



“We could scarce distinguish one
from another”

Towards a phraseological
perspective on modal auxiliaries in
three categories of Late Modern
English medical writing

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The present study investigates the patterns of use of modal auxiliaries in three categories of medical writing in the eighteenth century. The data is drawn from the corpus of Late Modern English Medical Texts (LMEMT), and it is approached through phraseological register analysis. The study focuses on the distribution of modal auxiliaries in medical texts, per main verb, in active constructions, and on the division of auxiliaries between epistemic and root modalities (deontic and dynamic) in recipe texts, surgical texts, and medical periodicals. The study looks into certainty of knowledge and the normativity of medical writing as reflected in the use of modal auxiliaries. It is assumed that the three medical text categories attest to differing patterns of use of modal auxiliaries and that the variation is indicative of the communicative purpose of each category.

Keywords: modality, auxiliaries, medical writing, Late Modern English, phraseology, register analysis

1. Introduction

Modality is an inherent element in all scientific discourse, be it spoken or written. Among other things, different types of modality employed in text inform the audience of the author's level of certainty on the knowledge they disseminate, and of the levels of normativity in the discipline at hand in general. Different linguistic means are used to modify the information, answering questions such as, "What is true?", "What is plausible?" (epistemic modality), "What is necessary?", "What is permissible?" (root / deontic modality), and "What is possible or customary?", "What is the intention?" (root / dynamic modality) (Palmer 1990: 5–8; Coates 1995: 55; Marin-Arrese 2009: 30, 34).

Modality is often marked grammatically through the use of modal auxiliaries, and many studies on scientific and medical discourse have accordingly focused on them (e.g. Vihla 1999; Taavitsainen 2001). However, as far as historical medical writing is concerned, beyond studies investigating epistemic space in certain medical genres (Whitt 2023), modality in medical texts from Late Modern English (LModE) has received surprisingly little attention. In addition, we also argue that previous research focusing on this register has not sufficiently considered the contributions from phraseological and constructionist approaches, which posit that language users do not necessarily depart from the meaning of individual modal verbs when constructing their utterances, but rather make choices to use strings consisting of modal verbs *and* other linguistic material, which have precise and predictable interpretations that suit their communicative purposes (e.g. Sinclair 2004; Cappelle and Depraetere 2016).¹ The present study aims to take the first steps to address these issues in the context of 18th-century medical writing, using the corpus of *Late Modern English Medical Texts* (LME_{MT}) as the data. The perspective adopted here is thus an amalgam of phraseological research and register analysis: our main research question is: *How does the use of modal auxiliaries,*

1 We concur with McEnery and Hardie (2012: 210–11) in seeing “neo-Firthian” corpus linguistics and Construction Grammar as convergent approaches and treat them as compatible in the context of the present study, despite their differences.

in particular as regards phraseological patterning, reflect the purposes of writing of each sub-register of Late Modern English medical writing?

To achieve this, we will study the distribution of modal auxiliaries in medical texts, per main verb, in active constructions, and the division of auxiliaries between epistemic and root modalities in three LModE sub-registers, i.e. *Recipe Collections*, *Surgical texts*, and *Scientific periodicals* (on these categories, see further Taavitsainen & Hiltunen 2019: 279, 299, 317). Our focus lies on how the certainty of knowledge and norms are expressed in the medical sub-registers through the use of modal auxiliaries. We expect to find differing usage patterns of modals, and we believe that the observed variation correlates with the communicative purposes of the sub-registers.

The phraseological analysis is centred on the colligation between modal auxiliaries and lexical verbs, and the analytical measures employed are *ATTRACTION* and *RELIANCE* (Schmid 2000), which have been successfully used in the study of scientific genres in earlier work (e.g. Hiltunen 2021). Along with shedding light on the usage patterns characteristic of individual sub-registers, our chosen approach highlights a more general point in the study of modality: due to the polysemous nature of modals, the scrutiny of their immediate textual context is crucial to determining their meaning in use, which is the sum of the phraseological configuration in its entirety, including (but not limited to) the modal verb and the verb it modifies (cf. Coates 1995: 56; Dehouck & Denis 2023). The second important aim of the article is to test the applicability of our methodology in the study of modality, hence the exploratory nature of the study. This study will motivate the phraseological approach adopted and show its uses in the study of modal auxiliaries and modality in general.

2. Literature review

2.1 Modality in historical / modern medical and scientific writing

Modality is a well-researched phenomenon, and there are several relevant studies that converge with the present study. Vihla (1999), a corpus study of present-day medical writing, is possibly the closest match to our choice of approach, and Whitt (2023) uses data from LMEMT as we do. Studies on earlier or later phases of medical writing that focus on modality (even if not

always on modal auxiliaries) include Whitt (2016a) (evidentiality in EModE medicine), Alonso-Almeida and Álvarez-Gil (2020) (modals in EmodE medical recipes), Alonso-Almeida (2015a) (modality and evidentiality in modern medical research papers), Alonso-Almeida (2015b) (epistemic modality and evidentiality in Early Modern English and Spanish medical writing), Kopaczyk (2013) (formulaic discourse in EModE medicine), Hiltunen and Tyrkkö (2011) (discursive practices in EModE medicine); Gray, Biber, and Hiltunen (2011) (stance expressions in EModE medicine), and Mäkinen (2022) (persuasive means in EModE medical recipes). Other studies on historical scientific registers outside the medical field that have informed the present study are Álvarez-Gil and García Alonso (2019) (*I think* in LModE scientific texts), Crespo-García (2011) (markers of persuasion in 18th century philosophical texts), and Whitt (2016b) (evidentiality and epistemology in EModE scientific discourse). Even if we draw on the same or similar pools of data or share the principles of semantic-pragmatic analysis of modals with many of the cited studies, our approach departs from them by letting the data-driven quantitative phraseological analysis inform our selection of items for qualitative analysis.

2.2 Modality and modal auxiliaries

Modality provides the means through which one can either assert or deny the possibility of utterances, or the permissibility and necessity of actions (Palmer 1990: 6). Modality in language can be expressed through many grammatical and lexical categories, e.g. adverbs, adjectives, full verbs, and modal auxiliary verbs. In this study, we focus on one facet of modality, modal auxiliaries, and we acknowledge that a quantitative approach alone will not fully capture the complexity of the phenomenon studied.

In the identification of modal auxiliaries, we lean on the formal criteria of the ‘NICE’ list of verb properties (Huddleston 1976: 333): modal auxiliaries 1) can be inverted with the subject, 2) can form a negative form with *-n’t*, 3) can retrieve the meaning of a preceding lexical verb in an elliptical expression (‘code’), and 4) can be used emphatically (Palmer 1990: 3–4). Any adjustments to the set of modals identified with the ‘NICE’ criteria will be discussed later in section 3.2.

As modality is a highly complex phenomenon, and therefore also widely studied, it is natural that the attempts to describe modality have created

several, somewhat differing terminological domains, each expressing their theoretical underpinnings.² The current study adopts the general division of modality into epistemic and non-epistemic (root) modalities (there is a general agreement of this division, cf. Palmer 1990: 5–8; Sweetser 1990: 50–51; Coates 1995: 55–56; Warchał 2015: 74), and acknowledges deontic and dynamic modalities as the sub-categories of the latter. In the analysis of modals in medical registers, we occasionally resort to more fine-grained terminology, but overall, our aim is to describe the differences in modalities between the registers by allocating the modal auxiliary + main verb pairs to the three main classes of modality.

To define the different modalities we work with, EPISTEMIC MODALITY expresses how the speaker judges the truth-value of a claim or a proposition in terms of necessity, probability, or possibility (Palmer 1990: 2, 7; Sweetser 1990: 49). DEONTIC MODALITY refers to the necessity or obligation of future actions expressed by the speaker or author (Hoye 1997: 43). Finally, DYNAMIC MODALITY is related to the ability or potential of a person or a thing, and as such does not necessarily require attitude-expressing subjectivity from the speaker (Palmer 1990: 7, 10).

2.3 From frequency counts to phraseology

As was already noted, the present study sets out from the position that speakers create meanings not word by word, but in multi-word phrases: linguistic items sharing the same cotext are interdependent upon one another (Sinclair 2008: 409). In the context of modality this means that modality-expressing categories interact with the cotext: the sense of the modified proposition cannot, therefore, be derived from the mere presence or absence of a modality-expressing item. Rather, the modified sense is the sum total of all the linguistic categories of the proposition in interaction (Depraetere, Cappelle, & Hilpert 2023: 4–5). As the interaction of linguistic categories defines the sense of a modal expression, a natural conclusion is that modals are inherently polysemous: they can lend themselves to creating both epistemic and root senses. This versatility of modals also allows for effective and flexible ways of meaning making. Our data-driven approach focusing on identifying (on

2 For a lucid review of different theories of modality, see Warchał (2015: 71–92).

formal grounds) modal auxiliaries and the main verbs modified by them is designed to free us from pre-conceptions sometimes attached to modals.³ The method allows us to observe the linguistic performance without interfering layers of interpretation.

3. Data and methods

3.1 Corpus

The data for this study comes from the *Late Modern English Medical Writing* corpus (LMEWT, Taavitsainen *et al.*, 2019), a representative corpus covering all the major registers in printed medical texts 1700–1800, which was POS-tagged for this study using CLAWS5 (C7 tagset). The corpus is divided into seven text categories, which represent different kinds of medical writing based on such factors as purpose and tradition of writing (see Taavitsainen & Hiltunen (2019) for more information on these categories). Of these, we chose three categories for analysis in this study: *Recipe collections* (REC), *Surgical and anatomical texts* (SUR), and *Scientific periodicals* (SC-PER). These categories were chosen as they represent maximally different types of writing:

- *Recipe collections* focus on the preparation and administration of remedies.
- *Surgical and anatomical texts* provide instructions on how to perform surgical operations.
- *Scientific periodicals*, which encompass two publications: *Philosophical Transactions of the Royal Society* (PT) and *Edinburgh Medical Journal*,

3 For example, even if the modal auxiliary *can* is most often associated with dynamic modality, it is also found in phrases that mitigate the asserted characteristics or ability (Carrió Pastor 2012: 123), as in *The weather in June can be nice*. The proposition can be paraphrased as (*In my experience,*) *on some days in June, the weather is nice*. The surface level of the proposition states the characteristics of weather in June; however, as the paraphrase involving a subjective element is possible, *can* may also introduce a sense of epistemic modality in the proposition, based on the speaker's prior knowledge.

represent the early stages in the history of the empirical research report.⁴

Given these differences and their concomitant effects at the textual level, which have been well-documented in earlier research, it is thus reasonable to expect that insofar as they give rise to differences in the use of modals (as predicted by our hypothesis), a corpus-based exploration will provide us data with which these can be described in detail.

3.2 Method of analysis

We begin the study with an exploratory approach assessing the frequencies of individual modal auxiliaries across the three categories of writing, following the approach used in several previous studies (e.g. Vihla 1999; Millar 2009; Leech 2014). This approach essentially consists of determining the frequencies of individual modal auxiliaries and comparing them across corpora, either synchronically (Vihla) or diachronically (Leech, Millar). As our primary focus is on sub-register differences, we do not consider possible diachronic change in the current study but adopt a synchronic perspective, treating the 18th century as a temporally undivided whole.

A limitation of this approach is that it does not take full account of the functions of clauses where modals occur, and hence the sense coefficient of the auxiliary and verb is lost. As an illustration of this, in (1) and (2) we see the modal auxiliary *must* used in an epistemic and dynamic clause, respectively. These senses can only be distinguished after analysing the clause in which the phrase SUBJECT + AUXILIARY VERB + VERB is embedded.

- 1 By a further Disquisition into this matter, we find that **the Doses must not only be** greater where the thickness of Blood is greater;

4 Note that *General periodicals* were not included in the analysis due to their communicative purpose that differs from that of *Scientific periodicals*. The category *General periodicals* in LMEMT, which encompasses articles from *The Gentleman's Magazine*, aims to represent how health matters were communicated to the general public, and was compiled following a different procedure (see Taavitsainen & Hiltunen 2019).

but that they must be encreas'd [...] (REC, Cockburn, *The Practice of Purging and Vomiting Medicines*, 1705)

- 2 **You must put** two ounces of White Sugar-candy into each Bottle, and let the Water drop on it; [...] (REC, Kettilby, *A Collection of Receipts in Cookery Physick and Surgery*, 1714)

In (1), *must* refers to the explanation (*disquisition*), making the sense expressed a logical conclusion of it. In other words, it is a clear example of epistemic necessity.⁵ In (2), the same auxiliary conveys neutral or facultative obligation which makes the example a case of deontic modality, almost like prescription (Silk 2022: 204), again something that is made apparent only by the study of the cotext.⁶ This being the case, quantitative analysis based on raw frequencies is problematic for two reasons, which are related to each other: first, the counts of individual wordforms may be altogether misleading, as they conflate different senses and different types of modality, as is evident in the case of *must*. Relatedly, they also fail to highlight what the characteristic uses of modals are in different textual contexts, yet it is precisely this type of information that would be relevant for describing how the use of modals is influenced by the conventions of registers and (sub-)registers.

For this reason, along with simple frequency analysis, the present study also looks into the phraseological patterning of modals.⁷ The reasons for preferring a phraseological approach can be derived from a commonly agreed-on premise underlying much of previous work in phraseology and

5 Lyons (1977: 792) and Palmer (1990: 7) note that in natural language use epistemic modality is always to some extent subjective, and hence any logical conclusion is based on inference by the speaker: the emphasis is more on the plausibility than the verifiability of the proposition. Therefore, even if (1) belongs strictly speaking to alethic modalities – logically, the proposition is necessarily true (see Wright 1951; Palmer 1990: 6) – in literature on modality it is customary to discuss epistemic necessity in cases like this.

6 Regarding (2), one could also argue that it is "common sense" necessity that makes it a case of deontic modality (Álvarez-Gil & García Alonso 2019: 47). The ambiguity in modals illustrated by (1) and (2) can be solved through the study of the cotext; the pragmatics of aux + main verb phrases imply the sense potential of modal auxiliaries and motivates the study of modals in interaction with their cotext (Sweetser 1990: 49; Leclercq 2023: 60).

7 The analysis thus incorporates both 'text-linguistic' and 'variationist' perspectives, using the terms introduced in Biber (2012).

corpus linguistics: rather than selecting words individually, language users want to express complete meanings and choose the words to match those intended meanings (e.g. Sinclair 2004). It follows that to understand the specific modal meaning of an utterance, it is often necessary to analyse it in its entirety, rather than just the specific modal auxiliary (or another item expressing modality). This idea has been recently restated in the framework of Construction Grammar by Depraetere, Cappelle, and Hilpert (2023: 4–5): the study of modals should be extended to the adjacent lexical items and syntactic categories, combining the consideration of semantics with pragmatics.

An obvious challenge with this approach is that it is much more difficult to automate the analysis of complete utterances than count individual words.⁸ Indeed, qualitative close reading might be the only way to ensure the correctness of such an analysis. For this reason, we opt for an approach that employs a semi-automatic method to look at phraseological features in the co-text of modal auxiliaries, focusing mainly on the **verb** with which the modal occurs. This analysis is complemented with a qualitative appraisal of the **subject** of the clause within which the modal verb is embedded. While these features are clearly not the only ones that have the potential to contribute to meaning, we argue that they are central in terms of clausal meaning and its relationship with modality, as they typically indicate what action was performed (verb), and by whom (subject). The influence of other possible factors (e.g. the object of transitive verbs) was left for further study.

We retrieved all the instances of modal auxiliaries from the three categories of *LMEMT* described above (using the tag **VM**). This query matched the following twelve wordforms:

- | | | |
|-----------------|-----------------|-------------------|
| 1. <i>can</i> | 5. <i>might</i> | 9. <i>shall</i> |
| 2. <i>could</i> | 6. <i>must</i> | 10. <i>should</i> |
| 3. <i>dare</i> | 7. <i>need</i> | 11. <i>will</i> |
| 4. <i>may</i> | 8. <i>ought</i> | 12. <i>would</i> |

8 We would argue that this statement still applies to most corpus linguistic research scenarios, despite major advances that have recently taken place in natural language understanding, in particular after the introduction of large language models (LLMs) (cf. Yu *et al.*, 2024).

Of these, *dare* and *need* were highly infrequent and were excluded from further attention, as was the semi-modal *ought to*. On the auxiliary *will*, earlier literature is somewhat divided: it is formally a modal auxiliary but expresses modality only to some extent. This argument is often supported by the modal's participation in periphrastic future constructions, such as *It will rain tomorrow*, or the association of the modal with “high probability” and hence with “less-than-factual” situations (see the discussion in Depraetere and Cappelle 2023: 16–19). Nevertheless, the formal features and the ‘NICE’ criteria (see Section 2.2 above) define *will* as a modal auxiliary (Palmer 1990: 160), justifying its inclusion in the analysis.

After removing false positives from the dataset (caused by tagging errors), we manually identified for each line in the concordance the lexical verb with which the auxiliary is associated, as well as the subject of the clause where the VP is found. With verbs, it should be emphasised that we do not attempt to provide a comprehensive appraisal of the lexicogrammatical preferences of modals. Rather, our aim in this part of the analysis is a more exploratory one: we intend to identify MODAL AUXILIARY + VERB pairings that (1) stand out in terms of frequencies of use, and (2) are relevant to describing discourse meanings in that they can be linked to specific functions characteristic of early medical writing.

To investigate the co-occurrence tendencies between specific auxiliaries and lexical verbs across the registers in focus, we determined two metrics related to the modals and the verbs that accompany them: *attraction* and *reliance* (Schmid 2000; Hiltunen 2021). *ATTRACTION* refers to the degree to which a modal auxiliary ‘attracts’ a specific verb, and it is calculated by dividing the frequency of the modal auxiliary by the total frequency of the MODAL AUXILIARY + VERB pairs in each category. The *RELIANCE* value, in contrast, represents to what extent the occurrence of the modal depends on a particular verb, and it is obtained by dividing the frequency of the modal co-occurring with a specific verb by the aggregate frequency of the modal in the category. This approach is convenient, as it enables visual exploration of the data in a two-dimensional space, and as such, makes it possible to gauge the relative contributions of different types of word associations across text categories in an intuitive manner, and also avoid missing important information in the data (see Küchenhoff & Schmid 2015: 546). Given the exploratory nature of the analysis of verbal collocations, it was deemed that these advantages outweigh the documented

shortcomings of the chosen measures as compared to other ways of measuring lexicogrammatical attraction,⁹ including the fact that since we consider two measures, it is not possible to obtain a single ranking of the colligations (Schmid & Küchenhoff 2013: 550–51). Following the exploratory quantitative analysis, we qualitatively examined the context of the main MODAL AUXILIARY + VERB pairings to identify and describe their local textual functions in the three categories.¹⁰

Regarding the qualitative appraisal of subjects, we classified them inductively into a small number of categories in a process that was informed by close reading, previous familiarity with the texts, and related work attempting to categorise grammatical subjects in academic writing (e.g. MacDonald 1992; Thomas & Hawes 1994).¹¹

4. Results

4.1 Overall frequencies of modals across categories

The frequencies of modal verbs across the three categories in focus are provided as a treemap in Figure 1. The treemap provides us with counts of modal auxiliaries in the three categories studied, and graphically represents (a) the counts of each modal with respect to the other modals in the three categories, and (b) the sum total of modals per category as compared to the other categories. As can be seen by comparing the relative sizes of the rectangles, texts in SC-PER boast the most modals and in REC the least. In addition, the parts of the graph corresponding both to REC and SUR begin in the same way – *may*, *will*, *must* – which could be indicative of broader similarities in the functions

9 It is not possible to discuss in detail the relative merits of different association measures here but see Schmid and Küchenhoff (2013), Gries (2015), and Küchenhoff and Schmid (2015).

10 Given that our main focus is on the sequence MODAL AUXILIARY + VERB, passive clauses were left out of this part of the analysis.

11 Subjects were first identified based on their position relative to the modal auxiliary, but manual verification was necessary, as they were frequently either located somewhere else than in L1 position in the concordance or implied in elliptical phrases. We also manually verified the accuracy of the identification of main verbs and active/passive (the latter was made difficult by the variable spelling of regular past tense suffixes (-'d vs. -ed).

of modals in these two categories. In this respect, the category of SC-PER stands apart from the other two, as the frequency-ranked list begins with *may*, *could*, *will*.

However, as previously indicated, the top-down analysis illustrated in Figure 1 does not directly tell us what types of modality are conveyed by the modals in different sub-registers, and to investigate that question, we now turn to phraseological analysis. Nevertheless, Figure 1 does guide our investigation: the modals selected for the *ATTRACTION* and *RELIANCE* analysis are the top three modal auxiliaries of each sub-register.

4.2 Core modal meanings in *Recipe collections*

To identify potentially interesting *MODAL AUXILIARY + VERB* pairings that could be linked to text functions characteristic of the three sub-registers of Late Modern English medical writing in focus, we determined the values of *ATTRACTION* and *RELIANCE* for each verb that co-occurred with any of the nine modal auxiliaries – *can*, *could*, *may*, *might*, *must*, *shall*, *should*, *will*, and *would* – and plotted them on a two-dimensional coordinate space. Based on visual exploration of attraction/reliance values, we can identify several discursively relevant pairings. We illustrate the complete procedure of employing visual exploration to arrive at a list of *CORE MODAL AUXILIARY + VERB* pairings for the first verb in focus – *will* in *Recipe collections* – whereas the visualisations are omitted from the treatment of remaining pairings for reasons of space.

will

We shall first explore the category of *Recipe collections*, focusing on *will*, *may*, and *must*. Figure 2 plots the values of *ATTRACTION* and *RELIANCE* for all the verbs in the category that co-occur with *will* and have the raw frequency of four or larger.

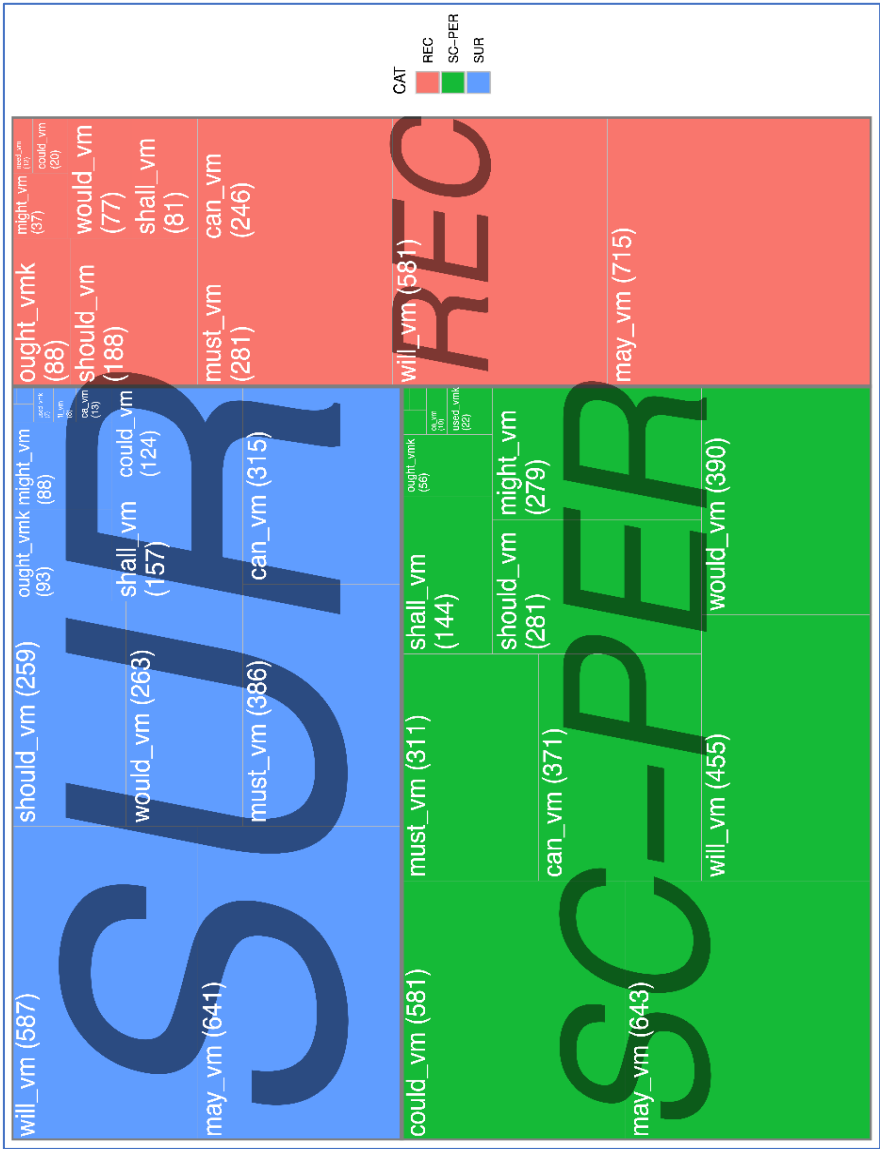


Figure 1. A treemap of modal auxiliaries and their frequencies across the three categories in focus.

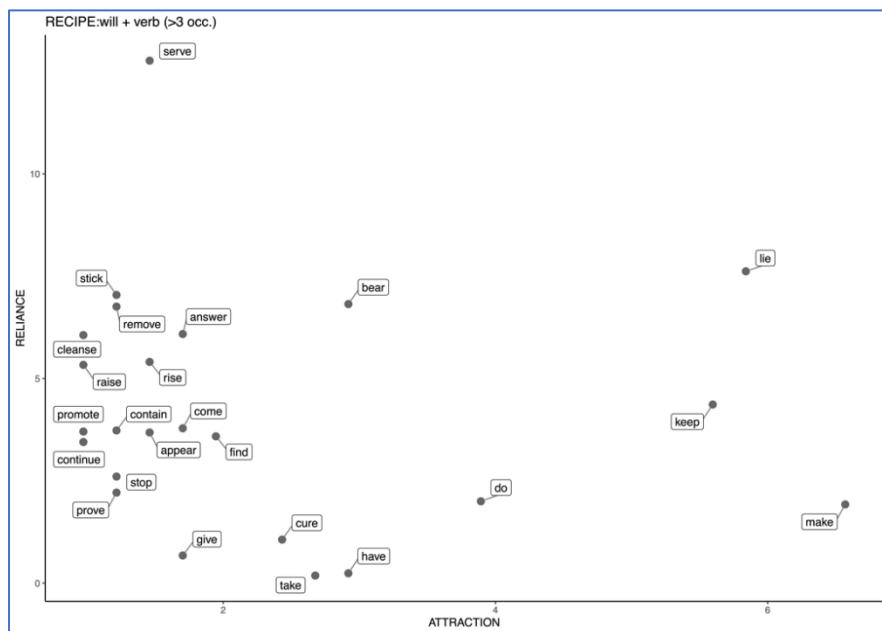


Figure 2. Attraction and reliance for verbs co-occurring with the modal auxiliary *will* in Recipe collections.

As can be seen, the top verb in terms of *ATTRACTION* is *make* (6.58), typically occurring in statements commenting on the effect of adding an ingredient, or the effect of the finalised produce (example 3). However, as *make* is a fairly frequent verb across the board, its usage in this category is not particularly dependent on this modal auxiliary, and this is reflected in its relatively low *RELIANCE* value of 1.92 (i.e. the occurrences of the *will + make* account for less than two per cent of the total frequency of *make* in *Recipe collections*). By contrast, *serve*, is only ranked on the thirteenth place in terms of *ATTRACTION* (1.46), but the instances of this verb are much more reliant on the use of *will*, such that *will + serve* comprise nearly 13 % of these instances. In terms of text function, *serve* is used for statements about the usability and effectiveness of

the substance discussed, but also about the preservation of the substance (example 4).

- 3 ...and adding the Sugar after it has stood in a gentle Warmth (about as much as that the Sun gives) for some weeks, it **will make** a beautiful-colour'd and grateful Tincture ... (REC, Quincy, *Pharmacopoeia Officinalis Extemporanea*, 1718)
- 4 This **will serve** very well till a proper ointment can be prepared. (REC, Cole, *The Lady's Complete Guide*, 1788)

We could thus argue that in terms of discourse function, the use of the modal auxiliary *will* is contingent on both *make* and *serve*, but the nature of the two-way lexicogrammatical relationship is different in each case: *make* is highly attracted to but only moderately reliant on *will*, whereas *serve* is less strongly attracted by *will*, but relies more on it for its use. As our aim is to describe MODAL AUXILIARY + VERB pairings that are both lexicogrammatically salient and discursively key, we used a rough heuristic to identify three types of pairings (listed here in the order of importance), for which

1. both attraction and reliance are high (or relatively high), or
2. reliance is high but attraction is relatively low (or low), or
3. attraction is high but reliance is relatively low (or low).

The pairings we identified for *will* in *Recipe collections* are listed in Table 1.¹² It can be seen that all of them are linked to core textual functions which are present in the category: comments on the effect of ingredients, instruction on preparing, preserving, and administering medical substances, how effective they are and what effect they have in the treatment of a condition. In the most common cases, a statement on the future effect and preservability of medicines is made with the phrase *will + do/keep/serve*. The subject is often a medicine or an ingredient, and the verb phrase expresses something about the characteristic properties of the subject (Salkie 2010: 192): *in all the cases when*

12 For reasons of space, example phrases have been abbreviated and the names of the source texts have been omitted in the tables.

X is used, the result will be Y. As the subject in these cases is non-sentient, any type of modality involving subjectivity must be that of the author. If there is an authorial comment, it is the confidence in the presented proposition or the weak commitment to the predictability of the future event which would count among EPISTEMIC POSSIBILITY (Coates 1983: 179). Therefore, it is the temporal / predictive use of *will* that seems to characterize recipe texts.

Table 3. Auxiliary + Verb pairings and their textual functions for *will* in Recipe collections.

Auxiliary	Verb	Main textual function	Example
<i>will</i>	<i>make</i>	Effect of an ingredient / of the medicine	(3)
<i>will</i>	<i>serve</i>	Effect / preservability of the medicine	(4)
<i>will</i>	<i>keep</i>	Preservability of the medicine	<i>it will keep many years</i>
<i>will</i>	<i>bear</i>	Instructions on dosage / administration	<i>[take every hour] if the stomach will bear it</i>
<i>will</i>	<i>lie</i>	Instructions on dosage	<i>[take] as much as will lie on a shilling</i>
<i>will</i>	<i>do</i>	Effect of an ingredient / of the medicine; process information	<i>[it dries,] which it will do in a day</i>

In the few cases with a personal subject (all of them with the verb *do*) we can observe a deontic use of *will*, as in (5):

- 5 But observe, if the pain is violent, you **will do** right first to give the purging apozem to promote stools ... (REC, Smith, *The Family Physician*, 1761)

Example 5 evaluates the alternative actions of the reader, and it can be paraphrased as *if X, you should Y*. Therefore, the example can be analysed as a case of DEONTIC NECESSITY. Such cases of *will + do* are but few, and they are all from expository passages, outside the instructional recipe texts. It can therefore be constituted that they are not necessarily characteristic uses of *will* in recipe texts, as such expository passage may occur in other medical sub-registers as well.

may and must

The pairings identified for *may* and *must*, listed in Table 2, are linked to statements of dosage and administration, efficacy of medicines, and regimens of health. Statements containing *may add* are found in recipes proper (and not in the adjacent commentary), in the part that describes the preparation of the medicine and the order of adding the ingredients. The phrases attest to ROOT POSSIBILITY, more specifically opportunity (see Depraetere & Cappelle 2023: 32).¹³ Examples of *may require* are all cases of EPISTEMIC POSSIBILITY, as they can be paraphrased as *it is possible that X requires* (see Depraetere & Cappelle 2023: 39). The function of sentences with *may require* is likewise limited to instructions on dosage and administration of medicines. *May serve* denotes ROOT POSSIBILITY (opportunity), but unlike the phrase *may add* described earlier, it does not occur in the actual recipes to make medicines, but in discussions of their efficacy. The phrase *may take* is most often found with dosage instructions, and they are usually restricted by some condition, often by the age of the patient. The type of modality is, therefore, ROOT POSSIBILITY, more precisely situation permissibility (Depraetere & Cappelle 2023: 33).

The modal *must* seems not to be a feature of recipes proper, but it typically occurs in the adjacent prose, often in regimen-like instructional passages. The examples of *must* listed in Table 2 are all cases of ROOT NECESSITY (deontic necessity).¹⁴ However, category-specific generalisations need to be made with caution, as the overall frequencies of individual AUXILIARY + VERB pairs are fairly low and sometimes the instances occur in just a couple of texts.¹⁵

13 The possibility is noted by a subject-external source, in this case the author of the text, but there is no consideration of the likelihood of the situation, hence it is a case of concessive use of *may*. The scope of the modal is narrow (it applies only to the verb and not to the whole situation), and there is no potential barrier nor condition that would cancel the action (i.e. the author does not list conditions under which the possibility would not stand).

14 Using the terminology of Depraetere and Cappelle (2023: 23–24), all examples are cases of objective deontic modality, or obligation where the deontic source is an authority, either named or implied, not the speaker/author of the text.

15 For example, of the 13 cases of *must take*, eight are from Smith's *The Compleat Housewife* (1728). The four cases of *must go* are all from regimens of health and from two texts (1788 Cole: *The Ladys Complete Guide* and 1795 Taylor: *Mrs Taylors Family Companion*) that seem to be (at least partly) copies of the same.

Table 2. Auxiliary + Verb pairings and their textual functions for *may* and *must* in *Recipe collections*.

Auxiliary	Verb	Main textual function	Example
<i>may</i>	<i>add</i>	Preparation	<i>you may add two spoonfuls of cinnamon water</i>
<i>may</i>	<i>require</i>	Dosage	<i>to be repeated as occasion may require</i>
<i>may</i>	<i>serve</i>	Efficacy considerations	<i>it may well serve as a substitute</i>
<i>may</i>	<i>take</i>	Dosage	<i>a robust person may take a spoonful</i>
<i>must</i>	<i>take</i>	Dosage / Regimen of health	<i>older children must take more</i>
<i>must</i>	<i>go</i>	Regimen of health	<i>the patient must go into a cold bath</i>
<i>must</i>	<i>eat</i>	Regimen of health	<i>you must eat the following diet</i>
<i>must</i>	<i>anoint</i>	Dosage / Administration	<i>you must anoint the reins of the back</i>

4.3 Core modal meanings in *Surgical texts*

will

The auxiliary *will* likewise co-occurs with a number of verbs in *Surgical texts*, of which the key ones are listed in Table 3. *Will make* is a prominent word pair, but in this category it is not linked to the efficacy of substances or end products as in *Recipe collections*, but to instruction on how to instrumentally treat specific pathological conditions (6) or exposition based on observations on human physiology.

- 6 ...; it [=the bandage] **will make** a pressure on the intestine while down, which may prove very pernicious, and has often been the sole occasion of a gangrene ... (SUR, Pott, *A Treatise on Ruptures*, 1756)

Other verbs co-occurring with *will* are also linked to common textual characteristics of surgical writing. For example, the phrase *will find* is typically used in abstract sense, about finding an argument or proving it, or (to a lesser extent) to instruct a medical practitioner (e.g. *surgeon*, *lithotomist*) how to locate something in the human body (e.g. a stone in the urinary tract). Phrases

will come, *will slip* and *will produce* describe physiological processes like the appearance of pain, and relatedly, *will happen* comments on the probability of the occurrence that is being discussed.

The phrase *will make* attests to the author or speaker’s confidence in the proposition, often based on first-hand experience. The VP is found in passages of EPISTEMIC POSSIBILITY and NECESSITY, sometimes supported by modally harmonious epistemic adverbs or adjectives, e.g. *will **certainly** make him fearful*¹⁶ and *will thereby make it **necessary***,¹⁷ respectively. In the cotexts described above, *will find* almost exclusively communicates EPISTEMIC POSSIBILITY, and *will admit* ROOT/DYNAMIC POSSIBILITY. Verb pairs *will come* and *will slip* attest to EPISTEMIC POSSIBILITY, with a more or less certain outcome: the likely sense of the modified VP can be elicited from the adverbs often following the VP (*always*, *sometimes*, *easily*, *most probably*). The remaining verbs, *appear*, *happen* and *produce*, belong to the realms of EPISTEMIC POSSIBILITY and ROOT/DYNAMIC POSSIBILITY, and they are often further supported by adverbs such as *always*, *almost infallibly*, *frequently*, *most probably*, *seldom* and *sometimes*.

Table 3. Auxiliary + Verb pairings and their textual functions for *will* in *Surgical texts*.

Auxiliary	Verb	Main textual function	Example
<i>will</i>	<i>make</i>	Procedural instruction	(6)
<i>will</i>	<i>find</i>	Procedural instruction	<i>he will find it</i>
<i>will</i>	<i>admit</i>	Procedural instruction / exposition	<i>[do X] if the part will admit it</i>
<i>will</i>	<i>come</i>	Physiological description	<i>will come out</i>
<i>will</i>	<i>slip</i>	Physiological description	<i>it will slip through</i>
<i>will</i>	<i>produce</i>	Physiological description / causes of symptoms	<i>will produce pain</i>
<i>will</i>	<i>appear</i>	Likelihood statement (‘to become evident’)	<i>it will appear that X</i>
<i>will</i>	<i>happen</i>	Likelihood statement	<i>will frequently / seldom happen</i>

16 SUR, Taylor: *An Account of the Mechanism of the Eye*, 1727

17 SUR, Pott: *A Treatise on Ruptures*, 1756

may and *must*

Table 4 lists the core word pairs for auxiliaries *may* and *must* and describes their textual functions.

Table 4. Auxiliary + Verb pairings and their textual functions for *may* and *must* in *Surgical texts*.

Auxiliary	Verb	Main textual function	Example
<i>may</i>	<i>observe</i>	Collaborative reasoning	(7)
<i>may</i>	<i>happen</i>	Likelihood statement	<i>it may happen that X</i>
<i>may</i>	<i>seem</i>	Likelihood statement	<i>X may seem strange</i>
<i>may</i>	<i>appear</i>	Likelihood statement	<i>it may appear to X</i>
<i>must</i>	<i>have</i>	Various	(8)
<i>must</i>	<i>take</i>	Procedural instruction	(9)

Interestingly, the functions assigned to these word pairs stand in stark contrast with those identified for *Recipe collections* in the previous section. As can be seen, instances with *may* are linked with cognitive processes and logical reasoning. With phrases like *may observe*, the subject is either *I* or inclusive *we* (7), where the reader is implicitly invited to participate in the cognitive process of working out the relative merits of different lines of treatment. The use of the auxiliary in these cases looks like permissive *may*, and as such it would point towards ROOT/DEONTIC MODALITY; nevertheless, the analysis of the cotext shows that *may observe* in surgical texts communicates EPISTEMIC POSSIBILITY. *Happen*, *seem* and *appear* comment on the likelihood of some proposition discussed in the text.

- 7 Mary Langley had the disorder in all seven weeks, and magnesia and nitre were joined with hemlock; and, upon the whole we **may observe**, that there are only seven cases out of the twenty, in which hemlock can possibly have all the credit of the cure, because other medicines were joined along with it; ...(SUR, Kirkland, *An Essay On*

The Methods Of Suppressing Haemorrhages From Divided Arteries,
1763)

What is also interesting is that *must* co-occurring with *take* almost exclusively exhibits ROOT NECESSITY, as in example (8), whereas the instances with *must have* (excluding *have* as auxiliary) attest to EPISTEMIC and ROOT NECESSITY in equal numbers, as exemplified in (9) (epistemic) and (10) (root).

- 8 The knife he **must take** in his fingers, like a pen, and lean the little finger of his right hand on the cheek-bone of the patient; (SUR, Bischoff, *A Treatise On The Extraction Of The Cataract*, 1793)
- 9 After every capital operation we should give our utmost attention to the application of the compresses and bandage; ...as long continued pain **must have** destructive consequences; (SUR, Gooch, *Cases And Practical Remarks In Surgery*, 1758)
- 10 It **must have** a gentle hold of the upper part of the Os Pubis or Sharebone; but take care it is not placed too high or too low: [...] (SUR, Brand, *The True Method Of Reducing Ruptures*, 1771)

4.4 Core modal meanings in *Scientific periodicals*

will

The pairings identified for *will* in *Scientific periodicals* are found in Table 5.

The fact that *appear* stands out as a key colligate of *will* owes much to examples like (11). Here, the author confidently expresses a proposition – *blood globules are not filled with elastic fluid* – using the epistemic verb *appear* as an indicator of near-categorical certainty (cf. Vihla 1999: 56) accompanied by a cataphoric deictic expression *following*, which indicates where the evidence for the proposition is found. Both *will answer* and *will succeed* contribute towards expressing a claim with a high degree of certainty, occasionally further emphasized by a comparative (*it will **better** answer*) or a highly inclusive pronoun (*it will answer **every** purpose*), or at times down-toned by an adverb like *sometimes*, lessening the speaker's / author's commitment to the proposition. All the cases of *appear*, *answer*, and *succeed* fall under

EPISTEMIC POSSIBILITY / NECESSITY.¹⁸ *Will do* occurs variously in constructions where the main contribution to the meaning comes from the direct object (e.g. *honour / justice / favour*), not the verb itself. *Will give* is found in expressions that communicate the author's confidence in the likelihood of future events. Both *will do* and *will give* mostly communicate EPISTEMIC POSSIBILITY.

- 11 And that they [=blood globules] are not fill'd with any sort of Elastic Fluid, **will appear** from the following Experiment. (SC-PER, PT Vol. 30, pp. 1000–1014, 1717–1719)

Table 5. Auxiliary + Verb pairings and their textual functions for *will* in *Scientific periodicals*.

Auxiliary	Verb	Main textual function	Example
<i>will</i>	<i>appear</i>	Introduction of evidence	(11)
<i>will</i>	<i>answer</i>	Prediction of accomplishment / outcome	will (not) answer the purpose / end
<i>will</i>	<i>succeed</i>	Prediction of accomplishment / outcome	will (sometimes) succeed
<i>will</i>	<i>give</i>	Declaration	I will give my account
<i>will</i>	<i>do</i>	Phrasal	will do me the justice/honour

may

Table 6 shows that as far as its verbal colligates are concerned, *may* predictably expresses different shades of meanings related to POSSIBILITY.

May have (and *may perform*) are found in statements like (12) where the proposition about the world is presented as a possible scenario (the person in question **possibly** contracting the plague), not a definite outcome.

- 12 ...the case is different in Italy, and in the south of France; to which countries a ship with a fair wind **may perform** a voyage in eight days from the Levant; during which time a person **may have** the

18 The evidence-introducing cases of *appear* could also be identified as attestations of EVIDENTIAL MODALITY, but in that case *appear* should be interpreted as a verb of perception (Vihla 1999: 30).

plague about him, without being confin'd to his bed; of which there are many instances. (SC-PER, PT Vol. 47, pp. 0514–0516, 1751)

Table 6. Auxiliary + Verb pairings and their textual functions for *may* in *Scientific periodicals*.

Auxiliary	Verb	Main textual function	Example
<i>may</i>	<i>have</i>	Possibility statement	(12)
<i>may</i>	<i>seem</i>	Projection	<i>it may seem (ADJ) that</i>
<i>may</i>	<i>serve</i>	Projection	<i>this may serve to point out X</i>
<i>may</i>	<i>conclude</i>	Projection	<i>we may conclude that</i>
<i>may</i>	<i>happen</i>	Projection	<i>it may easily happen that</i>

A similar epistemic qualification is present in instances with the other colligates listed in the table, which moreover are specifically related to projection (Halliday & Matthiessen 2013: 515–19).¹⁹ Thus, in (13), *may* mitigates the force of the claim being expressed in a simple catenative construction involving *serve* (compare with *This account serves to convince ...*), whereas *may seem* in (14) has a different function, that of projecting an adversative clause. In other words, the author uses *may seem* to present a conclusion that is possible (i.e. *that the present observations clash with some previous ones*) but not one which is ultimately adopted; instead, the actual claim is presented in the following sentence (*But [...] they will be found [...] to confirm them ...*).

19 The verbs in Table 6 occur in main clauses which project some kind of “stance” or “attitudinal meaning” on the following nominal complement, which may either be a noun phrase or nominal content clause. The stance in these clauses is partially constructed through the choice of the verb and can be further modified with the help of modal auxiliaries like *may* (cf. Gray, Biber, & Hiltunen 2011). The specific semantic dimensions involved in the constructed stance are dependent on the particularities of the verb.

- 13 This Account **may serve** to convince those who are of Opinion that Boys are conceived on the right Side, and the Girls on the left; ... (SC-PER, PT Vol. 44, pp. 0617–0621, 1746)²⁰
- 14 These observations **may seem** at first view to clash with and contradict those I have related: But, upon closer consideration, they will be found in reality to confirm them, ... (SC-PER, PT Vol. 49, pp. 0254–0264, 1755)

The examples of *may* in SC-PER and the related discussion has constituted the use of the modal to be related to possibility (ROOT POSSIBILITY in the case of *have* and *happen*, and EPISTEMIC POSSIBILITY with *seem*, *serve* and *conclude*).²¹ It is worth emphasising here that the specification of the modal meaning of an utterance is not limited to auxiliaries. For example, in (14), the verb *seem* is used epistemically: rather than being directly related to visual perception, it describes “a cognitive state concerning what is subjectively probably conditional on evidence” (Brogaard 2015: 13). Elsewhere in the corpus, it is not unusual to find occurrences of modally harmonious configurations involving *may* and adverbs (e.g. *we may reasonably conclude*, *it may easily happen*). All this underlines the usefulness of looking at the phraseology of modal expressions and not merely their frequencies when describing how they are used in discourse.

could

Finally, the core word pairs with their characteristic textual functions for *could*, the auxiliary that was established as having a comparatively high frequency in this very category, are summarised in Table 7.

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- 20 The idea of the left-right polarity of the body and its influence on sex determination of the child at conception was first recorded in ancient Greece (Pahta 1998: 41), and it might appear surprising that it is still found in medical writing in the 18th century. This idea was, in fact, even more persistent as it was perpetuated in medical discourse until at least the early 20th century.
- 21 Nurmi (2009: 338) has pointed out the rise of the epistemic sense of *may* in personal letters, effected by “educated high-ranking men” from the 16th century onwards. Personal letters and the different modalities of *may* provide, therefore, interesting points of comparison to scientific periodicals, which originally evolved from the register of letters.

Table 7. Auxiliary + Verb pairings and their textual functions for *could* in *Scientific periodicals*.

Auxiliary	Verb	Main textual function	Example
<i>could</i>	<i>discover</i>	Acquiring / failing to acquire knowledge	<i>I could (not) discover that X</i>
<i>could</i>	<i>perceive</i>	Acquiring / failing to acquire knowledge	<i>I could (not) perceive X</i>
<i>could</i>	<i>distinguish</i>	Acquiring / failing to acquire knowledge	<i>I could (not) distinguish X</i>
<i>could</i>	<i>get</i>	Success / failure in a procedure	<i>I could (not) get it out</i>

Three of the colligates – *discover*, *perceive*, and *distinguish* – are related to the domains of cognition and perception, and at first glance it would seem reasonable to hypothesise that authors use them to report how a specific piece of information was obtained. While such reports do occur (15), upon closer inspection this turns out to be only a partial explanation, as in addition we encounter a sizable sample of instances where these verbs occur in statements with negative polarity (in fact, only 1 out of 5 instances of *could discover / perceive / distinguish* reports a positive outcome). Using such statements, the authors relate their inability to perceive something, as illustrated in (16). Interestingly, this description bears a striking similarity with Sinclair’s well-known description of the phrase *naked eye* as a partial unit of meaning, which collocates/colligates with modals and negative polarity items, and which is associated with the semantic prosody of ‘difficulty’ (Sinclair 2004: 30–35). Hence, *could* mostly communicates ROOT POSSIBILITY (or, perhaps more accurately, “root impossibility”). The pair *could get* likewise frequently occurs in statements with negative polarity, but with a slightly different function: they most often report a medical procedure that was attempted but turned out to be more or less unsuccessful.

- 15 ...and the Remainder, where there had been no Adhesion, (as I **could perceive** from the smooth Surface of the Pleura) was torn away by Piece ... (SC-PER, PT Vol. 41, pp. 0623–0624, 1739–1741)
- 16 ...we **could scarce distinguish** one from another. (SC-PER, EMJ1 Vol. 4, pp. 0242–0244, 1747)

5. Discussion

The present study has followed an exploratory approach to modality in LModE medical writing, combining ideas from descriptive corpus linguistics, phraseology/constructionist approaches to grammar, and register analysis. The findings of the study have identified several meaningful connections between specific phraseological uses of modal verbs (operationalised as recurrent and salient pairings of AUXILIARIES and LEXICAL VERBS) and the communicative purposes of the three sub-registers of 18th-century medical writing. By doing so, the analysis lends support to the idea that the approach we have adopted is a viable one for the analysis of modality, which is sensitive to the syntagmatic connections of modal verbs and the discourse contexts within which individual instances are embedded, and feasible to implement on mid-sized specialised corpora, such as the individual text categories of the *Late Modern English Medical Texts* (LMEMT).

Some of the obtained results were entirely in accordance with the expectations. For example, it is unsurprising that modal expressions in *Recipe collections* are embedded in discourse where ways of preparing and administering medical substances are expounded, given that this is a major concern in much of the writing in this category. Here, our analyses acted as a confirmation of, and partially an elaboration on, informal hypotheses gleaned from earlier research and familiarity with recipes and related texts from earlier periods in the history of the register. Alongside this, the analysis also identified phraseological tendencies that were, perhaps, less obvious at first glance, but on closer inspection turned out to be entirely congruent with the rhetorical purposes of the texts. For example, the fact that *could* emerges as a salient modal auxiliary particularly in *Scientific periodicals* is due to a complex configuration of phraseological variables including the choice of the lexical verb and its associated semantics, the subject, and polarity, giving rise to recurrent variants of the phrasal template 1SG/PL + *could* + NEG + VERB + NP/*that*-clause.

While the present analysis has taken the first step towards the identification and description of these configurations, a comprehensive analysis clearly necessitates a study with wider scope that covers not only the remaining sub-registers of medical writing from the period, but also a wider range of phrase frames at a higher level of granularity. In particular, the qualitative appraisal of the role of clausal subjects suggests that their systematic incorporation into the framework of quantitative analysis emerges as a high priority

for future work. Similarly, we have deliberately excluded from the analysis both passive constructions (e.g. *it may be reckoned*) and other expressions that are clearly formulaic (e.g. *as hot as you can bear it* or *as plain as could be*) for reasons of space; assessing their frequency and discourse function is likely to offer further insights into the use of modals.

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