

# **TITLES OR HEADLINES? ANTICIPATING CONCLUSIONS IN BIOMEDICAL RESEARCH ARTICLE TITLES AS A PERSUASIVE JOURNALISTIC STRATEGY TO ATTRACT BUSY READERS**

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29

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## **1. Introduction**

In the last three decades there has been a general acknowledgement of the capital role of the titles of scientific research articles (RAs) in determining whether the text deserves further reading (Bird 1975; Diener 1984; Nahl-Jakobovits & Jakobovits 1987; Rymer 1988; Bazerman 1985 and 1988; White & Hernández 1991; Day 1995; Alley 1996; Yitzhaki 1994, 1997; Whissell 1999; Anthony 2001; Gross, Harmon & Reidy 2002; Haggan 2004). Research on RA titles has been focused from two different perspectives: works analysing the different typologies of titles of RAs from various disciplines (Dudley-Evans 1984; Fortanet et al. 1997, 1998; Haggan 2004; Soler 2007), and studies dealing with very concrete aspects such as the different levels of informativity of titles (Buxton & Meadows 1977; Yitzhaki 1997), the percentage of colons in the titles of RAs (Hartley 2005; Lewison & Hartley 2005), the relationship between the linguistic complexity of titles and abstracts and the citation status of the article (Whissell 1999), the complexity of the title as an indication of a parallel complexity in the field (White & Hernandez 1991), and the relationship between the length of the title and either the number of authors (Yitzhaki 1994) or the length of the article itself (Yitzhaki 2002). On the other hand, some authors have studied the features of titles of RAs in a particular discipline, in an effort to draw conclusions that could be useful for

researchers publishing in that field (Manten 1977; Goodman 2000; Anthony 2001; Wang & Bai 2007). The extensive research conducted has also showed up the variety of roles and pragmatic functions that RA titles fulfil. According to Swales & Feak (1994: 205), a title should indicate the topic and scope of the study, and be self-explanatory to readers in the chosen area. Yitzhaki (1997: 219), however, indicates that the function of the RA title is “to draw a reader’s attention to a paper and to indicate its content from a short glimpse, thus contributing to its initial selection or rejection”. Other authors put the emphasis on the need to offer highly informative titles to facilitate the process of storing, searching and retrieving the information (Black 1962; Mitchell 1968; Tocatlian 1970; Feinberg 1973; Manten 1977; Hodges 1983; Diodato & Pearson 1985), in an era in which “decisions to read a journal article are influenced by the style and content of titles and abstracts available in the database consulted” (Whissell 1999: 76). The heterogeneity of these studies does not definitely clarify what can be considered as standard practice in constructing titles within different disciplines, although some results can be used as a starting point for further analysis.

Thus, Haggan (2004) and Soler (2007) agree that titles can be classified into three/four structural categories, although they use a slightly different terminology: Full sentence titles, compound titles (i.e., two part titles separated by a colon or equivalent punctuation mark), nominal construction titles and question construction titles.

Both of these studies offer empirical data on the most recurrent structural constructions in different disciplines: literature, linguistics and science (Haggan) and social sciences and biological sciences (Soler). According to the observations of these researchers, there is a high prevalence of the nominal group construction in all the disciplines analysed. Compound titles – also called hanging titles (Day 1995) or colonic titles (Hartley 2005) – are more frequently used by researchers in the social sciences and humanities while full-sentence titles seem to be an exclusive peculiarity of scientific research papers, particularly in the life sciences. These observations, however, fail to conclude “whether these styles are fundamentally determined by the intrinsic differences characterizing the [...] disciplines and their practitioners and how much they are the result of accidental historic convention or tradition” (Haggan 2004: 313). On the other hand, a contrastive analysis of all these database studies reveals that the differences in the results obtained cannot always be explained on the basis of disciplinary differences, but may also depend on the corpus selected (often randomly) even within the same or related field. Thus, in a study covering a 45 year period, Berkenkotter & Huckin (1995) reported a steady and progressive increase of full sentence titles in scientific articles ( from 0% in 1944 to 21% in 1989), while Haggan (2004) surprisingly found a much lower percentage (8.5%) in the 307 science titles of 1998-1999.

More prescriptive approaches, while being useful, unfortunately offer contradictory advice, only increasing the insecurity of the RA writers, especially non-experienced researchers and non-native speakers of the language. Dudley-Evans (1984) concentrates exclusively on examples of the nominal group, and this is also the construction recommended by O'Connor (1991) and Alley (1996). Since the publication of Dillon's reports (1981a, 1981b) where the use of colons in titles was found to be a predominant characteristic of scholarly publication, an elevated number of works focused on the positive or negative aspects of this construction giving rise to the so-called Dillon-effect, with an increase in the number of hanging titles in most disciplines (Hartley 2005), and opposed reactions supporting (Lester 1993) or objecting to (Day 1995) its use. A more recent study (Hartley 2007) reports the preference of students and academics for titles with colons, although the author admits that these results may depend on the materials and methods used and suggests that further research is needed in different disciplines. Finally, full-sentence conclusive titles are preferred by Lindsay (1995) but considered improper and imprudent by Rosner (1990), while question titles seem to be almost exclusively used in the "soft" sciences to attract the reader's curiosity (Hyland 2002) and are disregarded in advisory manuals.

31

On the other hand, since the *Instructions for Authors* provided by the editors of research journals are usually limited to a recommendation of brevity in the composition of the title, the amount and type of information provided in titles and their structural construction would be a personal choice with all options open.

However, despite this apparent freedom previous works (Haggan 2004; Soler 2007) coincide in finding that both humanities and social sciences researchers seem to prefer either the nominal or compound constructions in their RA titles, which simply announce what the paper is about and only occasionally make use of full sentence titles whose aim is "to intrigue the reader by presenting a clever, arresting title which catches the attention and acts as a lure into the article itself" (Haggan 2004: 298). There is also agreement on the prevalence of nominal constructions in all disciplines analysed. Difficulties arise, however, when evidence observed in certain scientific journals shows a high percentage of propositional titles anticipating the results of the study by way of a highly informative full sentence, which contradicts the tendency indicated above. Thus, the dilemma in the choice of the title does not only refer to the structural construction but especially to the type of information and the pragmatic function the author decides to emphasize. This lack of clear indications and the frequent contradictions shown in the literature put the scientific RA writers at the risk of making a wrong choice when entitling their works and complicates EAP teachers' task when instructing postgraduate students or novice researchers about strategies for better title composition.

The present paper aims at clarifying whether the adoption of a journalistic approach in title writing corresponds to certain scientific disciplines exclusively, and the reason(s) why a researcher would anticipate the results of the study including this propositional information in the title, instead of maintaining a more traditional style which simply indicates the topic and scope of the research. The paper also explores the possible origin of this trend in order to establish whether it responds to a mere fashion or is the result of intrinsic differences in scientific disciplines, thus requiring the attention of EAP teachers delivering courses to specialists in those particular fields. As Anthony (2001: 193) suggested, “it is clear that before advice can be given on title writing, or any form of technical writing, extensive research needs be conducted to determine the discourse conventions within and across different disciplines and fields”.

## 2. A Note on Taxonomy

In order to avoid terminological misunderstandings regarding title typologies, RA titles are classified here into two broad categories:

A. *Indicative* titles (Huth 1990: 90; Goodman 2000: 914), also called “descriptive” titles (Fischer & Zigmond 2004), which announce what the article is about, and take the form of both noun phrase and compound or “colonic” titles. For example:

1. “Structure of the Protein Phosphatase 2A Holoenzyme” (*Cell* 2006, vol.127)
2. “Organization of the peripheral fly eye: the roles of Snail family transcription factors in peripheral retinal apoptosis” (*Development* 2006, vol.133)

B. *Conclusive* titles, which anticipate the conclusions and/or results of the research, labelled as “informative” (Goodman 2000: 914; McGowan & Tugwell 2005: 83; Huth 1990: 90) “declarative” (Smith 2000: 915), “conclusion titles” (Fischer & Zigmond 2004) “declaratory” (Goodman et al. 2001: 76) and “full-sentence” titles (Haggan 2004; Soler 2007).

3. “Loss of myogenin in postnatal life leads to normal skeletal muscle but reduced body size” (*Development* 2006, vol.133)
4. “Promyelocytic leukemia nuclear bodies behave as DNA damage sensors whose response to DNA double-strand breaks is regulated by NBS1 and the kinases ATM, Chk2, and ATR” (*Journal of Cell Biology* 2006, vol.175)

Titles that only aim at attracting the reader’s curiosity are too scarce in scientific studies to be considered as an independent variation.

### **3. Phases in Corpus selection and Progression of results**

The selection of the corpus was a most challenging task considering the number of disciplines which can be labelled as scientific and which should, therefore, be included in the analysis. On the other hand, the objective of establishing the origin of conclusive titles made it necessary to cover a broad period of time to avoid conclusions based on mere coincidences. It was decided that the study should be developed in different phases covering different periods of time and following a general-particular approach regarding the profile of publications to be used in the analysis.

#### **Phase 1: Preliminary selection and initial results.**

The first approach to selection was made according to two criteria: a) the articles should have been published in journals covering all fields of science and b) to avoid partial, local or individual approaches to publication, the journals should be known worldwide, accepted and highly valued in scientific circles. Regarding chronology, the review of literature presented in the introduction revealed that the period 1990-96 witnessed a considerable controversy between those in favour of or opposed to the use of conclusive titles in scientific articles, thus suggesting the early 90s as a possible origin of this trend. On the basis of these observations, the Science Journal Citation Reports was used and the first two publications in terms of impact factor were selected from the Multidisciplinary Sciences area (Science and Nature). All the articles published in these journals between October 1992 and April 1993 (producing a sample of 986 titles) were analysed searching for titles that anticipated the conclusions of the research. The results obtained are presented in Table 1.

33

<b>Journal title</b>	<b>Position in Impact list</b>	<b>Total No. Titles</b>	<b>No. Conclusive titles</b>	<b>%</b>
Science	1/64	463	4	0.8%
Nature	2/64	523	127	24.28%

TABLE 1: Conclusive titles occurrence in Multidisciplinary Sciences journals (1992-93)

In the journal *Science*, only four out of the 463 titles were in the form of a full sentence offering conclusive data, the rest corresponding to the noun-phrase construction. In *Nature*, however, 24.28% of the 523 did take the form of complete conclusive sentences, as illustrated by the following examples:

5. "Deletion polymorphism in the gene for angiotensin-converting enzyme is a potent risk factor for myocardial infarction" (*Nature* 1992, vol. 359)
6. "Colour is what the eye sees best" (*Nature* 1993, vol. 361)
7. "CENP-E is a putative kinetochore motor that accumulates just before mitosis" (*Nature* 1992, vol. 359)
8. "Apoptotic cell death induced by c-myc is inhibited by bcl-2" (*Nature* 1992, vol. 359)
9. "Oxidative stress and heat shock induce a human gene encoding a protein-tyrosine phosphatase" (*Nature* 1992, vol. 359)

The examples show that the titles clearly anticipated the results or conclusions of the research by way of a simple sentence with the verb in the present tense. The first observation was that while noun-phrase titles had been given to articles in all fields of science, only biomedical articles presented conclusive titles, although not all articles of these disciplines showed titles cast in this way. The next step was to delimit the sub-areas where this trend was followed.

## Phase 2: Focus on biomedical disciplines.

34

At this stage, advice was sought from our colleagues, specialists at the different departments located at the Faculty of Veterinary Sciences in Zaragoza (Spain), where most biomedical disciplines are represented. Following their recommendations, two new journals were chosen: *The Veterinary Record* and *The American Journal of Veterinary Research* (AJVR). They were among those most widely read by the researchers and practitioners in the faculty since they cover most biomedical areas (Pharmacology, Analytic and Diagnostic techniques, Physiology, Immunology, Pathology, Nutrition, Surgery, Toxicology...), and for the period selected at this stage of the study were ranked 6 and 15 respectively in the impact list of Veterinary Medicine, which included 90 journals. Again, all titles published in the same period were analysed, with the results shown on Table 2.

Journal title	Position in Impact list	Total No. Titles	No. Conclusive titles	%
<i>The Veterinary Record</i>	6/90	101	0	0%
<i>The American Journal of Veterinary Research</i>	15/90	225	1	0.4%

TABLE 2: Conclusive titles occurrence in Veterinary Medicine journals (1992-93)

Surprisingly, only one title anticipated the results in a sample of 326 articles. The question to be addressed was whether there were any special singularities in the articles published in Multidisciplinary Sciences journals that presented a full-sentence conclusive title. An in-depth analysis of those articles made by subject specialists revealed that they all dealt with aspects of either Molecular or Developmental Biology (DB). They suggested that this finding would explain the different percentages obtained in *Science* and *Nature*, since in their experience the latter, while publishing advances in any branch of science, traditionally includes a higher percentage of articles on biomedical disciplines.

### **Phase 3: Narrowing the scope**

In order to rule out any explanation based on coincidences, a new corpus selection was made aimed at verifying the scientific fields within the broad areas of Life and Health Sciences that followed the tendency of anticipating the results of the study in the title. Following the specialists' advice once more, this time we analysed the titles of all the articles published during the same period in the top journals from the areas of Biochemistry and Molecular Biology: (*Cell*) and Developmental Biology (*Development*), gathering a sample of 364 titles, of which 182 (50.5%) presented the conclusions of the article. Since the editors of these journals provided no guidelines on the construction of titles, a series of interviews with scholars from the different faculty departments was scheduled in search of a possible explanation for this phenomenon. The following faculty departments took part in the enquiry: Agriculture and Agricultural Economy; Anatomy, Embryology and Genetics; Pathology, Legal Medicine and Toxicology; Biochemistry and Cell and Molecular Biology; Pharmacology and Physiology, Applied Physics, Chemical Engineering and Environmental Technologies; Applied Mathematics; Microbiology, Preventive Medicine and Public Health; Animal Pathology; Animal Production and Food Science; Analytical Chemistry, Organic Chemistry; Inorganic Chemistry, and Physical Chemistry. The department representatives were selected on the basis of their research activity and publication rate in international journals. They were asked about their degree of familiarity with publications that anticipated the conclusions of their studies in the title of the articles and whether they could trace the origin of this fashion. The result of the enquiry was that only researchers whose specific field of research was directly or indirectly connected with Molecular and Developmental Biology were clearly familiar with this trend, while the rest considered it to a greater or lesser degree unsatisfactory, especially those who had been trained not to make strong claims for their results. When asked about the possible origin for this different approach, researchers in the affected areas provided the following tentative explanation.

In the late 70s anatomical studies had given rise to the creation of the new field of Embryology, which, at its inception, was only a descriptive science. However, with the introduction of experimental methods in this discipline, by which modifications in development can be made and their effects studied, the process of integration of a large number of areas under the general umbrella of Developmental Biology began, because scientists interested in any aspect of adult life realized that they had to study its development in order to fully understand all the processes. The process is summarized in Figure 1 below.

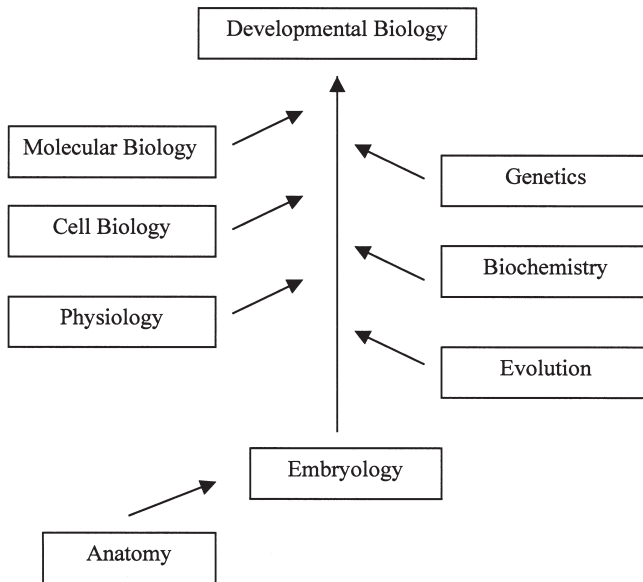


FIGURE 1: Convergence of scientific disciplines in developmental biology

The immediate consequence of this discovery was that all branches derived from Embryology converged in the study of DB and their corresponding investigations and findings affected all the biological sciences simultaneously. In the words of the biologist Gilbert (1988:7), “Developmental biology is one of the most exciting and fast-growing fields of biology. Part of its excitement comes from its subject matter, for we are just beginning to understand the molecular mechanisms of animal development. Another part of the excitement comes from the unifying role that developmental biology is beginning to assume in the biological sciences.



Developmental biology is creating a framework that integrates molecular biology, physiology, cell biology, anatomy, cancer research, immunology and even evolutionary and ecological studies. The study of development has become essential for understanding any other area of biology”.

Consequently, in order to verify whether all sub-areas converging in DB had incorporated this system of rapid communication, the corpus was extended to include journals corresponding to its different branches. This time, publications with a low impact factor were also incorporated. The results are shown in Table 3.

<b>Journal title</b>	<b>Position in Impact list</b>	<b>Total No. Titles</b>	<b>No. Conclusive titles</b>	<b>%</b>
Area: Biochemistry and Molecular Biology				
<i>Cell</i>	2/173	164	102	62%
<i>The EMBO Journal</i>	7/173	301	138	45.8%
<i>Molecular Microbiology</i>	27/173	212	57	26.8%
<i>Neurochemical Research</i>	92/173	116	14	12%
Area: Cell Biology				
<i>Journal of Cell Biology</i>	2/75	239	98	42.3%
<i>Histology and Histopathology</i>	72/75	150	0	0%
Area: Developmental Biology				
<i>Development</i>	2/21	200	80	40%
<i>Developmental Biology</i>	4/21	95	26	27%
<i>Differentiation</i>	7/21	56	11	20%
<i>Development, Growth &amp; Differentiation</i>	16/21	52	4	7.6%
Area : Reproductive Biology				
<i>Biology of Reproduction</i>	1/15	195	42	21%
<i>Journal of Reproduction &amp; Fertility</i>	4/21	95	18	7%
<i>Theriogenology</i>	(not included)	236	3.3	3.3%

TABLE 3: Conclusive titles occurrence in journals of areas converging in Developmental Biology (1992-93)

The figures demonstrate that:

1. Researchers in all areas converging in DB have extensively adopted the trend of anticipating the conclusions of their research in the title of the article, especially in works where the researcher is not only an observer but also takes an active part in the development of the functional process under study, which usually involves time-controlled experiments. It should be noted that purely descriptive works have not been found with such titles.

2. In general terms, the impact factor was not a determinant in the use of conclusive titles, as the absence of examples in the journals *Science* and *The Veterinary Record* indicates. However, when analysing titles restricted to the areas converging in DB, the impact factor is also an element that determines the percentage of use of this title typology (see Table 3). In *Biochemistry and Molecular Biology* the percentage decreased gradually from 62% in *Cell* to 12% in *Neurochemical Research* (nos.2 and 92 respectively in the impact list). Conclusive titles were rarely or never found in journals ranked low, such as in *Histology and Histopathology* (no.72 of 75 journals in the branch of Cell Biology). This finding might be explained by the fact that conclusive results which merit being “advertised” are usually published in the top journals, not the less highly rated ones. Evidence for this observation is shown in Table 4.

38

	No. Titles analysed	No. Conclusive titles	%
All Journals used	3423	730	21.32%
Only Multidisciplinary Sciences	986	131	13.2%
Only Biomedical Areas	2437	599	24.5%
Only areas converging in DB	2111	598	28.32%
Areas converging in DB and only high impact journals	798	322	40.3%

TABLE 4: Global percentages 1992-93

Phase 4: Checking the origin.

The theory that the origin and evolution of the use of conclusive titles were chronological was confirmed by the analysis of 630 new titles from the journal *Development*, which was formerly called *Journal of Embryology and Experimental Morphology* and changed its name in the mid-80s as a result of the new trend in the study of these disciplines. The titles were taken from issues published between 1980 and 1993. Table 5 shows the percentages obtained.

<b>Year of publication</b>	<b>Total No. Titles</b>	<b>No. Conclusive titles</b>	<b>%</b>
80-81	81	5	6.1%
82-83	80	4	5%
84-85	72	2	2.7%
86-87	135	17	12.5%
88-89	152	23	15%
90-91	109	33	30.2%
92-93	200	80	40%

TABLE 5: Origin and evolution in the use of conclusive titles. The case of *Development* (1980-1993)

Again, the progressive rise in the percentages is chronologically coincidental with the increasing importance of all these scientific areas for scientists working in biomedical fields. The number of publications that could be of interest to them suddenly rose dramatically, making it impossible for them to read even the abstracts of all these works. In 1991 Salager-Meyer (1991: 529) suggested that, because of the tremendous growth in the number of journals published and the interdisciplinary nature of research, scientists would have to rely more and more on abstracts as a short, concise, complete and accurate source of information and considered them as time-saving devices which could help readers to decide whether the whole article was worth reading, since they would not have time to follow the hyperproduction of professional literature. It seems that the same arguments can be offered to explain the appearance of titles which summarize the abstract presenting the most relevant and conclusive information using the smallest number of words compatible with accuracy and a rapid focussing of the reader's attention on the importance of the discovery which is being announced. In the mid-80s, the impact made by advances in DB on a large number of individual disciplines within biomedical science made it imperative for all researchers working in these fields to keep abreast of these developments. This would have been a practical impossibility under the traditional system of reliance upon abstracts, which, although comparatively short, still have an average of some 250 words.

#### **Phase 5: Assessing the evolution of the trend. Second period (2006).**

According to Stix (1994), the rate of publication of scientific information doubles about every 12 years. Assuming the veracity of this observation, the conclusion is that every twelve years researchers would have to double their efforts to keep up

with developments in their fields, and, consequently, conclusive titles should have gained ground as compared to abstracts as informative tools that facilitate the choice of articles to be read. In order to verify the validity of this hypothesis and the evolution of this trend, all issues published in 2006 of the same journals used in the previous phases were analysed. This produced a sample of 3668 new titles. There are several reasons for the choice of such an extensive corpus: the need for larger databases had been expressed in most studies on titles published till then; the number of journals on the areas under study has greatly increased during this period and each issue includes more articles, which requires a parallel increase of the samples used to avoid possible wrong deductions derived from random choices. The results obtained are summarized statistically in Table 6 below.

<b>Journal title</b>	<b>Position in Impact list</b>	<b>Total No. Titles</b>	<b>No. Conclusive titles</b>	<b>%</b>
Area: Multidisciplinary Sciences (184 titles)				
<i>Science</i>	1/48	78	17	21.8%
<i>Nature</i>	2/48	106	35	33%
Veterinary Medicine (422 titles)				
<i>The American Journal of Veterinary Research (AJVR)</i>	29/121	276	0	0%
<i>The Veterinary Record</i>	38/129	146	6	4%
Area: Biochemistry and Molecular Biology (1244 titles)				
<i>Cell</i>	2/261	285	224	78%
<i>The EMBO Journal</i>	15/261	524	288	54.9%
<i>Molecular Microbiology</i>	33/261	243	126	51.8%
<i>Neurochemical Research</i>	141/261	192	32	16.6%
Area: Cell Biology (416 titles)				
<i>Journal of Cell Biology</i>	12/153	321	246	76%
<i>Histology and Histopathology</i>	98/153	95	25	26.5%
Area: Developmental Biology (520 titles)				
<i>Development</i>	4/33	406	361	89%
<i>Developmental Biology</i>	7/33	57	31	54.3%
<i>Differentiation</i>	10/33	51	30	59%
<i>Development, Growth &amp; Differentiation</i>	27/33	56	21	37.5%
Area: Reproduction (832 titles)				
<i>Biology of Reproduction</i>	1/24	244	167	68%
<i>Reproduction</i>	2/24	178	62	35%
<i>Theriogenology</i>	10/24	410	25	6%

TABLE 6: Result of the evolution in the use of conclusive titles in biomedicine-related areas (2006)

Although the percentage of conclusive titles in the journals of Multidisciplinary Sciences has clearly increased, an analysis of the corresponding articles reveals that these figures can be misleading, as all titles following this trend dealt with topics that fall within the scope of Molecular or Developmental Biology. The actual percentage would, therefore be 100% in these areas, since no article on such topics was found corresponding to other title typologies. In the general area of Veterinary Medicine, the results are similar to those obtained in the first period. Unlike those in *Nature* and *Science*, the few conclusive titles found in *The Veterinary Record* correspond to studies on more basic medical or clinical aspects, and the headline-styled titles did not anticipate definite conclusions, but rather some of the results obtained. The following is an example:

10. “Methicillin-resistant *Staphylococcus aureus* isolated from a veterinary surgeon and five dogs in one practice” (*The Veterinary Record* 2006, vol. 158)

The difference in informative level with respect to the titles from *Science* and *Nature* is evident, as is clear from the following examples:

11. “Arginylation of  $\beta$ -Actin Regulates Actin Cytoskeleton and Cell Motility” (*Science* 2006, vol. 313)

12. “Mast cells are essential intermediaries in regulatory T-cell tolerance” (*Nature* 2006, vol. 442)

41

The number of conclusive titles in journals of the different branches of DB has increased dramatically in relation to the first period studied in all cases. Figures have doubled or even tripled where percentages were below 50% in 1993. When figures in the previous study indicated a tendency above 50% in favour of conclusive titles, the percentage is also higher and, more interestingly, even journals ranked low in the impact list present a noticeable number of such titles. Thus, the figures demonstrate the effectiveness of this informative strategy, the clear connection between the use of conclusive titles with publications related to any scientific field that bears on DB and also the scholarly recognition of the publication measured by way of its position in the corresponding impact list, as synthesized in Table 7.

	<b>Total No. Titles</b>	<b>No. Conclusive titles</b>	<b>%</b>
Only multidisciplinary sciences	184	52	28%
Only veterinary sciences	422	4	0.94%
Only areas converging in DB	3080	1638	53.18%
Areas converging in DB and only highest ranked journals	1296	998	79.4%

TABLE 7: Global percentages 2006

However, it was surprising to find that this tendency does not seem to have influenced other scientific fields, as seems to be suggested by the lack of this title typology in articles on other subjects published in top multidisciplinary journals.

#### Phase 6: In search of new disciplines

In order to verify whether any other scientific areas have adopted this strategy of conclusive titles, a review of the instructions for authors in the first position-ranked journals of several macro-areas was conducted in search of indications on the use of this informative device. In our choice of areas we omitted those that could have any connection with the broad field of Biomedicine, in order to avoid possible interferences with the already studied branches of Biology, which are present in a wide range of biomedical subareas. The areas selected were: Mathematics, Chemical Engineering, Analytical Chemistry, Geosciences (multidisciplinary), Applied Physics, Polymer Science, Transportation Science and Technology, Acoustics, Astronomy & Astrophysics and Materials Science (Composites).

The complete list of journals used in the analysis is offered in Appendix 1.

42

The requirements about titles made in these publications exclusively referred to title length and the need to be concise and specific. All titles to articles published in the selected journals in the last two 2006 issues were then reviewed to identify the title typology used in these prestigious scientific publications. None of the articles presented a conclusive title, all being limited to a presentation of the topic, with different degrees of specificity.

#### 4. Linguistic Characteristics of Conclusive Titles

Conclusive titles usually present a linguistically simple structure: Subject + verb (simple present) + complement(s). While being as concise as possible, they carry a high lexical density, which provides a great deal of information. Examples:

13. "Disulfides modulate RGD-inhibitable cell adhesive activity of thrombospondin" (*The Journal of Cell Biology* 1992, vol. 118)
14. "An SCN9A channelopathy causes congenital inability to experience pain" (*Nature* 2006, vol. 444)
15. "Leptin has concentration and stage-dependent effects on embryonic development in vitro" (*Reproduction* 2006, vol. 132)

The subject usually refers to the object of research. However, in other cases, the author prefers to use the passive form of the verb, giving in this way more importance to the new information provided than to the subject investigated:

16. "Extracellular proteolytic cleavage is required for activation of hepatocyte growth factor/scatter factor" (*The EMBO Journal* 1992, vol. 11)

17. "Stress fibers are generated by two distinct actin assembly mechanisms in motile cells" (*Journal of Cell Biology* 2006, vol. 173)

Unless sufficiently well known and univocal, noun subjects are accompanied by adjectives or followed by appositions which help to identify or remind the reader of aspects of the object of research:

18. "Ups1p, a conserved intermembrane space protein, regulates mitochondrial shape and alternative topogenesis of Mgm1p" (*Journal of Cell Biology* 2006, vol. 173)

19. "An Epididymal Form of Cauxin, a Carboxylesterase-Like Enzyme, Is Present and Active in Mammalian Male Reproductive Fluids" (*Biology of Reproduction* 2006, vol. 74)

The verbs used in this structure are either semantically neutral verbs (*to be, to have, consist of, lead to, result in...*) or those usually found in the results section of the paper, that is, verbs indicating the results obtained or changes observed. They are clearly predictable, which is supported by the finding that in the thousands of conclusive titles in our corpus, less than 200 different verbs have been used.

*To be* is the verb most used, usually when the title presents the identification and functional description of a new element:

20. "The RNA-binding protein FCA is an abscisic acid receptor" (*Nature* 2006, vol. 439)

21. "14-3-3 is a novel regulator of parkin ubiquitin ligase" (*The EMBO Journal* 2006, vol. 11)

Omission of the verb in these identifying attributive sentences is frequent, and results in advertisement-like sentences (Rush 1998), which suggest the possible influence of popularised scientific texts (science writing) on academic RAs (scientific writing):

22. "EMF, an Arabidopsis Gene Required 1645 for Vegetative Shoot Development" (*Science* 1992, vol. 258)

23. "PKC: a versatile key for decoding the cellular calcium toolkit" (*Journal of Cell Biology* 2006, vol. 174)

24. "AP-2: a regulator of EGF receptor signalling and proliferation in skin epidermis" (*Journal of Cell Biology* 2006, vol. 172)

These identifying titles very commonly include a relative clause (complete or shortened)

25. "DOCK2 is a Rac activator that regulates motility and polarity during neutrophil chemotaxis" (*Journal of Cell Biology* 2006, vol. 174)

- 26 “GLOBOSA: a homeotic gene which interacts with DEFICIENS in the control of Antirrhinum floral organogenesis” (*The EMBO Journal* 1992, vol. 11)
27. “Cullin3 Is a KLHL10-Interacting Protein Preferentially Expressed During Late Spermiogenesis” (*Biology of Reproduction* 2006, vol. 74)
28. “Protein tyrosine phosphatase TbPTP1: a molecular switch controlling life cycle differentiation in trypanosomes” (*Journal of Cell Biology* 2006, vol. 175)
29. “eIF4E is a central node of an RNA regulon that governs cellular proliferation” (*Journal of Cell Biology* 2006, vol. 175)

Another common combination is *to be* followed by a qualifying adjective expressing the researcher’s evaluation of the object of research and a prepositional phrase indicating its function, properties or applications.

30. “Synaptotagmin IV is necessary for the maturation of secretory granules in PC12 cells” (*Journal of Cell Biology* 2006, vol. 173)
31. “Lysosomal biogenesis and function is critical for necrotic cell death in *Caenorhabditis elegans*” (*Journal of Cell Biology* 2006, vol. 173)
32. “Neverland is an evolutionally conserved Rieske-domain protein that is essential for ecdysone synthesis and insect growth” (*Development* 2006, vol. 133)
33. “Nitric Oxide Produced During Sublethal Ischemia Is Crucial for the Preconditioning-Induced Down-Regulation of Glutamate Transporter GLT-1 in Neuron/Astrocyte Co-Cultures” (*Neurochemical Research* 2006, vol. 31)

Sometimes, the need for brevity produces rephrasing which involves an apparent return to the noun-phrase typology. The informative value of the title, however corresponds to the conclusive, journalistic type:

34. “Requirement for Map2k1 (Mek1) in extra-embryonic ectoderm during placentogenesis” (*Development* 2006, vol. 133)
35. “Drastic reduction in the virulence of *Streptococcus pneumoniae* expressing type 2 capsular polysaccharide but lacking choline residues in the cell wall” (*Molecular Microbiology* 2006, vol. 60)

Procedural, dynamic verbs are used in the simple present, which may infringe the basic rules of scientific language, since conclusions based on individual studies are elevated to the rank of universal truths, by way of the generalizing power of this tense.

36. “The Vac14p–Fig4p complex acts independently of Vac7p and couples PI3,5P2 synthesis and turnover” (*Journal of Cell Biology* 2006, vol. 172)
37. “Somite-derived cells replace ventral aortic hemangioblasts and provide aortic smooth muscle cells of the trunk ” (*Development* 2006, vol. 133)

Very often, however, a review of the discussion section of the article reveals that the results do not support such optimistic declarative sentences.



While a great majority of the titles present affirmative verbs, the negative form is used where the results throw a new light on aspects which were understood differently until then, or which are contrary to the general expectations or assumptions, but never indicate a failure in achieving the objectives of the research:

38. "Timing of Neutrophil Activation and Expression of Proinflammatory Markers Do Not Support a Role for Neutrophils in Cervical Ripening in the Mouse" (*Biology of Reproduction* 2006, vol. 74)
39. "Nicotine Exposure Does not Alter Plasma to Brain Choline Transfer" (*Neurochemical Research* 2006, vol. 31)
40. "Reducing Estrogen Synthesis Does Not Affect Gonadotropin Secretion in the Developing Boar" (*Biology of Reproduction* 2006, vol. 74)
41. "Neither Aurora B Activity nor Histone H3 Phosphorylation Is Essential for Chromosome Condensation During Meiotic Maturation of Porcine Oocytes" (*Biology of Reproduction* 2006, vol. 74)

Surprisingly, the use of hedging devices is infrequent (below 0.1% of the corpus), since they would help the writer "to anticipate peer's criticism and to take oratory precautions, i.e., to participate in the complex game of social interaction and negotiations involved in all scientific publishing where bold and presumptuous statements are frowned upon" (Salager-Meyer: 1995). It seems as if the rules of the game have changed and the writer may fear that busy readers would disregard titles which present weakened assertions. These are among the few cautious conclusions found in our corpus:

42. "Transcription of ribosomal genes can cause nondisjunction" (*Journal of Cell Biology* 2006, vol. 173)
43. "MP11, an essential gene encoding a mitochondrial membrane protein, is possibly involved in protein import into yeast mitochondria" (*The EMBO Journal* 1992, vol. 11)
44. "Formation of ovarian follicular fluid may be due to the osmotic potential of large glycosaminoglycans and proteoglycan" (*Reproduction* 2006, vol. 132)
45. "Dazl can bind to dynein motor complex and may play a role in transport of specific mRNAs" (*The EMBO Journal* 2006, vol. 25)

The use of interrogative sentences is not as frequent as might be expected of a proved attention-attracting device. This strategy seems to work efficiently in humanities and social sciences (Soler 2007), but biomedical researchers seem to feel more attracted by the information itself and seem to demand the answer, not the question. Lewison and Hartley (2005) remarked the scarcity of question marks in scientific articles titles. In our corpus, the few interrogative titles encountered reproduce the questions that the author assumes other researchers in the field would like to have an answer for, but the conclusions of the article do not allow the writer to make definite assertions, as in the example below:

46. "How does daily treatment with human Chorionic Gonadotropin induce superovulation in the cyclic hamster?" (*Biology of Reproduction* 1993, vol. 48)

The conclusion of the article leaves other alternatives open:

"It is postulated that in rodents the undifferentiated theca producing less androgen than normal is the precipitating factor in inducing atresia of antral follicles, **although other possibilities cannot be discounted**"

A question title would, therefore, suggest the lack of definite conclusions, which would indirectly offer a similar amount and type of information, letting the reader know that the answer is still pending, or that there are several possible explanations which require further reading.

Longer conclusive titles are becoming more frequent, showing that the author wants to inform of all the results obtained, not only the main conclusion. In these cases, compound sentences are used, building short paragraphs by way of coordination of simple clauses:

47. "The murine homologue of SALL4, a causative gene in Okihiro syndrome, is essential for embryonic stem cell proliferation, and cooperates with Sall1 in anorectal, heart, brain and kidney development" (*Development* 2006, vol. 133)
48. "PKA-activated ApAF–ApC/EBP heterodimer is a key downstream effector of ApCREB and is necessary and sufficient for the consolidation of long-term facilitation" (*Journal of Cell Biology* 2006, vol. 174)
49. "Retinoic acid guides eye morphogenetic movements via paracrine signalling but is unnecessary for retinal dorsoventral patterning" (*Development* 2006, vol. 133)
50. "Integrin-Linked Kinase (ILK) Is Highly Expressed in First Trimester Human Chorionic Villi and Regulates Migration of a Human Cytotrophoblast-Derived Cell Line" (*Biology of Reproduction* 2006, vol. 74)
51. "Meiosis, egg activation, and nuclear envelope breakdown are differentially reliant on Ca<sup>2+</sup>, whereas germinal vesicle breakdown is Ca<sup>2+</sup> independent in the mouse oocyte" (*Journal of Cell Biology* 1992, vol. 117)
52. "PSPC1, NONO, and SFPQ Are Expressed in Mouse Sertoli Cells and May Function as Coregulators of Androgen Receptor-Mediated Transcription" (*Biology of Reproduction* 2006, vol. 75)
53. "Expression of SV-40 T antigen in the small intestinal epithelium of transgenic mice results in proliferative changes in the crypt and reentry of villus-associated enterocytes into the cell cycle but has no apparent effect on cellular differentiation programs and does not cause neoplastic transformation" (*Journal of Cell Biology* 1992, vol. 117)

Less frequently, but not exceptionally, complex and complex-compound sentences are used in the title when the writer needs to specify time, place, purpose, comparison or contrast aspects which can only be expressed by way of a subordinate clause.

- 54. "To stabilize neutrophil polarity, PIP3 and Cdc42 augment RhoA activity at the back as well as signals at the front" (*Journal of Cell Biology* 2006, vol. 174)
- 55. "The allantois and chorion, when isolated before circulation or chorio-allantoic fusion, have hematopoietic potential" (*Development* 2006, vol. 133)
- 56. "Dissimilarities in sows' ovarian status at the insemination time could explain differences in fertility between farms when frozen-thawed semen is used" (*Theriogenology* 2006, vol. 65)
- 57. "Oocyte Bone Morphogenetic Protein 15, but not Growth Differentiation Factor 9, Is Increased During Gonadotropin-Induced Follicular Development in the Immature Mouse and Is Associated with Cumulus Oophorus Expansion" (*Biology of Reproduction* 2006, vol. 75)

The similarities with newspaper headlines are quite evident if we compare the following pairs of examples:

- 58a. "Shugoshin collaborates with protein phosphatase 2A to protect cohesin p46" (*Nature*, vol. 443, 2006)
- 58b. "Digital Resolve Collaborates with Microsoft to be Data Provider for Microsoft Phishing Filter in Windows Internet Explorer 7 and the Windows Live Tool" (*Worlds Technology News*, 6th September 2006)
- 59a. "Flies without Centrioles" (*Cell*, vol.125, 2006)
- 59b. "Elections Without the Electoral College" (*The Washington Post*, 11<sup>th</sup> April, 2007)
- 60a. "MP11, an essential gene encoding a mitochondrial membrane protein, is possibly involved in protein import into yeast mitochondria" (*The EMBO Journal*, vol.11, 1992)
- 60b. "U.S.: Shiite cell possibly involved in deadly Iraq blast" (*CNN News*, 18<sup>th</sup> June, 2008)
- 61a. "Selection for early and late adult emergence alters the rate of pre-adult development in *Drosophila melanogaster*" (*BMC Developmental Biology*, vol. 6, 2006)
- 61b. "Brazil Government Alters Tax Rate On Temporary Imports" (*Easy Bourse Actualité*, 6<sup>th</sup> February, 2009)
- 62a. "Inactivation of Tbx1 in the pharyngeal endoderm results in 22q11DS malformations" (*Development*, vol. 133, 2006)
- 62b. "Homer Hospital 's open house results in \$5,000 donation" (*The Guardian*, 15<sup>th</sup> May 2008)
- 63a. "Induction of Mesenchymal Stem Cells Leads to HSP72 Synthesis" (*Neurochemical Research*, vol. 31, 2006)
- 63b. "Disturbance Leads To Arrest" (*The Guardian*, 12th January, 2006)
- 64a. "Targeted disruption of cubilin reveals essential developmental roles in the structure and function of endoderm and in somite formation" (*BMC Developmental Biology*, vol. 6, 2006)
- 64b. "New InfoTrends Report Reveals Essential Features of Digital Photo Frames Photo" (*News Today*, 19th March 2009)

Other examples present obvious analogies with the language used in the first paragraph of a newspaper article, condensing the main contents of the news, in an effort to “abstract the abstract”, i.e. to include the major concepts in the article as suggested by Huckin (2006: 103):

60. “Aspergillus nidulans class V and VI chitin synthases CsmA and CsmB, each with a myosin motor-like domain, perform compensatory functions that are essential for hyphal tip growth”

61. “The retina is more susceptible than the brain and the liver to the incorporation of trans isomers of the DHA in rats consuming trans isomers of alpha-linolenic acid”

All the features listed above could also correspond to a description of the language used by journalists in building up headlines, which would support Fairclough’s (1993: 141) early suggestion that “[in today’s promotional culture] there is an extensive restructuring of boundaries between orders of discourse and between discursive practices... generating new hybrid, partly promotional genres” and may provide an answer to Bhatia’s question (1997: 191) “to what extent genres, and therefore generic forms and conventions, can be exploited or taken liberties with, in order to introduce innovations to achieve more complex communicative purposes in response to novel communicative situations?”. Our results suggest that for today’s scientists the only limit is efficiency and success in promoting their work and in making it easily accessible to the busy reader.

## 5. Discussion and Conclusions

Previous studies have revealed that scientists’ behaviour when reading journal articles is practically identical to that of newspaper readers (Bazerman:1985; Huckin:1987; Berkenkotter & Huckin:1995), in that they draw on schema knowledge to read selectively, searching for the most important information and novel results, always found in the headlines=titles and lead=abstract, a parallelism suggested by Berkenkotter & Huckin (1995:31). Aware of these preferences, newspaper editors and journalists build their texts following the inverted pyramid pattern, a pattern which facilitates the top-down, news-oriented reading schema. Scientific RAs have their own rhetorical conventions following a writer-based text schema, in which only the title and abstract allow for a top-down approach. According to Bazerman (1985: 9) when “the title and author provide inadequate, ambiguous, or misleading information, the reader will turn to the abstract to decide whether the article is worth reading”. But, what if the titles provide all the necessary information as is the case of those titles that are the focus of this study? The results of the study suggest that the authors of RAs from those biomedical areas which require interdisciplinary reading want to catch the interest of editors,

reviewers and readers from the first line of their studies, thereby avoiding the risk of their articles being lost in databases if the title makes no explicit mention of the findings of the research. Accurate information on the substance of the paper is not enough, a conclusive title barely presents what the study has established, its specific contribution to the development of knowledge. They attract by informing, but what matters is not what the information is about, but the surprise value of the news, much along the lines of newspaper headlines. Despite the general lack of a published policy regarding the use of conclusive titles, whenever possible, biomedical researchers make use of this anticipatory device, as the increasing percentages shown in this study demonstrate. The presence in the corpus of merely indicative titles, which only present juxtaposed elements of information on the topic studied needs an explanation which considers the risk their authors run of being disregarded by busy readers of those disciplines, readers already used to obtaining an anticipation of the findings. The reasons suggested by Goodman et al. (2001: 76) would not explain this choice. First, title length limitation cannot be the cause, as the abundant pre and post modifiers of the noun phrase needed to provide specific information on the topic are making indicative titles progressively longer. On the other hand, conclusive titles can be very short, when the nature of the research and the results obtained allow for an efficient information bite condensed in only one sentence. Furthermore, very few journals would pass the test of compliance with the instructions on title length. Our sample includes titles which triple the number of words suggested by the editors. Second, while the root topic can be considered of such capital importance that any other information would appear to be unnecessary at that level, according to the Principle of Presumption of Knowledge (Strawson 1964), the reader of such specialized texts would be able to infer the topic from the findings, but not otherwise, and, consequently, in Gricean terms (Grice 1975), conclusive titles would adhere to the cooperative principle, while topic-only titles in experimental biomedical areas could fail to satisfy the Maxims of Relevance and Quantity. Third, the suggestion that “information about methods and results will reduce the interest level of the readers” (Goodman et al. 2001:78) contradicts the almost predictable mathematical correlation found in our study between percentage of conclusive titles in a journal and its position in the impact list (Tables 3, 4, 6 and 7).

One possible explanation for the use of non-conclusive titles in areas where this trend is clearly implanted is simply that the nature of the research or the results obtained do not allow the author to condense this information in a single sentence. This is the case of structural, analytical or descriptive studies, which cannot be easily synthesized, and of those that are based on the development of analysis of a logic-mathematical nature, and of papers where the news value lies in the techniques employed (process, not results). That would also explain the lack of acceptance of

this tendency in the hard sciences shown in our Phase 6 analysis, and other areas, such as linguistics (Haggan 2004), namely in “journal papers which are organized within the framework of logical argument rather than experimentation” (Tarone et al. 1998: 115). The lack of full-sentence titles in review articles reported by Soler (2007) is explained by the practical impossibility of offering one conclusion that could reflect those reached in all the articles used in the review.

A second reason for the lack of conclusions in the title may be the failure to obtain relevant findings in the research conducted. A premature announcement of this relative lack of success would be unnecessary and strategically wrong. This suggestion is supported by the fact that the top publications (which are supposed to include the most relevant works of these areas) produce the highest percentage of conclusive titles, while these are practically absent in the lowest-ranking journals.

Some decades ago, Kinneavy (1971) reminded us that the norms of scientific proof are not the norms of information or of persuasion or of literature. At present, however, most institutionalized genres have incorporated elements of promotion, especially in highly competitive and interdisciplinary areas, as is the case of biomedicine. As Bhatia (1997: 191) indicates, “the notion of pure genres is very attractive and extremely useful for a number of pedagogical outcomes, [sic] in practice, however, it is unlikely to capture the complex communicative realities of the present-day professional and academic world”. The reality is that “to be successful, [scientists] must also possess a thorough familiarity with the conventions of writing in their subspecialty so that they can use these conventions to their best advantage” (Berkenkotter, Huckin & Ackerman: 1989).

Conventions in title construction on many biomedicine-related disciplines have changed in the last three decades (Gross et al.: 2002), at least in practice, “to better accommodate the needs of specialist readers and readers pressed for time” (Berkenkotter & Huckin: 1995: 33).

As writers of RAs, researchers working on experimental disciplines related to Life and Health Sciences follow the trend of anticipating results in the title whenever the nature of their research and the conclusions reached allow them to. As readers, however, they are more cautious and adopt the same critical method they use when scanning headlines in a newspaper: the title may serve to discard the article, but never replaces reading its content.

As Goodman (2001: 78) suggested, journal editors should consider “developing and publishing guidelines for titles that meet the needs of authors, editors and readers”. Along the same lines, scientific/academic English courses would benefit from the inclusion of journalistic strategies to avoid constructing misleading titles and making wrong deductions when reading conclusive titles that may promise more than they finally offer.

## Works cited

- ALLEY, Michael. 1996. *The Craft of Scientific Writing* (3<sup>rd</sup> ed.) New York: Springer-Verlag.
- ANTHONY, Laurence. 2001. "Characteristic Features of Research Article Titles in Computer Science". *IEEE Transactions on Professional Communication*, 44 (3): 187-194.
- BAZERMAN, Charles. 1985. "Physicists Reading Physics: Schema-Laden Purposes and Purpose-Laden Schema". *Written Communication*, 2 (1): 3-23.
- . 1988. *Shaping Written Knowledge*. Madison: University of Wisconsin Press.
- BERKENKOTTER, Carol, Thomas HUCKIN & John ACKERMAN. 1989. "Social Context and Socially Constructed Texts: The Initiation of a Graduate Student into a Writing Research Community". *Technical Report No. 33*: National Center for the Study of Writing and Literacy.
- BERKENKOTTER, Carol & Thomas HUCKIN. 1995. *Genre knowledge in disciplinary communication: cognition, culture, power*. Hillsdale, NJ: L. Erlbaum Associates: 27-44.
- BHATIA VIJAK. K. 1997. "Genre-Mixing in Academic Introductions". *English for Specific Purposes*, 16 (3): 181-195.
- BIRD, P.R. & M.A. KNIGHT. 1975. "Word count statistics of the title of scientific Papers". *The information Scientist*, 9 (2): 67-69.
- BLACK, J. D. 1962. "The keyword: its use in abstracting, indexing and retrieving information". *Aslib Proceedings*, 14: 313-321.
- BUXTON, A. B. & A.J. MEADOWS. 1977. "The variation in the information content of titles of research papers with time and discipline". *Journal of Documentation*, 33 (1): 46-52.
- DAY, Robert A. 1995. *How to Write and Publish a Scientific paper* (5<sup>th</sup> ed). Cambridge: Cambridge U. P.
- DIENER, R. A. 1984. "Informational dynamics of journal article titles". *Journal of the American Society for Information Science*, 35: 222-227.
- DILLON, J.T. 1981a. "The emergence of the colon: An empirical correlate of scholarship". *American Psychologist*, 36 (8): 879-884.
- . 1981b. "Functions of the colon: an empirical test of scholarly character". *Educational Research Quarterly*, 5: 71-75.
- DIODATO, Virgil & Karen PEARSON. 1985. "Source indexing in science journals and indexing services: a survey of current practices". *Science and technology Libraries*, 6: 103-118.
- DUDLEY-EVANS, Tony. 1984. "A preliminary investigation of the writing of dissertation titles". In James, G. (ed.) *The ESP classroom: Methodology, materials, expectations*, vol. 4. Exeter, UK: Exeter Linguistic Studies: 40-46.
- FAIRCLOUGH, Norman. 1993. "Critical Discourse Analysis and the Marketisation of Public Discourse: The Universities". *Discourse & Society* 4(2): 133-168.
- FEINBERG, Hilda. 1973. *The derivative Indexing techniques. A Comparative Study*. Metuchen, NJ: Scarecrow Press.
- FISCHER, Beth A. & Michael J. ZIGMOND. 2004. *Components of a Research Article*. Retrieved January 2009 from: 2009www.survival.pitt.edu/library/documents/ComponentsofaResearchArticle.pdf
- FORTANET, Inmaculada, Juan Francisco COLL, Juan Carlos PALMER & Santiago POSTEGUILLO. 1997. "The writing of titles in academic research articles". In Marín, R. & A. Romero (Coords.) *Lenguas Aplicadas a las Ciencias y la Tecnología: Aproximaciones*. Cáceres: Servicio de Publicaciones, Universidad de Extremadura: 155-158.
- . 1998. "Linguistic analysis of research article titles: disciplinary variations". In Vázquez, I. & I. Guillén (eds.) *Perspectivas Pragmáticas en Lingüística Aplicada*. Zaragoza: Ed. Anubar: 443-447.
- GILBERT, Scott F. 1988, 2<sup>nd</sup> ed. *Developmental Biology*. Sunderland, Massachusetts: Sinauer.

- GOODMAN, Neville. W. 2000. "Survey of active verbs in the titles of clinical trial reports". *British Medical Journal*, 320: 914-915.
- GOODMAN, Richard A., Stephen B. THACKER & Paul Z. SIEGEL. 2001. "What's in a Title? A Descriptive Study of Article Titles in Peer-Reviewed Medical Journals". *Science Editor*, 24 (3): 75-78.
- GRICE, Herbert Paul. 1975. "Logic and conversation". In Cole, P. & J.L. Morgan. (eds.) *Syntax and Semantics, vol III: Speech Acts*. NY: Academic Press: 41-58.
- GROSS, Alan G., Joseph HARMON & Michael REIDY. 2002. *Communicating Science: The Scientific Article from the 17th Century to the Present*. N.Y: Oxford U. P.
- HAGGAN, Madeline. 2004. "Research paper titles in literature, linguistics and science: dimensions of attraction". *Journal of Pragmatics*, 36: 293-317.
- HARTLEY, James. 2005. "To attract or to inform: What are titles for?" *Journal of Technical Writing and Communication*, 35 (2): 203-213.
- . 2007. "Planning that title: Practices and preferences for titles with colons in academic disciplines". *Library and information science research*, 29: 553-568.
- HODGES, P.R. 1983. Keyword in Title indexes: effectiveness in retrieval in computer searchers. *Special Libraries*, 74: 56-60.
- HUCKIN, Thomas. 1987. "Surprise Value in Scientific Discourse". Paper delivered at the Conference on College Composition and Communication, Atlanta, GA.
- . 2006. "Abstracting from abstracts". In Hewings, M. (ed.) *Academic Writing in Context: Implications and Applications*. London: Continuum: 93-104.
- HUTH, Edward J. 1990, 2<sup>nd</sup> ed. *How to Write and Publish Papers in the Medical Sciences*. Baltimore: Williams & Wilkins.
- HYLAND, Ken. 2002. "What do they mean? Questions in academic writing". *Text* 22 (4): 529-557.
- KINNEAVY, James L. 1971. *A Theory of Discourse*. Englewood Cliffs, NJ: Prentice-Hall.
- LESTER, James D. 1993. *Writing Research Papers. A Complete Guide*. NY: Harper Collins.
- LEWISON, Grant & James HARTLEY. 2005. "What's in a title: Number of words and the presence of colons". *Scientometrics*, 63 (2): 341-356.
- LINDSAY, David. 1995, 2<sup>nd</sup>ed. *A Guide to Scientific Writing*. Melbourne: Longman.
- MANTEN, A. A. & J.F.D. GREENHALGH. 1977. "Titles of scientific papers". *Animal Feed science and technology*, 2 (1): 1-6.
- MCGOWAN, Jessie & Peter TUGWELL. 2005. "Informative titles described article content". *Journal of the Canadian Health Libraries Association*, 26: 83-84.
- MITCHELL, John Howard. 1968. *Writing for Professional and technical Journals*. NY: Wiley.
- NAHL-JAKOBOVITS, Diane & Leon A. JAKOBOVITS. 1987. "Dependent and independent variables in research articles". *Research Strategies*, 5: 164-171.
- O'CONNOR, Maeve. 1991. *Writing Successfully in Science*. London: Harper-Collins.
- ROSNER, Judah L. 1990. "Reflections on science as a product". *Nature*, Vol. 345:108.
- RUSH, S. 1998. "The noun phrase in advertising English". *Journal of Pragmatics*, 29 (2): 155-171.
- RYMER, J. 1988. "The scientific composing process: How eminent scientists write articles". In Jolliffe, D. (ed.) *Writing in Academic Disciplines*. Norwood, NJ: Ablex: 211-250.
- SALAGER-MEYER, Françoise. 1991. "Medical English Abstracts: How well are they structured?". *Journal of the American Society for Information Science*, 42(7): 538-531.
- . 1995. "I Think That Perhaps You Should: a Study of Hedges in Written Scientific Discourse". In Miller, T. (ed.) *Functional Approaches to Written Texts: Classroom Applications*, 1. TESOL France Publications: 127-145.
- SMITH, Richard. 2000. "Informative titles in the BMJ". *British Medical Journal*, 320: 915.



SOLER, Viviana. 2007. "Writing titles in science: An exploratory study". *English for Specific Purposes*, 26: 90-102.

STIX, G. 1994. "The spread of write. Trends on scientific communication". *Scientific American*, 271:106-111.

STRAWSON, Peter. 1964. "Identifying reference and truth values". *Teoría*, 30: 96-118. Reprinted in Steinberg, D. and Jakobovits, L. (eds.)1971. *Semantics*. Cambridge: Cambridge U.P.

SWALES, John M. & Christine B. FEAK. 1994. *Academic Writing for Graduate Students*. Ann Arbor: The University of Michigan Press.

TARONE, Elaine, Sharon DWYER, Susan GILLETTE & Vincent ICKE. 1998. "On the Use of the Passive in Astrophysics Journal Papers: With Extensions to other Languages and other Fields". *English for Specific Purposes*, 17 (1): 113-132.

TOCATLIAN, J.J. 1970. "Are titles of chemical papers becoming more informative?". *Journal of the American Society for Information Science*, 21: 345-350.

WANG, Yan & Yongquan BAI. 2007. "A Corpus-Based Syntactic Study of Medical Research Article Titles". *Syntax*, 35 (3): 388-399.

WHISSELL, Cynthia. 1999. "Linguistic complexity of abstracts and titles in highly cited journals". *Perceptual and Motor Skills*, 88: 76-86.

WHITE, Arden & Nelda Rae HERNÁNDEZ. 1991. Increasing Field Complexity revealed through Article Title Analysis. *Journal of the American Society for Information Science*, 42 (10): 731-734.

YITZHAKI, Moshe. 1994. "Relation of title length of journal articles to number of authors". *Scientometrics*, 30 (1): 321-332.

—. 1997. "Variation in informativity of titles of research papers in selected humanities journals: A comparative study". *Scientometrics*, 38 (2): 219-229.

—. 2002. Relation of the title length of a journal article to the length of the article. *Scientometrics*, 54 (3): 435-477.

## APPENDIX 1. SOURCE JOURNALS FOR TITLES

1. *Analytical Chemistry*, 78 (23-24)
2. *Biology of Reproduction*, 47 (4-6), 48 (1-4), 74 (1-6), 75 (1-6)
3. *Cell*, 71 (1-6), 72 (1-6), 73 (1-2), 124 (1-6), 125 (1-6), 126 (1-6), 127 (1-6)
4. *Composites Science and Technology*, 66 (14-15)
5. *Development*, 116 (2-4), 117 (1-4), 133 (1-24)
6. *Development, Growth and Differentiation*, 34 (5-6), 35 (1-2), 48 (1-9)
7. *Developmental Biology*, 153 (2), 154 (1-2), 155 (1-2), 156 (1-2), 289 (1-2), 290 (1-2), 291 (1-2), 292 (1-2), 293 (1-2), 294 (1-2), 295 (1-2), 296 (1-2), 297 (1-2), 298 (1-2), 299 (1-2), 300 (1-2)
8. *Differentiation*, 51 (2-3), 52 (1-3), 74 (1-10)
9. *Earth Science Reviews*, 79 (1-4)
10. *Histology and Histopathology*, 7 (3-4), 8 (1-2), 21 (1-12)
11. *Journal of Cell Biology*, 119 (1-6), 120 (1-6), 121 (1-2), 172 (1-7), 173 (1-6), 174 (1-6), 175 (1-6)
12. *Journal of Catalysis*, 244 (1-2)
13. *Journal of Reproduction and Fertility*, 96 (1-2), 97 (1-2)
14. *Molecular Microbiology*, 6 (19-23), 7 (1-8), 59 (1-6), 60 (1-6), 61 (1-6), 62 (1-6)
15. *Nature*, 359 (347-864), 360 (1-768), 361 (1-768), 362 (1-870), 439 (1-1030), 440 (1-1244), 441 (1-1194), 442 (1-1076), 443 (1-1030), 444 (1-1104)
16. *Nature Materials*, 5 (11-12)
17. *Neurochemical Research*, 17 (10-12), 18 (1-4), 31 (1-12)
18. *Progress in Polymer Science*, 31 (11-12)
19. *Science*, 258 (5079-5090), 259 (5091-5103), 260 (5104-5108), 311 (5757-5769), 312 (5770-5782), 313 (5783-5795), 314 (5796-5807)

20. *The American Journal of Veterinary Research*, 53 (10-12), 54 (1-4), 67 (1-12)
21. *The Astrophysical Journal*, 653 (1-2)
22. *The EMBO Journal*, 11 (10-13), 12 (1-4), 25 (2-24)
23. *The Journal of the American Mathematical Society*, 19 (3-4)
24. *The Veterinary Record*, 131 (14-26), 132 (1-17), 158 (1-25), 159 (1-26)
25. *Theriogenology*, 38 (4-6), 39 (1-4), 65 (1-9), 66 (1-9)
26. *Transportation Research. Methodological*, 40 (9-10)
27. *Ultrasound in Obstetrics and Gynecology*, 28 (6-7)