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DIFFERENT WAYS TO EXPRESS PERSONAL ATTITUDES IN SPANISH AND ENGLISH ENGINEERING PAPERS: AN ANALYSIS OF METADISOURSE DEVICES, AFFECTIVE EVALUATION AND SENTIMENT ANALYSIS

Abstract

The hypothesis of this paper is that writers with similar academic backgrounds express personal attitudes in English and in Spanish differently in research papers. Thus, the main objectives are, first, to study the differences in the use of attitude devices in Spanish and English academic discourse; second, to compare the results in the different sections of articles; and finally to study the positive or negative semantic implications of the lexical items by carrying out a sentiment analysis. To this end, fifteen Spanish industrial engineering papers were compared with fifteen English industrial engineering papers. The results showed that there are in fact differences in the way academic writers communicate attitude, but the sentiment analysis revealed that neutral lexical items were the most commonly used in engineering research papers. Even though engineering researchers share the knowledge of the specialist content and the academic style of expressing their thoughts, personal attitudes were expressed in different ways in Spanish and in English.

Keywords

research papers, attitude devices, Spanish, English, engineering

1 Introduction

The expression of attitude has already been analysed by researchers such as Koutsantoni (2004), Hyland (2005), Gillaerts and Van de Velde (2010), Abdollahzadeh (2011), and Carrió-Pastor and Muñiz Calderón (2015a, 20015b), who describe the role of metadiscourse strategies used in academic papers written in English and, consequently, the nature of attitude devices. Some authors, such as Blagojevic (2009), Mur-Dueñas (2010, 2011), Lee and Casal (2014), Alonso Almeida and Carrió-Pastor (2015) and Carrió-Pastor (2016b), have contrasted the use of metadiscourse devices in two languages (English and Spanish/English and Serbian) but none have compared the writers' expressions of personal attitudes and the positive or negative meaning of the lexical items used in industrial engineering research papers. In order to fill this gap, in this paper my hypothesis is that

writers of different languages use dissimilar ways to communicate attitude in a specific academic genre. In particular, I study the lexical- and discourse-based items that indicate attitude and meaning associated with positive, neutral or negative sentiments. I focus on their role to indicate the writers' affective rather than epistemic perspectives to readers in Spanish and in English.

To collect the data for this corpus-based study in a comprehensive way, the methodological approach adopted was both qualitative and quantitative and a sentiment analysis was also conducted. The corpus selected in this study was extracted from research papers written in the specific domain of engineering. I argue that speakers of English and Spanish may use different strategies in the same specific field of study to transmit their attitude to academic readers and express their (positive or negative) position with regard to the proposition. Accordingly, the main objectives of this study are, first, to study the differences in the use of attitude devices in academic discourse when written by researchers with different linguistic backgrounds in the same context of publication; second, to contrast the use of attitude devices in the different sections of scientific papers; and, finally, to complement the text-based results with a sentiment analysis and study whether the frequency of attitude devices coincides with the positive or negative tokens used by the writers.

I believe that academic papers are used by researchers to interact with readers and explain their findings in a specific context by projecting their attitude or personal opinion to potential readers (Koutsantoni 2004; Hyland 2005; Carrió-Pastor and Muñiz Calderón 2015b; Carrió-Pastor 2016a, 2016b). These authors argue that unless readers and writers follow the same codes or ways of deciphering meaning in specific texts (in this case, attitude), communication may be interrupted. To complement the findings of other researchers, this study focuses on the identification of attitude devices and on sentiment analysis to investigate whether different or shared attitudes are displayed when Spanish and English scientific engineers transfer knowledge to their colleagues.

Thus, the main aim of this study is to examine whether writers' attitudes may change depending on the language used to communicate in a specific setting such as academic engineering papers. I also hypothesise that the frequency of attitude devices might vary in the different parts of the research paper. As Hyland and Jiang (2016: 13) state: "By categorically asserting statements that assume shared attitudes, the writer constructs a relationship along with a text, but this is a relationship where the writer is firmly in the driving seat". This question was also considered in the analysis to observe whether writers in the same discipline do indeed prefer to use some attitude elements in different parts of an article to transmit the writers' affective stances.

Taking all these into account, the research questions of this paper are the following:

- (a) Do engineering researchers use the same attitude markers in English and in Spanish to show readers their position with regard to a proposition? What are the preferred devices? Why/ Why not?

- (b) Do engineering researchers communicate the same affective evaluation in the different sections of a research paper? What could be the possible causes?
- (c) Is the meaning of the most frequent attitude devices connected to positive, neutral or negative meaning? Can sentiment analysis reveal more information about the writers' expression of personal attitudes?

To answer these research questions, firstly, I review the literature on attitude devices and sentiment analysis. Secondly, the corpus and method followed in this paper are explained and, after that, the results extracted from the analysis are shown and discussed. Finally, the conclusions of the analysis are presented taking into account the hypothesis, the objectives and the research questions of this study.

2 Theoretical background

In this article, there are two aspects that have been considered before analysing the corpus and designing the study. First, the framework of metadiscourse has been chosen to carry out an analysis of writers' attitudes in academic writing (Dahl 2004; Hyland 2005; Abdollahzadeh 2011). Here, I specifically focus on attitude devices, which are included in the interactional metadiscourse categories (Thompson 2001). Hyland (2005: 180) defines attitude first taking into consideration textual markers: "Attitude markers indicate the writer's affective, rather than epistemic, attitude to propositions, conveying surprise, agreement, importance, frustration, and so on, rather than commitment". But more recently, Hyland and Jiang (2016: 11) include attitudinal devices within affect, and state that they "[...] bring affect to the surface through forms with positive or negative meanings".

Some authors, such as Hyland and Tse (2004), Abdi, Rizi and Tavakoli (2010) and Mur-Dueñas (2011), have studied attitude devices from a general perspective, referring to them as one of the different metadiscourse strategies. Other authors, such as Gillaerts and Van de Velde (2010), Abdollahzadeh (2011), Mur-Dueñas (2010), Hyland and Jiang (2016) and Rodgers (2017), have focused on the study and classification of attitude devices taking into consideration the specificity of the discourse analysed, but only Blagojevic (2009) and Mur-Dueñas (2010) have dedicated a contrastive analysis to attitude devices used in specific settings; the former was centred on business management research papers written in Serbian and English and the latter studied academic papers dealing with the humanities written in Spanish and in English.

Focusing on the meaning of attitude devices and from a lexico-grammatical perspective, Koutsantoni (2004: 167) states that "[...] attitude markers comprise: evaluative adjectives (significant, interesting, important); evaluative, intensifying, and attitudinal adverbs (significantly, considerably, unfortunately); obligation and necessity expressions and modals (it is necessary, must, should) and discourse-based negative evaluations of previous research". Mur-Dueñas (2010) also provides a taxonomy that comprises assessment, significance and emotion to classify Spanish and English attitude

devices used in Business papers and based on Swales and Burke (2003). This evaluative perspective of attitude devices has been very useful for the design of this study.

The second aspect considered in this study is sentiment analysis, which studies affective states and aims to determine the attitude of consumers. Most of the research carried out so far has been related to computing (Taboada and Brooke 2011; Cambria, Schuller, Xia and Havasi 2013; Cambria and Hussain 2012; Moreno Ortíz et al. 2013; Moreno Ortíz and Pérez Hernández 2013) but, in this study, sentiment analysis complements the quantitative and qualitative analysis of the writers' expression of personal attitudes. Also known as opinion mining, it is a technique that goes well with the lexical study of attitude devices, as it is commonly used to know how people feel about a particular topic, and is crucial to analyse consumer reports and product reviews. The aims of sentiment analysis are to extract subjective information from texts and to determine the writer's attitude with respect to a given topic and the polarity of a text. In this sense, academic research papers should be neutral so as to describe objective findings. It should also be noticed that most studies have focused on the implications of sentiment analysis in natural language processing rather than on the study of discourse. Hence, this paper opens the door for a new type of analysis, by combining lexical and sentiment analysis to study the writers' expression of personal attitudes in Spanish and English engineering scientific research papers.

3 Procedure

3.1 Material

The corpus compiled to carry out this analysis was written in English and in Spanish and so it was divided into two sub-corpora: industrial engineering research papers written in English and industrial engineering research papers written in Spanish. Thirty research papers were selected taking into consideration the specific field of study, i.e. the sub-fields chosen were mechanical, electronic and electrical engineering, the language of publication and the nationality of the authors. Fifteen industrial engineering papers were written in English by native English-speaking authors and were collected from three online international journals specialised in mechanical engineering, electronic engineering and electrical engineering. The three journals were selected because they had a similar impact factor in Journal Citation Reports (JCR) in 2016 and most of the papers were written by authors that work in American (from United States of America) or British universities. It was noticed that papers written by Anglophone authors were uncommon in engineering journals and so it was decided that only papers with a minimum of 70% Anglophone authors and 30% English as a lingua franca authors would be included in the corpus. Authors from Great Britain, United States of America and Australia were considered Anglophones. In this paper I will refer to this corpus as the sub-corpus of English engineering articles.

A further fifteen research papers written in Spanish by Spanish writers were selected from three online international journals included in the ISI Web of Knowledge in 2016 and specialised in mechanical engineering, electronic engineering and electrical engineering. All the authors of the papers were Spanish and were also affiliated to Spanish universities. In this paper I will refer to this corpus as the sub-corpus of Spanish engineering articles.

The papers compiled were comparable in terms of the type of research published, prestige and intended audience. It was also taken into account that “[...] published articles in journals have undergone a strict peer review and editorial scrutiny. This assures that articles published in the journal are fairly representative of the journal genre in terms of content and style” (Connor 2004: 300). Furthermore, the length of the papers and the inclusion of different sections in the paper were also considered in the selection of the corpus. Each of the papers selected contained circa 7,000 words and was divided into the following sections: introduction, methodology, results and discussion, and conclusions. Some of the papers compiled in this first stage of the study were eliminated from the corpus when a clear division of sections was not included, some sections of the paper were longer than the average or the authors could not be contacted to determine their nationality or affiliation.

The total number of tokens in the sub-corpus of English papers was 102,234 and the total number of tokens compiled in the sub-corpus of Spanish papers was 103,004. The total number of tokens included in the corpus was therefore 205,238.

3.2 Method

Once the papers which made up the corpus had been collected, sub-corpora were created to divide the papers into different sections: introduction (including theoretical background), methodology, results and discussion, and conclusion. Then, the following step was to analyse the texts manually to look for attitude devices and to locate the words in the text. The occurrences obtained were carefully analysed in their context to identify whether they could be classified as attitude devices and expressed the authors’ assessment. When this process was finished, I used the software WordSmith Tools 5.0 to confirm the frequency of the attitude devices identified in the corpus. Following a lexical approach, that is, the syntactic nature of the words was taken into account, the attitude devices were classified into adjectives, nouns, adverbs and verbs. The locations of the items in the different sections of the paper were then identified and the occurrences extracted. The results obtained in the two sub-corpora were normalised to 1,000 words, since the total number of words in the two sub-corpora was not the same. To finish with the lexical analysis of the items, I used the classification of Mur-Dueñas (2010) to analyse the values expressed by the items found in the corpus.

A sentiment analysis was then carried out with Lingmotif 1.0 (Moreno-Ortíz 2016). As explained by Moreno-Ortíz (2016: 1): “Lingmotif is a multi-platform desktop application that analyses input texts from a Sentiment Analysis perspective. Basically, it determines the

semantic orientation of a text (whether it is positive or negative, and to what extent), by detecting linguistic expressions of polarity, i.e. positivity or negativity". The main aim of this second analysis was to complement the textual analysis with the levels of text sentiment score and text sentiment intensity. The tool measures the positive and negative items used by the authors to provide us with the positive or negative attitude of the writers. In industrial engineering, most of the papers are related to experiments which aim to sell a product or solve an engineering problem. In this sense, the tool measures semantically if authors use lexical items that convince readers about an idea, product, theory, etc. The sentiment analysis was carried out in the two sub-corpora and in the different sections of the papers.

Finally, after identifying the attitude devices and analysing the value of the items and the sentiment analysis, the data obtained were contrasted to identify the devices found, the items that communicated positive or negative attitude and their position in the research papers. Examples of attitude devices in context were also discussed. Finally, the results were commented on and the conclusions drawn.

4 Results and discussion

This section is divided into two sub-sections, the first devoted to the results of attitude devices and the second to the items found in the different sections of the research papers. Some of the results of this study are part of a research project on comparative metadiscourse analysis funded by the Spanish government (Reference FFI2016-77941-P).

4.1 Attitude devices identified in engineering papers and results of the sentiment analysis

After the analysis of the corpus, the following raw occurrences of attitude devices were found in the Spanish and the English texts devoted to engineering (see Figure 1). It can be observed that if we consider raw numbers, Spanish researchers used more attitude devices than their English counterparts. The results normalised to 1,000 also show us that Spanish researchers used a higher frequency of attitude devices (Spanish= 4.35 vs. English= 3.31).

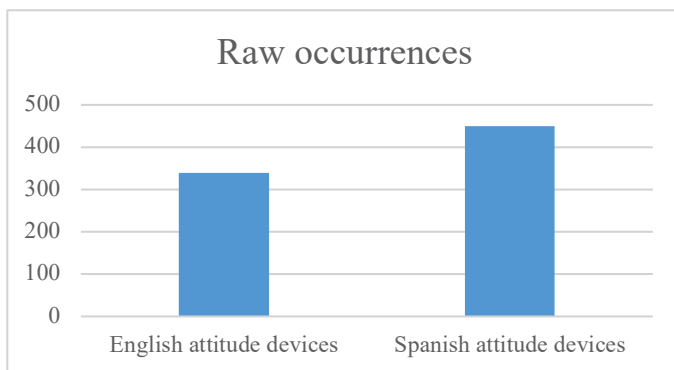


Figure 1: Attitude markers found in the Spanish and English sub-corpora.

Table 1: Attitude devices found in the English sub-corpus.

English attitude devices	Percentage/ Occurrences normed to 1,000 words
Important*	9.4/ 0.31
Expand	9.4/ 0.31
Consistency	9.4/ 0.31
Sufficient	9.2/ 0.30
New *	7.6/ 0.25
Only	7.4/ 0.24
Main	6.8/ 0.22
Robust	6.2/ 0.20
Major*	6.2/ 0.20
Significant*	5.1/ 0.16
Key*	4.4/ 0.14
Critical*	4.1/ 0.13
Fundamental	3.5/ 0.11
Valuable	3.2/ 0.10
Ensure	2.3/ 0.07
Improvement*	2.3/ 0.07
Dramatically	2.3/ 0.07
Limited	2.1/ 0.06
Significance	1.5/ 0.04
Exact	1.4/ 0.04
Relevant	1.3/ 0.03
Unique*	0.9/ 0.02
Maximize	0.8/ 0.02

The quantitative analysis of the attitude devices found in the English sub-corpus of engineering research articles is shown in Table 1. The total number of words analysed was 102,234. The number of types was 23 and the total number of tokens found was 339. The first column shows the attitude devices found in the sub-corpus and the second column offers the relative frequencies expressed as the percentage and the occurrences normalised to 1,000 words (from higher to lower frequency). Those attitude devices for which a close equivalent was observed in the texts in Spanish are marked with an asterisk.

It should be noticed that most of the attitude devices used by the English engineers confer positive meaning upon discourse, exceptions being *only* and *limited*. The most frequent lexical items found in the analysis (*important*, *expand*, *consistency* and *sufficient*) imply that writers share a positive attitude and seek to bring readers into agreement with it. Hyland and Jiang (2016: 12) explain that *important* is used not only “[...] to express a stance toward something but also to align that stance with the interests of their community”. The results of the engineering papers are then difficult to challenge. It should also be noticed that the syntactic categories of the most frequent devices are adjectives, verbs and nouns, which shows that attitude is not expressed through a variety of categories.

Examples of the most frequent English attitude devices are shown in examples (1) and (2):

- (1) “Similarly in aerospace, traditional hot worked metal with 110 ksi yield strength meets performance needs in landing gear where high compression strength and resistance to galling and seizing is *important*. For ductile materials, it is also *important* to reduce the contact area between the grit and work piece.” (*Advanced Material and Processes* – 01)

The authors express significance by explaining the actions described in the sentence and finish by stating the importance of the previous actions. To convince the readers of the relevance of the experiment, the author repeats *important* in the following sentence, thereby reinforcing a positive attitude with the repetition. As being conscious that some attitude devices may confer a positive or negative meaning to the proposition, the occurrences found in the corpus were checked in context. *Important* was always used with positive meaning, as shown in the examples: “[...] the signals received by neighbouring sonar sensors and is an *important* issue that [...]” or “[...] relative motion between transmitter and receiver plays an *important* role”. Also *critical* was used in the corpus with positive meaning in the few occurrences found, some examples are “[...] with the maximum amplification occurring at some *critical* value” or “[...] to solve the localization problem with a short data record is *critical*”.

- (2) “Reproducibility during the production process is a *key* factor in *maximizing* yield, throughput, and overall product consistency.” (*Advanced Material and Processes* – 02).

Attitude devices bring affect to research through devices with positive meanings in example (2), seeking to bring readers into agreement with it, as Hyland and Jiang (2016) also note

in their research. The noun *consistency* reinforces the positive attitude of the writer, marked previously with the verb *maximizing*. In consequence, the reader may be convinced of the reliability of the research.

The quantitative analysis of the use of attitude devices in the Spanish texts is shown in Table 2. English glosses are provided for Spanish examples below (E: English translation of the Spanish word). The devices are displayed from higher to lower frequencies. The total number of words analysed was 103,004; the number of types was 20 and the number of tokens was 449. Those attitude devices for which a close equivalent was observed in the texts in English are marked with an asterisk.

Table 2: Attitude devices found in the Spanish sub-corpus.

Spanish attitude devices	Percentage/ Occurrences normed to 1,000 words
<i>Interés</i>	10.6/ 0.46
<i>Aportación</i>	9.4/ 0.41
<i>Mejor</i>	8.4/ 0.36
<i>Importancia</i>	7.7/ 0.33
<i>Esencial*</i>	7.6/ 0.33
<i>Especial*</i>	7.1/ 0.31
<i>Problema</i>	7.1/ 0.31
<i>Limitación</i>	6.9/ 0.30
<i>Nuevo*</i>	5.6/ 0.24
<i>Grande*</i>	5.5/ 0.24
<i>Clave*</i>	4.2/ 0.18
<i>Excesivo</i>	3.7/ 0.16
<i>Fácil</i>	3.6/ 0.15
<i>Utilidad</i>	3.3/ 0.14
<i>Amplio</i>	3.1/ 0.13
<i>Razonable</i>	2.8/ 0.12
<i>mejora*</i>	2.0/ 0.08
<i>Gran</i>	1.8/ 0.07
<i>Importante*</i>	1.6/ 0.06
<i>Interesante</i>	1.1/ 0.04

In the case of the Spanish sub-corpus, the most frequently used lexical items are *interés* (E: aim), *aportación* (E: contribution), *mejor* (E: better), *importancia* (E: importance) and *esencial* (E: essential, key). All these Spanish lexical items imply positive meanings while also expressing a positive judgement and reflecting the writers' favourable positioning (Soler 2002).

Examples of the most frequent Spanish elements are shown in examples (3) and (4):

- (3) “Fueron definidos los constructos (principios, elementos y estructura) que sustentan un modelo de madurez más integral con un *interés* de lograr una evaluación y planificación del proceso de adopción de SOA”. (*Ingeniería Industrial* – 03)

The writers use one positive word that explicitly marks affect. *Interés* (E: aim) is the most used item in the Spanish sub-corpus, thus indicating that the writers bring affect to the reader through the positive meaning of this lexical item.

- (4) “Otras de las *aportaciones* más *interesantes* en la evolución de la PET”. (*Radiobiología* – 02)

In example (4), the writers use the noun *aportaciones* (E: contributions), which entails that new results are described in the research, and reinforces the positive meaning of the words with the adjective *interesantes* (E: interesting). By so doing, the researchers are positioning themselves as providers of interesting and decisive findings.

In order to contrast the expression of attitude and the positive and negative meaning of the lexical items, those attitude devices for which a close equivalent was observed in Spanish and in English are shown in Table 3. It can be observed that *critical* and *unique* were used less frequently than *esencial* (E: key, essential) and *especial* (E: special, unique), while *significant* and *important* (synonyms in the corpus) were used more frequently than *importante* (E: important). It seems that authors who write in English prefer to show a positive attitude to the reader, whereas researchers who write in Spanish do not use *importante* (E: important) and *gran* (E: great, large) so frequently, preferring the use of *esencial* (E: essential, key) and *especial* (E: special, unique) to convey importance and make their judgement appear reliable.

Table 3: Comparison of equivalent attitude devices used in English and in Spanish texts.

English attitude markers	Percentage/ normed to 1,000 words	Spanish attitude markers	Percentage/ normed to 1,000 words
important*	9.4/ 0.31	<i>importante</i> *	1.6/ 0.06
new *	7.6/ 0.25	<i>nuevo</i> *	5.6/ 0.24
major*	6.2/ 0.20	<i>grande</i> *	5.5/ 0.24
significant*	5.1/ 0.16	<i>gran</i> *	1.8/ 0.07
key*	4.4/ 0.14	<i>clave</i> *	4.2/ 0.18
critical*	4.1/ 0.13	<i>esencial</i> *	7.6/ 0.33
improvement*	2.3/ 0.07	<i>mejora</i> *	2.0/ 0.08
unique*	0.9/ 0.02	<i>especial</i> *	7.1/ 0.31

Examples of *important*, *significant*, *esencial* (E: essential, key) and *importante* (E: important) can be seen in (5) and (6):

- (5) “Sin embargo, aún queda mucho camino por recorrer en este sentido ya que todavía hay un número *importante* de materiales secundarios que podrían normalizarse para su utilización como adición del cemento. Esa es una condición *esencial* para poder ofrecer productos nuevos”. (*Materiales de construcción-01*)

The authors used the word *importante* (E: important) to communicate to the reader that a high number is involved, whereas to express significance to the reader they prefer *esencial* (E: key, essential). The attitude transmitted by the writers is positive as they are describing future research.

- (6) “Due to its high ductility, copper SEM (Fig. 3a) show evidence of *significant* plastic deformations on the bottom/floor of the scratch marks and *major* material pile-up on the shoulders constituting material displacement. [...] For ductile materials, it is also *important* to reduce the contact area between the grit and workpiece.” (*International Journal of Machine Tools & Manufacture – 04*)

In this sample, the writers used *significant* and *important* to highlight their affective perspectives towards the study, commenting on the materials and using the adverb *also* to reinforce this idea. The attitude devices of these samples entail positive meanings and seek to attract readers’ attention.

Focusing now on the grammatical categories of the corpus analysed, the attitude devices found in this study were adjectives, adverbials, nouns and verbs. The attitude devices found and their grammatical categories are shown below in Table 4:

Table 4: Attitude devices by grammatical categories.

	English	Spanish
Adjectives	important, significant, critical, key, robust, unique, valuable, major, main, relevant, limited, new, fundamental, sufficient	<i>importante</i> (E: important), <i>gran</i> (E: important), <i>grande</i> (E: important, vast), <i>amplio</i> (E: broad), <i>fácil</i> (E: easy), <i>mejor</i> (E: better), <i>excesivo</i> (E: excessive), <i>nuevo</i> (E: new), <i>razonable</i> (E: realistic, sensible), <i>interesante</i> (E: interesting), <i>clave</i> (E: key), <i>esencial</i> (E: key, essential), <i>especial</i> (E: special)
Verbs	ensure, expand, maximize	-
Adverbs	only, dramatically	-
Nouns	consistency, variety, improvement, significance	<i>importancia</i> (E: importance), <i>limitación</i> (E: limitation, drawback), <i>problema</i> (E: problem), <i>aportación</i> (E: contribution), <i>interés</i> (E: interest, concern), <i>utilidad</i> (E: usefulness), <i>mejora</i> (E: improvement)

Figure 2 compares the raw occurrences of English attitude devices by grammatical category:

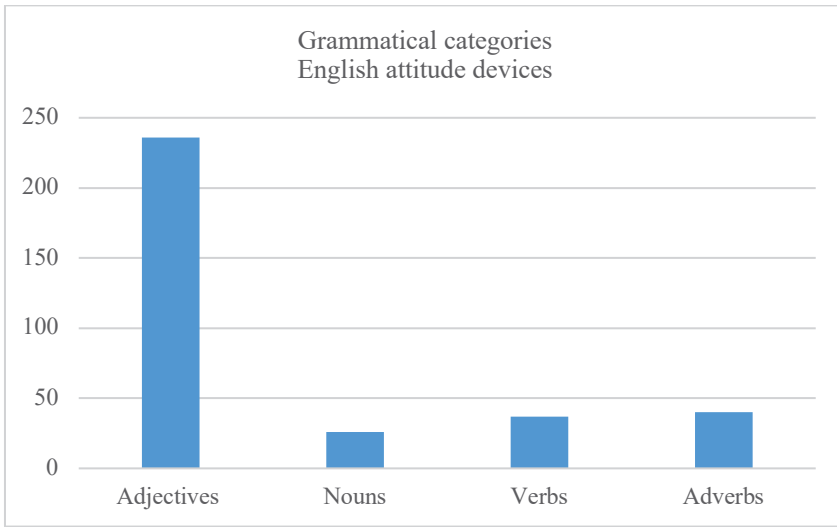


Figure 2: Raw occurrences of grammatical categories of English attitude devices.

The results of these categories coincide with those of Koutsantoni (2004), Mur-Dueñas (2010) and Hyland and Jiang (2016), who also noticed that attitude is mainly expressed through adjectives in English.

Figure 3 contrasts the raw occurrences of Spanish attitude devices by grammatical category. It should be highlighted that no verbs or adverbs that entail attitude were found in the Spanish corpus analysed:

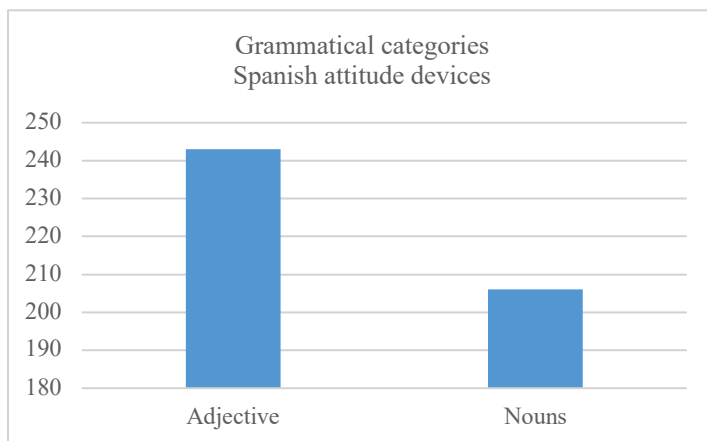


Figure 3: Raw occurrences of grammatical categories of Spanish attitude devices.

Nouns were also included in the analysis as I considered they played an important role in marking the attitude of the authors, following Jiang and Hyland (2016). It should also be noted that no verbs or adverbs signalling attitude were found in the Spanish sub-corpus of engineering articles and that in the whole corpus the researchers preferred the use of adjectives to express their position to readers. In her study, Mur-Dueñas (2010) noticed that adjectives were frequently used in Business research papers.

Focusing on adjectives, the most frequent grammatical category found in the corpus, Swales and Burke (2003) and Mur-Dueñas (2010) explain that such attitude devices may be either centralised (neutral) or polarised (positive or negative). In the corpus studied here, all the adjectives were polarised (for example, in English: *important*, *major*, *significant*, etc. and in Spanish: *importante* (E: important), *amplio* (E: broad), *mejor* (E: better), etc.), as the authors used them to imply that their research was valuable and contributed to scientific knowledge.

Moreover, Mur-Dueñas (2010) classifies the values of attitude devices as expressing assessment (i.e. efficacy, novelty, strength, etc.), significance (i.e. importance) and emotion (i.e. emotional judgements). All the attitude devices found in both sub-corpora express assessment or significance but emotion values were not found. I now discuss some examples of the attitude devices used by the English-speaking and the Spanish-speaking researchers, taking into consideration whether the authors uttered assessment or significance values. In examples (7) and (8), writers express the value of assessment with the attitude devices *robust* and *mejora* (E: improvement):

- (7) “Demand for more mechanically *robust* products continues in oil and gas exploration markets and the TS tempers are beginning to satisfy this demand.” (IEE – 01)

Here, the writers justify the relevance and soundness of their research with the adjective *robust*, from which one may infer a sense of security and assessment in the products explained in their research.

- (8) “También, el proceso normativo ha contribuido a la *mejora* de las propiedades y de la calidad de los cementos a lo largo del tiempo y a la introducción de un enfoque proactivo con relación a la *mejora* del medio ambiente”. (*Materiales de construcción* – 03)

The authors use the noun *mejora* (E: improvement) to express an evaluation of the process being described, in this case, positive assessment. In this sense, this attitude device is used to describe the properties of a material and the environment and to transmit to the reader that the process is a positive one and has been improved, thus justifying the research.

Significance is expressed by English writers with attitude devices such as *fundamental* and *key*, as can be seen in examples (9) and (10):

- (9) “Alternatively, satellite reflections around the *fundamental* Bragg reflections in x-ray diffraction patterns can confirm spinodal decomposition in copper-nickel-tin and other alloy systems”. (*Advanced Material and Processes* – 03)

Here, the authors stress the importance of Bragg reflections and thus also the research undertaken, expressing significance.

- (10) “The presence of multiple robots allows for simultaneous exploration of disjoint areas of the environment and cooperative viewing of the same location from multiple vantage points, but raises several *key* questions not present in single-robot scenarios. Namely how should robots communicate with each other and how should robots coordinate their actions?” (*IEE* – 02)

The attitude device *key* is used to highlight the interest of the research that the authors carried out, expressing significance; additionally, they finish the paragraph with two questions in order to hold the reader’s attention and transmit the idea that their research will answer these questions.

In Spanish papers, significance is expressed with the word *clave* (E: key), as can be seen in example (11):

- (11) “Otro factor *clave* a tener en cuenta es que los ensayos de fatiga fueron realizados bajo el criterio de utilizar siempre una tensión máxima fija”. (*Materiales de construcción* – 05)

Tables 1, 2 and 3 show us the different elements used as attitude devices and, after their analysis, it should be noted that most of them are used with a positive meaning to express a position and empathise with readers. Only the adjective *limited* in the English attitude devices and the nouns *limitación* (E: limitation) and *problema* (E: problem) in the Spanish

list have a limiting or negative meaning. To check if both English and Spanish writers used positive elements, a sentiment analysis of the two sub-corpora was carried out, as explained in the Methodology section. Figure 4 shows the results of the sentiment analysis of the English engineering papers carried out with the tool *Lingmotif 1.0* (Moreno-Ortiz 2016):

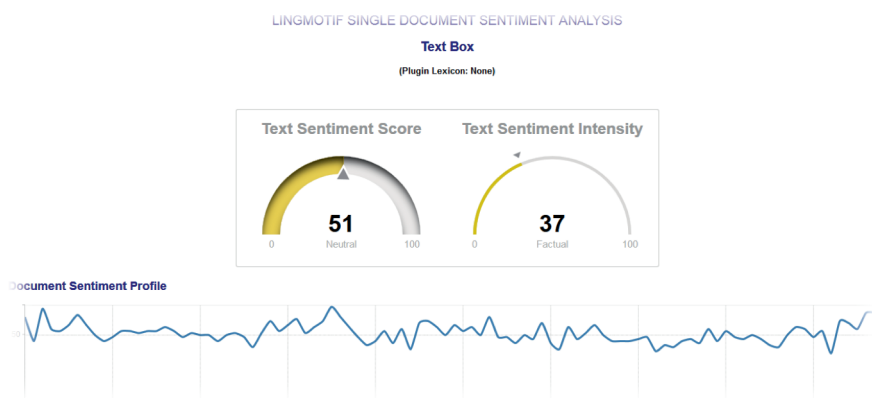


Figure 4: Text sentiment score of the English engineering articles.

Figure 4 shows that English researchers did not use many positive words in the texts to express their attitude to readers. This coincides with the results extracted in this analysis, as the normalised frequency of attitude devices was 3.31, i.e. the attitude devices that could increase the text sentiment score were not frequently used. English writers used more positive than negative items (this matches the results of attitude devices of this study) but, in general, neutral items were preferred.

Figure 5, below, shows the sentiment analysis of the Spanish engineering articles. The score of the sub-corpus of Spanish engineering papers is slightly positive, only a bit higher than the score obtained in the English papers. The results obtained from the tool *Lingmotif 1.0* coincide with the frequencies of attitude devices extracted from the Spanish sub-corpus, which are higher than those found in the English sub-corpus. But, in general, the score in the Spanish and English sub-corpora is quite similar:

It should be noted that the self-esteem and personal awareness of the academic writers is positive, but the frequency of Spanish attitude markers is 4.35, which is too low to change the overall results of the text sentiment score. Finally, it should be noticed that the score in the Spanish and English sub-corpora is quite similar, so the results reveal that the attitude transmitted, taking into account the whole corpus, is quite similar.

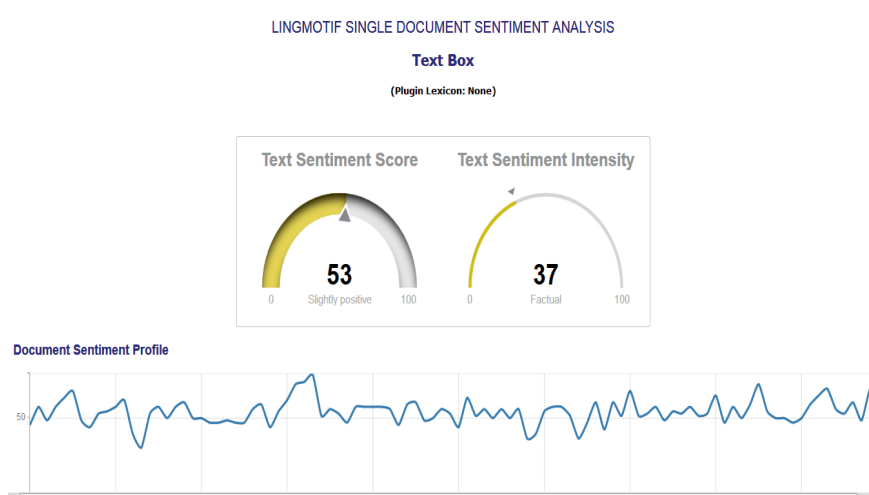


Figure 5: Text sentiment score of the Spanish engineering articles.

4.2 Attitude devices in the sections of the research paper

A search was conducted to identify the attitude devices used by Spanish and English authors in the different parts of the research papers, as explained in the Method section: introduction, methodology, results and discussion, and conclusion. The attitude devices found can be seen in Table 5 divided into the parts where they were found, together with the raw and normalised occurrences. Figure 6 shows the comparison of the raw numbers of the English and Spanish attitude devices identified by section.

It can be observed that English writers prefer to use attitude markers in the Results and discussion and Conclusion sections of research papers. Spanish researchers, in contrast, prefer to express assessment in the Introduction, Results and Conclusion sections. It should be taken into account that the position of the attitude devices in the research papers may reveal the writers' intention to express assessment and significance in different parts of the paper. Most of the attitude devices expressing assessment are found in the Introduction and Methodology sections, while those expressing significance are mainly found in the Results and discussion and Conclusion sections. Moreover, this is so irrespective of the language used, English or Spanish.

The differences found in the two sub-corpora may identify intercultural differences in the way engineering authors construct meaning in a genre (Belcher 2014). In this sense, attitude devices may be linked to specific cultural contexts, as Spanish engineering researchers expressed their affective evaluation of given parameters more frequently in the Introduction section.

Table 5: Attitude devices classified according to the sections of the research paper.

Sections of the engineering research papers	Spanish attitude markers	English attitude markers
Introduction	<i>importante</i> (E: important), <i>mejor</i> (E: better), <i>problema</i> (E: problem), <i>amplio</i> (E: broad), <i>nuevo</i> (E: new), <i>clave</i> (E: key), <i>fácil</i> (E: easy), <i>interés</i> (E: interest, concern), <i>utilidad</i> (E: usefulness) Raw no.: 143 Normalised to 1,000: 1.38	<i>important, key, main, major, fundamental</i> Raw no.: 49 Normalised: 0.47
Methodology	<i>especial</i> (E: special), <i>esencial</i> (E: critical), <i>nuevo</i> (E: new), <i>amplio</i> (E: broad) Raw no.: 53 Normalised: 0.51	<i>key, critical, fundamental, sufficient, only</i> Raw no.: 54 Normalised: 0.52
Results and discussion	<i>razonable</i> (E: realistic), <i>excesiva</i> (E: excessive), <i>aportación</i> (E: contribution), <i>limitación</i> (E: limitation), <i>gran</i> (E: great), <i>grandes</i> (E: great), <i>mejor</i> (E: better) Raw no.: 125 Normalised: 1.21	<i>robust, unique, key, limited, new, ensure, expand, consistency, only, most, variety, dramatically</i> Raw no.: 135 Normalised: 1.32
Conclusion	<i>interés</i> (E: interest, concern), <i>utilidad</i> (E: usefulness), <i>aportación</i> (E: contribution), <i>problema</i> (E: problem), <i>nuevo</i> (E: new), <i>importancia</i> (E: importance), <i>clave</i> (key), <i>mejora</i> (E: improvement), <i>excesiva</i> (excessive), <i>interesante</i> (E: interesting) Raw no.: 128 Normalised: 1.24	<i>important, significant, valuable, major, new, expand, improvement, relevant, maximize</i> Raw no. 101 Normalised: 0.98

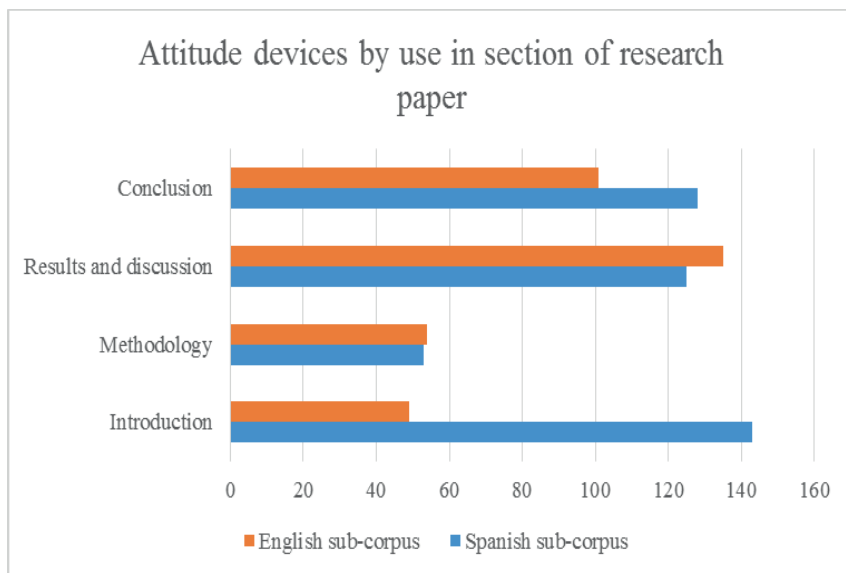


Figure 6: Frequencies of English and Spanish attitude markers in the different sections of research papers.

Finally, the results obtained in this paper may be compared with the studies of Blagojevic (2009) and Mur-Dueñas (2010), which were focused on the analysis of attitude markers and also detected differences in the use of attitude devices when two languages are contrasted. These studies, unlike this one, compared two languages but in a different specific context. In our results, it could be observed that there are differences in Spanish and in English as regards the way an affective attitude to propositions is transmitted in the devices used, the grammatical categories and in the different parts of the research paper. The frequencies extracted from the sentiment analysis showed that Spanish and English yielded a similar text sentiment score, but when the attitude devices were analysed in detail in the two sub-corpora, it was clear that there are intercultural differences that identify the culture of the writer. The attitude devices used by Spanish writers do not reflect a strong position toward both the content in the text and the reader, on the contrary, English engineers clarify their views contained in the utterance being made with attitude markers.

The small size of the study corpora and the resulting low frequencies may have impacted the results, but my main interest was to offer useful findings to connect the relationship of two languages in academic writing and to assist Spanish scholars who are increasingly pressured to publish in international English publications and need to contextualise the way attitude is shown in academic English.

5 Conclusions

The aim of this study was to analyse the use of attitude devices as discursual elements that show the attitude the author wishes to display to the reader. In this sense, it was observed that writers in English and Spanish communicate attitudes differently, to a certain extent. The total number of attitude devices found was lower than those found in other studies (Koutsantoni 2004; Mur-Dueñas 2010, 2011), but I think this may be due to the specific field of the research articles chosen. In this study, it should be noted that most of the attitude devices used by Spanish as well as by English researchers entailed a positive meaning.

This paper has explored attitude devices in a corpus of research papers devoted to engineering coming from two different cultural contexts: Anglophone and Spanish. The results show that some of the attitude devices coincide with those detected by other researchers, such as Koutsantoni (2004), Blagojevic (2009), Abdi, Rizi and Tavakoli (2010), Gillaerts and Van de Velde (2010) and Mur-Dueñas (2010, 2011), but this article illustrates that attitude is transmitted by Spanish engineers in a different way in the sense that the words *limitación* (limitation) and *problema* (problem) are among the most frequent. Spanish researchers did not use motivating and encouraging words in their papers as English writers did.

The positive or negative meanings of the devices used by the writers as well as the positive lexical items of the whole corpus have also been studied. In the results, it can be seen that adjectives were preferred by engineers to express affective evaluation and that Spanish engineering researchers used slightly more positive expressions to engage their peers than English engineering researchers.

Focusing on the research questions of the paper, the first one was concerned with detecting whether engineering researchers express the same attitude in English and in Spanish to show readers their stance with regard to a proposition. The data analysed revealed that Spanish researchers used more affective elements in their research papers and also the lexical features chosen were different, as Spanish only used adjectives and nouns while English used adjectives, nouns, adverbs and verbs. This fact may have to do with the way knowledge is constructed and research is done in the Spanish culture. This difference was not found in studies involving similar research, such as the analysis performed by Mur-Dueñas (2010, 2011), as she also found verbs and adverbial phrases in her Spanish sub-corpus. Furthermore, in Table 3 I have identified the attitude devices used by Spanish and English authors that are equivalent in both languages, a total of eight. These data also show that researchers seldom used semantically equivalent items to express affective evaluation in English and in Spanish.

The second research question of this paper studied whether researchers transmitted the same affective evaluation in the different sections of a research paper. It was observed in the data extracted from the analysis that attitude devices were used more in the Introduction section by Spanish researchers while English researchers preferred to use them in the Results and discussion section. This difference may be caused by the interest of the Spanish

writers in positioning themselves with respect to their peers, as affective evaluation is closely related to self-esteem and personal awareness. In this case, Spanish researchers prefer to transmit their attitude at the beginning of the analysis. Thus, Spanish researchers positioned themselves from the start, but attitude devices were also used in the Results and Conclusion sections. English researchers preferred to use affective evaluation in the Results and Conclusion sections, which may be explained by bearing in mind that English authors displayed a special preference for promoting and evaluating their own research and findings. This difference in the positioning of attitude devices may entail a cultural attitude to show an initial positive attitude (Spanish writers) rather than not showing affective attitude and evaluation till the end of the research paper (English writers).

The third and last research question in this study focused on comparing whether the frequency of attitude devices was complemented with the use of positive or negative tokens after a sentiment analysis. First, it should be mentioned that most of the attitude devices found in the corpus entailed a positive meaning and attitude, as stated above, but the sentiment analysis did not reinforce this idea. The results of the sentiment analysis revealed that the corpus analysed has similar text sentiment scores (51 vs. 53). This may mean that in the specific field studied, i.e. engineering, researchers tend to use neutral lexical elements and, also, that the occurrences of attitude devices are not so frequent as to increase the scores. Another cause of this finding may be the low number of occurrences found in the corpus. Sentiment analysis calculates polarity taking into account the meaning of all the words in each sub-corpus, which overall is neutral, following the traditional objectiveness of hard sciences. The meaning of the most frequent attitude devices was positive (see Tables 1 and 2) but their low frequency does not result in a change in the positive, neutral or negative meaning of the engineering papers. In this sense, a study with more research papers should be carried out to ensure that sentiment analysis can be used to analyse academic discourse and that the findings of the attitude of the writers are in line with the findings of the sentiment analysis.

It should be highlighted that Spanish writers used 14% more attitude devices than English authors. In this sense, I agree that writers with different linguistic backgrounds may perceive concepts from different perspectives or, as Qi and Liu (2007: 158) put it, from “[...] different ways of construing the world”. Most of the Spanish papers described experimental studies involving a machine or material that may be available for subsequent purchase by companies. The writers may feel the need to use positive evaluative attitude devices in order to transmit to the readers the idea that the experiment they are presenting is attractive and useful; they have to involve the readers in the discourse and make them become part of the experiment by using more positive attitude devices.

Spanish and English writers use attitude devices that express assessment and significance to make a favourable impact on the reader and, conversely, emotion attitude devices are not used. Emotion is seldom used in academic English, as some researchers (Blackwell and Martin 2011) point out. It is stated that scientific findings should be objective and unemotional and, in this sense, the number of attitude devices found here is

in line with this, although other authors (Koutsantoni 2004; Mur-Dueñas 2010) identified a higher number of attitude devices when studying academic papers.

To sum up, the attitude devices used in the specific field of engineering show that Spanish and English writers demonstrate a critical insight and build up personal credibility, thereby creating positive evaluation of research in the Introduction, Results and Conclusion sections. Although a limited range of attitude devices were found if compared with similar studies (Koutsantoni 2004; Mur-Dueñas 2010), the results revealed that attitude devices were used in a different way by Spanish and English researchers and also in different parts of the research paper.

Finally, I am aware that further research is needed in this field concerning the use of attitude devices in different disciplines to identify patterns and conventions in different specific fields of academic English. Future work will attempt to address these areas.

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