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Comparative and contrastive observations on scientific titles written in English and Spanish

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ABSTRACT

This research focuses on the structural construction of scientific titles in English and Spanish in research papers (RP) and review papers (RVP) in the biological and social sciences. The questions raised were (i) whether structural construction is a key distinctive feature between RP and RVP titles; (ii) whether the inherent peculiarities of scientific disciplines imprint differences on the structural constructions of RP and RVP titles; and (iii) whether language-specific differences can be identified. To this end, a total of 1140 titles were analyzed, words per title were counted to measure their length and all structural constructions detected were registered. The major findings are: (a) the prevalence of nominal-group titles as a linguistic strategy of scientific discourse rather than as a disciplinary, generic or language characteristic; (b) the frequency of full-sentence construction in RP titles of the biological sciences; (c) the predominance of RP compound titles in the social sciences, and more flexibility of Spanish in the use of punctuation marks for the division of this title type; and (d) statistically significant differences in the length of RP titles in terms of discipline and language. Lines of evidence from this research contribute to underlining suggestions on how to guide novice scientists to write titles appropriately.

1. Introduction

Titles are succinct descriptive labels of texts and are meant to fulfil different purposes, such as to individualize a publication, summarize its content and appeal to its audience, among others. In science, in particular, they are ideally relevant to present the content of a study and, in general, they are self-explanatory to their readers. They thus result from a set of requisites, among which being informative and precise, concise, easily classifiable and storable in databases, and reader-friendly (Goodman, Thacker, & Siegel, 2001; Hartley, 2005, 2008; Lewison & Hartley, 2005) are crucial to the construction, communication and progress of new knowledge. Encoding this variety of heterogeneous requisites is not an easy linguistic task and varies depending on a series of factors such as, editorial policies, individual researchers' stylistic preferences, generic variables, disciplinary variables, and an awareness of the role and expected impact of the title on the audience it addresses. In view of this, "writing scientific titles is a challenging exercise as it requires a series of skills from authors to be able to include all these requirements appropriately in the titles of their papers" (Soler, 2007, p. 91).

Swales (1990) claimed that titles are an issue in academic genres which has not yet been fully studied. Several years later, this observation seems to have generated response as the newly-born field called "titleology" (Baicchi, 2003) has grown since then and has diversified itself through a heterogeneous range of topics, including titleology in highly advanced scientific discourse. In this particular area of titleology, literature is not only vast and rich but also varied from the point of view of

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study designs (Goodman et al., 2001), topics analyzed (Berkenkotter & Huckin, 1995; Fortanet, Coll, Palmer, & Posteguillo, 1997; Fortanet Gómez, Posteguillo Gómez, Coll García, & Palmer Silveira, 1998; Haggan, 2004; Laurence, 2001; Whissell, 1999), size of databases examined (Laurence, 2001), outcoming applications (Goodman et al., 2001; Huth, 1987), and genres considered (Dudley-Evans, 1984; Hamp-Lyons, 1987; Soler, 2007; Yakhontova, 2002). Previous research also shows that titles of scientific papers vary across disciplines (Haggan, 2004). However, Gesuato (2005, 2008) claims that research on journal article titles has not yet answered the question of whether or not titles of scientific papers differ across genres.

Exceptions to this observation are Hartley's (2005, 2007, 2008), Dillon's (1982) and Soler's (2007) studies. Based on findings derived from examining several hundred titles of academic publications, Hartley concludes that titles differ across genres. He observed, in particular, differences in length and content between book titles and article titles. Dillon's findings (1982) indicates that compound titles are more common in the titles of books and articles rather than in the titles of dissertation abstracts. Soler (2007) analyzed the most recurrent structural constructions of review paper (RVP) and research paper (RP) titles written in English in the biological and social sciences and observed that the full-sentence title construction seems to be not only a generic characteristic of RP titles but also a disciplinary peculiarity of RP titles in the biological sciences.

In addition, and because titleology in scientific discourse has focused almost exclusively on titles written in English, another issue, also left unaddressed, concerns the analysis of titles written in languages other than English and whether or not the languages chosen imprint particular semantic, pragmatic and/or cultural characteristics on to scientific titles. Marginal exceptions to this observation are Yakhontova's (2002), Nord's (1995) and Soler's (2009) studies. Yakhontova (2002) analyzed titles of conference presentation abstracts of linguistics and applied mathematics in English versus Ukrainian and Russian. She recorded preferences of conference titles for certain structural patterns, for example, the English title *corpus* she analyzed includes a considerable amount of "colon" titles while her Ukrainian and Russian *corpus* includes a considerable amount of nominal-group titles. From the semantic and pragmatic point of view, she also detected a strong tendency towards self-promotion and "interestingness" in the group of titles written in English, which was almost absent in the Slavic title group. Nord (1995) conducted research on titles and headings of different publications, including scholarly journal articles written in English, French, German and Spanish. She identified three functions of titles, which are relevant to the general communicative situation, and three optional functions of titles determined by specific interactional circumstances. She also observed intra-*corpus* differences concerning, for example, the highest and lowest degree of expressivity in the German and Spanish titles, respectively. Soler (2009) analyzed the structural construction of scientific RP and RVP titles of the biological and social sciences written in Spanish. Soler found a prevalence of the nominal-group title construction in RP and RVP, a prevalence of the compound title construction in the social sciences analyzed, and a non-significant frequency of the full-sentence title construction exclusively in RP titles, particularly of the biological sciences investigated. It has therefore not yet been concluded whether or not titles of scientific publications differ across genres (Gesuato, 2005). Nor has it been concluded whether or not title constructions in science vary among languages.

The present research, which is an attempt to answer these issues, fuses results derived from two previous studies which examined separately the most recurrent structural constructions of titles written in English (Soler, 2007) and Spanish (Soler, 2009) in two different genres, namely, RVPs and RPs in two fields: the biological and social sciences. In view of the above, the present study aims to answer the following questions: (i) whether the structural construction of titles written in English and in Spanish is a key distinctive feature between RP titles and RVP titles; (ii) whether the inherent peculiarities of scientific disciplines imprint differences on the structural constructions of RP and RVP titles in the two languages; and (iii) whether language-specific differences can be identified.

To this end, a *corpus* containing 1140 titles was constructed for their analysis. The present study, which is framed on an empirical, descriptive and exploratory basis, could be considered as a cross-generic and cross-disciplinary study. Because this research is a continuation of two previous studies (Soler, 2007, 2009), we thought it convenient to follow their approach. Thus, a "macroscopic" analysis, that is, an analysis restricted only to the structure with which titles appear at surface level, was carried out. In our view, the data collected from one external variable will facilitate further studies of internal variables as they will provide a background to elucidate the reasons why certain internal variables are recurrent within specific structural constructions.

2. Materials and methods

2.1. Material analyzed

Eighty RP titles were separately chosen per discipline in English and in Spanish, thus yielding a total of 480 RP titles for each language. Furthermore, 15 RVP titles were separately chosen per discipline in English and in Spanish, thus yielding a total of 90 RVP titles for each language. A total of 1140 titles were therefore analyzed, of which 570 (both RP and RVP titles) were written in English and the remaining 570 (both RP and RVP titles) were written in Spanish, all covering the period 1996–2002. Titles were selected from the following disciplines: Anthropology, Linguistics and Psychology (social sciences), and Biology, Biochemistry and Medicine (biological sciences). None of the selected journals indicate specific instructions regarding the structural construction of titles. Table 1 shows the selected journals from which RP titles were chosen for the present study.

Table 1
Journals (1996–2002) from which research paper titles were selected.

Social Sciences		
Anthropology	Linguistics	Psychology
Journals written in English		
Journal of Human Evolution USA, ISSN 0047-2484	Journal of Linguistics UK, ISSN 0022-2267	Journal of School Psychology USA, ISSN 0022-4405
Journal of Anthropological Archaeology Holland, ISSN 0278-4165	Language and Communication UK, ISSN 0271-5309	Journal of Experimental Child Psychology USA, ISSN 0022-0965
Journals written in Spanish		
Chúngara Chile, ISSN 0717-7356	Signos Chile, ISSN 0718-0934	Psicothema Spain, ISSN 0214-9915
Revista Española de Antropología Biológica Spain, ISSN1134-7368	Estudios Filológicos Chile, ISSN 0071-1713	Anales de Psicología Spain, ISSN 0212-9728
Biological Sciences		
Biology	Biochemistry	Medicine
Journals written in English		
Journal of Biological Chemistry USA, ISSN 0021-9258	Journal of Neuroscience USA, ISSN 0270-6474	American Journal of Cardiology USA, ISSN 0002-9149
Journal of Cell Biology USA, ISSN 0021-9525	Journal of Neuroimmunology Ireland, ISSN 0165-5728	Journal of Hepatology Ireland, ISSN 0168-8278
Journals written in Spanish		
Revista Iberoamericana de Micología Spain, ISSN 1130-1406	Bioquimia México, ISSN 0185-5751	Medicina Intensiva Spain, ISSN 1578-7710
Revista Latinoamericana de Microbiología México, ISSN 0034-9771	Bioquímica y Patología Clínica Argentina, ISSN 1515-6761	Anales de Pediatría Spain, ISSN 1695-4033

A distinction between RPs and RVPs must be firstly made in order to frame the discussion in the present research. An RP is a genre which serves as a generator of new knowledge about a specific subject and generally displays the IMRAD format, that is, an Introduction, a Materials and Methods section, a Results section, and a Discussion. All these sections evidence a good deal of experimental work. An RVP is an integral type of research because it includes findings gathered on a given subject by different groups of researchers after several years of study. Therefore, RVPs result from several previous RPs and are thus markedly less in number than the latter. For example, the *Journal of Cell Biology*, Volume 135, which was selected for our *corpus*, includes 150 articles, of which only 2 are RVPs. This made it difficult to find as many RVPs as RPs for the present research. As a result, our *corpus* containing RVP titles could not be strictly restricted to the same journals as those that included RPs. Still, it includes RVP titles from different journals provided they correspond to the scientific disciplines selected for this research. Table 2 shows the selected journals from which RVP titles were chosen for the present study.

Titles were chosen at random from journals covering a wide geographical scope, namely the United Kingdom, the United States, Holland, Ireland, Spain, Mexico, Chile and Argentina. This geographical spectrum, as well as the inclusion of the social sciences journals in our study, posed two challenging limitations requiring solutions. One is the fact that not all the journals selected are ISI listed, and the other, which is also related to the former, is that, according to data from the UK, social science research is not widely represented in the ISI journal lists (Economic and Social Research Council, 2004), nor are journals written in Spanish.

Therefore, in order to prevent these limitations from creating an imbalance between the two sets of data analyzed in our study, the similarity constraints considered by Connor and Moreno (2005) to achieve *tertia comparationis* were controlled to secure baseline data for our comparative/contrastive analysis. *Corpus* balance was thus secured in relation to the following prototypical features:

- Communicative purpose (*tertium comparationis* 1): All journals selected aim at publishing articles that make a clear contribution to the debate in specific fields of research. Interestingly, they also promote interdisciplinary contributions.
- International nature (*tertium comparationis* 2): All journals selected are international.
- Representativity (*tertium comparationis* 3): All journals selected are representative samples of discourse-community populations in the two writing cultures analyzed.
- Editorial process followed (*tertium comparationis* 4): All journals selected follow the same editorial process which is initiated upon submission of manuscripts for consideration of publication. Manuscripts are reviewed by at least one member of the editorial board for general suitability and strength of advance. If the manuscripts cover the scope of the journal, a full review by leading scientists active in the relevant field, follows. Their decision is communicated by an editorial board member familiar with the topic as soon as all referees' reports are compiled. This strict peer review process evaluates not only the scientific studies performed but also the writing strategies used.

Table 2
Journals (1996–2002) from which review paper titles were selected.

Social Sciences		
Anthropology	Linguistics	Psychology
Journals written in English		
American Journal of Physical Anthropology	Journal of Linguistics	Journal of Applied Psychology
USA, ISSN 0002-9483	UK, ISSN 0022-2267	UK, ISSN 0021-9010
Journal of Human Evolution	ELT Journal	Journal of School Psychology
USA, ISSN 0047-2484	UK, ISSN 0951-0893	USA, ISSN 0022-4405
–	–	International Journal of Psychology
–	–	UK, ISSN 0020-7594
–	–	Psychological Review
–	–	USA, ISSN 0033-295X
Journals written in Spanish		
Chúngara	Signos	Revista Psichothema
Chile, ISSN 0717-7356	Chile, ISSN 0716-0934	Spain, ISSN 0214-9915
Nueva Antropología	Estudios Filológicos	Anales de Psicología
México, ISSN 0185–0636	Chile, ISSN 0071–1713	Spain, ISSN 0212–9728
Scripta Ethnológica	Revista Española de Lingüística	–
Argentina, ISSN 0325–6669	Spain, ISSN 2010–1874	–
Alteridades	Literatura y Lingüística	–
México, ISSN 0188–7017	Chile, ISSN 0716–1874	–

Biological Sciences		
Biology	Biochemistry	Medicine
Journals written in English		
Journal of Cell Biology	Trends in Neurosciences	Arteriosclerosis, Thrombosis and Vascular Biology
USA, ISSN 0021-9525	UK, ISSN 0166-2236	USA, ISSN 1079-5642
BioEssays	Nature Neuroscience	Transfusion Medicine Reviews
UK, ISSN 0265-9247	USA, ISSN 1097-6256	Holland, ISSN 0887-7963
International Review of Neurobiology	–	Archives of Internal Medicine
Holland, ISSN 0-12-366857-3	–	USA, ISSN 0003-9926
Journals written in Spanish		
Revista Ibeoramericana de Micología	Bioquimia	Medicina Intensiva
Spain, ISSN 1130-1406	México, ISSN 0185-5751	Spain, ISSN 1578-7710
Revista Latinoamericana de Microbiología	Química Clínica	Anales de Pediatría
México, ISSN 0034-9771	Spain, ISSN 1139-2436	Spain, ISSN 1696-4033

- Editorial policy followed (*tertium comparationis* 5): When submitting a manuscript, authors must affirm that the material has been neither published nor submitted for publication elsewhere.
- Audience (*tertium comparationis* 6): All journals selected address a peer reader with expertise in specific fields of study related to the disciplines selected for the present research.
- Chronological coverage (*tertium comparationis* 7): All journals selected include RPs and RVPs published during the same 7-year span, that is, from 1996 to 2002.

2.2. Statistical analysis

The disciplines analyzed were grouped into social sciences and biological sciences for the statistical analysis. A three-factor (genre × discipline × language) ANOVA test was used to assess differences in title length ($2 \times 2 \times 2$). As interaction was found among these factors, a mean comparison was carried out for the combination of each factor level (population) via the Least Significance Difference (LSD). As to the assumptions for the ANOVA test, the normality test was not found to be necessary because mean values were obtained from an amount of data whose magnitude secured the normality assumption. In the case of homoscedasticity, the Levene test yielded non-significant values; consequently it was not included in our study.

The Maximum Likelihood *G*-test (Sokal & Rohlf, 1981) was used to compare the frequency of occurrence of all the title constructions recorded in each population by means of a homogeneity test applied to a contingency table (4×8). Furthermore, although the full-sentence and question construction titles were analyzed separately in Section 4 for reasons of clarity, for the statistical analysis in particular, these groups were fused into one category because the values expected for the question group were lower than five. The software package used for our statistical analysis was InfoStat, version 2010 (Grupo InfoStat, Universidad Nacional de Córdoba, Argentina). The reason why the *G*-test was used instead of the Chi-squared test, although they yield similar results (Sokal & Rohlf, 1981), is that the *G*-test has the property of allowing *G*-statistics to be additively decomposed into hierarchically minor *G*-statistics. This property offers an advantage over the Chi-squared test and therefore made our statistical analysis more rigorous.

3. Results

3.1. Length of the titles analyzed

A preliminary analysis was carried out to derive quantitative data on the length of the scientific titles selected. Tables 3 and 4 show the mean number of words per title and the corresponding SD.

As the three-factor ANOVA evidenced interaction ($F_{\text{discipline}\times\text{language}} = 8.6$ and $F_{\text{discipline}\times\text{genre}} = 11.8$; $p < 0.01$), no conclusions on each factor could be made unless the other factors were considered. LSD was thus applied to each population. Results are shown in Figure 1.

RP titles demonstrated highly significant differences ($P < 0.05$) in terms of discipline. In particular, the RP titles of the social sciences were found to be shorter than those of the biological sciences in the two languages analyzed (Fig. 1). This finding coincides with Haggan's (2004) observations on RP titles in science. In addition, the RP titles of the biological sciences group showed no statistically significant differences ($P > 0.05$) in terms of language (Fig. 1) whereas those of the social sciences revealed significant differences ($P < 0.05$) in terms of language as the RP titles written in Spanish were found to be longer than their counterparts in English.

RVP titles were found to be shorter than RP titles in all the populations analyzed. Furthermore, they indicated no significant statistical differences ($P > 0.05$) which could be due either to the language or the discipline analyzed. However, an interesting disciplinary peculiarity worthy of note in this group is that Linguistics RVP titles in Spanish were found to be not only the longest in this group but also longer than their counterparts in the biological sciences group (Table 4).

3.2. Structural construction occurrence of the titles analyzed

Table 5 shows the occurrence of the structural constructions found in the titles analyzed, namely:

Table 3
Length of research paper titles.

Social Sciences				Biological Sciences			
Discipline	Number of RP titles	Mean of number of words	SD	Discipline	Number of RP titles	Mean of number of words	SD
Titles written in English							
Anthropology	80	12.7875	3.8638	Biology	80	15.4000	4.4738
Linguistics	80	7.9625	3.6159	Biochemistry	80	14.6500	5.1216
Psychology	80	12.2750	3.5399	Medicine	80	15.8500	5.2917
–	Total	11.0083	4.2545	–	Total	15.3000	4.9788
Titles written in Spanish							
Anthropology	80	14.5500	4.6002	Biology	80	15.2500	5.5632
Linguistics	80	10.9750	3.7920	Biochemistry	80	13.7125	5.7196
Psychology	80	12.7375	4.7220	Medicine	80	14.9750	5.5483
–	Total	12.7542	4.6106	–	Total	14.6458	5.6275

Table 4
Length of review paper titles.

Social Sciences				Biological Sciences			
Discipline	Number of RVP titles	Mean of number of words	SD	Discipline	Number of RVP titles	Mean of number of words	SD
Titles written in English							
Anthropology	15	7.7333	2.8900	Biology	15	7.6000	4.1884
Linguistics	15	5.4000	2.2297	Biochemistry	15	8.8000	2.5128
Psychology	15	9.4000	4.3883	Medicine	15	10.7333	4.2840
–	Total	7.5111	3.622	–	Total	9.0444	3.8903
Titles written in Spanish							
Anthropology	15	7.8000	2.89	Biology	15	8.9333	3.4115
Linguistics	15	9.9333	3.7123	Biochemistry	15	7.2667	4.3337
Psychology	15	9.4667	4.3894	Medicine	15	9.1333	3.3778
–	Total	9.0444	3.7525	–	Total	8.4444	3.745

(i) The nominal-group construction (Bloor & Bloor, 1997), for example:
Titles written in English:
– **Relation of tissue Doppler-derived myocardial velocities to serum levels and myocardial gene expression of tumor necrosis factor-alpha and inducible nitric oxide synthase in patients with ischemic cardiomyopathy having coronary artery bypass grafting**. Kalra DK, Ramchandani M, Zhu X, Lawrie G, Reardon MJ, Mann DL, Zoghbi WA, Nagueh SF. *The Am. J. Cardiol.* 2002, 90:708–712 (Medicine RP).

– **A quantitative review of the guilty knowledge test**. MacLaren VV. *J. Appl. Psychol.* 2001, 86:674–683 (Psychology RVP).

Titles written in Spanish:
– **Incidencia de los factores Nivel de escolaridad y Nivel socio-educativo en la comprensión lectora adolescente (Incidence of school level and socio-educational level in the reading comprehension of adolescents)**. Viramonte de Ávalos M, Carullo de Díaz AM. *Signos* 1997, 30:177–195 (Linguistics RP).

– **El electrocardiograma en la estimación inicial del pronóstico de pacientes con infarto agudo de miocardio (The electrocardiogram in the initial diagnostic determination in patients with acute myocardial infarction)**. García Díaz F, Sánchez Olmedo JI, Frías Ochoa J, Fajardo López-Cuervo J. *Medicina Intensiva* 2000, 24:220–230 (Medicine RVP).

(ii) The compound construction, for example:
Titles written in English:
– **Synthetic zinc finger transcription factor action at an endogenous chromosomal site: Activation of the human erythropoietin gene.** Zhang L, Spratt SK, Liu Q, Johnstone B, Qi H, Raschke E, Jamieson AC, Rebar EJ, Wolfe AP, Case C. *J. Biol. Chem.* 2000, 275:33850-33860 (Biology RP).

– **Parameters and the periphery: reflections on syntactic nuts**. Fodor JD. *J. Linguistics* 2001, 37:367–392 (Linguistics RVP).

Titles written in Spanish:
– **Cazadores recolectores costeros y sus contextos de tarea: Una visión desde el asentamiento holocénico temprano de Punta Penitente (LV. 014), Los Vilos (Coastal collector hunters and their work contexts: A view from the early holocenic settlement in Punta Penitente (LV.014), Los Vilos)**. Mendez Melgar CA. *Chúngara* (Arica) 2002, 34:135–166 (Anthropology RP).

– **Determinación de homocisteína en plasma: metabolismo, metodología, interpretación de resultados y papel en la evaluación del riesgo vascular (Determination of homocysteine in plasma: metabolism, methodology, interpretation of results and its role in the evaluation of vascular risk)**. Blanco Vaca F, Deulofeu R, Vilaseca MA, Chacon P, Dulín E. *Química Clínica* 2002, 21:243–250 (Biochemistry RVP).

(iii) The full-sentence construction, for example:
Titles written in English:
– **Phosphorylation of the PTEN tail acts as an inhibitory switch by preventing its recruitment into a protein complex**. Vazquez F, Grossman SR, Takahashi Y, Rokas MV, Najamura N, Sellers WR. *J. Biol. Chem.* 2001, 276:48627–48631 (Biology RP).

– **Oligocene sivaladapid primate from the Bugti Hills (Balochistan, Pakistan) bridges the gap between Eocene and Miocene adapiform communities in Southern Asia**. Marivaux L, Welcomme J-L, Ducrocq S, Jaeger J-J. *J. of Human Evolution* 2002, 42:379–388 (Anthropology RP).

Titles written in Spanish:
– **La DNA polimerasa beta de rata sustituye la capacidad de la DNA polimerasa I de reparar el daño letal causado por la luz ultravioleta (Beta DNA polymerase substitutes DNA polymerase I's ability to repair ultraviolet light-derived lethal damage)**. Hernández-Escamilla R, Espinosa-Lara JM, Quintana-Hau JD, Uribe-Luna S, Loyola-Abitia P, Santiago-Hernández JC, Maldonado-Rodríguez R. *Rev. Latinoam. Microbiol.* 2002, 44 (2):58–64 (Biology RP).

El propofol no inhibe la vasoconstricción pulmonar hipóxica (Propofol does not inhibit hypoxic pulmonary vasoconstriction). Álvarez Ruiz AP, Tamayo Lomas L, Castañeda Casado F. *Med. Int.* 2001, 25:291–297 (Medicine RP).

(iv) The question-like construction, for example:
Titles written in English:
– **Are there features of language that arose like birds' feathers?** Botha RP. *Lang. & Comm.* 2002, 22:17–35 (Linguistics

(*continued on next page*)

RP).

– **Where is APC going**? Mimori-Kiyosue Y, Tsukita S. *J. Cell Biol.* 2001, 154:1105-1110 (Biochemistry RVP).

Titles written in Spanish:

– **¿El ruido afecta a la focalización de la atención visual? (Does noise affect visual attention focus?)** Santalla Peñaloza Z, Alvarado Izquierdo JM, Santisteban Requena C. *Psicothema* 1999, 11:97–111 (Psychology RP).

– **¿Pueden basarse las indicaciones de los antifúngicos en los estudios de sensibilidad? (Can antifungal indications be based on sensitivity studies?)** Cuenca-Estrella M, Rodríguez-Tudela JT. *Rev. Iberoam. Micol.* 2002, 19:133–138 (Biology RVP).

Although question titles could be included within the full-sentence title construction, for reasons of clarity, they were analyzed separately in Section 4.

The Maximum Likelihood *G*-test showed heterogeneity for the general test ($G = 269$; $p < 0.01$), thus the contingency table was subdivided. In the group of RP titles, heterogeneity was clearly illustrated in terms of discipline and language ($G = 247$; $p < 0.01$) whereas in the RVP title group, homogeneity was evident ($G = 6.8$; $p > 0.05$). Within the RP title group, the contingency table was subdivided. In the biological sciences group highly significant differences ($P < 0.05$) between the two languages analyzed (Fig. 2a) were observed ($G = 126$; $p < 0.01$). In contrast, this was not observed in the social sciences ($G = 3.0$; $p > 0.05$) in which title structural construction occurrence was found to be balanced both in English and Spanish (Fig. 2b).

Results from our count also showed that the highest occurrence corresponded to the nominal-group construction, a phenomenon which was seen not only in all the disciplines analyzed but also in the two languages considered. In agreement with findings from León and Divasson (2006, 2008), this group was found to reveal heterogeneity in the nominal structure of all the titles analyzed in English and in Spanish. Such heterogeneity was evidenced through a very rich variety of structural constructions ranging from "extremely brief units to exceedingly long word strings with intricate interconnections and the capacity to express complex ideas" (León & Divasson, 2006, p. 290). The former refers to a complex made up of only one word or a head and one or two premodifiers in the English construction or a head and a postmodifier in the Spanish construction. The presence of either one or more premodifiers in simple nominal-group constructions written in Spanish is not a regular characteristic. Reasons for this phenomenon are explained below, for example:

– **Seminalplasmin**. Sitaram N, Nagaraj R. *BioEssays* 1997, 17:415–423 (Biology RVP title).
– **German noun inflection**. Cahill L, Gazdar G. *J. Linguistics* 1999, 35:1–42 (Linguistics RP title).
– **Actinomicetoma (Actinomycetoma)**. Castrillón RLE, Palma-Ramos A, Sampedro-Pérez JG. *Bioquimia* 1998, 23:21–29 (Biochemistry RVP title).

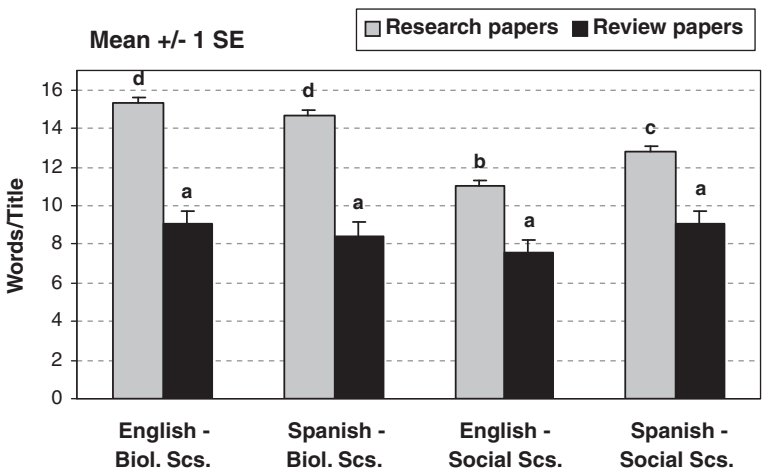

Fig. 1. Length of research paper titles vs. length of review paper titles. Disciplines were grouped into social sciences and biological sciences. A three-factor (genre × discipline × language) ANOVA test was used to assess differences in title length ($2 \times 2 \times 2$). As interaction was found among these factors, mean comparison was carried out for the combination of each factor level (population) via Least Significance Difference (LSD). The different letters denote significant differences among the genre-, discipline- and language groups analyzed ($P < 0.05$).

Table 5
Numerical title construction occurrence.

Genre	Language	Discipline	Title structural construction occurrence				Number of titles analyzed
			Nominal construction	Compound construction	Full-sentence construction	Question construction	
Research papers	English	Biology	35	4	41	0	80
		Biochemistry	33	11	36	0	80
		Medicine	56	10	13	1	80
		Anthropology	52	26	1	1	80
		Linguistics	48	28	0	4	80
		Psychology	46	33	0	1	80
	Spanish	Biology	68	11	1	0	80
		Biochemistry	62	17	0	1	80
		Medicine	53	26	1	0	80
		Anthropology	47	33	0	0	80
		Linguistics	51	29	0	0	80
		Psychology	53	25	0	2	80
Review papers	English	Biology	10	4	0	1	15
		Biochemistry	8	7	0	0	15
		Medicine	7	6	0	2	15
		Anthropology	8	4	0	3	15
		Linguistics	11	3	0	1	15
		Psychology	6	7	0	2	15
	Spanish	Biology	6	8	0	1	15
		Biochemistry	11	4	0	0	15
		Medicine	6	9	0	0	15
		Anthropology	6	9	0	0	15
		Linguistics	8	6	0	1	15
		Psychology	8	6	0	1	15

– **Desórdenes plaquetarios (Platelet disorders)**. López M, Avigliano A, López D. *Bioquímica y Patología Clínica* 2001, 65:35–42 (Biochemistry RP title).

More complex nominal-group constructions refer to structures consisting of a chain of either a head with premodifiers and post-modifiers, or a head followed by several post-modifiers. The latter is a structure of modification that prevails over the former in the titles written in Spanish. This is a common characteristic of Spanish which has a different word order in structures of modification, with respect to English. Adjectives or other content words used attributively as premodifiers in English become, in general, post-modifiers in Spanish (for further details see Soler (2002)).

In agreement with previous studies (León & Divasson, 2006, 2008; Salager-Meyer, 1985), heterogeneity is also a characteristic that typifies the nature of the components of either the premodifiers of complex nominal-group titles written in English or the post-modifiers of complex group titles in English and in Spanish. As examples of such heterogeneity, several

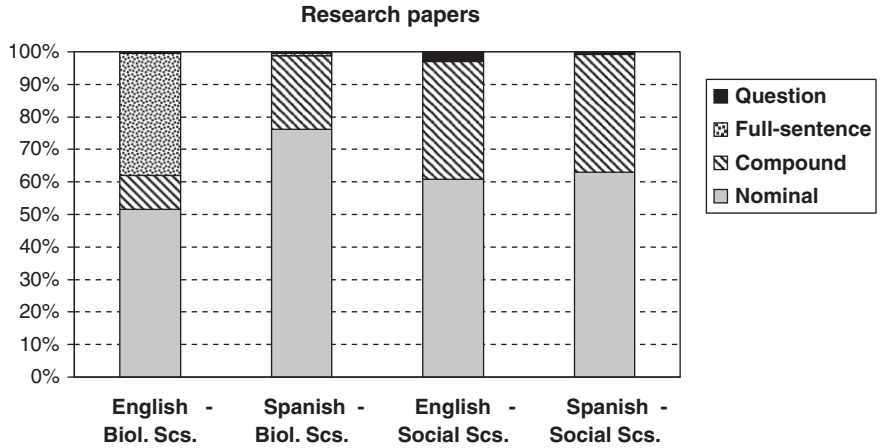

Fig. 2a. Title construction occurrence in research paper titles.

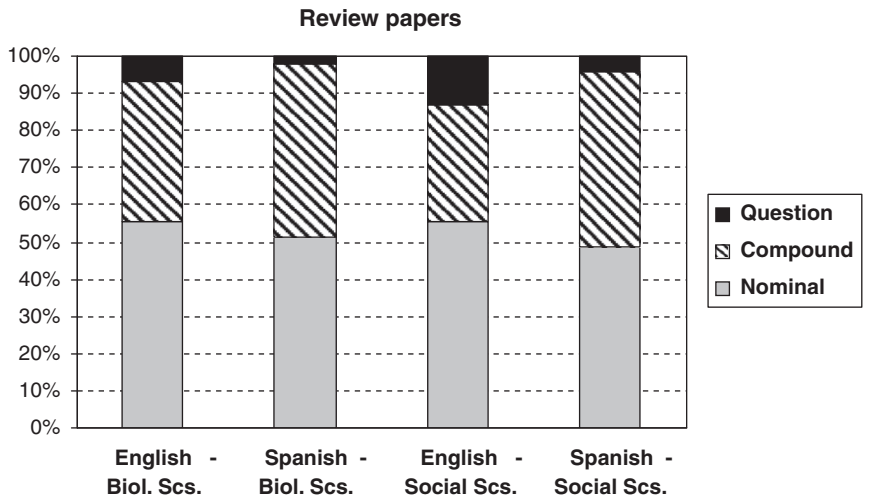

Fig. 2b. Title construction occurrence in review paper titles.

instances of nominal groups including prepositional-phrase post-modifiers were registered in the titles written in English and in Spanish, for example:

- **Glucocorticoid receptor expression in the spinal cord after traumatic injury in adult rats**. Yan P, Xu Y, Li Q, Chen S, *J. Neurosc.* 1999, 19:9355–9363 (Biochemistry RP title).
- **A meta-analytic review of gender differences in perceptions of sexual harassment**. Rotundo M, Nguyen D-G, Sackett PR. *J. Applied Psychol.* 2001, 86:914–922 (Psychology RVP title).
- **Las tradiciones de tierras altas y de valles occidentales en la textilería arqueológica del Valle de Azapa (Traditions of high soils and western valleys in the archaeological textile activity in Valle de Azapa)**. Agüero Piwonka C. *Chúngara* (Arica) 2000, 32:217–225 (Anthropology RP title).
- **Mecanismos virales de bloqueo de la apoptosis como estrategia de evasión de la respuesta inmunológica (Viral blocking mechanisms of apoptosis as a strategy to evade an immunological response)**. Chacón-Salinas R, Sánchez-Cruz P. *Rev. Latinoam. Microbiol.* 2000, 42:83–93 (Biology RVP title).

Also, in the titles written in English, more complex constructions, such as "-ing" structures inside prepositional-phrase post-modifiers, were found, for example:

- **Comparison of positron emission tomography with the resting electrocardiogram for assessing viable myocardium in chronic ischemic cardiomyopathy involving the anterior left ventricular wall**. Desideri A, Zanco P, Bertella M, Bigi R, Cortigiani L, Bax J, Suzzi G, Celegon L. *The Am. J. Cardiol.* 2002, 90:878–882 (Medicine RP).
- **Multiorgan autonomic dysfunction in mice lacking the β2 and the β4 subunits of neuronal nicotinic acetylcholine receptors**. Xu W, Orr-Urtreger A, Nigro F, Gelber S, Ballard Sutcliffe C, Armstrong D, Patrick JW, Role LW, Beaudet AL, de Biasi M. *J. Neurosc.* 1999, 19:9298–9305 (Biochemistry RP title).

Comparative observations between the nominal construction titles of the two languages analyzed showed that nominal postmodification revealed higher complexity and variability in its constituents than nominal premodification. As to the variability in the length of nominal construction titles, lengthy nominal postmodification (León & Divasson, 2006) was found to be a common characteristic in the two languages studied.

Occurrence of the nominal-group title construction was followed by the compound title construction which occurred more frequently in the social sciences group both in English and in Spanish, particularly in the RP titles (Table 5). The full-sentence title construction took place at a significantly higher rate in the RP titles of the biological sciences written in English, particularly the RP Biology titles. This finding is not only in agreement with Berkenkotter and Huckin's (1995) results and Haggan's (2004) conclusions but is also indicative of a marked contrast with respect to the same construction in the titles of the social sciences. In Spanish, full-sentence title constructions were present only in the biological sciences group as well, though their occurrence was insignificant when compared to English. Interestingly, they were absent in the social sciences group in Spanish.

As stated above, our statistical analysis also revealed structural construction homogeneity in the RVP titles in all the disciplines examined as well as in the two languages analyzed. Nonetheless, some peculiarities were found to be worthy of note,

such as the absence of the full-sentence construction in the RVP titles written in English and in Spanish. Also, the question title construction occurred at an insignificant but higher rate in the RVP titles of the social sciences, both in English and Spanish, with respect to the same construction in the RP title group (Table 5 and Figs. 2a and 2b).

4. Discussion

In agreement with previous studies on titles (Buxton & Meadows, 1977; Haggan, 2004) our research corroborates that there are two features that are common to all the titles analyzed independently of the genre or the discipline to which titles belong and independently of whether titles are written in Spanish or in English. These features are informativity and economy. The latter characteristic results from the need to adjust the title to an extremely small section of the paper without affecting intelligibility. Scientists therefore make use of different linguistic strategies, such as nominal-group constructions (further details below), simple full-sentence constructions (further details below), monosyllabic verbs and/or nouns, and so forth. Concomitantly, these strategies contribute to synthesizing informativity in such a way that the topic that will be further discussed in the paper is presented in miniature in the title.

As stated above, our count shows that the nominal-group construction is the most recurrent title structure in the two genres and languages considered as well as in all the disciplines analyzed (Table 5). This cross-generic and cross-disciplinary phenomenon has also been observed in previous studies focused on titles written in English (Bloor & Bloor, 1997; Soler, 1994, 2003, 2007; Wang & Bai, 2007, among others) as well as in studies focused on titles written in Spanish (Soler, 2009). This type of construction, which has been defined as "a rhetorical structure which soon developed as the prototypical discourse pattern for experimental science" (Halliday & Martin, 1993, p. 7) seems to corroborate the classificatory process of the scientific activity. That is: "the possibility of ordering the things of the experiential world in some field-specific way presupposes both observing and naming relevant phenomena. Observation may be, in part, an empirical and nonlinguistic activity, but the record of observation is always a linguistic one: it involves giving things names. (Wignell, Martin, & Eggins, 1993, p. 143)".

Both in English and in Spanish, the nominal-group construction seems to be an appropriate frame for titles as it permits the straightforward materialization of informativity through the piling up of pre- and post-modifiers or through lexical density (Gesuato, 2008) which is measured as the overall ratio of content words to function words. Title lexical density is the amount of information provided as a function of the number of content words used. Thus, the denser the title lexicality is, the higher its synoptic informativity (Gesuato, 2008). In addition, the nominal group's lexical density in the two genres and languages analyzed: (i) enables scientists to account for their studies and findings synoptically, (ii) contributes to demonstrating the specification of either the object of study or the results collected, (iii) imprints impersonality, thus placing emphasis on the object of the study rather than on the author of the study, and (iv) caters to the readers' particular needs as these titles map the main subject matter of the papers within the corresponding scientific field. This corroborates Haggan's observation (2004, p. 20) that "titles are texts in miniature", which guide the reader in such a way that what he/she sees printed below the title deals with something in particular.

Because our analysis was restricted to title construction at surface structure, the connections between these structural features and their communicative functions in relation to other sections of the papers to which the titles analyzed belong were not explored in the present study. Nonetheless, and based exclusively on what this type of title construction shows at surface level, it can be confirmed that the following discursive rhetorical features: "object-centered perspective; synthetic, expository and informative style; specialized terminology" (León & Divasson, 2008, p. 151) were found condensed in the titles belonging to this group in English and Spanish. A final comment on this title group concerns internal constituency as the different word order pattern in structures of modification between English and Spanish may pose a challenge to the study of the differences and similarities of title nominal internal constituency and complexity in these languages. In agreement with previous studies (León & Divasson, 2006, 2008) and in spite of this different word order pattern, the titles belonging to this group in our study showed that premodification and postmodification complexity do not always correspond to the use of long word chains. This confirms that it is this horizontal discourse, which involves the shared specific knowledge and specific linguistic codes of the members of the same scientific discourse community, rather than explicit connections among the nominal internal constituents, which secures the appropriate interpretation. Therefore, a detailed systematic and comprehensive study focused exclusively on internal nominal constituency will shed light on how the complexity of specialized knowledge is conveyed by the inner syntactico-semantic interrelations of nominal-group title constructions.

Compound titles (Table 5 and Figs. 2a and 2b) show an interrelationship between the two parts constituting them, thus succinctly illustrating the presentation of the object of study in two different ways. For this interrelated title construction, Swales and Feak (1994) proposed the categories of problem–solution, general–specific, topic–method, and major–minor, in a similar way to Fortanet et al. (1997). Of these, the general–specific prevailed in the examples registered in our study, that is, the authors generally present the object of study while simultaneously indicating the specificity of such study, for example:

- **Cotext as context: vague answers in court**. Janney RW. *Language and Communication* 2002, 22(4):457–475 (Linguistics RP).
- **Emotions: From neuropsychology to functional imaging**, Berthoz S, Blair RJR, Le Clech G. *International Journal of Psychology* 2002, 23(4):193–203 (Psychology RVP).

- **Cifosis angular de la columna vertebral: Identificación del Mal de Pott en una momia guane prehispánica de Colombia (Angular cyphosis in the vertebral column: Identification of Pott Disease in a prehispanic Guane mummy from Colombia)**. Romero WM, Willian M, Herrasti L. *Chúngara* 2000, 32(1):41–48 (Anthropology RP).
- **Anticuerpo antitransglutaminasa: utilidad en el diagnóstico de la enfermedad celíaca (Antitransglutaminase antibody: utility for the diagnosis of celiac disease)**. Palacios Sarrasqueta M, Rivero Marcotegui A, Sánchez Valverde Visus F, Feijoo Blanco E, Ramos Arroyo MA, Olivera Olmedo JE, García Merlo S. *Anales de Pediatría* 2000, 53(06):542–547 (Medicine RP).

In view of the above, this type of construction shows that titles are not only a succinct presentation of a given study but also a succinct reference to a specificity related to that study, evidencing a sort of cadence from the general to the particular. The prevalence of this construction in RP titles over RVP tiles, in the two languages analyzed, could be related to the nature of RPs, which – as stated above – focus on a specific aspect of the object of study, thus not contemplating other aspects. This specificity is linguistically facilitated via this type of construction, which could therefore be interpreted not only as a descriptive device to denote such specificity but also as a stylistic alternative with respect to the regular nominal-group title presentation of the RP content. In this case, the difference between the compound title construction and the nominal title construction is that the former evidences a cadence that is not present in the nominal-group title construction.

Furthermore, the prevalence of the compound title construction in RP titles of the social sciences group in the two languages analyzed may lead to the conclusion that this title construction is a disciplinary characteristic of the social sciences as well as a generic characteristic of the RP titles of these sciences. Nonetheless, further studies, including larger databases, would be necessary to deduce whether or not this title construction is either a disciplinary and generic characteristic or whether it depends on the type of research being conducted independently of the discipline and the genre. Still, in the light of interpreting this construction as a possible stylistic strategy, the social sciences show a higher degree of flexibility for title formatting in contrast to the biological sciences which evidence a preference for a straightforward presentation of the object of study.

An interesting difference between the compound titles written in English and those written in Spanish lies in the very rich variety of punctuation marks with which the latter indicates the division of the two parts forming these titles. In this respect, English seems to be more neutral and marks such division, in general, by means of a colon, whereas Spanish resorts either to a comma, a stop, a colon, or a dash (Soler, 2009).

Full-sentence title constructions were also found in our study (Table 5). They are affirmative or negative declarative statements which, compared to the other title constructions recorded in this research, more clearly demonstrate the researcher's compromise with respect to the announcement of his/her object of study or his/her results. Through this title construction the researcher is left exposed to his/her peers and therefore takes precautions linguistically when reporting – through titles – findings, evaluations, conclusions or the nature of his/her study. Caution is therefore a crucial strategy for this title construction because highly advanced scientific discourse is horizontal. In this respect, the prevalence of present tense in all the full-sentence title constructions recorded in this research in the two languages studied, can be considered a linguistic strategy of caution to avoid refutations from peers, for example:

- **Cytoplasmic dynein/dynactin drives kinetochore protein transport to the spindle poles and has a role in mitotic spindle checkpoint inactivation**. Howell BJ, McEwen BF, Canman JC, Hoffman DB, Farrar EM, Rieder CL, Salmon ED. *J. Cell Biol.* 2001, 155:1159–1172 (Biology RP).
- **Disruption of Laminin β2 chain production causes alterations in morphology and function in the CNS**. Libby RT, Lavallee ChR, Balkema GW, Brunken WJ, Hunter DD. *The J. Neurosc.* 1999, 19:9399–9408 (Biochemistry RP).
- **La DNA polimerasa beta de rata sustituye la capacidad de la DNA polimerasa I de reparar el daño letal causado por la luz ultravioleta (Beta DNA polymerase substitutes DNA polymerase I's ability to repair ultraviolet light-derived lethal damage)**. Hernández-Escamilla R, Espinosa-Lara JM, Quintana-Hau JD, Uribe-Luna S, Loyola-Abitia P, Santiago-Hernández JC, Maldonado-Rodríguez R. *Rev. Latinoam. Microbiol.* 2002, 44:58–64 (Biology RP).
- **El propofol no inhibe la vasoconstricción pulmonar hipóxica (Propofol does not inhibit hypoxic pulmonary vasoconstriction)**. Álvarez Ruiz AP, Tamayo Lomas L, Castañeda Casado FJ. *Medicina Intensiva* 2001, 25:291–297 (Medicine RP).

Present tense prevalence is indicative of, in Haggan's terms (2004, p. 5), "a note of confident optimism being projected by the writer that what he is reporting stands true for all the time" and is evidence of a high degree of proximity to the present although the conclusion revealed in the title occurred in the past.

Based on the quantitative data collected, the full-sentence title construction was found to be both a generic and a disciplinary characteristic as it prevailed exclusively in RP titles of the biological sciences, particularly in English. In Spanish, as the rate of occurrence of this construction in RP titles was extremely low, further studies based on larger databases will be necessary to be able to conclude whether or not this structure type is also a distinctive characteristic of RP titles written in this language. On the other hand, in the absence of instances of this type of construction in all the selected RVP titles written both in English and in Spanish, it could be appropriate to categorize this construction as a generic characteristic of RP titles in English.

As stated above, RPs are restricted to reporting one study in particular while RVPs summarize the state-of-the-art on a given subject by making reference to all the previous studies conducted in relation to that subject. RVPs are thus indicative

of the "ceiling" reached, thanks to previous RPs, and contribute to paving the way for future RPs on a given subject. Past, present and future studies seem to be joined together in RVPs and title constructions should therefore indicate this fusion. Based on our count, the full-sentence construction seems not to be the ideal structural framework to convey this in RVP titles in English or in Spanish. In contrast, this construction in RP titles allows researchers to present the general findings of their studies both synthetically and conclusively in one sentence, thus fusing informativity with economy.

The possibility of considering this title construction as a disciplinary variable is supported by its high occurrence in the biological sciences groups, particularly, in Biology, which, in fact, evidenced the highest percentage in the group of titles written in English. This phenomenon contributes to strengthening the differences in the strategies through which the biological sciences and social sciences progress with respect to their object of study. Although our study is restricted to title construction at surface level, it could be anticipated that the higher percentage of full-sentence title constructions in the biological sciences group than in the social sciences group contributes to showing the degree of compromise of researchers in the presentation of their results through RPs in the biological and social sciences. The biological sciences tend to trust the findings of more "evidentials", "metadiscoursal features which provide intertextual support for the writer's position", and quantitative methods and they seem, therefore, to base their arguments on them (Hyland, 2004, p. 147). The presentation of results via full-sentence construction in the biological sciences seems to be easier as evidentials, as well as other tools, such as tables, photographs and figures, support such results. Therefore, the compromise that precludes the researcher from presenting results in an assertive way is attenuated as there are evidentials that fully support his/her conclusions, thus preventing refutations from occurring. In contrast, the social sciences, which deal with human subjects, "rely on qualitative analyses or statistical probabilities to construct and represent knowledge. For these reasons, they require elaborate exposition and considerable tentativeness in expressing claims" (Hyland, 2004, p. 145). The absence of this type of title construction in the social sciences in our study (except for one instance in a RP title of Anthropology) corroborates Hyland's observation.

On the other hand, Berkenkotter and Huckin (1995) claim that full-sentence titles illustrate the growth of the informativity of RP titles, while Haggan (2004), based on her study of Science, Linguistics, and Literature titles, claims that their conclusion seems to be the case for Science titles but does not seem to relate to Linguistics and Literature titles. In this respect, our numerical findings on social sciences titles, both in English and Spanish, coincide with Haggan's observation.

In Spanish, the full-sentence title construction distribution pattern is the same as that of titles written in English. However, the rate of occurrence of this construction is lower than in English and is therefore not statistically significant ($P > 0.05$). This finding poses questions about the reasons for the preference of this title construction in English rather than Spanish. Determining whether or not this preference is due to the title-specific editorial policies and practices of scientific journals written in Spanish, the cultural and/or idiosyncrasy variables that differentiate the English scientific community from that of the Spanish, or the individual authors' stylistic preferences, requires further multidisciplinary studies based on larger databases than that of the present research.

As to the question title construction, our count (Table 5) revealed, in general, a very low occurrence of this title-type. No significant quantitative differences were observed between RP and RVP titles or between the titles written in English and Spanish. From a disciplinary point of view, this title type was found to occur more in the social sciences than in the biological sciences.

Furthermore, although the question title constructions found in English and Spanish do not occur within a face-to-face conversational situation, it is evident that, as regularly happens in adjacent conversational pairs, the author interacts with his/her reader and this lets him/her imprint expectations on the content of his/her paper. Furthermore, when the object of study is announced through a question construction, the author of that study seems to attain one of the following objectives: (i) to ask himself/herself about the object of study and to find an answer to this query through the study he/she carries out; (ii) to avoid making a straightforward statement about the object of study in the absence of answers to his/her queries; or (iii) to invite readers to read his/her paper thus stimulating their interest in the object of study. In these three cases, there is an interaction between the author and his/her audience independent of whether the title is written in English or in Spanish. Even in instance (i) the author himself/herself plays the role of both participants in any conversational pair. The distinctive feature of objective (iii) lies in the fact that interaction is not transactional (as there is no reply) but nonetheless expectation is created. That is, according to objective (iii) the question title construction serves to arouse interest in a given aspect of the object of study, thus inviting the reading of the paper. It can thus be concluded that in the two languages analyzed objectives (i) and (ii) seem to be related to the development of a research study and its writing process, and that objective (iii) seems to be related to a particular pragmatic effect.

Finally, as to language-specific differences other than those analyzed, an interesting finding relates to the variety of punctuation marks in the compound titles. In this respect, the richer variety of punctuation marks for the division of compound titles in Spanish, rather than English, demonstrates how the greater flexibility in the punctuation mark pattern of Spanish can convey meaning.

5. Conclusions

This research provides lines of evidence on the most recurrent structural constructions of RP and RVP titles written in English and in Spanish in the biological and social sciences. It also provides information on the frequency of such constructions in the two languages considered.

As to the queries posed in the Introduction, this study shows that all the titles analyzed resort, in general, to the same structural constructions described above though with a different rate of occurrence and with the peculiarity that:

(a) The prevalence of the nominal-group title construction in RP and RVP in the two languages analyzed and in the two groups of sciences studied is indicative of neither a disciplinary nor a generic variable. On the contrary, this title construction seems to operate, independently of whether the title is written in English or in Spanish, as a means to imprint the nominal, lexically dense and impersonal style that typifies scientific discourse.
(b) The full-sentence title construction shows in English: (i) a tendency to be a generic peculiarity of RPs and (ii) a propensity to be a disciplinary peculiarity of RP Biology titles. On the other hand, the low occurrence of this title construction seems to confirm that, in the two languages analyzed, it operates as a resource that evidences assertiveness and a high epistemic value and therefore its use requires caution.
(c) The compound title construction could be considered a disciplinary and generic characteristic of RP titles of the social sciences in the two languages studied. In Spanish, in particular, this phenomenon was also accompanied by a variety of punctuation marks indicating the division of this type of titles. In this respect, Spanish could therefore be considered a more flexible language than English.
(d) No statistically significant occurrence of the question title construction was found in terms of discipline, genre and language. Although this construction type showed a very low occurrence it is evident that the choice of this type of construction depends on the underlying intentions of the author. That is, it can be used either to clearly identify a particular problem regarding the object of study or to arouse interest, thus inviting the audience to read the paper.
(e) A statistically significant difference in length was recorded in terms of discipline in the RP titles in English and in Spanish, as RP titles of the biological sciences were found longer than the RP titles of the social sciences.
(f) A statistically significant difference in length was recorded in terms of the language in the RP titles of the social sciences, in particular. The latter were in fact longer in Spanish than in English.
(g) No further significant language-specific differences indicative of particular cultural traits were observed in the title constructions analyzed in English and Spanish.

In view of the above, it can be concluded that in order to address researchers' needs as writers of highly advanced scientific papers, a comprehensive syllabus must be carefully planned to include titles and their writing practice among the topics to be taught. In this respect, a structural title analysis must include a range of variables, such as content and function words, punctuation marks, length, structural constructions, and so forth. In all instances, their semantic as well as pragmatic implications must be analyzed in detail with the potential writers.

This research provides a framework to further proceed with the analysis of internal title variables in relation to the most recurrent structural title constructions as well as to further analyze title structural constructions in larger databases including, not only a higher number of journals per discipline, but also other genres and disciplines.

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