

Epistemic and Deontic Modality: A Linguistic Indicator of Disciplinary Variation in Academic English

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1. Modalization and disciplinary variation in academic English

According to pragmatic linguistic analyses, language has to be analyzed and interpreted in relation to the social context which generates and uses it. Language is not to be considered an isolated system of either symbols or mental rules, but a system used in a specific setting and for specific communicative purposes. It is within this pragmatic paradigm that English for Specific Purposes (ESP) develops in the 60s and continues to the present.

In this context, RAs are among the most widely researched genres, but most of these studies have focused on their structural organization (Crookes, 1986; Swales, 1990; Nwogu, 1990, 1991, 1997; Bhatia, 1993; Berkenkotter & Huckin, 1995; Posteguillo, 1996a-b, 1999; Estévez & Piqué, 1997; Piqué & Andreu-Besó, 2000), or on the structural organizations of individual sections within the RA itself (Swales, 1981; Dudley-Evans & Henderson, 1990; Brett, 1994; Holmes, 1997; Piqué & Andreu-Besó, 1998; Bloor, 1999).

It is true that these macrostructural descriptions represent a major feature of RAs as a genre, but there are other linguistic and communicative phenomena which differentiate the RA from other genres which have not been analyzed in such detail, especially having in mind disciplinary variation. For instance, some other authors have studied alternative discourse functions of RAs, such as the use of citations and

references (Jordan, 1990), or the use of argumentation (Hyland, 1990; Thompson, 1993).

Alcaraz (2000: 139-140) considers that RAs are defined by four major features: (a) a specific macrostructure, (b) modalization (i.e., the use of modalized or hedged statements), (c) their main communicative purpose (i.e., scientific claim), and (d) academic politeness (i.e., acknowledging other scientists' research by means of references). The macrostructural component has been widely studied (see references above). However, modalization, or the use of hedges, has also become a major line of investigation in relation to RAs, both from a synchronic (Gosden, 1995; Grabe & Kaplan, 1997; Meyer, 1997; Gledhill, 2000) as well as from a diachronic perspective (Atkinson, 1992; Skelton, 1997; Salager-Meyer, 1998). There is also a recent interest in the disciplinary variations to be detected regarding the use of hedging in RAs, as the works of Hyland (1994, 1996), Crompton (1997), and Lewin (1998) illustrate.

However, most of these studies have not taken into consideration a significant linguistic categorization of modalized or hedged statements which is to be found in linguistic theory since the late 70s, namely the division of modalized statements into epistemic and deontic assertions –with the exception of Simpson's (1990) study, as we indicate below, and more recently, Vihla's (1999) research on medical writing. Mood and modality express the speaker's attitude or opinion regarding "the contents of the sentence" (Palmer, 1986: 14) or "the proposition that the sentence expresses" (Lyons, 1977: 452). Palmer (1986: 21) defines mood as realized by the verbal morphology, whereas modality appears as a linguistic feature generated by a variety of linguistic phenomena among which modal verbs play a special role, as Downing and Locke (1992: 383-384) describe. Quirk et al. (1985: 219), discussing modality, speak of "constraining factors of meaning" namely in terms of intrinsic and extrinsic modality. In other words, the meaning of some kind of intrinsic human control over events would signify "permission", "obligation" and "volition" (deontic, according to Lyons, Palmer, and Downing & Locke). On the other hand, where such intrinsic control is not involved, the meaning would indicate "possibility", "necessity", and "prediction" (epistemic, using Lyons', Palmer's, and Downing & Locke's terminology). The terms epistemic and deontic are the ones consistently used in this paper.

More specifically, deontic modality (DeM) means that the speaker "intervene[s] in the speech event by laying obligations or giving permission" (Downing & Locke, 1992: 382), as in *One must look into this matter in detail ...*, *Shall we negotiate peace now?* or *This experiment should be repeated*. On the other hand, epistemic modality (EpM) implies that the speaker assesses "the probability that the proposition is true in terms of the modal certainty, probability or possibility"

(ibid.), as in *It may be the case that Results might change if certain conditions ...*, or *The concert must be over*. Simpson's (1990) study, which takes into account this epistemic versus deontic distinction, has noted that DeM is a distinguishing feature of, for example, literary criticism.¹

Our aim here is to analyze the language in three different academic contexts (medicine, biology, and literary criticism) in order to detect possible variations in the use of modality, whether EpM or DeM, and to compare our results with those obtained by Simpson and other researchers. In order to do this, we have focused on testing the following hypotheses:

- a) It may be possible that different disciplines would favor a different use of EpM and DeM by means of modal verbs;
- b) Due to the different epistemological grounding of medicine and biology texts (analytical and experimental) on the one hand, and literary criticism (more creative and subjective) on the other, we suggest that medicine and biology RAs will EpM, whereas literary criticism RAs might combine the use of both EpM and DeM;
- c) some modal verbs may be more epistemically or deontically oriented depending on the discipline.

Taking into consideration these initial hypotheses, we present a categorization of modalized and unmodalized statements in academic writing adapted from Hyland's (1996) categorization of scientific hedges.

2. Method of study

To test the applicability of these hypotheses, three distinct corpora have been analyzed. We have selected a corpus of medical RAs (C1), a corpus of RAs in biology (C2), and a third corpus of literary criticism RAs (C3). We have included medicine and biology because –even though both may be considered to fall within the umbrella category of health sciences– in our corpus in medicine, authors usually deal with people, whereas in our biology corpus this is not necessarily the case and, consequently, their results may offer some differences. We were interested in detecting whether this fact generated any differences in the use of modals. Corpus 1 (C1), containing 51,199 words, is made up of different RAs from top medical journals; Corpus 2 (C2), with a total of 50,335 words, contains biology RAs; and corpus 3 (C3), with 51,314 words, is composed of RAs in literary criticism. Table 1 illustrates the organization of the corpus.

Table 1. Organization of the three corpora.

	Corpus 1	Corpus 2	Corpus 3
Field	Medicine	Biology	Literary Criticism
Journals	<i>British Medical Journal</i> <i>Heart Lung</i> <i>Hypertension</i> <i>Journal of the American Medical Association</i> <i>Journal of Clinical Epidemiology</i>	<i>Behaviour</i> <i>BioEssays</i> <i>Biological Review</i> <i>FEBS Letters</i> <i>Journal of Chemical Technology and Biotechnology</i> <i>Journal of Structural Biology</i> <i>Systematic Biology</i>	<i>Early Modern Literary Studies</i> <i>Publications of the Modern Language Association</i> <i>Victorian Literature and Culture</i>
No. of words	51,199	50,335	51,314

All journals are relevant academic periodicals in each of the disciplines being studied; in these publications, it is assumed a homogeneous expert audience. In addition, we have only selected research articles and disregarded other contents in the form of other genres, such as editorials, book reviews, short research notes, systematic reviews and the like. The modals selected for this study, following Quirk et al. (1985) and Downing and Locke (1992), are: *can, could, dare, may, might, must, need, ought, shall, should, will, and would.*²

Using Scott's *WordSmith Tools* (1996), we listed and individually analyzed all the modal and semimodal verbs contained in the three corpora applying the theoretical distinction between EpM and DeM as outlined in section 1. In other words, we looked into each modal verb and considering its function in the sentence we classified it as deontic or epistemic. In all instances, the full context of the modal was taken into account to identify the function of the verb. Sometimes this involved considering a full paragraph or even a complete section in a paper. Each corpus was analyzed by one of the authors of this study. However, complex instances where the modal verb used was difficult to classify were discussed by the three authors together in the regular meetings held in the process of writing this paper.

We also used the χ^2 test through the statistics package *Epi Info 6* to assess the statistical significance of the data obtained, comparing the three sets of data distinguishing EpM and DeM.

3. Results

The results obtained are summarized in table 2 below, in which data from our three corpora are shown, along with the totals of EpM and DeM, respectively. We have found a total of 1,063 instances of modal verbs in the corpora, of which 939

(88.33%) were examples of EpM and 124 (11.67%) of DeM. The column frequency (f) indicates the total number of times that each modal appears in each one of the three corpora, while the next two columns indicate the percentage (%) of appearance of each modal verb according to its epistemic or deontic meaning in the three corpora.

Table 2. Epistemic (EpM) and Deontic Modality (DeM) Comparison in three Corpora (figures in bold type account for the most significant differences).

	C1-Medicine					C2-Biology					C3-Literary Criticism				
	Total modals	EpM		DeM		Total modals	EpM		DeM		Total modals	EpM		DeM	
		f	%	f	%		f	%	f	%		f	%	f	%
<i>can</i>	48	48	100	0	0	106	106	100	0	0	66	59	89.39	7	10.61
<i>could</i>	31	31	100	0	0	29	27	93.11	2	6.89	43	32	74.42	11	25.58
<i>dare</i>	0	0		0	0	0	0		0	0	0	0		0	0
<i>may</i>	144	144	100	0	0	124	123	99.19	1	0.81	50	39	78	11	22
<i>might</i>	21	21	100	0	0	30	30	100	0	0	34	26	76.47	8	23.53
<i>must</i>	2	1	50	1	50	10	5	50	5	50	19	9	47.37	10	52.63
<i>need</i>	5	5	100	0	0	4	4	100	0	0	7	3	42.86	4	57.14
<i>ought</i>	0	0		0	0	0	0		0	0	3	1	33.33	2	66.67
<i>shall</i>	0	0		0	0	0	0		0	0	7	5	71.43	2	28.57
<i>should</i>	18	9	50	9	50	37	17	45.95	20	54.05	28	13	46.43	15	53.57
<i>will</i>	6	6	100	0	0	37	37	100	0	0	44	38	86.36	6	13.64
<i>would</i>	30	30	100	0	0	24	22	91.67	2	8.33	56	48	85.71	8	14.29
Totals	305	295	96.72	10	3.28	401	371	92.52	30	7.48	357	273	76.47	84	23.53

Totals	EpM	295	371	273	939 (88,33%)
	DeM	10	30	84	124 (11,67%)
					1063

The initial count of the use of deontic modality (DeM) in C1 (medicine RAs) shows a minimum use of this type of modality, that is, only 3.28% in a total of 305 modal and semimodal verbs used. In fact, many of the modals and semimodals show 100% of epistemic usage. Such is the case of *can*, *could*, *may*, *might*, *will* and *would*, as the following examples from corpus 1 illustrate:

- [1] C1-EpM *Tricyclic antidepressants, however, can also have significant adverse effects, such as arrhythmias, postural hypotension, sedation, dry mouth, constipation, confusion, and urinary retention.*
- [2] C1-EpM *The quantities of the factors could limit the amount of renin mRNA that can be produced, even under conditions of normal salt loading and in the absence of pharmacological interventions.*
- [3] C1-EpM *These observations suggest that a local spiral artery renin-angiotensin system may play a role in pregnancy-induced remodeling of these vessels.*
- [4] C1-EpM *Since 80% of the protein-bound serum calcium, which represents half of the total serum calcium, is bound to serum albumin, some authors [5,6] have suggested that the observed effect of serum albumin on blood pressure might be actually due to serum calcium.*

- [5] C1-EpM *Approximately 10% to 15% of all people with herpes zoster develop PHN. The age distribution of its victims, however, includes a disproportionate number of the elderly; nearly half of older patients with herpes zoster will have enduring neuropathic pain.*
- [6] C1-EpM *Bradykinin is a potent stimulus for tPA secretion in ACE-pretreated bovine aorta endothelial cells, in animal models, and in humans. Thus, ACE inhibitors would be expected to favorably alter fibrinolytic balance by decreasing Ang II and increasing bradykinin.*

In corpus 2 (C2), with texts from biology, epistemic modality (EpM) is again the major type of modality (92.52%). There is here, however, a significant increase in the use of deontic expressions (7.48%). In particular, the case of the modal *must* may draw readers' attention. This modal is used both as an epistemic and a deontic modalizing device especially in corpora 2 and 3 (see table 2). The following examples illustrate the fact that *must* has two modal meanings:

- [7] C2-EpM *Thus, some other factor must be important in determining the behavior of these snails.*
- [8] C2-DeM *The lesson that the Equidae pose in socio-ecology is that studies of variation in social and spatial organization must be more judicious in their use of comparative field observations.*
- [9] C3-EpM *He therefore bases his reasoning on what appears a fairly sensible notion: that from the records of prosecutions for publishing obscene books one must presume the existence of a trade in obscene literature.³*
- [10] C3-DeM *But my readers must not therefore suppose that I intended to discourage the collection of really good specimens of art manufacture.*

The data obtained in the analysis of literary criticism texts (corpus 3) show statistically significant differences. Here almost one out of four modals conveys deontic meaning. In this respect, it is also interesting to note that of the seven verbs (*can, could, may, might, need, will* and *would*) which only convey epistemic modalizing meaning in C1 (medicine), and four (*can, might, need, will*) in C2 (biology), none has remained in such a permanent usage in C3 (literary criticism). On the contrary, in literary criticism (C3) several instances of deontic modalization (23.53%) are to be found with several of these verbs, as in the case of *could, may, might, need, will* or *would*, as illustrated in the following examples:

- [11] C3-DeM *Any publication judged by British legal authorities after 1727 to be obscene and to display a tendency to corrupt the morals of the general population could be suppressed and prosecuted for obscene libel.*
- [12] C3-DeM *If Credit represents the historically progressive power of aesthetic imagination, we might say that the tyrant embodies a kind of pernicious, historically backward anesthesia.*

- [13] C3-DeM *Feminists, in particular, have often been at the vanguard of personal criticism, arguing that traditional forms of academic language need to be replaced by a more personal voice.*
- [14] C3-DeM *I would like to suggest that a different picture arises when the same generic and historical questions are considered from the point of view of cultural reception and legal history.*⁴

Consequently, there seems to be a progressive increase in the use of deontic modality as we move from C1 (medicine) to C2 (biology), and especially when we move from C2 to C3 (literary criticism). This is particularly shown in the totals for each category of modality used, whose differences are statistically significant ($p < 0.05$). In fact, statistically, C3 seems to function differently from C1 and C2. Tables 3a and 3b show marked statistically significant differences in the overall use of EpM and DeM when, on the one hand, the medicine and literary criticism corpora are compared ($p = 0.000$) or when, on the other, the biology and literary criticism corpora are compared ($p = 0.000$).

Table 3a. EpM and DeM totals in C1 and C3.

C1-Medicine			C3-Literary Criticism				
Total	EpM	DeM	Total	EpM	DeM		
modals	f	f	modals	f	f	χ^2	p
305	295	10	357	273	84	55.36	0.000

χ^2 representative if $p < 0.05$

Table 3b. EpM and DeM totals in C2 and C3.

C2-Biology			C3-Literary Criticism				
Total	EpM	DeM	Total	EpM	DeM		
modals	f	f	modals	f	f	χ^2	p
401	371	30	357	273	84	38.07	0.000

χ^2 representative if $p < 0.05$

Table 3c. EpM and DeM totals in C1 and C2.

C1-Medicine			C2-Biology				
Total	EpM	DeM	Total	EpM	DeM		
modals	f	f	modals	f	f	χ^2	p
305	295	10	401	371	30	5.72	0.017

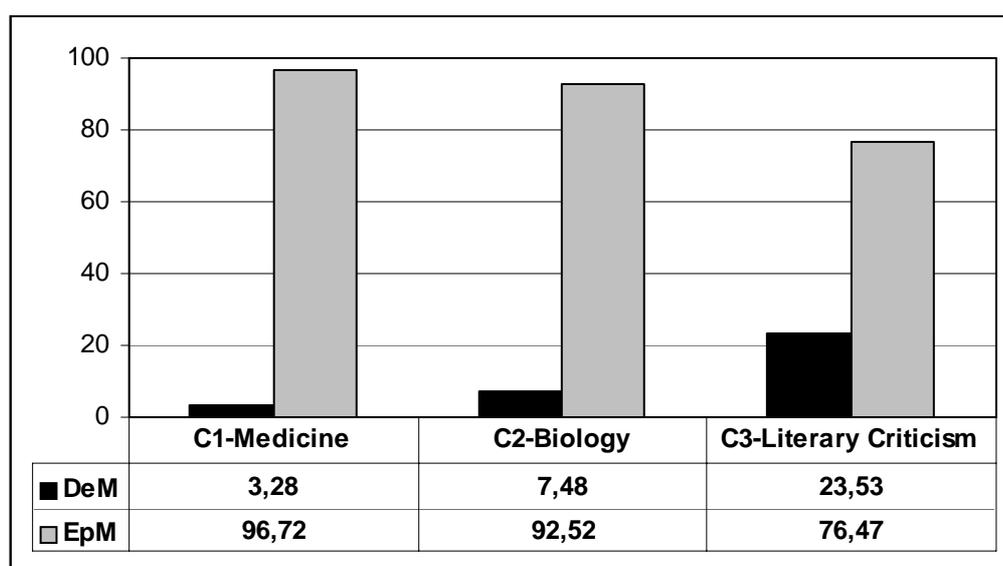
χ^2 representative if $p < 0.05$

However, as can be seen in table 3c, although the comparison between medicine (C1) and biology (C2) also appears statistically significant ($p < 0.05$), the raw figures (table 1) suggest that only a moderate use is made of DeM, thus showing that it may be feasible to consider medicine and biology as highly similar epistemologically speaking, at least in the realization of epistemic/deontic modality

($p = 0.017$). If so, literary criticism would appear as a distinct discipline in the use of modality, thus reinforcing the possibility that epistemology and communicative purposes of literary RAs may be somehow substantially different from RAs in biology and medicine RAs.

Figure 1 below graphically summarizes the results reported in table 2, illustrating this progressive increase in the use of DeM and corresponding decrease in EpM.

Figure 1. Epistemic (EpM) vs Deontic Modality (DeM) in the Three Corpora (in %).



4. Discussion

It therefore seems that our initial hypothesis (a) –that different disciplines favor different types of modality– is only partially confirmed. It is fully confirmed in the case of a comparison between medicine (C1) and literary criticism (C3) RAs, but not in relation to comparing medicine (C1) and biology (C2).

Focussing on the opposition between medicine and literary criticism, it should be noted that we are dealing with the same genre and a similar corpus in terms of size (as measured by number of words); but in the case of medicine RAs, EpM is the most frequent choice, whereas in the case of literary criticism RAs both choices are acceptable depending on the context. It seems that literary critics may resort to either epistemic assertions or deontic statements depending on their communicative purpose. This fact opens a whole new area of linguistic and sociolinguistic research: Does the communicative purpose of RAs in literary criticism differ from the communicative purpose of RAs in medicine and/or biology? This may very well be the case due to the different epistemology underlying each discipline.

Dudley-Evans (2000: 8) suggests, quoting Rizomilioti’s current research in this area (work in progress), that literary critics use fewer epistemic modals – downtoners, in their terminology– than, for instance, biologists and archeologists.

Our data also confirm this tendency of using fewer epistemic modals and semimodals in literary criticism—not just in relation to the overall usage as shown in percentages (see figure 1), but also if we look into the absolute numbers. Medical researchers used 295 epistemic modals, biologists 371, and literary critics only 273 (see table 2).

As we have mentioned above, Simpson (1990: 88) reported the tendency of literary critics to be highly assertive in their statements. In fact, he described many instances of unmodalized assertions in the text he studied –*The Great Tradition*, by F. R. Leavis. Simpson quotes Leavis' (1950: 1) famous opening statement as a typical example of unmodalized assertion:

- [15] Leavis: *The great English novelists are Jane Austen, George Eliot, Henry James and Joseph Conrad—to stop for the moment at that comparatively safe point in history.*

Leavis might have resorted to a more modalized statement and have said “The great English novelists *may* be...” or “*could* be”, or any other similar epistemic statement. Probably, feeling the enormous intensity of his opening assertion, he himself tries to mitigate his own statement by adding the dashed non-finite clause “–to stop for the moment at a comparatively safe point in history”. But the addition of this clause limits his unmodalized statement only after Conrad's time, but not before –so it is only a *partial* hedge.

It is true, however, that Leavis, as a well-reputed literary critic, could allow himself to be especially assertive and thus resort to a frequent use of deontic statements. In that respect, Simpson's study –valuable as it is– shows its limitations, since it does not look into other literary critics' work, especially into other literary critics who may not afford to be so bold in their comments. But the issue here is whether such strong deontic statements –as example [15]– would be acceptable in a different academic setting. The answer seems to be that they would *not* be acceptable. Our data have illustrated how modals, in the case of medical RAs and to a certain point also in the case of biology texts, are systematically epistemic, that is, used in order to question the certainty or probability of the statements where they appear or to express possibility.⁵ But in literary criticism, modals, when used, are not only applied to question the certainty or probability of a statement or to express possibility (i.e., epistemically). They are also used, in a substantial number of instances (e.g., *must*, *could*, *might*, *need*, and *would*, in examples [10] to [14]), to impose the author's specific point of view. Similarly, Simpson highlights some instances where Leavis (1950: 2, 12) also makes a deontic use of a modal as in the following sentences:

- [16] DeM-Leavis: (...) *Jane Austen* (...), needs to be studied at considerable length ...
- [17] DeM-Leavis: '*Portrait of a Lady*' is one of the classics of the language and we can't simply regret the conditions that produced something so finely inspired.

Simpson's study, as we noted above, has the shortcoming of having analyzed only one text and, accordingly, the writing of only one literary critic, and of not providing specific quantitative data. However, he signaled the relevance of considering the deontic usage of modals in literary criticism. Our analysis of the writing of several different literary critics confirms that literary criticism uses fewer epistemic modals than other academic disciplines. It also confirms that, in turn, when literary critics do use modals they may do so in either epistemic or deontic assertions. This allows us to suggest that the combination of DeM and EpM is a representative feature of, at least, research articles in literary criticism.

Our results also suggest that some modal verbs tend to be more systematically used as either epistemic or deontic modalizing devices, such as the case with *can*, *could*, *may*, *might* or *will*, which are mostly epistemic, or the examples of *must*, *need* or *should* which in some corpora are mostly deontic. This would confirm hypothesis (c), that is, that some modals and semimodals may be more deontic or epistemic oriented depending on the discipline.

In our opinion, the epistemological opposition between biology and medicine on one hand, and literary criticism on the other, is due to the fact that while medicine and biology focus on describing scientific research, literary criticism aims at persuading their readership by means of rhetorical devices. This statement may be an oversimplification because the situation is more complex. To be more precise, let us revise a set of longer examples. These extracts illustrate the way EpM and DeM are put to work in each discipline for different purposes.

Examples [18] to [25] below show how literary critics, as we have just mentioned, aim at persuasion. It could very well be argued that that is precisely the objective (primary or secondary, depending on the discourse community) of any RA in any discipline. The difference is then not so much in the objective itself but in the way each discourse community attempts to persuade their distinct readerships. Scientists in medicine and biology –and most likely in most experimental disciplines– strive to do so by means of accruing a significant amount of data (see examples from medicine and biology below). Literary critics, however, rely on combining both “data”—in the form of biographical writers' data or examples from the texts analysed—with *deontic* persuasion. This combination in turn generates the necessary mixture of epistemic and deontic modality usage. This is what examples [18] to [25] show.

LITERARY CRITICISM	
[18] DeM	<p>Addressing the question "What is pornography?" in a recent essay, Randolph Trumbach begins with the following caveat: "it <u>must</u> be made clear that, in eighteenth-century England, there was not much of what the twentieth-century viewer or reader <u>would</u> recognize as hard-core pornography.</p> <p>(...)</p> <p>I <u>would</u> like to suggest that a different picture arises when the same generic and historical questions are considered from the point of view of cultural reception and legal history. A lack of eighteenth-century texts in English that we today <u>would</u> recognize as pornography does not mean that the notion of pornography, especially in Kendrick's embattled sense, is irrelevant to describing works caught in legal and social conflicts in Britain in the eighteenth century. We only <u>need</u> shift from considering pornography as a set of writerly conventions and practices to viewing it as a specific cultural status producing specific social and legal conflicts. One difficulty here is the problem of historicizing obscenity in its legal discursive sense; another is how to imagine the existence of a generic effect in an age seemingly bereft of clear, recognizable generic causes. Put in another way, while we <u>may</u> lament the dearth of recognizably pornographic productions in the eighteenth century—those texts that Trumbach or any "twentieth-century viewer or reader <u>would</u> recognize"—we <u>should</u> not ignore a contrasting predilection for pornographic receptions, particularly in a century that prosecuted other kinds of books in ways that we usually associate with the prosecution of pornography.</p>
[19] EpM	
[20] DeM	
[21] EpM	
[22] DeM	
[23] EpM	
[24] EpM	
[25] DeM	

Here, the literary critic, while discussing the subject of the historical appearance and evolution of pornography in literary works, does resort to the combined use of EpM and DeM. The extract contains eight modals –underlined in the example. One of these is a quote, but this quote is part of another RA in literary criticism and not from a literary piece, and thus it is also representative of literary criticism discourse. Of all these modals, *would* (three times) and *may*⁶ are epistemic, while another instance of *would*, plus *need* and *should* are deontic. The *must* in the quotation is also deontic. All these deontic modals are used to convey the literary critics' strong opinions on the matter under discussion in such clauses as *it must be made clear*, *I would like to suggest*, *we only need shift* or *we should not ignore*. Complementarily, these deontic forms represent a device to discretely address readers in a subtle strategy to make them co-participants of the authors' opinions. Interestingly, the epistemic modals are also embedded in direct appeals to the readership in such clauses as *the reader would recognize*, *we today would recognize* or *we may lament*; but here the modality is restricted to express possibility on the basis of what has already been explained. The distinctive element, however, of literary criticism is the fact that it is acceptable in this discipline to address the reader both deontically and epistemically, whereas medical researchers or biologists are expected to reduce DeM to a minimum. In other words, it is epistemologically acceptable in literary criticism to combine deontic and epistemic expressions, while the use of DeM is highly questionable in medicine or biology.

Next, examples [26] to [29] and [30] to [34] below are good instances of distinctive different use of modals and semimodals in medicine and biology, respectively, as opposed to the way these forms are used in literary criticism. In examples [26] to [28], *may* (in three instances) and *would* (once), example [29], are used to account for a set of possible implications suggested by the detailed results which have just been described. The authors are trying to convince the readership, as in literary criticism, but here the argument is built on a substantial amount of data from which presuppositions are epistemically drawn. That *may* appears so frequently is consistent with our data where this form is, by far, the most frequently used modal in medicine.

MEDICINE	
[26] EpM	<i>The mechanisms through which activation of the RAS increases or ACE inhibition reduces the risk of ischemic cardiovascular events in selected populations are not known. One possible explanation involves an interaction between the RAS and fibrinolytic system. Accumulating data suggest that angiotensin II (Ang II) modulates fibrinolysis. For example, Ang II and its hexapeptide metabolite Ang IV stimulate plasminogen activator inhibitor-1 (PAI-I) expression in cultured endothelial cells in a dose-dependent manner. Infusion of exogenous Ang II has been shown to increase PAI-I antigen selectively in both normotensive and hypertensive subjects. These findings <u>may</u></i>
[27] EpM	<i>be of clinical significance because PAI-I is the major inhibitor of tissue plasminogen activator (tPA) in vivo. Increased PAI-I expression has been observed in atherosclerotic plaques in humans and <u>may</u> contribute to the progression of vascular disease. Elevated PAI-I levels are observed in insulin-resistant states and appear to be a risk factor for recurrent MI.</i>
[28] EpM	<i>ACE inhibitors not only block the formation of Ang II but also prevent the degradation of bradykinin. We have previously proposed that the prothrombotic effects of Ang II <u>may</u> be balanced by the antithrombotic effects of bradykinin. Bradykinin is a potent stimulus for tPA secretion in ACE-pretreated bovine aorta endothelial cells, in animal models, and in humans. Thus, ACE inhibitors <u>would</u> be expected to favorably alter fibrinolytic balance by decreasing Ang II and increasing bradykinin.</i>

In examples [30] to [34] below, EpM again remains as the only type of modality applied by the authors of the RA. In this case, the biologists are describing an automated system for information extraction in molecular biology and its possible applications and, as in the case of medicine, DeM is not applied. Biologists below systematically resort to the use of an epistemic *can* (five instances) –the second most frequent modal in biology (see table 2). The text results in the description of a set of possible applications of the system.

BIOLOGY	
[30] EpM	<p><i>Information retrieval (IR) techniques are used to select documents that are relevant according to a user's needs. Information extraction (IE) techniques are used to extract relevant information from text according to pre-specified templates (e.g., for a terrorist action, extract place, date, victim and outcome). They do not need an understanding of the text under analysis, which is approached by natural language processing (NLP), but they <u>can</u> benefit from it.</i></p> <p><i>NLP <u>can</u> be applied at the level of words out of context (for lexical matching and morphological analysis or stemming) or at the level of sentences (for syntactic parsing, namely, analyzing a sentence to determine its structure, usually in order to identify noun sentences and their components).</i></p> <p><i>Understanding a text <u>can</u> ultimately be possible only if the system <u>can</u> refer to an ontology (or controlled vocabulary), i.e. the association of words to meanings, maybe including hierarchical relations between them. They <u>can</u> be general (e.g., WordNet from the Cognitive Science Laboratory, Princeton University) or specific to a domain of knowledge, e.g., to medicine as the unified medical language system or to eukaryotic genes as in gene ontology.</i></p>
[31] EpM	
[32] EpM	
[33] EpM	
[34] EpM	

5. Conclusion

We believe that the use of modals is highly representative of the type of modality which a certain discourse community may prefer in a specific professional or academic setting. We also think that the selection of one specific type of modality (i.e., EpM or DeM) is a matter of deliberate stylistic choice of scientists and researchers influenced by the pragmatic contexts of their respective specific academic/professional discourse communities.

Our results suggest that literary critics favor a combined use of DeM and EpM, whereas medical researchers or biologists restrict the use of deontic expressions and favor the use of epistemic modalizing devices. The objectives of RAs in the three disciplines may be similar –to describe research and persuade the readership–, but the means to attain such goals seem to be epistemologically different.

Complementarily it may also be relevant to extend this study to account for the use of the epistemic/deontic dichotomy realization in other academic disciplines; or to check if the epistemic/deontic usage of modals varies depending on the section of the RA (i.e., across introductions, methods, results or discussions). These remain as open areas of research that demand further linguistic inquiry.

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NOTES

1. It should be noted that modality is a complex linguistic phenomenon and it cannot be reduced to the use –or non-use– of modal and semimodal verbs. Modality may be generated by means of a large variety of linguistic devices. For instance, lexical verbs, lexico-modal auxiliaries, modal disjuncts, modal adjectives used in impersonal sentences and modal nouns, *if-clauses*, or the remote past can also be used to create modality.
2. In this list we have included the semimodals *dare* and *need* since these two verbs in many ways function as proper modals. They are however considered as marginal modals by Quirk et al. (1985) or as semimodals by Downing & Locke (1992) because there are also homomorphic verb forms for *dare* and *need* which operate as lexical verbs.
3. We believe that *must*, in this example, conveys epistemic meaning, since it expresses a possible inference that may be drawn from what is being said. In fact, we understand that *must*, in this case, could be replaced by *may*.
4. The deontic meaning of *would* in this example may be questioned. It is our belief that *would*, in this context, is deontic; however, it may be considered that the expression *like to* is the deontic word group, whereas *would* may in fact be functioning as an epistemic hedge. We have, however, resorted to the first interpretation.
5. Engineering texts also seem to limit the number of epistemic modals. For instance, we have found that in a similar corpus of about 50,000 words of engineering RAs 89.45% of all modals and semimodals were epistemic for only 10.55% of deontic instances.
6. It must be noted that the modality of *may* in this specific statement is open to interpretation. We have considered it as epistemic, taking into account that it is expressing possibility, although should we interpret that the author is somehow imposing what may be considered as his personal point of view on the reader the modal could then be thought of as deontic.

ABSTRACT

Epistemic and Deontic Modality: A Linguistic Indicator of Disciplinary Variation in Academic English

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We present a pragmatic analytical framework to explore the reasons underlying the differences in the use of modal verbs in English research articles (RAs) in three different academic disciplines: medicine, biology and literary criticism. Sentences may be either modalized or unmodalized. The use of modalized statements is a key feature of academic writing, and this expression of modalization has been widely researched. However, most of this investigation has not considered the linguistic distinction of types of modalization: epistemic modality (questioning the certainty or probability of a statement) and deontic modality (laying obligations or giving permission to the reader/audience). This linguistic dichotomy may be an important tool to describe disciplinary variations in academic writing. It is hypothesized that different disciplines favor different types of modality. Results in this study indicate that scientific RAs (i.e., in medicine and biology) mostly use epistemic modality, whereas literary criticism RAs combine the use of both epistemic and deontic modality. It is our contention that the selection of one specific type of modality (i.e., epistemic or deontic) is a matter of a deliberate stylistic choice of writers influenced by the pragmatic context of their specific and distinct academic discourse communities.
