

# From “Mr. Guthrie is profoundly mistaken ...” to “Our data do not seem to confirm the results of a previous study on ...”: A diachronic study of polemicity in academic writing (1810-1995)

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## Abstract

**Objective:** *The objective of this paper is to investigate the quantitative and qualitative diachronic evolution of critical (Cr) with respect to non-critical (NCr) references in English medical discourse over a 185 year-period.*

**Materials and Methods:** *We analyzed a corpus of 90 medical articles drawn from 34 different journals published between 1810 and 1995. Cr and NCr references were recorded in each paper and their frequency of occurrence was computed per 20 year-period. Results were analyzed by means of Chi-square tests.*

**Results:** *Our quantitative results indicate that in the corpus as a whole NCr significantly outweigh Cr references. When diachronically analyzed, our quantitative data revealed that the corpus analyzed could be divided into 2 blocks: Block A (1810-1929) and Block B (1930-1995), the cutting point being the 1930's when NCr references started exhibiting a dramatic ascent. Our findings further showed that, proportionally speaking, Cr references were significantly more frequent in Block A than in Block B, but that NCr references significantly outnumbered Cr ones in Block B. Our quantitative data also indicated that the NCr/Cr reference ratio remained rather constant for the first 120 years studied, but that it changed radically from the 1930's. Finally, our qualitative findings revealed that 19th and early 20th century Cr references were formulated in a much more direct, involved, personal and author-responsible manner than their mid- and late 20th century counterparts, the rhetorical features of the latter being a pronounced hedginess and the shifting of the disagreement responsibility from a human agent (who became a detached and apparently neutral actor) to an inanimate “talking fact/finding” which is then given a prominent thematic position.*

**Conclusions:** *We conclude that 19th and early 20th century medical papers adopted a critical stand more frequently than mid- and late 20th century medical discourse did, and that the evolution of the tone of voice of Cr references over the 185 years studied mirrors the shift from an author-centered and privately-based medicine (an “involved production context”) to a fact-invoking, professionalized and highly competitive scientific community (an “informational production context”) where academics feel the need to save their own face as well as that of their opponents’.*

**Key words:** Medical English, diachronic analysis, professional conflict, critical

## 1. Introduction

Up to the mid-20th century, the main *raison d’être* behind citation analysis was the validation and refinement of certain statistical laws (such as the Lotka’s law) applicable to bibliographical data. Then citation analysis studies switched their attention to the search –through the counting of bibliographical references– for a method of assessment, ranking and evaluation of research (be it a country, an institution or an individual scientist) on the assumption that the more a journal/institution/scientist is cited, the more prestigious or “visible” it is, a trend undoubtedly on the rise today not only in the United States but also worldwide. The publication of the *Science Citation Index* (SCI) in 1961 by the Institute for Scientific Information certainly gave impetus to such studies. Since then a number of other indexes have appeared, viz., the *Social Science Citation Index*, *Sociological Abstracts*, *Pascal* (a French-based journal index, unfortunately<sup>1</sup> much less widely known and used as a reference than the world-famous SCI), to cite just a few of these ranking listings of scientific periodicals. In the social sciences there are about 40 different such indexes, 4 (that I know of) in the field of linguistics alone.

This type of “quality” evaluation –especially that which intends to relate a researcher’s worth to the number of times his/her publications are cited– has been criticized on the grounds that simple, straightforward citation countings do not necessarily reflect the quality and value of research, and cannot therefore be considered as reliable and equitable techniques for carrying out evaluative studies (see Swales 1986 for a listing of the main drawbacks of such simple countings). In an attempt to find a solution to the unsatisfactoriness of such simplistic countings and to try to categorize citations so that their quality and weight can be appropriately accounted for, several researchers – mainly within the field of information science (Cronin 1981) and sociology of science (see below)– have developed a typology of “content citation” with the aim of classifying citations according to their contextual environment. Among those studies, the most influential has been the pioneering work of Moravcsik and Murugesan (1975) who offered a multidimensional typology of citations that reflects the psychological

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<sup>1</sup> I say “unfortunately” because this French multidisciplinary database covers a much wider range of languages than the SCI which is used in the great majority of Latin American universities as THE hallmark against which university professors’ scientific production is assessed (for a criticism of the English-biased SCI, see Arvanitis and Chatelin 1988 and Swales 1990).

processes of citing behavior, i.e., a typology that takes into account the rhetorical objectives citers might be wanting to achieve when citing a particular source. These authors analyzed a corpus of 30 articles on theoretical high energy physics drawn from the *Physical Review* and published between 1968 and 1972. They found, *inter alia*, that about 40% of the citations referred to in these papers were “perfunctory” (simple acknowledgments that some work in the same general area has been performed) rather than “organic” (essential for the understanding of the citing paper). Moravcsik and Murugesan (1975: 91) made the following comment:

*A large fraction of the references were perfunctory. This raises serious doubt about the use of citations as a quality measure, since it is then quite possible for somebody or some group to chalk up high citation counts by simply writing barely publishable papers on fashionable subjects which will then be cited as perfunctory ‘also ran’ citations.*

Chubin and Moitra (1975) proposed a modified version of Maravcsik and Murugesan’s citation classification, they applied it to 43 physics research articles, and reached results similar to those obtained by Maravcsik and Murugesan with respect to the high frequency of “perfunctory” references.

But there is another bias in the straightforward counting of citations as an assessment of an individual’s worth as a scientist: I am referring here to the use of self-citations. In this respect, Meadows and O’Connor (1971) analyzed 10,000 references in the astronomy and space science literature and found 1,300 self-citations (i.e., a 13% self-citatorial level). In the same vein, Swales (1986) reports an overall 10%-15% self-citation level in the applied linguistic literature, and a similar trend has also recently been noted by Salager-Meyer (1998a). Indeed, in her diachronic study of intertextuality in medical discourse, she found that self-citations started exhibiting an important rise from the 1950’s on (an average of 3 self-citations per paper from the 1950’s on as compared to .6 in the preceding 140 years). She moreover remarked that this self-citation practice will very likely keep rising in the future because citation rate is becoming increasingly important as an index of success within medical academia (and perhaps, within Western academia in general). And the job to find out how many times one’s papers have been cited is not a real problem any longer: a user-friendly software package of programs that minimizes the arduousness and maximizes the benefit of the self-citation process has recently been developed (Craddock et al. 1996): it is called “Selfcite 2.0: a career enhancing software!”<sup>2</sup>

Other linguists and sociologists of science have studied the issue of citational behavior from different angles. Meadows (1974), for example, reviewed work on the percentage of citation made to books rather than to other types of publications (such as the

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<sup>2</sup> As Swales (1990: 140) remarks, although the level of self-citation in some texts may be abnormally high (e.g., the present paper!), the question is to know whether one can avoid citing one’s own previous work in science. Nowadays when research is more and more specialized, when there are more and more sub-specialties within one and the same discipline, and when academics develop “research lines” (perhaps 2 or 3 in their whole life as active researchers), it should not be that surprising to find a much higher self-citation rate in today’s research articles than in yesterday’s. I would even venture to say that self-citation is almost inevitable in today’s scientific research.

research paper), and found substantial differences across the three disciplines he studied (physics, biological and social sciences). In the same vein, in his *Genre Analysis* book, Swales (1990) remarked that references to books declined over the 20 first years of publication of *TESOL Quarterly* (1970-1990), whereas those to shorter works (especially articles and chapters of scholarly edited collections) rose. In that same book, Swales further presents a distinction between “integral” vs. “non-integral” citations according to the way in which the cited source is mentioned (e.g., Is it cited in subject position? Is it part of a possessive noun phrase? Is it an ‘adjunct of reporting’? etc.). Gilbert (1977) interpreted citation practice as a rhetorical device resorted to by scientists for persuading readers of the validity of their arguments, for supporting newly announced findings and for implicitly displaying allegiance to a particular section of the scientific community. Along the same lines, in a study of a sample of highly cited documents in chemistry, Small (1978) offers an interpretation of citation practice in scientific prose which regards citations of documents as acts of symbol usage. Finally, the studies of citation use and transformation (e.g., Small 1978 and Cozzens 1985) have indicated some of the patterns by which interpretations and evaluations of read texts become meaning-carrying elements in new writing.

The linguists and sociologists who have looked into the narrower issue of *critical referential behavior* have reached the consensus that critically attacking others’ work in contemporary science is one of the most sensitive issues in the use of source texts. Ziman (1968), for example, points out that scientists meticulously avoid personal attacks in order to maintain a free flow of information although attacks can be made outside the scientific paper. In their study of 43 physics papers referred to above, Chubin and Moitra (1975) found no instances of total criticism and reported that even partial “negational references” are rare, thus corroborating Ziman’s observation. Along the same lines, Kourilová (1994) remarks, on the one hand, that blunt criticism in print is so threatening and offensive that it is usually avoided and, on the other, that when challenging papers by other authors, epistemic modality or subtle hedging strategies are used abundantly. MacRoberts and MacRoberts (1984), Belcher (1995), Myers (1989), Swales (1990), North (1992), Schramm (1996), Swales and Feak (1995) and Kourilová (1996), in one way or another, all echo this opinion by saying that criticism to prior texts in research articles is much more subtle and implicit than critical speech acts in book reviews and referees’ comments on manuscripts submitted for publication. Hunston’s study (1993) of professional conflict in research articles belonging to three different disciplines (sociolinguistics, history and biochemistry) adds further support to the thesis that direct disagreement is very rare in today’s academic writing. Moreover, Hunston was able to demonstrate that the linguistic strategies used to convey professional conflict are discipline-specific, thereby lending support to Swales and Feak’s (1995) observation that critical statements in book reviews are not equally popular in all fields.

Another interesting approach to the problem of critical citing behavior is that adopted by Taylor and Chen (1991) and Bloch and Li (1995) who were concerned with the cross-linguistic and cross-cultural aspect of the problem by contrasting Chinese and Anglo-American academic writing. Taylor and Lee remarked that Chinese scientists seem not to be as contentious as their Western counterparts. Bloch and Li, however, point out

that there are more critical citations in the physical science texts written by Chinese authors than in social science papers written by Chinese academics, thus suggesting that there is some evidence that Chinese writers can and do take critical positions, though not necessarily as often and not in the same way as Anglo-American scientists do.

The last approach to the study of citation practice or citation behavior that I am aware of has consisted in examining differences and similarities in citation patterns over time. This issue has been dealt with by several historians of academic discourse such as Bazerman (1984, 1988, especially chapters 6, 7 and 10) who analyzed the dynamic of the development of citing behavior in spectroscopic papers published between 1893 and 1980 in the *Physical Review*. Atkinson (1992, 1996) too touches upon the problem of citation practice (although not in depth) in his excellent work on the evolution of medical papers published in the *Edinburgh Medical Journal*. Finally, Dudley-Evans and Henderson (1993) make *in passim* remarks to citational data in their work on economics articles published between 1891 and 1980.

To my knowledge, three studies only exclusively deal with the evolution of citational patterns from a diachronic standpoint. I am first of all referring to Valle (1993, 1995) who examined that specific issue in articles published between 1710 and 1870 in the *The Philosophical Transactions of the Royal Society of London*. The second and third papers I have in mind here are our previous research on the quantitative evolution of intertextuality in medical papers written in English and published between 1810 and 1995 (see Salager-Meyer 1997 for an overall study of the problem; 1998a for the evolution of citational patterns *per se*; and 1998b for an analysis of the more specific problem regarding the evolution of references made to journal articles vs. books over the 185 year-period studied).

The previous discussion about citation studies raises several issues that can be used as a basis for a further exploration of this problem. The present research thus builds on and complements the results of the previously mentioned synchronic and diachronic research, especially that concerned with critical citation analysis. Of particular interest here is the evolution of critical (Cr) references in relation to that of and non critical references<sup>3</sup> (NCr) (see definitions in the *Methods* section below) over the last 185 years. The interest of analyzing this problem lies in the fact that, as Latour (1988) remarked, the study of rhetoric in general is of importance in understanding how arguments and intertextual knowledge (of which referential behavior is an obvious manifestation) are developed in scientific and technical texts. Moreover, as Swales (1986) argues, given the growing interest in and reliance on citation studies in the modern academic world, linguistics, and particularly discourse analysis, has an opportunity to become involved in a potentially fruitful area of application that it has so far neglected. I hope that the

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<sup>3</sup> Although some authors indiscriminately use the terms "references" and "citations", I preferred to use the former because one of its meanings is precisely what is intended in the present paper, i.e., "to give sources in a book or article" (*A Dictionary of Reading and Related Terms*: 1981), whereas the word "citation" refers to the act of quoting the exact words of a given author. Likewise, I adopted the word "referential" instead of "citational."

present paper will answer, at least in part, Swales' plea for more research in this area and will add an interesting dimension to the study of the evolution of medical thought and medical writing in general.

## 2. Purpose

The data reported here were gathered as part of a larger and still continuing study on the diachronic evolution of English and French medical discourse. The broad objective of the present paper is to analyze the quantitative evolution of Cr references with respect to that of NCr references in a corpus of medical English articles published between 1810 and 1995. Particular emphasis will also be made on the most salient qualitative features of the evolution of *Cr references*.<sup>4</sup> It is indeed my contention that a close examination of the manner in which the linguistic realizations of such references evolved over time could reveal important features about the structural development of medical science and of the medical community at large. The present study thus inserts itself in the spirit of Bazerman's call for more studies of cultural forms using quantitative and qualitative methods, studies that should moreover consider scientific languages as a historical phenomenon. As Bazerman (1988: 315) puts forth:

*We need to understand why regularities emerge, evolve and vanish; what the writers accomplish through the use of these features within the activity of the discipline; why these particular symbolic choices have seemed advisable to so many members of the community that they become regular practices; whether these habitual practices have become institutionalized; and what the effect of regularities and institutions on science's ongoing work is.*

The present study then builds on the assumption that there is a clear connection between a text and its context (Gunnarsson, 1994; Atkinson, 1992, 1996, among others), i.e., that writers do not communicate in a vacuum but are embedded in a constraining sociolinguistic setting from which they make the lexical, grammatical and rhetorical choices in order to indicate the purpose of their statements and their point of view (Régent, 1994; Schramm 1996). The view of knowledge thus assumed in this paper (as something which is essentially constructed by texts) owes much to the work of the sociologists of science (see Myers 1990 for an overview).

To sum up, my central concern here is to analyze, on the one hand, how the NCr/Cr reference ratio evolved over the 185 year-period studied and, on the other to examine the linguistic indexations of Cr references at a given time period with the aim 1) of shedding more light on the development of referencing behavior (especially that concerned with the taking of a critical stand) and 2) of linking that evolution with the value-system of the scientific community at a given time period. It is hoped that the results of this research will help us gain a fuller understanding of the development of

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<sup>4</sup> Readers interested in the broader issue of the evolution of reference citing in general (i.e. without discriminating between NCr and Cr references) are referred to Salager-Meyer (1997 and 1998a) where the problem is dealt with from a socio-constructivist perspective.

English-language research writing in the last 185 years, and to make apparent cognitive processes that are often hidden.

### 3. Linguistic corpus

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 material. The characterization presented in the following *Results and Discussion* sections is then based on the analysis of 90 randomly chosen articles written in English by native-English speakers<sup>5</sup> and published in 34 different American and British medical journals between 1810 and 1995. The source journals were in the main generalist rather than specialist medical periodicals.<sup>6</sup>

Articles were taken from 1810 and thereafter at 20 year-interval up to 1995 (the last period covers 25 years), each 20-year period being made up of 10 articles. The articles chosen in this manner totalled a number of 195,897 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. As Sardinha (1995: 5) so rightly expresses: “Unless one has access to all the languages written in the world, any corpus will be limited. A corpus will always contain a limited portion of the language stock available to its users.” Finally, in order to get an accurate picture of the data distribution, it was decided to use full-length papers –instead of a given length of papers– as our basic unit of analysis.

The selection of 19th century source journals from which we sought our sample texts was mostly based on the availability of materials.<sup>7</sup> The choice of the 20th century journals from which we sought our sample texts was made on the basis of two specialists’ informants recommendations (medical practitioners at the University Hospital of The Andes –Mérida, Venezuela– and fluent readers of English) as well as Garfield’s ranking listing of journals in the Journal Citation Report of the Science Citation Index. This criterion has been used by Crookes (1986) in his scientific text-structure validation study. This method involves working down the Garfield’s ranked listing of journals based on the number of times a journal has been cited in a particular period. Thus, as Crookes (1986: 82) says: “it is possible to determine the importance of a particular journal in terms of its likelihood of being encountered by anyone reading or doing research in a given area.” The reason for choosing the most prestigious journals was that, knowing the rigorous vetting (80% of submitted manuscripts are rejected, [Lindeberg, 1994: 648]) and the numerous revisions processes of these

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<sup>5</sup> Native English speaker status was assessed on the basis of the authors’ last names and of institutional affiliation (especially the address of the first named author).

<sup>6</sup> The full corpus may be obtained at cost from Françoise Salager-Meyer. Apartado 715. Mérida. 5101. Venezuela.

<sup>7</sup> About half of our 19th century texts were generously sent by Dr. Imogen Evans and Dr. Mc. Connell, Senior Editors of *The Lancet* when we started this research. The other half was collected from the library of the *Faculté de Médecine*, Lyon (France).

journals (several rounds of revisions with several referees often over 2 or 3 years), it can be assumed that what eventually gets published reflects a certain standard of quality. Therefore, in order to describe the accepted conventions of a discipline, it seems sensible to use the best journals by exploring both avenues, as we just said: 1) subject specialists' recommendations and 2) reference to Garfield's ranking. In such a way, we can be certain to have selected what Swales (1990) calls "prototypical exemplars of the genre".

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

a. Nineteenth century medical articles, such as:

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

2. Summation of knowledge about specific conditions. According to the journals, these were entitled "annual addresses" or "annual speeches", "Gulstonian" or "Croonian" lectures or simply "lectures" or "courses of lectures on ...", and were quite similar in communicative function to present-day review papers.

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

b. Twentieth century medical articles: e.g., original research papers, survey or review articles, editorials and case reports.

Book reviews, laboratory reports, letters to the editor and articles such as discussions of ethical and/or sociological issues of medical practice, salary, work conditions, etc. were excluded.

#### **4. Methods**

The approach adopted in the present study is text-based. Because in such an approach, texts are read and interpreted by one reader only, the question is often raised as to whether this is not too subjective and whether other analysts would not get different results. As a response to this problem and in order to validate one's interpretation, the idea of resorting to "specialist-informants" (or subject-matter specialists) has been put forward in LSP-related discourse analysis (e.g., Selinker, 1979; Trimble, 1985). This is the behavior we adopted in the present research by holding informal discussions with



two medical doctors, active researchers in their respective specialty (cardiology and internal medicine) and fluent readers of English.

What about categorizing citations? This is a very difficult matter indeed. As Peritz (1983) argues, a practical method of labeling citations has not yet been found because "... quality and context, let alone underlying motives, involves a large degree of personal judgment as well as an in-depth knowledge of the subject-matter." Some authors have even suggested that the only way out of the dilemma is to approach individual authors or papers (Edge 1977, Cronin 1981), an obviously impossible task in our case. In view of these very real difficulties, it was decided to define a Cr reference as one which refers to a paper whose results or conclusions disagree or enter in conflict with the claims presented by the citing author (hereafter "the citer"). What is here called a "Cr reference" has received several names in the literature: "negational" citation (Chubin & Moitra, 1975), "rival claims" (Kourilová, 1994), "conflicting knowledge claims" (Hunston, 1993), "contentious knowledge claims" (Bloch & Li, 1995) or "faulty" or "critical" citations (Bloch & Li, 1995), but whatever the label, all the definitions point to the same direction, i.e., to some sort of disagreement or conflict with the claims presented by the citer regardless of the intensity of that conflict. It should be mentioned, however, that Chubin and Moitra (1975) distinguished between "partial negational" and "total negational" citations. According to their definition, if a citer suggests that the paper s/he refers to is erroneous in part only –and if s/he offers a correction– the reference is typed as "partial negational." If, on the contrary, the citer refers to a paper as being totally wrong and offers an independent interpretation or solution, then, the reference is classified as "total negational." Now, in view of the difficulty –if not of the material or intellectual straightforward impossibility– of making such a distinction, I decided not to adopt Chubin and Moitra's "total/partial" distinction in the present paper, but to classify ALL critical/negational/rival/contentious references as "Cr." Indeed, nuances and gradations can be so varied so as to defy any a clear-cut distinction. By contrast, those references which did not express conflicting claims or disagreements were all classified as NCr references.

Each time a reference was encountered in each one of the 90 papers analyzed, it was classified as belonging either to the Cr or to the NCr category. The total number of references was then computed per paper and per 20 year-period. The data thus obtained were analyzed using non-parametric  $\chi^2$  test for contingency tables to determine whether statistically significant differences were put forward between the two categories of references over time. Alpha value was set up at  $p < .05$ . Finally, in order to enhance the internal validity of the present study, the data were recorded and analyzed by one of our subject-specialists in a sample of 10 medical articles. Inter-rater reliability was .86.

## V. Quantitative results

### V. 1. Global results: distribution of Cr and NCr in the whole corpus (especially Table 1)

	A 1810-1929 (60 texts)	B 1930-1995 (30 texts)	Whole Corpus 1810-1995 (90 texts)
<b>Critical references</b>			
Absolute Value	109	77	186
Proportion	41.6%*	17.4%**	26.4%***
<i>Average number per text</i>	1.8	2.5	2
<b>Non-critical references</b>			
Absolute Value	153	365	518
Proportion	58.3%*	82.6%**	73.6%***
<i>Average number per text</i>	2.5	12.2	5.7
Total	262	442	704
Proportion	37.2%***	62.8%***	
<i>Average number of (Ncr + Cr) per text</i>	4.3	14.7	7.8

Table 1. Total Number, Proportions and Average Number per text of Critical (Cr) and non-Critical (NCr) References per Block and in the Whole Corpus

\* Calculated over the total number of references in Period A  
 \*\* Calculated over the total number of references in Period B  
 \*\*\* Calculated over the total number of references in Whole Corpus

As Table 1 shows, a total of 704 references was recorded in the whole corpus. These were distributed as follows: 186 Cr and 518 NCr references. Proportionally speaking, Cr references then account for 26.4% of the total number of references recorded in the whole corpus, whereas NCr account for 73.6%. The difference was found to be highly significant ( $p = .0001$ ). Table 1 also indicates that there is an average of 2 Cr and of 5.7 NCr references per paper, i.e., of 7.8 references per paper in the corpus considered as a whole. (It is very important to keep in mind that this last figure –an average of 7.8 references per paper– represents the average number of references per paper in the entire corpus as if our corpus were an homogeneous entity, i.e., regardless of the distribution of references over time).

In view of the fact that our results show a clear-cut distinction in the evolution of the proportion of Cr vs. NCr references (see Figure 1, Table 1), I shall now present the results obtained according to the Blocks identified on Figure 1.

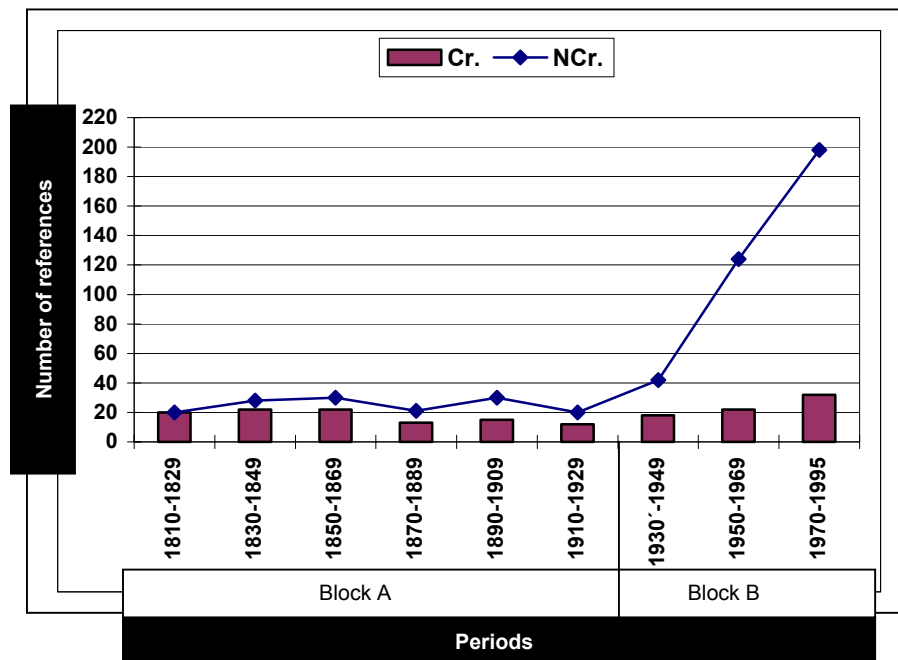


Figure 1. Diachronic Evolution of Critical (Cr) and Non-Critical (NCr) References (1810-1995).

### 5.2. Diachronic evolution of Cr and NCr references (Table 1, Figures 1 and 2)

Figure 1 displays the diachronic evolution of our data per 20 year-period, the proportion of Cr and NCr references per period being calculated over the total number of references recorded per period.

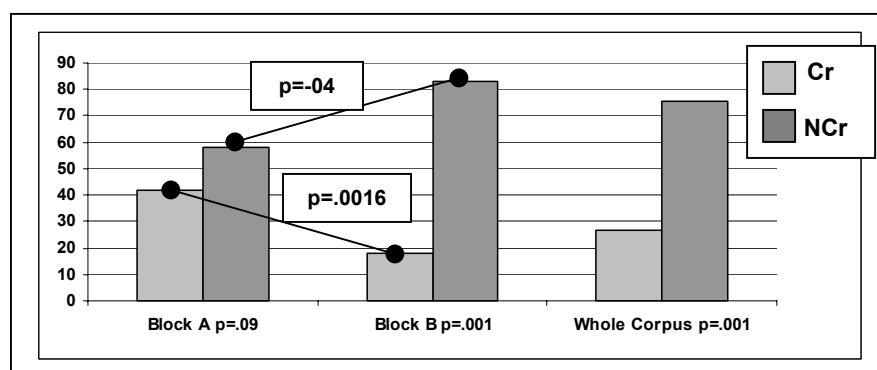


Figure 2. Proportions of Critical (Cr) and Non-Critical (NCr) References per Block and in the Whole Corpus.

Figure 1 clearly shows that the 185 years studied can be divided into two blocks, the cut-off point being the 1930's when NCr references started their breathtaking ascent (whereas Cr remained relatively stable over the 185 years studied). All in all, then, the 185 year-period studied can be divided into 2 distinct Blocks: Block A that covers 120 years (1810-1929) and Block B that covers 65 years (1930-1995). Let us examine the results recorded in each Block separately.

### **Block A (1810-1929)**

In Block A (see Table 1) we recorded a total of 262 references which were distributed as follows: 109 Cr vs. 153 NCr references. Proportionally speaking, this means that Cr made up 41.6% and NCr 58.3% of the total number of references recorded in Block A. The difference was not found to be statistically significant. Table 1 also indicates that there is a slight (but non-significant) difference between the average number of Cr and that of NCr per text in Block A (1.8 vs. 2.5 respectively), the average number of references (NCr and Cr combined) per text in Block A thus being 4.3. It is finally interesting to note (Figure 1) that during the 120 years covered by Block A, although NCr always outnumbered Cr in each one of the 20 year-period, the difference between the two reference categories was never statistically significant, except during the 1890-1909 period ( $p = .02$ ). In other words, with the exception of that 20 year-period, Cr references were as frequently used as NCr references in the texts published in the first 120 years studied.

### **Block B (1930-1995)**

As Table 1 indicates, a total of 442 references was recorded in Block B: 77 Cr vs. 365 NCr references, making up 17.4% and 82.6% of the total number of references recorded in that Block respectively, the difference between the two types of references being highly significant ( $p = .0001$ ). Moreover, the absolute values displayed on Table 1 with respect to the average number of Cr and NCr per text during Block B indicate that there was an average of 2.5 Cr and of 12.2 NCr references per text, thus making up an average of 14.7 references (Cr and NCr combined) per text. The difference in the average number of Cr references as compared to that of NCr references was also found to be significant ( $p = .011$ ).

The first thing that strikes the eye when looking at Figure 1 is the sharp and highly significant rise in NCr references from 1930 on. Indeed, the difference in the frequency of NCr references recorded between 1910-1929 and that noted between 1930-1949 was found to be highly significant ( $p = .0082$ ), as well as that observed between 1930-1949 and 1950-1969 ( $p = .0001$ ) and that recorded between 1950-1969 and 1970-1995 ( $p = .0001$ ). The data displayed on Figure 1 furthermore allow us to deduce (bearing in mind that each 20-year period is made up of 10 texts) that the average number of NCr references per text in Block B "jumped" from 4 between 1930 and 1949, to 12 between 1950 and 1969 and to 20 between 1970 and 1995, the difference between the average recorded in the first and the last period of Block B being statistically significant ( $p = .04$ ).

The evolution pattern exhibited by the Cr references over the 65 years covered by Block B (see Figure 1) contrasts sharply with that displayed by NCr references. Indeed, Cr references also increased significantly between the first and the last 20-year period of Block B ( $p = .03$ ), but not at all in the same “rocket-like” fashion as NCr references did. Moreover, the Cr reference data displayed on Figure 1 allow us to note that the average number of Cr references per text in Block B increased (though not significantly) from 2 between 1930-1949 to 3.4 between 1970 and 1995. Therefore, although the total number of Cr references significantly increased between 1950 and 1995, their average number per text during that period remained stable. As can readily be seen, then, these results stand in stark contrast to those recorded with NCr references.

Regarding the evolution of the NCr/Cr reference ratio in Block B, our findings thus allow us to state that it is from the first 20 year-period of Block B (1930-1949) that the difference between Cr and NCr references started being statistically significant ( $p = .0032$ ). This difference keeps accentuating till 1995, the NCr reference representing-curve displaying an almost perpendicular ascent from the 1950's on.

#### **Block A vs. Block B** (especially Table 1 and Figure 2)

A comparison of the data recorded in Block A with those recorded in Block B allow us to draw the following conclusions:

1. If we compare the total number of Cr references recorded in the first 20 year-period of Block A (1810-1829) to that observed in the last period of Block B (1970-1995), it can be concluded that Cr references exhibited a borderline significant increase between both ends of the 185 year-period studied ( $p = .05$ ). However, if we compare the average number of Cr references per text between both ends of that 185 year-period, the difference is not significant.

2. Proportionally speaking –and this is a most important finding– Cr references were significantly more frequent in Block A than in Block B ( $p = .0016$ ).

3. By contrast, NCr references were significantly more frequent in Block B than in Block A ( $p = .04$ ). When comparing both ends of the 185 year-period analyzed, the difference in the total number of NCr references recorded in the first 20-year period (1810-1829) and that observed in the last 25-year period (1970-1995) was found to be highly significant ( $p = .0001$ ) as well as the difference in the average number of NCr references per text in these 2 periods ( $p = .0001$ ).

4. The total number of references recorded in Block B (NCr and Cr references combined) is much greater than that recorded in Block A ( $p = .0001$ ) in spite of the fact that Block A covers twice as many years as Block B. This is due to the very high occurrence of NCr references recorded in Block B when compared to that recorded in Block A.

5. The difference in the average number of references per text (NCr and Cr combined) in Block A and in Block B is statistically significant ( $p = .017$ ), i.e., there is a much greater average number of references per text in Block B than in Block A (cf. Salager-Meyer, 1997).

To sum up our findings regarding the relationship between NCr and Cr references over time, it can be concluded on the one hand, that Cr references remained rather stable over the whole period studied, whereas NCr started increasing significantly from the 1930's on. In other words, the NCr/Cr reference ratio remained constant over a period of 120 years (between 1810 and 1930), but changed significantly from the 1930's on precisely when NCr references started exhibiting their dramatic ascent.

## 6. Discussion

In the remainder of this paper, I shall firstly briefly discuss the overall quantitative results of this study by focusing on the evolution of the NCr/Cr reference ratio over time. I shall then illustrate, by means of examples, the transformation suffered by the linguistic realizations of Cr references over time, and discuss it from a socio-historical perspective, i.e., I will try to relate that transformation to the social and historical context surrounding the doing and writing of medical research at given time periods. It is only in so doing that our findings can make sense.

### 6.1. Quantitative results

#### 6.1.1. Global results

Our global results indicate that Cr accounted for over 25% of the total number of references recorded in the whole corpus, i.e., an average of 2 per paper (vs. almost 6 NCr references in average per text). It is somewhat difficult to compare our findings with those of previous studies because the results of the scanty literature that reports quantitative data on the subject are controversial. At any rate, it would seem that the average of 2 Cr references per paper reported here is relatively high when compared to that reported by previous research. In fact, Moravscik and Murugesan (1975), in their study of contemporary physics papers, found no instance of total criticism and only 5% of partially negational one. These authors moreover reported that negational citations –whether total or partial– mainly occur after the publication of a controversial and disputed paper and then decay rapidly. Likewise, Hunston (1993) did not find any example of “incorrect knowledge claims” in biochemistry texts. (She did, however, find quite a few examples of such claims in history texts). In fact, as Hunston notes, it appears that in the physical sciences, papers which specifically address themselves to the correction of errors are treated as a separate genre and printed in a separate section of physics journals labeled “*Technical comments*”.

Quite at variance though from Moravscik and Murugesan's and Hunston's studies, Bloch and Li (1995) found an average of 2 “critical citations” in physical science texts written by English-speaking scientists and of 4 in social science texts. As can be seen, then, the results previously reported are inconsistent. It could be that some disciplines are more “critical” than others, but this assumption remains to be confirmed by further research.

At any rate, our global findings concerning the frequency of Cr references in written medical discourse apparently contradict the widely attested phenomenon (see Introduction) that criticism is almost non-existent in today's scientific papers. I believe that this apparent discrepancy could be ascribed to the nature of the linguistic corpus

studied here. Indeed, the researchers who have examined the problem of disagreement or conflict in academic discourse have analyzed the issue in research articles only – what Dudley-Evans (1994) and Johns (1994) labeled “high-culture” papers and what Skelton (1987: 48) called “the bread and butter of scientific enquiry”. By contrast, we here studied the problem not only in research articles, but also in editorials, review articles and case reports. Now, my impression is that Cr references have always been more frequent in editorials and review articles (even in contemporary ones) than in research articles per se. It is my contention indeed that the particular communicative feature of review papers and editorials (cf. Salager-Meyer, 1994) could account for the apparent increase in Cr references in these two types of text (hence, in our whole corpus) where scientists’ reputation, competence and integrity –as well as the refutability or faillibility of their claims– are not so much at stake as they are in research articles where academics report and defend their own research claims.<sup>8</sup> Had we analyzed research articles only, our results would have very likely substantially differed from those obtained and reported here. This surmise, however, needs to be confirmed by additional research.

## 6.2. Qualitative evolution of Cr references over time

Our data showed that proportionally speaking Cr references were much more frequent than NCr references in 19th and early 20th century papers (an average of 1.8 Cr references and 2.5 NCr references per paper) than in mid- and late 20th century medical papers (an average of 2.5 Cr references and 12.2 NCr per text). This means that the average number of Cr references per paper slightly (but not-significantly) increased over time, but not at all in the same proportion as the average number of NCr references per text did (these exhibited a fivefold significant increment, see footnote 4). This also means that earlier papers adopted a much more critical tone than modern ones, a qualitative difference which I am now going to discuss and hopefully give evidence of.

However, before getting to the heart of the matter regarding the qualitative evolution of Cr references over the 185 years studied, I would like to point out that the linguistic means by which such references are formulated –as most pragmatic textual features– cannot always be isolated or identified as individual words or phrases because they are built into the text structure as a whole. However, for lack of space, I cannot but illustrate the various points I present and discuss hereafter with examples taken out of

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<sup>8</sup> It is interesting to remind the reader of the results of Kourilová’s (1996) study on peer reviews, a genre not publicly available and written by anonymous referees: she indeed observed that the reviewer’s authoritative position and even authoritarian attitude is strongly manifested by overt expressions of judgment in the form of blunt or even caustic criticism (e.g., “*you are absolutely wrong in suggesting that ...*”), this sort of criticism being about 4 times as frequent as hedged criticisms. In such a discourse, as Kourilová so rightly remarks, the discourse status of the author and that of the reviewer are clearly characterized by a great difference in power. (Such is not the case in *peer-writing* such as research article writing). However, an editorial recently published in the *British Medical Journal* urges manuscript reviewers to avoid writing “... gratuitously negative reports crafted primarily to wound, to show the reviewers’ prowess and to vent strong feelings” (Goldbeck-Wood, 1998: 86). This is why that journal recently opted for an “open review” process, whereby reviewers are asked to sign their comments. Behind this decision lies the idea that “courtesy is a core attribute of a good reviewing.” (Goldberg-Wood, 1998: 86).

their broader contextual environment. I thus hope that they will be conspicuous enough so as to support my arguments.

### **19th and early 20th century Cr references (1810-1929)**

As just I said, our study has clearly put forward an evolution in the rhetorical and linguistic formulation of critical thinking patterns, i.e, in the way scientists expressed their criticisms or disagreements over time. Nineteenth and early 20th century Cr references were indeed expressed in a very direct and personal fashion. The following examples give plentiful evidence of unrestrained direct and personal Cr references recorded in medical papers published at that time.<sup>9</sup>

1. Mr. Brodie objects to my experiments that they were not exact repetition of his, and therefore not entitled to much consideration in estimating the causes of animal heat .... *I cannot conceive*, I am afraid, *on what Mr. Brodie's opinion is founded*. (1823)

2. The assertion of Professor F.T. Roberts, a gentleman of a very distinguished character, that regions situated at a low level present a large number of cases *is altogether too sweeping*.... This is a view that *finds no support* in the facts that Professor Roberts has presented. (1845)

3. *I do not agree with Wenzel*, my distinguished countryman, that you must poke out a hatful of eyes before you can hope to perform this operation with success. (1823)

4. Mr. Bloch and Mr. Dumeril obtained the same results. It is easy, however, to perceive that *both these respectful gentlemen were profoundly mistaken*. (1832)

5. Dr Lawrie is disposed, *incorrectly* I think, to consider the amputation of the leg more fatal than that of the thigh. (1840)

Examples 1-5 illustrate how 19th and early 20th century scientists overtly criticized previous research by fully committing themselves to either the endorsement or denial of the reported propositions. Moreover, these examples beautifully demonstrate the provocative, highly polemical, personal (almost face to face) and dialogic fashion in which 19th century scientists used to convey their disagreement. Atkinson (1996) refers to this polemical behavior as “oppositional discourse”, a signal marker of 19th century scientific writing. As Bazerman (1988: 138) moreover puts forward:

*Although at first criticism may have seemed a rather irritating byproduct of public exposure, ... this too became seen as a necessary, though unpleasant, medicine. Statements acknowledging the usefulness of criticism appear in a variety of articles and letters in the 17th and 18th century, even from the notoriously intolerant Newton.*

It should be reminded at this point that most of what was published in early 19th century medical journals were printed versions of talks delivered on subjects of interest to fellow physicians which mainly remained at the level of the anecdotal, i.e., histories of particular and generally unusual cases –what Biber (1988) labeled “involved production” and Atkinson (1996: 359) “the rhetoric of immediate experience”– rather than the accumulation of series of cases examined to reach general principles. What then seems to the “modern eye” a manifestation of professional arrogance (examples 1-5 above) should rather be considered as a reflection of the essentially narrative, oral

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<sup>9</sup> Italicized words refer to the linguistic formulation of *Cr references*, and the year indicated after each example corresponds to the year of publication of the article from which the example was drawn. The (\*) symbol used from example 6 on means that a parenthetical or superscripted reference was indicated in the original paper.



and anecdotal status of these early texts whose prominent authors/actors were not much concerned about the rhetorical impact, personal offense or possible threat their critiques could engender! This supports Skelton's (1997: 52) observation that in 19th century *British Medical Journal* articles, truth-value judgments were strongly associated with the first person pronoun "I" that proves an "overt arrogation of responsibility". Thus, the results of our research not only confirm Skelton's finding, but tend to prove that this "overt arrogation of responsibility" when taking a critical stand is a rhetorical hallmark of 19th century medical writing and, I would venture to posit, of 19th century academic writing in general.

Interestingly enough, as examples 1 and 5 above illustrate, 19th century scientists quite frequently softened the blow of their blunt attacks by means of parenthetical clauses such as "*I think*", "*I am afraid*" which stress the extremely polite, humble and modest attitude so characteristic of early 19th century gentlemanly conduct. Another means of softening harsh criticisms was by using lukewarm epithets of politeness and praise (ex. 2, 3 and 4 above) –also called "courtesy markers" (Valle 1991, 1993; Atkinson, 1996) or "manners of dispute" (Shapin, 1984)<sup>10</sup>– that qualified either the physicians cited or their works and provided a note of profound deference. The presence of these laudatory expressions as markers of general personal praise in a disagreement context has also been noted by Valle (1993) in 18th century biological texts. It should be mentioned, however, that these courteous and flattering adjectives that mirrored a civil and gentlemanly conduct were not confined to the negative context of Cr references only, but could be found in any positive context as well (cf. Gläser, 1995; Salager-Meyer, 1998b). Indeed, as Atkinson (1996) remarked, the relationship among scientists at that time depended on a conventionalized civility which in theory accorded polite treatment to any gentleman in any situation, even when the author of an article went on to criticize a colleague's work. According to Valle (1993), it is precisely in the area of these genteel conduct markers that early scientific texts differ perhaps most from modern ones. As we noted elsewhere (Salager-Meyer, 1998a), these courtesy markers started disappearing at the turn of the 20th century, but are still to be found, although to a much lesser extent and generally not as the antechamber of a conflict, in today's medical editorials.

Moreover, apart from depicting a personal and direct way of presenting conflicting claims, examples 1-5 above reflect an individually-, privately-, author-based and non-specialized medicine practiced by a small, non-professionalized and highly "visible" (Dudley-Evans & Henderson, 1993) scientific community where physicians, especially those with a particular interest in the issues being discussed, were familiar with the authorities cited in scientific papers; perhaps, they even knew them personally.

Noteworthy in our results, finally, is the finding that in the 19th and early 20th century papers, the great majority of Cr references tended to appear in a diffused and unpredictable fashion throughout the article, i.e, contrary to what occurred in later periods (see below), they were not associated with any particular phase of the article.

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<sup>10</sup> Such a rhetorical strategy is also called "agreement prefaces" (Pomerantz, 1984: 72) and "good news/bad news pairing strategies" (Belcher, 1995: 145).

This is in essence the result of the chronological ordering of events which was the guiding organizational principle of 19th century medical prose, itself characterized by a lack of conceptual integration (Atkinson 1992, 1996 and Skelton 1997). Then, 19th century Cr references were potentially appropriate at any stage of the “unfolding drama” being reported or, as Skelton so vividly puts it (1997: 51) of the “*mise en scène*.”

### Later Cr references (1930-1995)

Perhaps the most obvious qualitative difference between early and late Cr references resides in the switch from the personalized, harsh and at times merciless tone evidenced in the previously mentioned 19th century Cr references (ex. 1-5) to the more gentle, neutral, dispassionate, matter-of-fact, apparently indifferent tone of voice of mid- and late 20th century Cr ones. Moreover later Cr references are formulated in a such a way that it is either the inconsistency of the results (ex. 6, 7 and 8 below) or the fallibility of the research methods (ex. 9, 10 and 11 below) that is being criticized, not the researchers themselves who cannot directly be accused of incompetence or fraud, if fraud there is.

6. We have carried out both the test of Akerfeldt and Gibbs (\*) and *have been unable to confirm the findings of either investigator*. (1960)

7. *There is no firm evidence* for any of the three hypotheses tested by Trovers (\*). (1974)

8. Unlike Rosner and Flower (\*) *we found the side effects to be significantly fewer*. (1983)

9. However, most of the studies previously carried out (\*) have considered leukemia *without discussing* the immunological heterogeneity of differentiating stages of the disease. (1989)

10. Studies analyzing the effect of natural disasters on suicide rates *have yielded insufficient information* primarily because they *have focused only on suicidal ideation* or because they have looked at single disasters with *population too small to allow significant comparisons to be made* between pre-disaster and post-disaster suicide rates (\*\*\*) (1995)

11. These studies (\*\*) have examined the socio-economic gradient in mortality in diabetic people, and *none has included a non-diabetic population for comparison* (1995).

Another rhetorical finding of interest is that, contrary to what was observed in 19th century Cr references which were found throughout the article in an unpredictable fashion, the great majority of Cr references such as the ones presented in examples 6-11 above was mostly confined to the introduction of contemporary research papers<sup>11</sup> (more specifically to the “gap-filling” move mentioned by Swales, 1990), a section known to be more persuasive than purely descriptive, to be a distant reconstruction of the original rationale for the study, and to manifest considerable negotiation between author, reader, editor, referee, knowledge and claim (Fredrikson & Swales, 1994) with the aim of justifying the research and of optimizing the chance of acceptance, i.e., of publication. The increase in Cr references noted between 1970 and 1995 is very likely

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<sup>11</sup> Articles through the 1930's read as continuously reasoned arguments, i.e., they had no internal divisions although their rhetorical structure was, in the main, fairly clear. This is why the information related to the identification of the rhetorical section of papers where Cr references appeared could not be recorded much before the 1940's when the IMRAD (Introduction, Materials, Methods And Discussion) pattern started developing –even if the different sections were not always marked typographically– under pressure from the increasing constraints of journals' editors in favor of a modest uniformity of style. It is only in 1979 that the American National Standards Institute formally defined the IMRAD structure (Birch, 1994) which then became rigidly conventionalized as a “straightjacket around the author” (Lock, 1988) to the point where even marginally scientific texts are today sometimes placed in this format (Atkinson, 1996).

due to the fact that these “justifying” introductory Cr references are almost indispensable in today’s medical research reporting. Such was not the case in 19th and early 20th century medical discourse where Cr references only served the purpose of showing some conflict or disagreement, not that of justifying the publication of a manuscript.

The more we approach the closing years of the 20th century, the more clearly is another qualitative feature of Cr references evidenced. I am referring here to what one of my specialist informant labeled “an increasing tiptoeing” in the linguistic indexation of Cr references, i.e., their accentuated delicateness, their purposeful and deliberate camouflage, which is linguistically realized in one of two ways: 1) by means of traditional “sugar-coating” linguistic devices (Wilss, 1997: 45), i.e., impact-attenuating hedging elements<sup>12</sup> that make assertions less categorical and less negatable (Hübler, 1983) (cf. Markkanen & Schröder, 1997 for a recent publication on the subject) and/or 2) by presenting the Cr reference as if it were not the responsibility of a human agent but that of “talking facts” (Meyer, 1997: 21). Let us examine each strategy in more depth.

#### “Sugar-coating” hedging devices

As it is well known, one of the rhetorical purpose of hedging devices –such as modal verbs (ex. 12) and probability adverbs (ex. 13)– is to weaken the strength of speech acts. Examples 12-14 illustrate the use of the softening strategy of “face-threatening speech acts” (Brown & Levinson, 1979) or “actor’s face-saving strategies” (Mauranen, 1997) and of the “deliberate avoidance or damping down of critical comments” (Becher, 1989: 99) in contemporary academic writing, thus showing reduced illocutionary commitment on the citer’s side. It is precisely the weakness of the citer’s involvement that accounts for the hedging effect. The use of the ‘arguing’ verb ‘*claim*’ in examples 13 ad 15 is interesting because it by itself implies a disagreement between citer and original researcher (see Thompson & Ye, 1991 for a thorough classification of attitudinal verbs), thereby giving the reader a hint of the writer’s attitude toward the propositional content of the utterance. As Swales and Feak (1995) point out when referring to Western academia, authors imply their attitude toward a source through the choice of reporting verbs.

12. This observational study (\*) *may be more likely to reflect what is occurring in general practice only than results from clinical trials* in which both patients and physicians are motivated to continue treatment. (1993)

13. Probably, the large benefits claimed by some observers (\*) *are confined to the minority of patients with severe sleep apnoea ... These benefits are unlikely to be generalizable* to those with less severe apnoea. (1995)

14. It has been claimed that vaginal breech delivery is associated with an increased mortality from intracranial hemorrhage (\*). *Our study somewhat contradicts this claim.* (1992).

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<sup>12</sup> As it has been repeatedly noted (Grabe & Kaplan, 1997; Meyer, 1997; Wilss, 1997; Salager-Meyer, 1998c), hedges are first and foremost the product of a *mental attitude*, i.e., the interpretation of a linguistic formulation as hedge or non-hedge rests significantly on the subjective assessment capacity of the reader. There is no question that the marking off of hedges reflect subjective decisions and poses important theoretical problems (Crompton, 1997). Grabe and Kaplan (1997: 162) even points out that “making decisions about linguistic markers of hedging ... will vary somewhat from text-type to text-type.”

### Non-human “talking-facts” rhetorical strategy

Citers’ commitment can be further reduced by pretending that they are not putting forward the Cr reference by their own accord, but that some non-human entity (e.g., a finding, a result, some data) actually speaks for itself and compels writers to disagree with some previous finding/conclusion/data. What we observe in examples 15-17 below, then, is a phenomenon which could be subsumed under the broad notion of ‘shifting of responsibility’ from the personal agent –the citer/actor– to a “speaking fact” which becomes the agent and leads the citer, almost unwillingly, to the Cr reference. Luukka and Markkanen (1997: 168) refer to this rhetorical means as a “sub-strategy of impersonalization” which is particularly frequent in medical papers published in the last two decades of the 20th century.

15. *Our data are statistically different and conflict with the information previously reported (\*\*).* (1990)

16. *Indeed, that is what our results indicate, although other studies found no such difference (\*).* (1991)

17. *The results of our survey do not agree with the results of a survey conducted in France in 1984 (\*).* (1994)

Related to the previous modulating strategy, though slightly distinguishable, is the shifting of the criticism responsibility to a non-human entity as well, but this responsibility shifting is moreover followed by a hedging word (ex. 18 and 19).

18. *Marx et al. found that Apgar scores were higher when a regional anesthetic was used (\*). Based on our results, this does not seem to be the case.* (1993)

19. *The results from these experimental studies do not seem to provide sufficiently robust evidence for the effectiveness of continuous positive airways pressure (\*).* (1995)

As I argued before, the linguistic realization of examples 15-19 clearly give the impression that the disagreement (i.e, the mention of a Cr reference) does not arise from a researcher in the flesh but from the outcome of research experiments which misled the criticized researchers. Research outcomes are then attributed a prominent thematic position, whilst the “authorial persona” (Atkinson, 1996) –the citer– pretends to remain unnoticed, detached and distanced in the Cr reference background as if the criticism formulated were beyond his/her control. In such a way, the intervention of the personal element is subtly denied in keeping with an ideal of scientific objectivity, thereby displaying an essentially “object-centered rhetoric” (Atkinson, 1996). We are very far indeed from the author’s/actor’s “overt arrogation of responsibility” previously noted regarding the formulating of 19th century Cr references. Moreover, the deliberate intention of not directly identifying the authors of an opposed claim in contemporary medical discourse is evidenced in examples 9-18 above by the widespread use of superscripted or parenthetical numbers as the almost unique referencing behavior in English contemporary medical writing, although the surnames of the criticized authors are sometimes provided in the body of the paper itself, but this mostly occurs in editorials and review articles, not so much in experimental research articles.

With respect to the rhetorical sections of the research articles where these hedged, cautiously formulated Cr references are found, our data showed that they are mainly encountered in the discussion sections –where both the speculative and the evidential are combined to discuss research outcomes in an “informational production” context (Biber, 1988)– in response to what Skelton (1997: 55) called “the distortion of

chronology built into the new logical ordering developed in the course of the 20th century” for the reporting of scientific findings.

Examples 12-19 above finally lend further support to Myers’ (1989) remark that researchers employ today a great amount of collegiate politeness or tactfulness when they interact with one another, mainly because the social distance between team members (that determines the degree of formality and familiarity among them) is great and is also characterized by equal power among its members. Consequently, when scientists today criticize fellow researchers’ works, they cannot do it openly, but use instead subtle modulating strategies which allow the critic not to impinge directly the source cited. Such strategies moreover present the advantage of giving a stance of uncertainty and of a somewhat guarded position and neutrality with respect to the criticized source, thus exonerating the citer if the proposition is disproved and avoiding a boomerang effect. After all, as Mauranen (1997: 115) so rightly puts it:

*... Scientific discourse is a world where observations suggest that something might be the case; where states of affairs appear to hold; where it seems reasonable to suggest, and where one might infer. In other words, it is a world of uncertainties, indirectness and non-finality – in brief, a world where it is natural to cultivate hedges. (The italicized words appeared as such in the original.)*

The previously mentioned guarded position moreover finds its justification in the fact that, as I said before, strong competitive pressures in Western academia require investigators –who compete not only for visibility but also for power and prestige– to make every effort to find a research space for their works. Fredrickson and Swales’ (1994: 10) ecological metaphor is certainly relevant here: “Populations of researchers competing for visibility and resources are similar to populations of plants competing for light and nutrients.” Obviously, the more tilled the research area –e. g., in the medical field: research on cancer, genetics, AIDS, molecular biochemistry, prevention and treatment of cardiovascular diseases– the greater the competition and the rhetorical effort needed to find that research space.<sup>13</sup>

## Conclusion

The quantitative results of the present research lead us to a number of relatively safe general conclusions. Firstly, our study has clearly put forward a rather stable behavior pattern of Cr references across time. Indeed, although these references showed a significant (but borderline) increase over the 185 years studied, their average number per text did not change significantly over time. By contrast, NCr references remained quite stable for 120 years only (between 1810 and 1929), period during which they slightly (but non-significantly) outnumbered Cr references. From then on, NCr references started displaying a continuous significant rise which lasted up to the closing years of the 20th century, their evolution-representing curve exhibiting an

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<sup>13</sup> Competition can be measured in terms of the number of research papers per topic area, conference or journal acceptance rates, promotion criteria and percentage of funded proposals (Fredrickson & Swales, 1994).

almost perpendicular ascent with respect to that representing the Cr reference diachronic evolution. In other words, it is only from the 1930's when NCr references started significantly outweighing their Cr counterparts, and the difference between both categories of references kept accentuating till the end of the period studied. Our findings thus give clear evidence of the fact that, proportionally speaking, Cr references were much more frequent in 19th and early 20th century medical papers than in their mid- and late 20th century counterparts. From a qualitative standpoint, this means that earlier medical articles were more critical than later ones.

Secondly, our study has evidenced a clear qualitative evolutionary trend as regards the way Cr references were expressed over the last 185 years. Indeed, 19th and early 20th century CR references were found to be formulated in a much more personal and direct author-responsible manner than their later 20th century counterparts which were characterized for being hedgy and fact-finding (i.e., object-) responsible. If we try to explain these qualitative findings from a socio-historical perspective, it could be said that the diachronic changes observed in the linguistic realizations of Cr references mirror the evolution of a privately-, individually-based and author-centered medicine towards a tight, object-centered and highly professionalized scientific community in which a group of expert specialists (almost totally "invisible" colleagues) in a narrowly defined field write for a target readership composed of peer expert specialists in that field. These experts are not inclined to making forceful negative judgments on their peers' previous research either because they are genuinely uncertain –uncertainty is one of the fundamental principle of today's science– and want to protect themselves against potential criticism, or because, as Myers (1989) puts it, they take up the role of humble and polite servants of the discipline. In all these cases, when mentioning a Cr reference, these experts rather remain non-committal and modulate their statements by means of hedging devices –the trademark of which is "inoffensiveness" (Wilss, 1997: 138)– or by shrugging off their shoulders the responsibility of the Cr reference and by blaming it to a non-human entity.

Our research thus corroborates Bazerman's (1988) and Berkenkotter and Huckin's (1995) studies according to which academic writing has evolved over the last few centuries with notorious modifications even in the last few decades in response to the changing structure, values and needs of the scientific community. Moreover, our research supports the fact that societal development is a determining factor in the changing of textual patterns, and that persistence and change in the social system are both reflected in the text and brought about by means of text, i.e., that determining factors of linguistic change are intimately linked to and brought by the social, historical and cultural context in which discourse is produced.

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