ON WRITING SCIENCE IN THE AGE OF REASON

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Abstract

Female authors of scientific works written in English were just a few in the eighteenth century in comparison with the increasing production of male writers. Their limited presence in the scientific panorama of the period could, therefore, account for the lack of research on how these women wrote or the sort of linguistic strategies they were familiar with from a present-day perspective. Some external considerations should be also reckoned as contributing to this situation such as a prescriptive behaviour for each of the sexes. By the comparison of four linguistic parameters expressing overt persuasion in texts written by male and female authors from the C*oruña Corpus of English Scientific Writing*, I will concentrate on the way in which eighteenth-century women writers of science on the one hand, and men, on the other, make use of argumentation/persuasion strategies in order to ascertain the truthfulness of their propositions and to attract the readers' attention.

Keywords: Female scientific writing, eighteenth century, persuasion, argumentation.

Resumen

Las autoras de trabajos científicos escritos en inglés eran solamente unas cuantas en el siglo dieciocho en comparación con la creciente producción de los escritores. Su limitada presencia en el panorama científico del período podría explicar la carencia de trabajos de investigación sobre el modo de escribir de estas mujeres o el tipo de estrategias lingüísticas que empleaban en sus escritos. En el estudio del uso de la lengua, es interesante tener en cuenta ciertas consideraciones externas a los propios usos lingüísticos, como son las prescripciones de comportamiento establecidas para hombres y mujeres que puedan jugar un papel importante. A través del estudio de cuatro parámetros lingüísticos que expresan persuasión en textos escritos por hombres y mujeres recogidos en el C*oruña Corpus of English Scientific Writing*, este trabajo se centra en el análisis de cómo hombres y mujeres emplean estas estrategias con objeto de determinar la veracidad de sus proposiciones y atraer la atención del público lector.

Palabras clave: escritura científica femenina, siglo dieciocho, persuasión, argumentación.

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INTRODUCTION

This paper discusses how certain argumentative and persuasive strategies, generally reckoned to indicate so (Biber 1988, 1995; Biber and Conrad 2009; Atkinson 1999; Mischke 2005, Nesi 2009, Włodarczyk 2010, Moskowich and Crespo, 2012), were used by eighteenth-century male and female writers of science. This discussion will focus on a quantitative and qualitative comparison of the sort of strategies and the degree of use either men or women made of them in their works.

For this purpose scientific texts have been taken from three of the current sub-corpora of the *Coruña Corpus of English Scientific Writing* (henceforth, *CC*). The *CC* has been designed as a tool for the study of language change and variation in English scientific writing in general as well as within the different scientific disciplines, and contains texts produced between 1700 and 1900, excluding medicine[1] (Crespo 2015). This time span is intended to reflect the establishment of the empirical approach to science in the seventeenth century, leading to a modification in scientific discourse, and ends at the time of a further shift, some two centuries later, when the evolution of science and society, through the Enlightenment and the Scientific revolution, led Huxley (1898) to claim the need for a "special" scientific discourse (Moskowich 2012).

Although men and women both tended to observe the linguistic considerations commonly present in scientific works, I contend that women were more prone than men to the use of personal strategies given their naturally subjective character (Holmes). For this analysis I have selected eighteenth-century text samples from Astronomy, Philosophy and Life Sciences. As a matter of fact, my working hypothesis also contemplates that both discipline or subject-matter and the genre used to address audiences with different levels of knowledge or different social roles can help explain more in detail the general results of the analysis. Whenever possible I will resort to the prefaces of their works as an aid to exploring their attitudes as scientific writers.

The paper will be divided into the following sections: after the introduction, Section 1 will present a brief overview of the social status of women "scientists"

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[1] By way of summary, three main parameters of compilation have been followed: classification, time-span and degree of representativeness. No random selection has been made but this has been based on certain external parameters to ensure fruitful linguistic analyses. From the point of view of thematic grouping, we have adhered to the current UNESCO classification of science as a starting point, though the compilers have borne in mind important differences in how science was viewed before and after Empiricism, which is especially visible in eighteenth-century samples. Indeed, the authors are compiling independent sub-corpora which share a similar structure, organisation and mark-up (Moskowich and Crespo 2007; 2012; Crespo and Moskowich 2010): *CETA, CEPhiT,* and *CELiST*. One of the peculiarities of these corpora is that, apart from the texts themselves fulfilling the same external criteria for the purpose of representativeness, they include metadata files with information about the author and the text itself to which the sample belongs. In addition, a corpus management tool has been implemented to facilitate the use of different kinds of searches of all the sub-corpora. It works like most concordance programmes, but the *Coruña Corpus Tool* incorporates special features adapted to the characteristics of the *Coruña Corpus* (Crespo and Moskowich 2010).

confronted with that of men and their cultural milieu. Section 2 will cover the methodology and the corpus material selected for analysis. An analysis of these data will then be provided in Section 3. I intend to examine possible differences between male and female discourse, considering as variables the particular scientific discipline and the genre used to convey information. Finally, concluding remarks will form part of section 4.

1. WOMEN AND SCIENCE IN THE EIGHTEENTH CENTURY

At first, women of a high rank were able to take part in so-called "scientific circles", where men used to meet; the atmosphere being one of uncertainty for all participants. But this uncertainty was accompanied by a growing interest in the observation and analysis of all kinds of phenomena without following any clear parameters or rules. Everything scientific, from meetings to debates, came into fashion in the last quarter of the seventeenth century for those moving in the highest circles of society, and thus certain women were able to participate in such events (the Duchess of Newcastle, Lady Ranelagh among others).

On the contrary, men devoted to scientific issues were members of the gentry or the aristocracy who had been educated and their discourse, a genteel one, was perceived as true and reliable. They represented a social group admired and respected by the majority of the population. In particular some of the male authors included in this study were members of the Church, being their professional activities mostly religious services (Whiston, Watts, Costard); some others devoted themselves to teaching (Wilson, Bonnycastle, Harris) but many had shared a previous formal training in Mathematics, Physics, Geology or Life Sciences by institutional means (Steward, Ferguson, Hill). The socio-cultural background for men and women at the intermediate stage in their education is radically different. Men can evolve independently; women are subject to external conditionings. In the private sphere or in small circles the work done by women is accepted and even praised but in the public sphere society obstacles the development of women's science (Hunter, 2005). This is a social prejudice against the female sex which does ignore status, cleverness or wisdom.

Hunter (2005) claims that women were devoted to practicing science in the household domain pushing science developed by women to the background. Nevertheless, they really performed scientific tasks, as Bathsua Makin explains in *An Essay to Revive the Ancient Education of Gentlewoman* (1673, 35):

> *To buy wooll and Flax, to die* [sic] Scarlet and Purple, requires skill in Natural Philosophy. To consider a Field, the quantity and quality, requires knowledge in Geometry. To plant a vineyard, requires understanding in Husbandry: She could not merchandize, without Knowledge in Arithmetick: she could not govern so great a Family well, without Knowledge of Politicks and Oeconomicks: She could not look well to the ways of her Household, except she understood Physick and Chirurgery: She could not open her Mouth with Wisdom, and have in her Tongue the Law of Kindness unless she understood Grammar, Rhetorick and Logick.

Women's exclusion from scientific knowledge runs parallel to the process of the institutionalisation of science which developed between the last part of the seventeenth century and throughout most of the eighteenth century (Solsona i Pairó 1997, 86-87) with the creation of societies and specialized associations to which women were not admitted even if highly-esteemed as was the case of Boyle's sister, Lady Ranelagh, or Caroline Herschel, a century later. Nevertheless, the dissemination of science among the growing number of literate people also included the tentative participation of women in these matters. In fact, "from 1730 onward there was a European-wide effort led by Newtonians (...) to find a female audience for science. British periodicals appeared specifically aimed at making science accessible to women" (Jacob 2003, 206). The *Female Spectator* was one of these, but women also attended lecture courses and endeavored to find sponsors to write textbooks.

Samples from both male and female works, included in the CC, will be studied in the pages that follow to compare the use of argumentative/persuasive strategies.

2. THE CORPUS MATERIAL

The core of the methodology used in this paper lies in the study of some of the linguistic features that authors have generally agreed to transmit persuasion (Biber 1988, 1995; Biber & Conrad 2009; Atkinson 1999; Mischke 2006; Nesi 2009; Włodarczyk 2010; Moskowich and Crespo 2012). The expression of persuasion allows for the study of the extent to which the author is present in his/her writings, exerting pressure to convince the reader or to make him participate in an *a priori* unidirectional communicative process.

For this paper, a preliminary approach to persuasive or argumentative strength in scientific writing, predictive and necessity modals, suasive verbs and conditional subordinators have been considered.

TABLE 1. LINGUISTIC FEATURES (FROM BIBER 1988)

Predictive modals	Necessity modals	Conditional subordinators	Suasive verbs
Would	*Must*	*If*	agree, allow, arrange, ask, beg, beg, command, decide, decree, demand, desire, determine, enjoin, entreat, grant, insist, instruct, intend, move, ordain, order, pledge, pray, prefer, pronounce, propose, recommend, request, require, resolve, rule, stipulate, suggest,urge, vote
Shall	*Ought*	*Unless*	
Will	*should*		
Contracted forms*			

* In the case of contracted forms (*'till* and *'ll*), there is no way of knowing whether they are contactions of *will* or of *shall*, and for this reason I have treated them separately.

As a result of quantifying the frequency of occurrence of the linguistic features selected I feel I will be in a position, on the one hand, to provide a general depiction of the use of persuasive strategies in scientific texts and, on the other, to

offer more peculiar and interesting data about women's and men's scientific writing by using variables such as the genre of the samples and the discipline involved. For the qualitative analysis other aspects also mentioned by Biber (1988, 70) will be taken into account where necessary: "Subject-matter, purpose, rhetorical structure, and style in addition to situational parameters" such as the relation between communicative participants, the relation of the participants to the external context and the relations of the participants to the text itself..." will be considered in those cases in which they are useful for the interpretation of data (Biber & Conrad, 2009).

In my analysis, as we will see in Section 3 below, figures will be normalised to 1,000 to provide more accurate results.

I have worked initially with 608,658 words, which correspond to the total number of words recorded for the three disciplines analysed, namely Philosophy, Life Sciences and Astronomy in the eighteenth century. Thus far, the different sub-corpora that will be examined are:

TABLE 2. SUB-CORPORA CONTAINED IN THE *CC* AND NUMBER OF WORDS IN MALE VS FEMALE WRITING

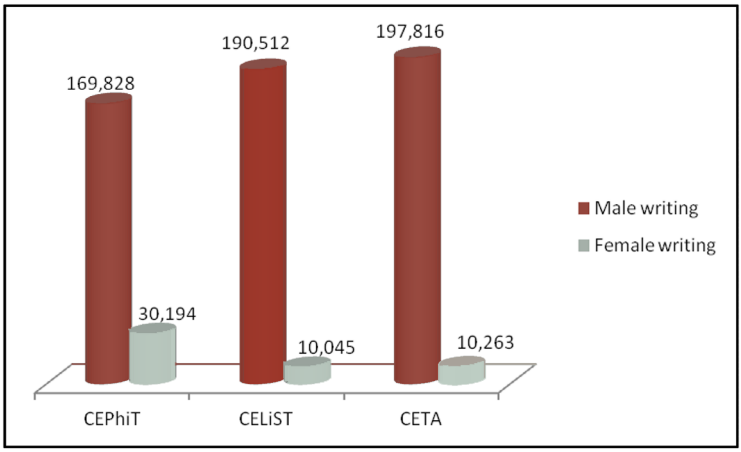
Sub-corpus	Discipline	Total No. of words	Male writing	Female writing	
CEPhiT (Corpus of English Philosophy Texts)	Philosophy	200,022	169,860	30,162	15.09%
CELiST (Corpus of English Life Sciences Texts)	Life Sciences	200,557	190,480	10,077	5.00%
CETA (Corpus of English Texts on Astronomy)	Astronomy	208,079	197,816	10,263	4.93%
TOTAL		608,658	558,156	50,502	9.04%

As can be seen in Table 2, only 50,502 words, corresponding to 9.04% of all the samples recorded belong to women's texts whereas 558, 156 (91.70%) belong to samples written by men.

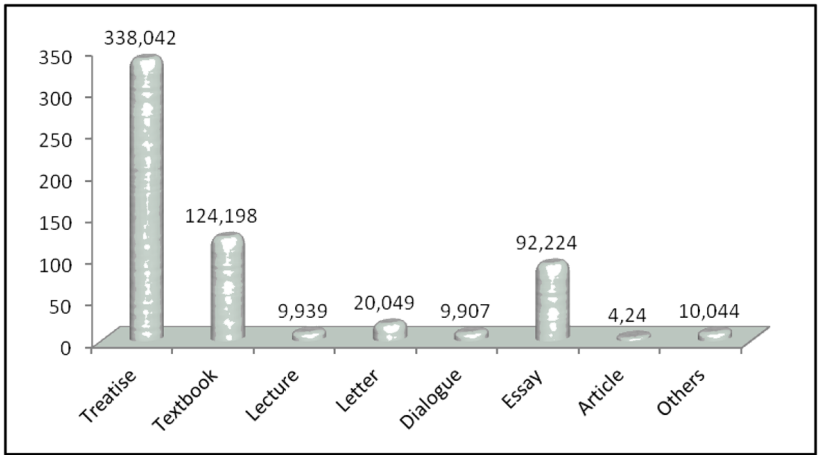
The scant number of words from texts written by women can be explained, on the one hand, by several socio-external factors: the political, cultural, socio-economic and religious environment of the period, as well as the well-known practice of women leaving their names off a work or using a male pseudonym (Lareo 2011, Moskowich 2012); and, on the other, by looking at the specific requirements of corpus compilation applied to the *CC*: for an author to be included in the corpus it was necessary that some kind of biographical data be added to the metadata section, and in most cases of female authorship this information was difficult to obtain.

The distribution per discipline of the total number of words can be observed in Graph 1.

Although it is undeniable that academic prose production was certainly a male task, it is worth noting that the distribution, however similar, is not exactly the same in all disciplines. As shown in Graph 1, Philosophy contains the highest number of samples of female authorship. It falls in the field of the Humanities, which seems to have been a typical area of activity for women. Moreover, the period



Graph 1. Distribution per discipline of eighteenth-century male and female writing.



Graph 2. Words per genre in general.

under analysis here coincides with a moment in history when the vindication of women's rights was gaining importance in the social discourse, not only but mostly in authors within this field (Agassiz was a botanist but was worried about women's education and their social role).

If we look at the second variable we will employ in the analysis, that of genre, the distribution is as shown in Graph 2.

More than half the total number of words (55.54%) represents the genre treatise. Textbook (20,4%), essay (15.15%) and letter (3.29%) come next. Treatises,

then, were the most common texts in our samples. We assume that the kind of genres used by the authors included in the *CC* and their distribution could serve as a guidance of the sort of genres preferred in general terms.

For the sake of comparison I have crossed this variable with sex and the results are displayed in Table 3:

TABLE 3. WORDS PER GENRE DISTRIBUTED ACCORDING TO SUB-CORPUS AND SEX

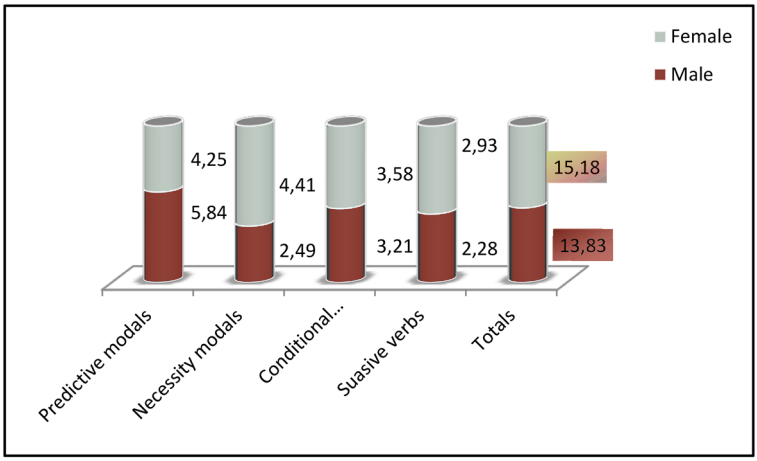
	CEPhiT		*CETA*		*CELiST*		TOTAL
	Male	Female	Male	Female	Male	Female	
Treatise	109,628	20,117	47,672		150,58	10,045	338,042
Textbook	10,064	_____	93,858	10,263	10,013	_____	124,198
Lecture	_____	_____	9,939	_____	_____	_____	9,939
Letter	_____	_____	9,975	_____	10,074	_____	20,049
Dialogue	_____	_____	9,907	_____	_____	_____	9,907
Essay	50,136	10,077	12,180	_____	19,831	_____	92,224
Article	_____	_____	4,240	_____	_____	_____	4,240
Others: dictionary	_____	_____	10,044	_____	_____	_____	10,044

A similar preference for treatises can be observed if we just look at female works. The remaining samples belong to the categories textbook and essay which is in line with the overall textual patterns described for male authors. So long as these genres coincide in the case of men and women it is reasonable to think the rhetorical formats which are going to be followed but we might wonder whether the linguistic uses will be also the same. This is something to be answered in the results and discussion section.

Searches were carried out with the aid of the *Coruña Corpus Tool* (henceforth *CCT*) but in many cases, automatic searches were also checked manually, a procedure also mentioned by Biber (1988, 67). Moreover, in the case of suasive verbs all the verbal forms were contemplated (ending in *-s,-ed,-ing* or irregular forms).

Manual disambiguation has produced an important difference in some cases between the number of tokens that could have been found and those which were actually representative of each linguistic feature. Interestingly enough, this phenomenon is to be observed in predictive modals and in suasive verbs, as will be explained in sub-section 3.1 below.

In what follows I will examine the significance of those persuasive strategies used by eighteenth-century authors, the differences between male and female writers and how the expression of persuasion is affected by discipline or genre.



Graph 3. Persuasive markers in *CETA*, *CELiST* and *CEPhiT*.

3. RESULTS AND DISCUSSION

The total number of forms expressing overt persuasion which have been found in my material amounts to 8,491, which corresponds to 13.95 instances per 1,000 words (nf).

Cases found in male writings amount to 13.83 in normalised frequencies which contrasts with the 15.18 forms retrieved from female texts. Women are assumed to be more involved than men and, hence, more engaged with their writings (Argamon *et al* 2003). In the light of this claim, I could say that this is more so when writing on science since they feel the necessity of paving their own way in a male-dominated world. This goes against the empiricist canon of objectivity which guided eighteenth-century science but goes in favour of seeking the trustworthiness or reliability on the readers' part so predicated by Bacon's and Boyle's doctrine.

Although, obviously, these results reveal that women resort to more persuasive strategies than men, they must be taken with care since on closer inspection different results for each individual linguistic feature will be determined as can be seen in Graph 3 below:

As can be deduced, women seem to prefer necessity modals in the first place (4.41), followed by predictive modals (4.25) and conditional subordination (3.58). The expression of persuasion on the part of male authors focuses on predictive statements which include the corresponding modals. It is interesting to note that the most salient distinctive feature in both male and female writing lies in the expression of modal meanings.

In the following pages I will present an individual analysis of each linguistic feature analysed. The first of these features is, precisely, that of predictive modals.

3.1. Predictive modals

The three types of predictive modals searched (*will, shall* and *would*) have all been found in our samples. The general counts (including *'ll*) reveal that a total of 3,710 instances have been traced; of these, 3,422 (6.13 nf) have been found in texts written by men whereas 288 (5.7 nf) belong to texts by women. Thus, there does not seem to be a dramatic distance between male and female writers although predictive modals are clearly more abundant in the former.[2] *Shall* and *will* represent two modes of expressing prediction: *shall* conveys extrinsic prediction whereas *will* transmits volition or intrinsic prediction. According to Coates (1983) "will ranks high in the scale of confidence" and this might have compelled male authors to use it and comply with the goal of argumentation in scientific writing: influence the addressee by configurating a system of significant values and conceptual relations. In addition, *will* reinforces the validity of an assertion provoking a reaction in the reader (Beaugrande and Dressler, 1981, 184). Table 4 accounts for the raw and normalised frequencies of predictive types male and female authors have used according to discipline or subject-matter:

TABLE 4. USES OF PREDICTIVE MODALS IN MALE AND FEMALE WRITING PER DISCIPLINE

Male	*CETA*	Nf	*CEPhiT*	Nf	*CELiST*	Nf	Total	Nf
Will	1187	6.00	407	2.39	484	2.54	2240	4.01
Would	332	1.67	338	1.98	133	0.69	803	1.43
Shall	130	0.65	137	0.80	112	0.58	379	0.67
	1649	8.33	882	5.19	729	3.82	3422	6.13
Female	*CETA*	Nf	*CEPhiT*	Nf	*CELiST*	Nf	Total	Nf
Will	42	4.09	111	3.68	0	0	153	3.02
Would	15	1.46	76	2.51	1	0.09	92	1.82
Shall	14	1.36	29	0.96	0	0	43	0.85
	71	6.91	216	7.16	1	0.09	288	5.70

As for the three types expressing prediction in descending order of frequency, *will* (3.93) comes first followed by *would* (1.47) and finally by *shall* (0.69). The results of each individual item are displayed in Table 5:

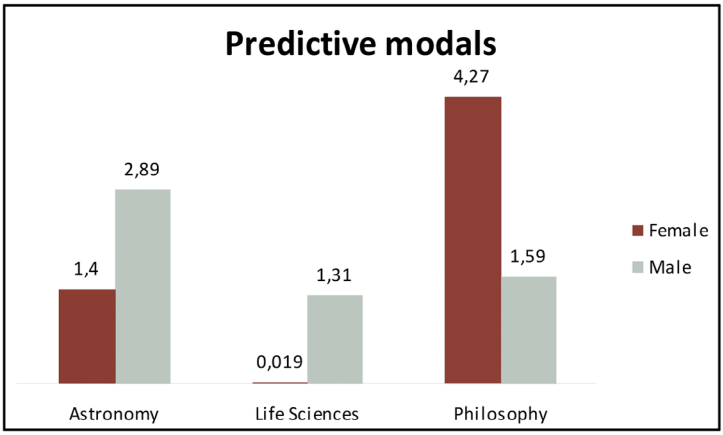
[2] After using *CCT,* manual checking found that not all the cases corresponded to verbal forms. *Will* could belong to the nominal category or it could have a different meaning.

TABLE 5. PREDICTIVE MODALS: RAW AND NORMALISED FREQUENCIES		
Predictives	Raw figures	Nf/1000
Will	2393	3.93
would	895	1.47
shall	422	0.69

Comparing normalised frequencies of men and women, I have detected that, although the order of general frequencies is maintained, the presence of one predictive modal or the other varies: *will* is more often used by men (4.01) than in women (3.029). A different situation is found with *would*. Cases in women writers amount to 1.82 whereas in men writers the figure remains in 1.47. The same applies to *shall*: women present 0.85 cases whereas men present 0.67. *Would* ranks low on the scale of confidence, paraphrasing Coates (1983), since it conveys the meaning of remote possibility. The proposition containing this modal is not likely to happen and this improbability derives in a weak persuasive force. Likewise, *would* expresses tentativeness and politeness which yields a trait of cooperativeness between writer and reader. Women are more empathetic than men, with a more categorical and imposing style (Cameron, 2009). The implication of the author in the expression of prediction is lower in the use of *shall*. Persuasion, in this case, causes a weaker reaction in the reader since the proposition reveals a general assumption and not the particular intention or the private opinion of the author.

As noted in the introduction to Section 3, above, I have also included discipline as one of the variables in the analysis, since I think scientific writing may be discipline-dependent (Moskowich, 2013). In this sense, some epistemological restrictions imposed by a discipline on the author's choices in text production could be observed (Garzone, 2004). Findings here are interesting. Writers on astronomy matters are the leaders in the use of predictive modals (8.26) followed by philosophy writers (5.48) and life sciences writers (3.63). It is shocking that a more observational and experimental science such as Astronomy allows for a more personal participation of the author trying to convince the reader of the truth of his/her propositions. Yet, we could think that this has to do with the period in which these texts were written: the empiricist procedures and techniques are beginning to be settled, it is the initial stage of a new movement which will gradually set out a particular discursive method giving birth to the specific scientific register.

The same order in the frequency of use of predictive modals in the different disciplines applies to both male and female authors except for philosophy. The latter (7.16) surpass the former (5.19). This discrepancy lies in the nature of the discipline itself: philosophy forms part of the humanities according to the UNESCO classification (1988) of sciences and it allows for more authorial presence, the manifestation of enthusiasm (or lack of it) and personal commitment. This is especially so when the topic is one of vindication, morality, beliefs, ethic principles. All these topics leave space for the author's stream of ideas explained through deep argumentation and reasoning which is characteristic of the soft sciences. As Hyland (2005, 187) contends, "...writers (...) in the humanities and social sciences taking



Graph 4. Predictive modals in men's and women's writings per discipline.

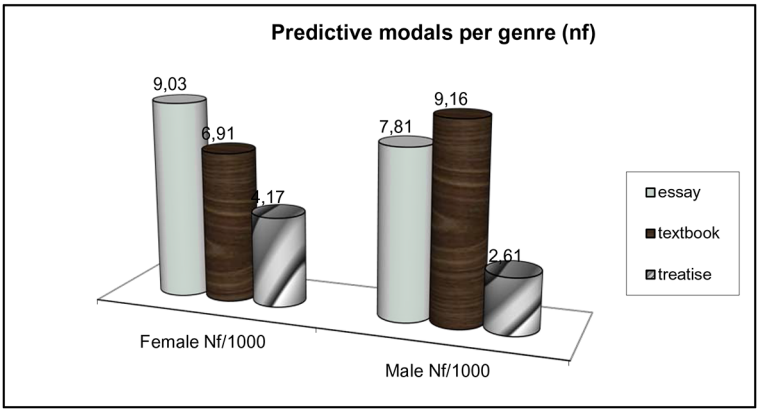
far more explicitly involved and personal positions than those in the science and engineering fields". Therefore, if we compare both sex and discipline we can note that it is precisely the group of female authors of philosophy (mainly vindicating a different role for women in society) the one that stands out over the rest:

The analysis of predictive modals as one of the parameters in the dimension concerning persuasion and argumentation is in accordance with what might be expected, given that the two disciplines with the highest frequency of occurrence, Philosophy and Astronomy, are those in which their own epistemological properties induce authors to influence readers. Philosophy is a highly argumentative discipline, and whereas Astronomy itself may be grouped with other observational sciences, the genre selected by the author here (textbook) requires to a certain extent the use of persuasive strategies to attract the reader's attention and foster adherence to the topic. It is a way of disseminating knowledge, by the implication of the target addressee. In the sample representing Life Sciences (Blackwell, 1737, *A Curious Herbal, containing five hundred cuts of the most useful plants which are now used in the practice of physick. Vol I*) description and condensed explanations prevail. This particular treatment of the topic could be the reason for the low number of occurrences here.

As for genres, Table 7 below shows the irregular distribution of the modal forms expressing prediction.

TABLE 7. PREDICTIVE MODALS PER GENRE (NORMALISED FIGURES)

Genre	Predictive modals (female)	Nf/ 1000	Predictive modals (male)	Nf/ 1000	Total	Nf/ 1000
Essay	91	9.03	642	7.81	733	7.94
textbook	71	6.91	1044	9.16	1115	8.97
treatise	126	4.17	804	2.61	930	2.75



Graph 5. Predictive modals per genre.

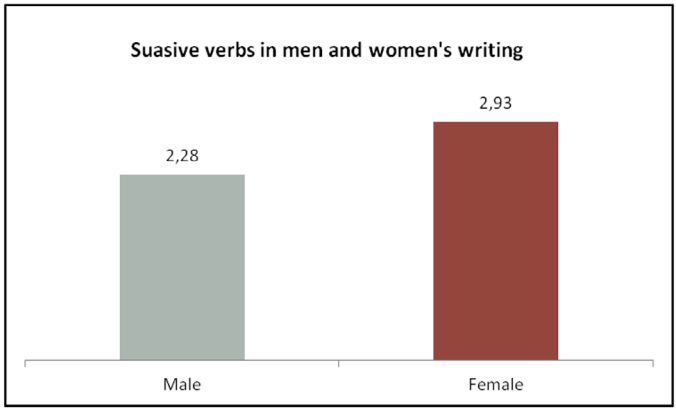
The normalisation of figures reveals that modals abound mainly in textbooks, followed by essays and treatises. This is clearly seen in Graph 5:

The characteristics of each of the genres play a part here. Treatises represent consolidated knowledge previously agreed upon by members of the epistemic community. Essays occupy intermediate levels at the pyramid of knowledge promoting the exchange of 'wisdom' whereas textbooks tend to be informative. The presence of these modals implies a decrease in the level of objectivity normally attributed to scientific discourse (Garzone, 2004) since authors may choose to "violate the principles of scientific expression to enhance the persuasive force of their text" (Sokól 2006, 44) for the sake of trustworthiness. Treatises are addressed to a readership that is placed at the same level of the author within the epistemic community. In them the author's intention is to disclose his/her findings without being influential on anyone, transmitting well-accepted and established knowledge. Textbooks are oriented to learners with different levels of knowledge. Authors may feel the necessity to reassert themselves and to make use of argumentative mechanisms to strengthen their position in the teaching-learning process and persuade the readership to rely on their discourse. In terms of the target audience, then, predictive modals predominate in texts which aim to move and persuade the reader to agree on the author's viewpoint, as in textbooks and essays.

The second feature involved in the analysis is that of suasive verbs.

4.2. Suasive verbs

I have traced a total of 1,422 instances of suasive verbs in our material which are distributed as follows: 1,276 have been found in texts written by men and 146 in texts by female authors. The normalisation of figures reveals that 2.28



Graph 6. Suasive verbs in men and women's writing.

forms occur every 1,000 words in male texts whereas this figure rises to 2.93 when we work with female writings:

Suasive verb forms, then, are more frequently used by women than by men in eighteenth-century scientific works. This might agree with the female authors' necessity to reaffirm their presence in the texts by means of an overt expression of persuasion in contradiction with the assumption of tentativeness mentioned for the lower presence of predictive modals. They need to be more persuasive to the eyes of the scientific community to validate their claims, although, unconsciously, they may be separating themselves from some of the canonical patterns of empiricist discourse on being their texts imbued with this evident manifestation of authorial presence.

According to the list of suasive verbs found in Biber (1988) and Quirk *et al* (1985), many of the expected types were not recorded and some others either did not belong to the lexical category we were examining, or, despite being verbs, were not used with a suasive meaning[3]. Examples (2) to (4) illustrate some of these suasive uses of verbs:

(1) deviating from my settled rule of conduct in all I <instruct> you in by communicating that which i did not fully (Bryan 1797,104)

[3] Of all the suasive verbs proposed, 71 types have not been found at all. It is worth noting that, on occasions, the explanation for this absence is that the suasive meaning is recorded later than the date in which the text was published. This is the case with *suggest* according to the *OED*. In other cases the suasive meaning of certain verbs was developed during the eighteenth century, and thus was not yet of common use among contemporary writers. An example of this is *stipulate* with the meaning of "To make an express demand for something as a condition of agreement," first recorded in 1790.

(2) And for thoſe other little things that <move> their Envy and Ambition, they are of no Eſteem with a juſt Conſiderer, nor will ſuch as violently purſue, find their Account in them. (Astell 1700, 49).
(3) reſiſting the injuries of the air and weather I now <propoſe> a more ſure and certain method by which the moſt (Blair 1723, 7).

Allow, determine, and *require* are the types that appear most frequently, with 175, 265 and 237 tokens each. The suasive meanings of these verbs are recorded in the *OED* in the following terms:

Determine	†7. *trans*. To settle or fix beforehand; to ordain, decree; to ordain what is to be done. b. *fig*. To direct, impel, give a direction or definite bias to. *a*. To order, instruct, or oblige (a person) to do something.
Require	intr. To make a request or demand. b. *trans*. To demand (a thing) authoritatively or as a right; to demand, claim, or insist on having (something) *from* or *of* someone.†c. *trans*. To ask for (something) as a favour; to beg, entreat, or request (a favour).
Allow	*a*. *trans*. To accept as true or valid; to acknowledge, admit, grant. Also: (of a statement) to enable (another statement) to be true or valid.

Examples 5 to 7 below illustrate these uses in the samples under survey:

(1) motion of the fixed stars it is fit that we <allow> the preceſſion of the equinoctial point eſpecially when not only (Whiston 1715, 20)
(2) their ſituation magnitudes diſtances and motions and enables us to <determine> with preciſion the length of years months and days and (Adams 1777, 1)
(3) more and generally the education of their younger children may <require> the joint attention of the parents for many years after (Hutcheson 1755, 161)

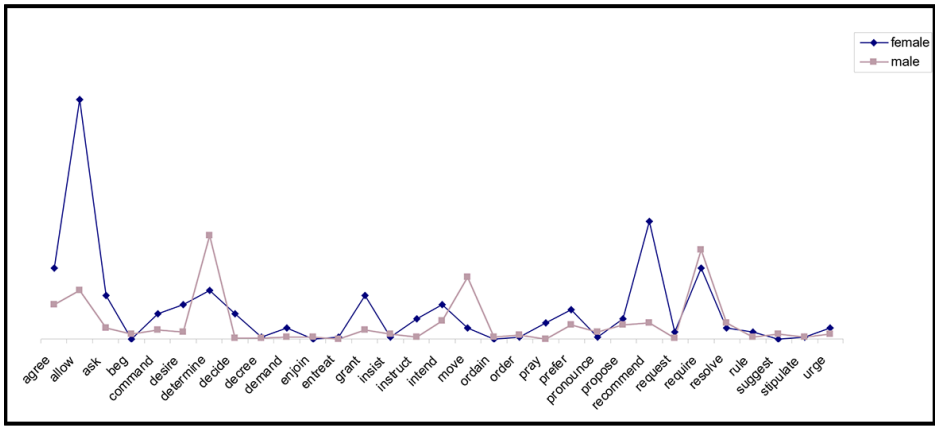
Sex differences in the usage of suasive verbs are illustrated in Graph 8 below containing normalised figures.

From the data obtained we can draw the conclusion that there is an uneven distribution of suasive verb forms in texts produced by men or women. The tendency in male writing is to use verbs such as *allow, determine, move* or *require*. Women prefer *agree, allow, ask, grant, intend, prefer* or *recommend*. On closer inspection, the histogram then, reveals, that the range of lexical forms used by women is wider than that used by men. Might this be symptomatic of greater lexical richness in works by women, further research is needed to answer this question but this could be the beginning.

As for the variable genre, the distribution of suasive verb forms is as Graph 8.

TABLE 8. SUASIVE VERB TOKENS PER GENRE (NORMALISED FIGURES)

Genres	Suasive verb tokens (female)	Nf/ 1000	Suasive verb tokens (male)	Nf/ 1000
essay	35	3.47	256	3.11
textbook	19	1.85	250	2.19
treatise	90	2.98	869	2.82



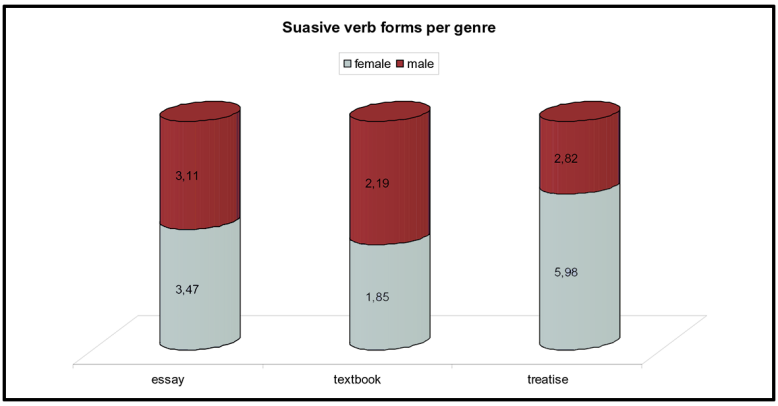
Graph 8. Male/Female uses of suasive verbs.

The counts for both men and women writers have yielded similar results as for the order of frequency: essay is the genre with the highest number of suasives (3.47-3.11), followed by treatise (2.98-2.82), where the author's concerns about being credible and presenting actual facts or theories when addressing the reader are clearly important. Textbook comes last (1.85-2.19). Female uses of suasive verb forms surpass those of male uses in both essay and treatise but the reverse applies for textbook. Men authors seem to be more concerned with argumentative strategies than women only in handbooks conceived of for instruction with a descriptive and informative goal. Similarly, in essays and treatises, as pieces addressed to the same epistemological community as the writer, these features seem to be more pervasive. Normalised rates might suggest a direct relation between the type of genre selected by the author and the greater or lesser presence of these features.

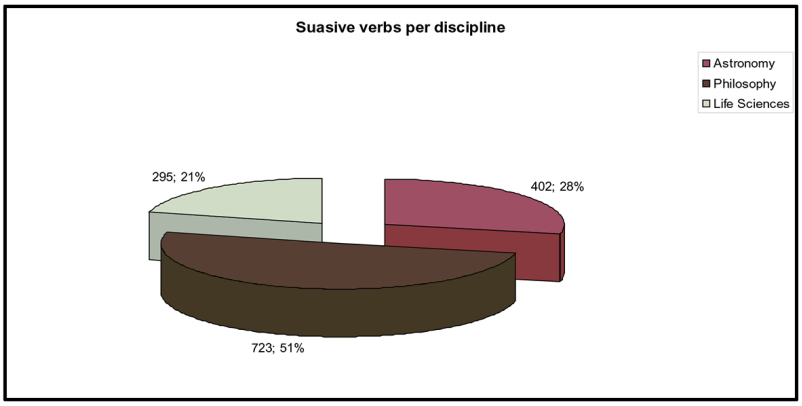
Though both Table 8 and Graph 9 indicate the presence of suasive verb tokens, the abundance of types must be noted, especially in female works. Thus, 23 different types have been found in the essay, the sample by Astell (1700). The sample of textbook writing from Bryan contains 15 different types. It might be noted that certain types such as *allowed* present 30 tokens in the text sample from the observational sciences Bryan represents.

Treatises are better represented as a genre in our corpus since the genre is represented by four authors (Blackwell, Scott, Macaulay and Wollstonecraft) and automatic searches yielded 64 different types. Several types that are *hapax legomena* (see section 4.1), some are very common (*asks, decides*), but others are less so (*decreed, entreat* or *stipulated*). This argues in favour of the lexical variety of female writing, as mentioned above (see also Moskowich's paper in this special issue).

The lowest number of suasive verb forms to be found in textbooks may be due to the fact that authors, when writing textbooks (informative) do not have to convince or persuade but rather to describe or inform their audience.



Graph 9. Use of suasive verbs per genre.

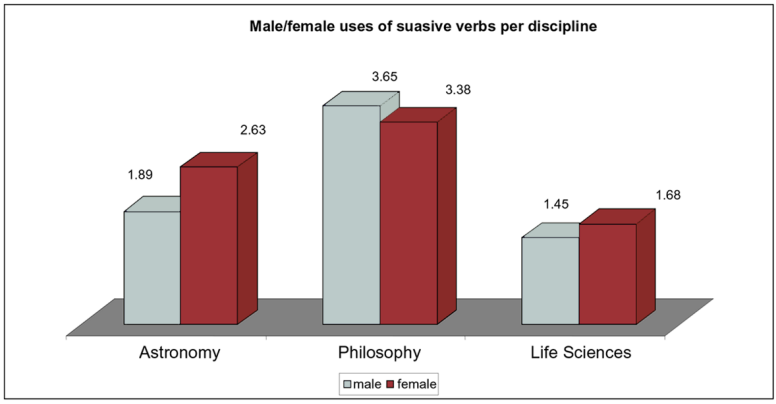


Graph 10. Suasive verbs per discipline.

The last variable to be examined here is discipline. Graph 10 below reminds us of the predominance of suasive verbs in texts pertaining to the area of the Humanities: Philosophy.

As noted earlier, the nature of the discipline itself and the topics it deals with might provide the appropriate explanation for this predominance. This is connected with the fact that more women include more suasive verb forms in their writings on Philosophy than on any other discipline as Graph 11.

The presence of a higher proportion of suasive verbs in female writings is attested in the case of Astronomy (1.89-2.63) and Life Sciences (1.45-1.68). Notwithstanding, it is in philosophy that this proportion barely diminishes with regard to men (3.65-3.38).



Graph 11. Male/female uses of suasive verbs per discipline.

Conditional subordination is another linguistic device that can be used to gain endorsement to the author's claims (Warchal 2010, 141; Puente & Monaco 2013). How women and men resort to this device will be analysed in the pages that follow.

4.3. Conditional subordinators

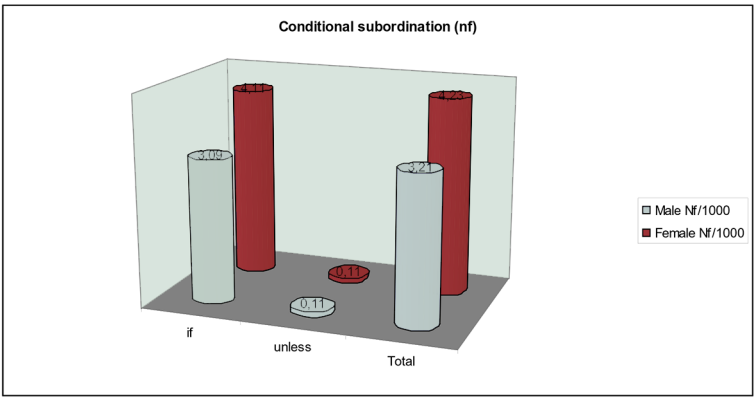
The two types of conditional subordinators analysed are *if* and *unless*. The 2006 tokens found are very irregularly distributed, since 1938 correspond to *if* whereas only 68 correspond to *unless*. Conditional clauses are used for discourse framing and, I should add, for authorial positioning in terms of an "assessment of the advisability or likelihood of an event presented to persuade the addressee" (Biber 1988, 111). Both raw and normalised frequencies are displayed in Table 9 below:

TABLE 9. CONDITIONAL SUBORDINATORS

	Male	Nf/ 1000	Female	Nf/ 1000	Total	Nf/ 1000
If	1730	3,09	208	4,11	1944	3,19
Unless	62	0,11	6	0,11	70	0,11
Total	1792	3,21	214	4,23	2014	3,3

There is a discrepancy in the use of conditional subordinators which can be appreciated in Graph 12.

Female authors resort to the use of conditional clauses (4.23) more often than men (3.21) when we come to scrutinise the frequency of occurrence of the type



Graph 12. Use of conditional subordination by male and female scientists.

if. Conditional subordination manifests the principles of logical argumentation and inherent reasoning which form the underpinnings of empiricist science. Women seem to make an effort to demonstrate they can also adapt to modern times and follow the dictates of the new science. In this sense we can interpret that women are status-conscious (Romaine, 1994) in eighteenth-century society. Equally frequent is the use of a more formal counterpart to express conditionality, *unless*, (0.11 in both cases), the scarcity of which could only be explained by the necessity to comply with the principles of clarity and simplicity praised by their precursors and the authors' final goal: the spread of knowledge.

If and *unless* have been found in all genres in our samples except for textbooks in female writing. Tables 10 and 11 below display raw figures and their corresponding normalised frequencies:

TABLE 10. CONDITIONAL TOKENS PER GENRE IN FEMALE WRITING

Female	if	Nf/1000	unless	Nf/1000	Total	Nf/1000
Essay	57	1,12	4	0,07	61	1.2
textbook	17	0,33	0	0	17	0.33
treatise	84	1,66	2	0,039	86	1.7

TABLE 11. CONDITIONAL SUBORDINATORS PER GENRE IN MALE WRITING

Male	if	Nf/1000	unless	Nf/1000	Total	Nf/1000
Essay	312	0,55	15	0,02	327	0,058
textbook	364	0,65	9	0,016	373	0,668
Treatise	924	1,65	36	0,064	960	1,71

General counts evince that women writers clearly surpass men writers in the use of conditional subordination in essay (1.2 vs 0.058). However, the reverse is true in the case of textbook (0.668 vs 0.33). In treatise the difference is hardly appreciated (1.71 vs 1.7). As suggested above, essays represent the kind of genre which admits hypothesis and allows for the testing of truths. Essays are more dialogic among members of the epistemic community and provide free space for debate and ongoing discussion, they allow for the verbal expression of experimentation and in this sense are to be more amenable to the incorporation of this kind of linguistic strategies: A is fulfilled if...; If B develops, then A...; something could happen if... A higher number of occurrences in essays also transmit a higher degree of cooperation and negotiation with the discourse community. As stated above, treatises convey well-accepted knowledge, so hypothesise occurs more rarely. The purpose of a textbook is not to argue in favour or against theories or concepts but it should limit to the teaching role of transmitting knowledge. Under these conditions, women seem to be more argumentative and agreement-seeking than men when writing essays, maybe because they have to write as scientists but also as women and they have to advocate this double role in contemporary society. To demonstrate they can be the equals of men, to be listened, they have to emulate male strategies.

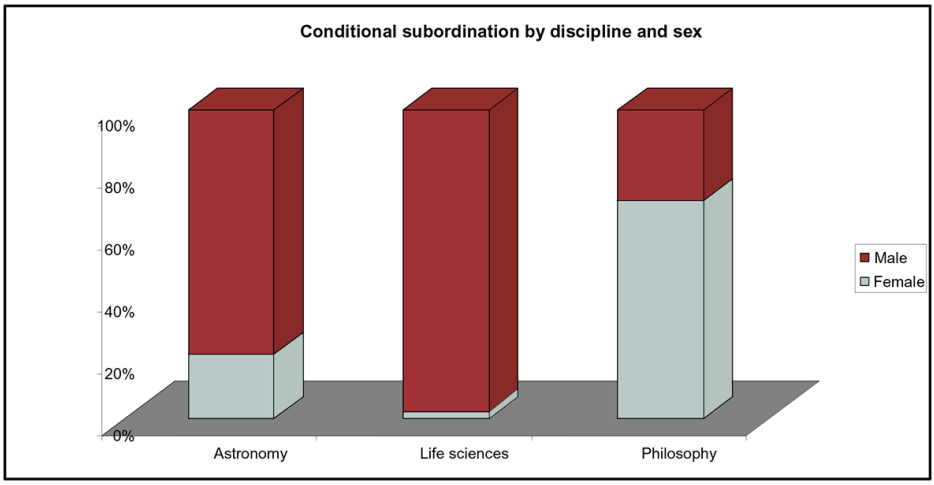
It is worth mentioning, in this sense, that *unless* is used only on 6 occasions by women, all of them by Mary Wollstonecraft in *A Vindication to the rights of women*. This use is related to the strongly argumentative nature of her work, in which she struggles to shake the collective consciousness of women and make them wake up from their lethargy regarding their position in society. The topicalisation provoked by the use of *unless* has, then, obvious pragmatic, even, socio-political, intentions.

As in previous features, the next variable to be scrutinised is the scientific domain or discipline to which samples belong.

TABLE 12. CONDITIONAL TOKENS PER DISCIPLINE

Discipline	Conditional tokens (female)	Nf/1000	Conditional tokens (male)	Nf/1000
Astronomy	17	0.33	701	1.25
Life sciences	1	0.019	416	0.74
Philosophy	146	2.89	675	1.2
TOTAL	164		1792	

Table 12 shows the normalised figures for the occurrence of the conditional subordinators under examination in the three sub-corpora. Subordinators clearly predominate in Philosophy, the argumentative discipline *par excellence,* in the case of female authors (2.89). Samples from other disciplines only contain instances of *if*. Once more, it seems the case that topicalisation may be playing a part as a rhetorical device typical of this particular field (see Graph 13).



Graph 13. Conditional subordinators per genre and sex.

In the case of male authors it is the field of astronomy that stands out (1.25) closely followed by philosophy (1.2), where the use of *unless* is more prominent. (see table 13 below).

TABLE 13. *IF* AND *UNLESS* PER DISCIPLINE IN TEXTS BY MALE AUTHORS

Male	*CETA*	Nf/1000	*CEPhiT*	Nf/1000	*CELiST*	Nf/1000
If	688	1.23	637	1.14	405	0.72
Unless	13	0.02	38	0.068	11	0.019

Astronomy agrees with the kind of observational and experimental field which calls for this logic argumentation, especially because of its application to navigation and other utilities which promoted social advancement. Suffice it to say that some of the samples in *CETA* deal with navigation and the creation of instruments and all this was expressed by a mathematical language (Crespo, 2012).

There is an overwhelming difference on the use of conditionals between men and women writing about astronomy and life sciences. Such a difference could be interpreted as a sign of women fulfilling their expected female role in delving into traditionally-men issues but being more persuasive in a field which fitted best their final goals.

Still, to draw a more complete picture of persuasion and argumentation in eighteenth-century scientific writing and how this differed in male and female authors, we will tackle the fourth linguistic feature in detail: modals indicating necessity.

4.4. Necessity modals

Three necessity modals, *must*, *ought* and *should*, as also mentioned by Biber (1988), have been studied as linguistic elements conveying persuasion.

Table 14 below sets out the number of tokens found for each type:[4]

TABLE 14. OCCURRENCES PER TYPE IN NECESSITY MODALS

Necessity modals	Female tokens	Nf/1000	Male tokens	Nf/1000
must	124	2.45	850	1.52
ought	32	0.63	102	0,18
should	125	2.47	472	0.84
TOTAL	281	5.56	1425	2.55

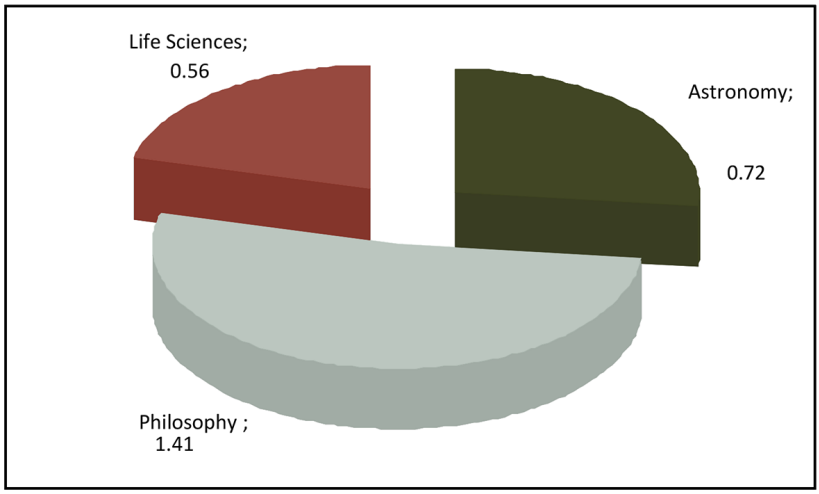
The number of occurrences shows a clear tendency towards the use of strong modality forms, with *must* and *should* prevailing over *ought*. This may be related to a stronger authorial presence (Von Fintel, 2006) in texts where the intention is to move or influence the addressee. This, of course, contradicts the apparent objectivity of scientific discourse, as described, for example, by Vassileva (2000, 9) when she states that the author "is expected to remain hidden behind facts, research results, tables, formulas and the like". In this paper not only have we found a good deal of necessity modals but it also seems that the use of necessity modals is clearly subject-matter dependent, as we will note later.

On a scale from weak to strong, *must* and *should* express a different degree of obligation. *Must* represents the highest value of imposition in this scale since as Kech and Biber (2004, 21) have argued, the 'obligation meaning of must (is) used to convey information with certainty and authority' whereas the obligation implied by *should* is much weaker. This central modal expresses requirement (Vine, 2001) merged with an idea of tentativeness (Palmer, 1990) and this reduces its imposing nature. In texts by women both central modals double or triple their presence when compared with texts by men.

As regards genres, normalised figures show that more formal ways of conveying scientific information, such as essays or treatises, occupy the first and second position respectively on the scale. Nonetheless, occurrences in essays almost double those in treatise.

The presence of necessity modals in the different genres is manifested in table 15 below.

[4] As in the case of predictive modals, some contracted forms (*shou'd*) have been found as variants or alternative spellings.



Graph 14. Necessity modals per discipline.

TABLE 15. NECESSITY MODALS PER GENRE				
Genre	Necessity modals (female)	Nf/1000	Necessity modals (male)	Nf/1000
essay	74	7.34	273	0.48
textbook	38	3.7	172	0.30
treatise	153	3.02	833	1.49

A possible explanation of this is that essays are more restricted in scope than textbooks or treatises and authors may feel the need to convince their audience of the very specific issue they are dealing with. However, treatises, frequently containing a general treatment of a topic, tend to present information with a more descriptive and informative purpose and have a weaker argumentative force, exerting less of an influence on their interlocutor in the communicative process.

As for discipline, our analysis reveals that philosophy (1.41) contains the highest number of occurrences (normalised), followed by astronomy (0.72). Not surprisingly, life sciences comes last with only 0.56 occurrences in normalised figures, as can be seen in Graph 14.

Normalised figures reveal that the presence of necessity modals in our corpus follows the stronger to weaker scale, *must* occupying the highest position, followed by *should*, and finally *ought*. In principle we might think that the argumentative character of philosophy as a discipline would lead it to be first in its use of modals indicating strong necessity. Normalised figures, however, show that it is the discipline of astronomy that contains the greatest proportion of *must* forms. The only female author, Margaret Bryan, had to convey the idea of Laws governing

the Universe, general truths. Also, her work, a collection of lectures that she had given to students, was transcribed in the form of a textbook, and the written version may have preserved some of the argumentative and persuasive features of her oral delivery. The rest of the findings in Table 15, above, are to be expected, and are in keeping with authors' intention and epistemological constraints, clearly illustrated by the very low use of *must* in life sciences.

4. FINAL REMARKS

The eighteenth century was a crucial time in the development of science in the Anglophone world, and especially so for the involvement of women in intellectual work. Their need for society's recognition can be inferred from the way they used language.

From the findings discussed in the previous sections I can conclude that to convince their readership building up a scientific text with coherent and consistent argumentation, authors have mainly resorted to strategies of modality. The analysis of persuasive markers may be interpreted in terms of function and context or situation. The linguistic strategies expressing persuasion that have been studied are not equally used by male and female authors in our corpus. The expression of modality occupies the top on a rank scale for frequency of occurrence: modals of prediction being first and followed by modals of necessity. In the third place I have found conditional subordination and, finally, suasive verbs. However, this general order is altered when we consider the sex of the author. First and foremost, it should be noted that, generally speaking, female authors use a higher proportion of these strategies than male authors but this is not true for each of the strategies individually considered. Necessity modals, conditional subordination and suasive verbs are more often employed by women whereas predictive modals seem to be more characteristic of male writing.

The mechanisms used by women writers, taken into account that suasive verbs are the least frequent strategy, might be the linguistic corollary of the pressure eighteenth-century society exerted on women which compelled them to stand out so as to be minimally considered. To the well-known principles of scientific writing in the Restoration period, objectivity, clarity and conciseness, women had to add subtlety to their discourse. The avoidance of suasive verbs highlighted this necessary subtlety. In this sense I contend that their persuasive or argumentative force was not necessarily overt but was somewhat veiled.

From the many possible options denoting persuasion and argumentation, I have chosen to carry out my study at a microscopic level; indeed, to the linguistic features of his dimension 4 I have added two variables, genre and discipline, as possible factors in the characterisation of male vs. female scientific discourse.

Another conclusion is that persuasive strategies are dependant on extrasystemic circumstances. It might be assumed, then, that these strategies are discipline- and genre-constrained: the topic dealt with, the authors' intention, the target readership are all factors that have an effect on the choice of linguistic elements and

this effect is not felt exactly the same by both men and/ or women writers. The latter are additionally subject to the limitations imposed by society on their sex.

The features examined in the four parameters considered here occur mainly in essays, the genre in which they intended to exert the same kind of pressure on readers with the rapid and continuous development of science as is the case in works by men. We have also observed that the way in which the different linguistic features under study appear has a more or less parallel behaviour in essays and textbooks (in their use of predictive modals) and treatise and essay (in their use of suasive verbs) with some discrepancies: conditional subordinators abound in treatises and textbooks by men and necessity modals in essays and textbooks by women.

Disciplines have also been seen to behave differently, with philosophy containing more strategies for the overt expression of persuasion, as expected. Even though philosophy texts are the ones with the highest numbers for these indicators thus corroborating Hyland's studies on disciplinary discourses (2000), and given that it is a vindicative genre *par excellence*, suasive verbs are the least represented linguistic feature. This could lead us to believe that an open manifestation of persuasion is not in itself an overt feature of female scientific writing in the eighteenth century.

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