited as such, i.e., without any further sort of documentation such as a book title, a journal's name or a journal article title. Very rarely was a year of publication indicated.

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1. Richerand, Dupuytren and Roux have each given brilliant written directions by which articulations may be found. (1823)
 2. It was first resorted to by Mrs. Jean Gibson and Michel Pillier. (1834)
 3. This has been recorded by the eminent Mr. Guthrie of Toulouse. (1856)
 4. The elaborate chamber constructed by a most brilliant surgeon, Mr. Pettenkofer in 1863, and his important inquiries with Professor Voit into the respiration of man should be placed on the record. (1869)
 5. In 1864, the distinguished Dr. C. Speck published very elaborate papers on respiration. (1871)
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Table 1: Examples of Undocumented References
(the date following each example indicates the year of publication of the article from which the example was drawn)

The frequency of occurrence of UnR references and of references to books and journal articles (i.e., their percentage over the total number of references cited) was then computed per decade as well as

³ A complete list of the 162 articles analyzed can be obtained by writing to Françoise Salager-Meyer, Apartado 715. Mérida. 5101. Venezuela.

the frequency of reference to E and NE sources. The results thus obtained were grouped according to the 4 blocks identified in our previously mentioned study (Salager-Meyer, 1996a), referred to here as Block I (1810-1859), Block II (1860-1909), Block III (1910-1949) and Block IV (1950-1995).

The obtained data were then analyzed using non-parametric C^2 tests for contingency tables to determine whether statistically significant between-block differences were observed. In order to enhance the internal validity of the present study, the data were recorded and analyzed in a sample of 30 medical articles by two applied linguists and a medical doctor (specialist informant), all fluent readers of English. Inter-rater reliability was .84.

4. Results and discussion: global and block-discriminated findings

4.1 Global results

Figure 1 displays the percentage of references made to undocumented sources (UnR), books and journal articles written in English (E) and in languages other than English (NE). These percentages are expressed in relation to the total number of sources referred to in the whole corpus over the 185 years studied.

Figure 1 indicates that E journals are by far the most frequently cited type of reference ($p = .0001$ when compared to all the other types of sources referred to). Figure 1 also shows that, as a whole, E journals were significantly more frequently cited than NE journals ($p = .0001$), as were journal articles with respect to books ($p = .0001$) and E sources in comparison to NE ones ($p = .0001$). By contrast, the difference observed between the percentage of reference to E books *vs.* that of NE books cited in the whole corpus was not significant ($p = .09$). Our data finally indicate that UnR references make up 12% of the total number of references cited in the whole corpus.

The two following factors can account for the significantly greater number of references made to journals than to books in our corpus as a whole:

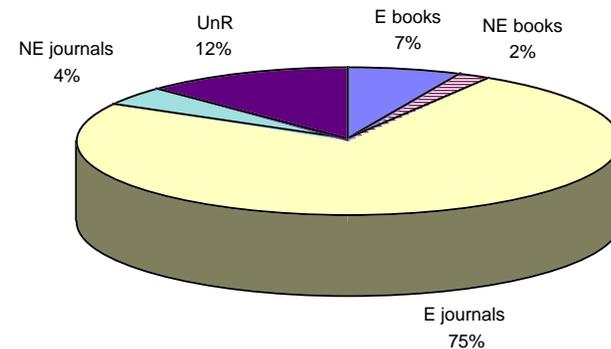
- 1) The linguistic sample studied was made up of journal articles (not books), the main and fundamental objective of which is to

transmit the latest (sometimes controversial) scientific knowledge, i.e., to update their readers' knowledge in a given field of expertise. In order to do so, authors of journal articles more frequently refer to other journal articles than to books, whose basic communicative function is, by contrast, to transmit well-established and (supposedly) unquestionable knowledge.

2) Books are only published once (sometimes with 1 or 2 re-editions, although one of the references cited in a 1995 article was the 36th edition of a book on anatomy published in 1986), whereas most medical journals are published periodically (on a weekly or monthly basis). In 1989, for example, Lock estimated that in the field of medicine alone there were about 25,000 journals, i.e., the equivalent of about 2.000.000 papers published per year. Eriksson (1983) also reports that journals were 5 times as numerous in 1950 as in 1900.

The significantly greater amount of E sources vs. that of NE sources can be readily explained by the fact that the linguistic corpus studied was made up of British and American journal articles only. It would be interesting to know to what extent this proportion would vary had we examined a linguistic sample made up of, say, journals edited in France, Spain, Germany, China or Russia. My own occasional readings of medical and linguistic journals edited in France and Germany indicate that references to E sources are somewhat less numerous in these journals than in journals edited in English-speaking countries. On the contrary, references to articles written in languages other than English tend to be more frequent in journals edited in countries where English is not the dominant language than in countries where it is.⁴

⁴ In the field of medicine, I am referring to journals such as *Archives des Maladies du Coeur et des Vaisseaux* edited in France, *Acta Cardiologica* edited in Belgium, a journal that publishes articles written in French, English and German. In the field of linguistics, this is clearly evidenced in *AS.p. (Anglais de Spécialité)*, a journal edited in France that deals with the teaching of English for Specific Purposes and publishes articles written in French (generally written by French-native speakers) and in English (written both by English and French native speakers), or as *FINLANCE*, a linguistic journal edited in Finland that publishes papers written in English and German. But suffice it to read linguistic papers written in English or German by German scholars to understand my point: their authors refer to articles written in German which are hardly ever cited in articles written on very similar topics by their native English counterparts.

Figure 1**Overall Distribution of Cited References
in the Whole Corpus (1810-1995)**

NE: sources written in languages other than English
 UnR: undocumented references
 E: English-written sources

4.2 Block-discriminated findings: diachronic evolution of cited sources and of their linguistic origin

Figure 2 displays the diachronic evolution of the sources cited per year-block (UnR references, books and journal articles) regardless of their language of publication.

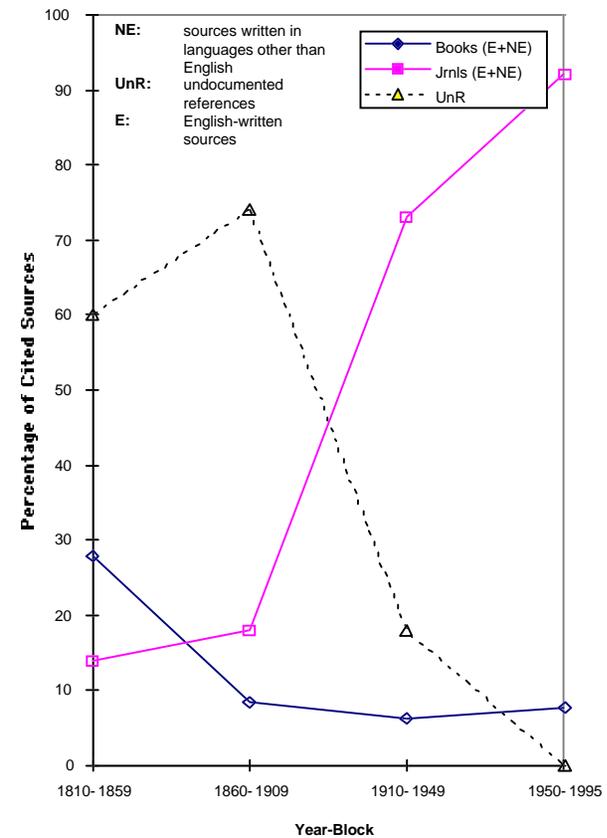
4.2.1 Undocumented references (UnR)

As explained elsewhere (Salager-Meyer, 1996b) and as Figure 2 clearly illustrates, UnR references were one of the most important marker of intertextuality referencing throughout the 19th century: 60% of the total number of cited sources in Block I and 74% in Block II (the observed increase is nonetheless not significant). When comparing the frequency of occurrence of these UnR references to that of documented sources (books and journals) in the 19th century, the results of the

statistical tests performed indicate that the former are significantly more frequent than the latter ($p = .04$ in Block I and $p = .0001$ in Block II). UnR references then sharply and significantly decrease in Block III ($p = .0001$ when compared to their frequency of occurrence in the previous Block) and disappear entirely in Block IV.

It is of interest to note that the few examples of undocumented references found in early 20th century medical articles appeared in medical editorials only, whereas they were encountered in all the articles in the 19th century, regardless of text-type.

Figure 2:
Diachronic Evolution of Cited Sources
 (undocumented references, books and journal articles)
 per Year-Block (1810-1995)



These undated and undocumented references were typical exponents of an individually, privately-based and non-specialized medicine and of a small, non-professionalized and "visible" scientific community. (I borrowed this very accurate expression - which means "the fellow physician next door"- to Dudley-Evans and Henderson 1993). They also reflect the absence of an explicit codified system of scientific documentation. This lack of precision with respect to cited sources contrasts sharply, however, with the extreme precision with which authors used to refer to other researchers at that time. Indeed, not only were the cited surgeons'/physicians' surnames mentioned, but so were their first names preceded by a polite and genteel "Mr." or "Professor", sometimes followed by their place of work, and generally accompanied by laudative, flattering and courteous adjectives (see Table 1). Perhaps by citing well-known scientists in such hyperbolic terms, writers were trying to make their study more persuasive.

The sharp and significant decrease in the frequency of UnR references in the closing years of the 19th century can be accounted for by the fact that it is precisely at the end of that century when the most famous reservoirs of the world medical thought, such as the *Index Medicus* and the *Index Catalogue of the Library of the Surgeon's General Office*, were developed. The timely creation of these indexes of the literature of scientific and clinical medicine then allowed physicians to gain access to the rapidly growing medical literature of the world, and to cite other researchers' works with greater precision and accuracy.

The above quantitative finding corroborates the results obtained by Valle (1993) in 18th century biological texts and by Gläser (1994) in early papers published in the *Encyclopedia Britannica* who both report that writers by then did not consider it necessary to specify cited sources with precision, thus taking for granted the readers' familiarity with the authorities cited. Now, as Valle (1991: 262) remarks, "whether this is because the field was still small enough for the writer to assume that his addressees would know the reference or because the apparatus for academic and scholarly documentation was not yet sufficiently developed remains an open question," although it is very likely that both factors have exerted an influence on the way scientists in general used to refer to their colleagues at that time.

A qualitative feature of these undocumented references stands in contrast with a characteristic noted by Bazerman (1988) in references from 19th century *physics* papers. Indeed, Bazerman reports that, by the closing years of the 19th century, physicists did not place their claims/observations in a larger body of knowledge and that the sources cited rarely related to specific findings or to specific topics investigated by the author, i.e., they were only loosely related to the reported research. By contrast, the UnR recorded in our 19th century medical sample are indeed quite closely related to the work being described: they mainly refer to surgical procedures performed, successful or unsuccessful treatment administration and/or experiments carried out by fellow physicians. In other words, what Gunnarsson (1994: 895) called the "on-going debate" among scientists was reflected even in our early texts. But this debate was based more on the physicians' personal experience and observation - or on that referred to by colleagues or renowned physicians - than on a body of "de-personalized" knowledge, accumulated over time through systematic and rigorous observation and experimentation.

4.2.2 References to books and journals (all languages combined)

Our documented data indicate that references to books in general fell sharply from Block I to Block II ($p = .001$). They then keep declining slowly until 1995. By contrast, references to journal articles - which exhibit a slight increase from Block I to Block II - rose significantly from Block II to III ($p = .0001$). They keep increasing between 1949 and 1995 (from 73% to 92% of the total number of references cited) but in a non-significant fashion. This suggests that the diverging behavior of references to books vs. journals took place during Block III.

Our data also indicate that references to books were significantly greater than those to journal articles but *in Block I only* ($p = .02$), i.e., during the first half of the 19th century. In Block II, journal articles started outnumbering references made to books, although the difference is, statistically speaking, "borderline" ($p = .06$). By contrast, from the turn of the 20th century on, journals have always been much more frequently resorted to than books ($p = .0001$ in both Blocks III and IV), thus suddenly and steadily imposing themselves as the primary and almost exclusive means of communicating medical research findings.

When comparing the frequency of reference to books recorded throughout the 19th century (Blocks I+II) to that recorded throughout the

20th century (Blocks III+IV), our data reveal that the difference observed is "borderline" ($p = .06$). A highly significant difference, however, was observed ($p = .0001$) between the frequency of reference to journal articles recorded during the 19th century (Blocks I+II) and that recorded during the 20th century (Blocks III+IV). This means that over the 185 years studied, the relatively low frequency of reference to books as knowledge sources has been quite stable - although it was slightly more elevated during the 19th century -, whereas references to journal articles dramatically increased over time. It is likely, however, that the importance of books as reference sources in *19th century papers* is underestimated in the present study because UnR references - the characteristics of which, as I said before, precluded us from determining whether the source cited was a book or a journal article - accounted for the great majority of the sources cited throughout the 19th century (see 4.2.1 above). It is highly probable indeed that a great proportion of these UnR references corresponded to books rather than to journal articles.

We can then infer from the above mentioned quantitative data that in the first half of the 19th century books kept interacting with the emerging medical journals - e.g., *The New England Journal of Medicine* founded in 1812 and *The Lancet*, first launched in 1816⁵ - as a means of communicating medical information, but from the 1860's on, journals started displacing books to a secondary place. As early as 1876, Billings indeed explained that medical journals, rather than textbooks or monographs had been the main vehicle for transmitting new knowledge since the mid-19th century. This led the prominent Boston physician and pioneer of public health, Henry Ingersoll Bowditch, to declare in 1902 that "... modern science does not let any book remain long useful" (1902: 146). He obviously did not mean that there was no book literature, but simply that books go out of date quickly.

Not only were important quantitative differences observed in the evolution of the frequency of reference made to books when compared to that made to journal articles, but qualitative differences also were put to the fore by our data. Indeed, most of the books cited in early 19th century

⁵ America's first medical journal, *The Medical Repository*, appeared in 1797, and the oldest English-language medical journal still in existence is *The Edinburgh Medical Journal* which was launched in 1733 (Atkinson 1992). On the other hand, the first English scientific periodical, *The Philosophical Transactions of the Royal Society of London*, was founded in 1665 by Oldenburgh (see Kronick 1976 and Bazerman 1988, and footnote 4).

medical papers were clinical lectures (e.g., *Lathan's Clinical Lectures on Diseases of the Heart*, published in 1840), treatises (e.g., *Treatises on Specific Conditions*, published in 1850; *Treatise on Fractures*, written by Hippocrates), textbooks (e.g., *Pathological Anatomy, The Nature of the Treatment of Cancer, Heart and Lungs*), encyclopedias (e.g., *Encyclopedia of Practical Medicine*, published in 1850). In the closing years of the 19th century and in the first decades of the 20th century, the situation evolved quite significantly. Indeed, a close look at the titles of the books referred to at that time clearly indicates they gradually became accessory, second-hand research tools which either fulfilled what we could label a "dictionary function", or were used as non-medical consultation sources in such fields as statistics, geography and/or history (e.g., *Statistical Methods, Clinical Ethics*) or as knowledge sources for meta-analytic research (reviews, up-to-date handbooks). Moreover, and as we approach the closing decades of the 20th century, the books cited are also international conference / workshop proceedings, unpublished dissertations, government / World Health Organization / Surgeon General / committees' reports and/or bulletins. Over time, then, not only have books been less and less consulted as reference sources, but they also evolved from being a fundamental research/knowledge tool to becoming a second-hand bibliographical source.

As I said before, references to journal articles dramatically increased from 1910 on, precisely when specialization and subspecialization in medicine gained momentum as a response to economic and intellectual forces especially in American society (cf. 4.2.3 below). As a consequence, a demand rose for specialty and sub-specialty journals, and research-oriented journals as well as biomedical research in general increased dramatically (Salager-Meyer 1996 a). Editorial business started blooming. Eriksson (1983) reports that journals were 5 times as numerous in 1950 as in 1900. This trend has accelerated and expanded in the 1970's (Fye, 1987) - this is clearly reflected in the previously mentioned quantitative data - when medical research became more and more complex and technology-oriented, thereby requiring more sophisticated equipments and the participation and collaboration of an ever increasing number of scientists. Another important factor should also be held responsible for the increase noted (especially from 1950 on) in journal referencing in 20th century medical articles. I am referring here to journal diversity (itself a consequence of the growth in medical specialty and sub-specialty, see 4.2.3 below) which knew its heyday in the 1980's. Indeed scientific journals were much more diversified in 1980

than in 1940 (Gunnarsson, 1990): what was one technical journal in the 1900's had split in the 1990's into several journals, each specializing in a certain branch of the discipline concerned. In the 1970's, for example, the main cardiology journals were *Circulation*, *The American Heart Journal*, *Progress in Cardiovascular Disease*, *The British Heart Journal*, and *The American Journal of Cardiology*, which published papers on any topic related to cardiology. Less than 2 decades later, these "mother" periodicals split into several sub-specialty journals which started publishing articles concerned with highly specific topics within the specialty, e.g., *PACE*, *The Journal of Cardiovascular Electrophysiology*, *Journal of Hypertension*, etc. In the field of nephrology, we could cite the following "mother journals:" *The American Journal of Nephrology* and the *American Journal of Kidney Diseases*, and the following "satellite journals": *Nephrology*, *Dialysis and Transplantation* and *Hypertension and Pregnancy*. As a matter of fact, we could add as many examples as there are specialties.

The findings reported here corroborate other researchers' results. Swales (1990: 116), for instance, noted that between 1968 and 1986, the number of books cited in the papers published in the *TESOL Quarterly* declined, whereas references to shorter texts (articles, chapters of scholarly edited collections) increased. Along the same lines, Meadows (1974), who reviewed works on the percentage of references that were made to books rather than to other types of publications (principally papers), showed that book references accounted for only 10% of the total number of cited works in physics articles, for 20% in biological sciences and about 50% in the social sciences (sociology, history and arts). It would thus seem that references to books or journals not only depend on a given time period, but also on the field of study. The relation between types of sources cited and field of study - and the rationale for the variation observed - would be worthy of investigation.

4.2.3 Linguistic origin of cited sources (Figure 3)

4.2.3.a NE sources

As can be seen on Figure 3, documented NE sources (books and journals) not only remained quite low during the whole period studied, but also slowly decreased over time: 13% of the total amount of cited sources in Block I, almost 14% in Block II, 6% in Block III and 5% in Block IV. These data reveal that references to NE sources decreased

significantly over the 185 years studied: $p = .05$ when comparing their frequency of occurrence in Block I to that recorded in Block IV, and $p = .03$ when comparing their frequency of occurrence in Block II to that recorded in Block IV. However, if we combine the frequency of reference to NE sources recorded in Blocks I and II (i.e., throughout the 19th century) and compare it with their combined frequency in Blocks III and IV (i.e., throughout the 20th century), the difference observed is "borderline" only ($p = .06$). In other words, the contribution of NE sources to British and American medical literature has been relatively stable over the 185 year-period studied, although, as I said before, it was slightly greater in the 19th than in the 20th century.

When comparing the frequency of reference to NE sources with that of E sources, our data indicate that, *except in Block II* where both NE and E sources - the latter being mainly of British origin - were cited with equal frequency (about 13%), NE sources have always been less frequently cited than E sources. Nevertheless, as is clearly evidenced in Figure 3, the difference observed is much greater (and statistically significant $p = .0001$) in the 20th century (Blocks III and IV) than in the 19th century (Block I) where it is also statistically significant ($p = .01$). It should be kept in mind, however, that 60% of the references cited in Block I (first half of the 19th century) were classified as UnR, the linguistic origin of which was most of the time impossible to trace. Now, since quite a few of these UnR references were translations (into English) of works originally written in languages other than English, it is highly probable that the contribution of NE sources to *early 19th century* British and American medical literature is underestimated in the present paper, as is that of books mentioned earlier (see 4.2.2 above).

Certain contextual factors can explain why the contribution of NE sources (mainly German, French and, to a lesser extent Dutch⁶) was greater during the 19th than during the 20th century. Indeed, the 19th century (and especially its first half) corresponds to a time when scientific production in the United States of America was quite low. According to Fye (1987), the lack of financial support for research retarded the development of medical research in 19th century America, and the

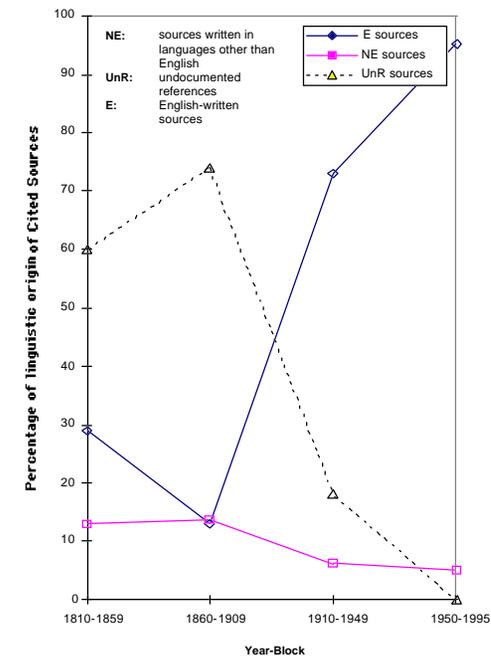
⁶ Examples of 19th century French medical periodicals are: *Leçons de Physiologie*, *Gazette des Hôpitaux*, *Gazette Médicale de Strasbourg*, *Gazette Médicale de Paris*, and of 19th century German medical journals: *German Deutsche Klinik*, *Berlin Klinik Wochr*, etc.

"mediocrity" of American medical literature by then (when compared to German and French) was partially due to the fact that American research was not rewarded by money or prestige. Consequently, American physicians had little incentive to conduct research. American publications, then, drew heavily on European medical literature and American physicians were obliged to consult foreign sources if they wanted to publish medical works of real merit and originality. It should also be kept in mind that, throughout the 19th century, the most advanced scientific work was published in German and French - proof of that is the relatively high frequency of untranslated French and German verbatim quotes in medical papers published at that time (Salager-Meyer, 1996b).

In the early decades of the 19th century, the Paris school of medicine indeed assumed a role of leadership in the world of medicine. This leadership was due, as Fye (1987) explains, to the unique structure and philosophy of the European system of medical education which, by the way, America took as a model in later years. Broadly speaking, then, the relatively heavy reliance on European works in the early 19th century was due to the fact that 19th century Europe had a strong scientific tradition (the explosion of scientific activities in Europe in fact dates back to the 17th century⁷) which was lacking in the United States of America, a country which had been colonized by puritan farmers who did not consider science as an important product of human endeavor.

⁷ According to Kronick (1976), the number of active, substantive scientific journals in Europe increased from 7 in 1710 to 27 in 1750 and 118 in 1790. This author also reports that the first scientific journal in English (*The Philosophical Transactions of The Royal Society of London*) was founded in 1665 by Oldenburgh. However, as Bazerman (1988) remarks, it is not certain whether it is France or England which had the honor of having given birth to the first scientific journal because the French *Journal des Scavans* was apparently published for the first time 3 months prior to the *Philosophical Transactions*.

Figure 3
Diachronic Evolution of the Linguistic Origin of Cited Sources



Although NE sources are rarely cited in 20th century British and American medical prose, two interesting qualitative features are worthwhile mentioning. On the one hand, the closer we approach the end of this century, the more diversified the linguistic origin of the NE journals cited (Japanese, Scandinavian, Portuguese, Spanish, Russian). On the other hand, even though these journals are published in countries where English is not the dominant language, the articles cited from these journals tend to be more frequently written in English than in the researchers' mother tongue. It is also interesting to note that it is mostly the non-native English speaking scientists who, by referring to NE papers (see footnote 4), contribute to the above mentioned linguistic diversity.

4.2.3.b English-written sources

The diachronic evolution of E sources displays a picture quite different from that of NE sources. After a significant, though moderate, decrease from Block I to Block II ($p = .01$), E sources (mainly American)

started their breathtaking ascent from the turn of the 20th century on. Indeed, they significantly rose from Block II to Block III ($p = .0001$) and kept increasing afterwards although in a non-significant fashion. Our data also indicate that, contrary to NE sources, E sources were significantly less frequently referred to throughout the 19th century than throughout the 20th century ($p = .0001$).

A close look at the E sources cited over the 185 years studied reveals that the majority of those cited in 19th century medical papers were of British origin, whereas most of those cited in 20th century medical papers were of American origin. This is very likely related to the fact that there were more British medical journal articles in the 19th than in the 20th century linguistic corpus under study. To a certain extent, this reflects the fact that, as I said before, 19th century European (including British) medical science was more developed than its American counterpart. Therefore, in the random selection of the sample texts analyzed, British medical papers have probably been better represented in the 19th century corpus than in that of the 20th century. Conversely, from the turn of the 20th century on - period when American science started taking the lead of worldwide scientific production - the random sampling procedure "selected" more American than British journals.

Several contextual factors can account for the dramatic rise in the frequency of reference to E sources over the 185 year-period studied. It is precisely in the closing years of the 19th century and in the early 20th century that new medical schools opened their doors in the United States of America. The number of hospitals also grew from 400 in 1850 to over 4,000 in 1909, to almost 7,000 in 1918 when World War I ended (Reiser, 1991). These hospitals served as central repositories for the medical records of the community. Hospital medicine, then, allowed the systematic gathering of observation and the standardizing of verification methods that led to and permitted broader generalizations to be made and triggered interpretation and theoretical formulation. Perhaps most important of all was that a growing number of American scientists - who, in the 19th century were only part-time medical faculty who lacked financial support and incentive to carry out research - evolved in the closing years of the 19th century into a huge body of full time medical teachers and researchers (grouped in newly formed research centers) who sought to publish the results of their research. Most of them, then endowed with salaries for full-time faculty members, felt a commitment to research and believed that specialization and sub-specialization in

medical practice would accelerate the discovery and improve patients' care (Fye, 1987: 451). It is then after World War I that North America dethroned Europe as the leader on the scientific scene and that English started imposing itself as the scientific *lingua franca*, the dominant vehicle for information exchange and research communication. English medical periodicals, then, not only significantly increased in number, but were also read by a growing number of scientists worldwide who, in their research reports, quoted the journal articles they had consulted while conducting their investigation.

The development of communication network and the fact that, from the 1950's on, many non-native-English-speaking scientists started publishing the results of their research in English (in English journals) rather than in their native language, are two additional factors which contributed to the dramatic rise in E sources noted from the 1950's on. This has led some scholarly commentators such as Skuttnabb-Kangas and Philipson (1989), Clyne (1991) and Philippon (1992) to refer to this situation as "linguistic imperialism."

Last but not least, economic factors - intimately related to the previous ones - played an important role as well in the development of science in general at that time. Indeed, the closing years of the 19th century were marked by a general increase in the European and, even more notably, in the American gross national product (GNP) that entailed a rise in these nations' wealth and greater incentives to develop cultural and scientific activities. Besides, governing elites started being intimately convinced that science could play a fundamental role in the enhancement of their nations' material development and welfare. All this led to an explosion of scientific development, the protagonist of which was no longer Europe, as I said, but the United States of America and, to a lesser extent, peripheral countries such as Japan, Canada and the then Soviet Union.

A combination of the above mentioned historical, economic and social factors mentioned above led not only to the increasing number of E periodicals being published, but also to the strengthening and widening of American scientific community in general.

5. Conclusions

The present study has put forward a clear evolutionary trend in the quantitative and qualitative referencing behavior to books and journal articles over the 185 years studied, thus corroborating the first working hypothesis. Indeed, our data revealed that UnR were typical exponents of 19th century medical discourse and that references to books declined gradually over time. In early 19th century medical papers, books - mostly foreign works written in French, German and Dutch - were the main and fundamental vehicle for transmitting new medical knowledge in the form of treatises, encyclopedias, monographs and textbooks written by famous medical doctors. In the mid-19th century, books started being slowly displaced by the emerging medical journals to a secondary role as bibliographical references. References to books not only evolved on a quantitative basis but on a qualitative basis too. Indeed, the great majority of the books cited in 20th century medical papers are no longer first-hand reference sources (as they were in earlier years), but rather secondary and support-like references such as statistics handbooks, conference proceedings, government or committees' reports and/or bulletins. Conversely, references to journals sharply increased at the turn of the 20th century; from then on, they imposed themselves as the main transmissor of medical research findings, the mid-20th century being, *inter alia*, a period characterized by medical journal explosion and diversity.

NE sources remained in general quite low over the whole period studied, but they were proportionally more frequently cited in early 19th century medical papers than in the remaining 3 Blocks, this being a consequence of the fact that by then, Europe (a continent whose scientific activity dates back to the 17th century) was playing the leading role on the medical scene, and that American scientific production was, by contrast, quite poor. After World War I, America -which benefited from a series of economic, historical and social factors - dethroned Europe as the leader of scientific production. This is clearly evidenced by the breathtaking rise in the number of references to E journals from the mid-20th century on. Two interesting qualitative features of these NE sources were put on the fore by the results of the present study: on the one hand, the nearer we come to the end of this century, the more diversified the linguistic origin of NE sources; on the other hand, NE sources are more frequently cited by non-native English speaking scientists than by their native English counterparts. The second hypothesis on which the present paper is based is then only partially corroborated in the sense that the evolutionary trends observed have been smooth and gradual but up to the

mid-20th century only when American medical science exhibited a breathtaking development.

There is of course no one single exhaustive and indisputable answer to why the developments mentioned in this paper have occurred. It seems, however, obvious that they are related to changes in the social contexts of texts. The findings of the present research, then, add credence to the social constructivist intellectual movement according to which the construction of scientific knowledge is part and parcel of the human construction of social modes of investigation and knowledge production. Indeed, the changes observed across time both in the linguistic origin of the sources cited and in the very nature of these sources tend to support the idea that scientific community is a part of society as a whole and is therefore closely tied to it. It gets its character from its relation to the outer world, i.e., from the interaction of scientists with actors outside the scientific community and from the roles scientists play in society in general. Changes in science as such and in the linguistic means by which it spreads the fruit of its creativity can thus be traced to internal and external factors or, better perhaps, to an intertwinement of internal and external factors.

Recebido em 02/1997. Aceito em 06/1997.

Acknowledgments

I am indebted in Dr. A. Fuenmayor, M.D., for his constructive and insightful comments on the original draft of this manuscript and for helping in the data recording and classification. I am also grateful to Nahirana Zambrano for her help in carrying out part of the data recording and analysis, and to Dr. Imogens Evans and Dr. Mc. Connell, Senior Editors of *The Lancet*, for having generously sent part of the linguistic corpus on which the present paper is based. Any remaining shortcomings are, of course, my own.

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