

Expression of Modality in Biomedical Texts

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This paper aims to explore modality and its expression in biomedical research papers. The issue of modality was selected because it performs important linguistic functions in scientific communication. It is also assumed that modal expressions may be employed in all sections of a research article (introduction, material and methods, results, discussion). The corpus is based on the data excerpted from current biomedical research papers written by native speakers. These are investigated through quantitative and qualitative analyses and compared with the research articles written in English by Slovak researchers. The results are expected to be applied in developing Slovak writers' and translators' awareness of scientific discourse conventions within their specific research community.

Key words: modality, biomedical, research articles, scientific discourse, English for Specific Purposes, translation

1. Introduction

Modality has been investigated from various perspectives by many linguists. Simultaneously, numerous definitions of *modality* have been proposed. The Oxford Concise Dictionary of Linguistics by P.H. Matthews (2005: 228) defines the term *modality* as “category covering either of a kind of speech act or the degree of certainty with which something is said.” Palmer (2001: 1) suggests that “*modality* is a valid cross-language grammatical category that can be the subject of a typological study.” According to Quirk (1985: 219) “*modality* may be defined as the manner in which the meaning of a clause is qualified so as to reflect the speaker’s judgement of the likelihood of the proposition it expressed being true.” On the other hand, *modality* is a difficult concept to define especially in cross-linguistic studies as Bybee and Fleischman (1995: 3) point out “because of the extent to which languages differ in their mapping of the relevant semantic content onto linguistic form.”

Frequently it is distinguished between *intrinsic* and *extrinsic modality* (Quirk, 1985) although other terminologies such as *root* and *epistemic modality*, *deontic* and *epistemic modality* may be encountered. Moreover, a number of other types of *modality* for instance evidential, volitional, dynamic may be distinguished. Since it seems impossible to deal with such a complex issue within one paper, we have decided to focus on expression of *epistemic modality* in biomedical professional texts. The reasons should hopefully become clear in the course of this paper.

What definitions of *epistemic modality* are offered by some of the well-known linguists? According to Lyons (1977: 793)

Epistemic modality is concerned with matters of knowledge, belief, or opinion rather than fact.

In her study “*The Semantics of the Modal Auxiliaries*” Coates (1983: 18) points out that *epistemic modality*

is concerned with the speaker's assumptions or assessment of possibilities and, in most cases, it indicates the speaker's confidence (or lack of confidence) in the truth of the proposition expressed.

Palmer (1986: 51) suggests that the term *epistemic modality* should apply to

any model system that indicates the degree of commitment by the speaker to what he says. it is to be interpreted as showing the status of the speaker's understanding or knowledge; this clearly includes both his own judgements and the kind of warrant he has for what he says.

All the presented definitions strongly indicate a close relationship between scientific writing and the concept of *epistemic modality*.

An essential concept that cuts across the field of *modality*, more specifically *epistemic modality*, is that of *hedges*. Similarly, numerous definitions of *hedges* may be found varying a lot in their scope. The term hedge was first introduced into linguistics by Lakoff (1972). Lakoff (1972: 195) focused mainly on the logical properties of words and phrases like *rather*, *largely*, *in a manner of speaking*, *very*, and their ability "to make things fuzzier or less fuzzy." Since then the concept of *hedges* has been widened and adopted in speech acts theory (Brown and Levinson, 1987), oral discourse, pragmalinguistics and academic discourse analysis (Hyland, 1995, Markkanen and Schroder, 1997). Brown and Levinson (1987) define hedging within the speech acts theory and interpret it as a sign of politeness. Hyland (1995: 1) was mainly concerned with the use of hedges in academic discourse and considers hedging essential to scientific writing due to the fact that "hedges indicate interpretations and allow writers to convey their attitude to the truth of the statements they accompany, thereby presenting unproven claims with caution and softening categorical assertions."

According to the Oxford Concise Dictionary of Linguistics (2005: 160) hedges are presently defined as

any linguistic device by which a speaker avoids being compromised by a statement that turns out to be wrong, a request that is not acceptable, and so on. Thus, instead of saying "This argument is convincing", one might use a hedge and say "As far as I can see this argument is convincing: instead of simply giving an order "Carry it into the kitchen!" one might use an interrogative as a hedge and say "Could you perhaps carry it into the kitchen?"

The presented definitions clearly indicate the overlap between modality and hedging. Simultaneously, a question of a relationship between the above mentioned terms arises. As Markkanen and Schroder (1997: 4) suggest

it seems possible to see the relationship between modality – mostly of the epistemic type – and hedges in two ways: either modality is the wider concept and includes hedges or the other way round, hedging is the umbrella term and epistemic modality a part of it.

For the purposes of the present paper it seems unnecessary to search for the correct answer to the above stated question. The aim of raising it was to point to different areas of language study exploring the same phenomenon and showing different perspectives of its investigation within scientific discourse. Needless to say, it proves that language phenomena do not exist in

a vacuum and cannot be examined in isolation but rather in connection with related language items.

The present paper examines the expression of *epistemic modality* in biomedical research articles written in English by native speakers and Slovak researchers. The issue of *epistemic modality* has been selected due to its importance not only when conveying the attitude to the truth value of the statement but also when attempting to influence potential readers and sell their scientific results convincingly. Besides modal verbs there exist other linguistic expressions of modality, which might be referred to as modal expressions (Huddleston and Pullum, 2002) or stance markers (Biber, 1999). These include modal adjectives (*possible, likely*), modality adverbs (*certainly, possibly, undoubtedly*), other verbs (*seem, appear, insist, require*), and nouns (*possibility, necessity, permission*). This paper explores the use of modal verbs and modality adverbs not only in isolation but also in combinations. It is supposed that modal verbs and modality adverbs as well as their combinations may be found in all sections of a research article (*abstract, introduction, material and methods, results, discussion*). It is also assumed that the differences in the use of modal verbs and modal adverbs by native and Slovak speakers are likely to occur. The excerpted material will also be examined from a semantic point of view with the purpose of proving its important role in successful and effective scientific writing in English.

2. Data and Data Analysis

The data is based on the corpus of ten biomedical research articles published in top scientific journals accessible through the Internet database Science Direct. One of the criteria for the selection of research articles was that they were written by at least one native speaker. These were compared with another corpus of ten biomedical research articles written in English by Slovak scientists. The research articles were also published in leading scientific journals available via the above mentioned database.

Originally, we intended to compare the research articles written in Slovak by Slovak researchers. However, our intention failed due to the most obvious reason - there are no Slovak scientific journals in the biomedical field publishing research articles in Slovak. This may be regarded as further evidence supporting a dominant role of the English language in science. At present, progress in biomedical research is extremely rapid and the only possible way to communicate the breaking scientific findings is, firstly, in English and secondly, in top international scientific journals. It follows that Slovak scientists are required either to write their research articles in English by themselves or have them translated into English. Comparison of similarities and differences between the articles written by native speakers and Slovak scientists are discussed later on in this paper.

All the articles were stripped of all figures, tables, acknowledgements and references, and the remaining text kept in files that reflect the usual division into introduction, material and methods, results, and discussion made by the original author or authors. The manual and computer analysis of the two corpuses was combined. The manual analysis was preferred to the computerised one when identifying modality expressions for its more individualistic character. The computerised analysis was applied to total word count, frequency per section (*introduction, material and methods, results, discussion*) and their comparison within each corpus and between the two above described corpuses. The research articles were published between the years 2000-2005 as it is assumed that the use of the modal verbs and modality expressions in research articles might have changed over the time.

The data based on the corpus from the research articles written by native speakers are discussed first. The total number of words in the selected articles was 63 741, out of which

892 modality expressions were identified. Modal verbs totalled 216 items and modality adverbials with 676. The results are summarised in Table 1.

Research articles written by native speakers	MODAL VEBS	MODALITY ADVERBIALS
ABSTRACT	12	39
INTRODUCTION	29	101
MATERIAL AND METHODS	12	90
RESULTS	12	185
DISCUSSION	151	261
TOTAL	216	676

Table 1 *Total number of modal verbs and modality adverbials per section of research articles written by native speakers*

Having compared the distribution of modal verbs per individual sections of research articles written by native speakers, the highest number (151 items) occurred in the *discussion* section. The difference between *discussion* and the remaining sections seems striking with 12 modal verbs found in the *abstract*, *material and methods*, *results* and 29 elements in the *introduction*. Similarly, the highest number of modality adverbs (261 items) was found in the *discussion* section, followed by the *results* (185 items), *introduction* (101 items), *material and methods* (90 items) and *abstract* sections (39 items). This corresponds with the principal function of a *discussion* section – to analyse the data and relate them to other studies. In general, it is recommended that the analysis presented in the *discussion* section should evaluate the meaning of the results in terms of the previously stated hypothesis as well as point out its significance. The *discussion* section should also contain possible explanations for unexpected results, which clearly calls for the use of modal verbs and modality expressions.

The results described above are compared with the data from the selected research articles written by Slovak scientists. Table 2 outlines the results. The most striking difference was observed in the total number of modal verbs (88 items) and modality adverbials (264 items). The comparison of the distribution of modal verbs and modality adverbials per each section of the selected research articles revealed the lowest occurrence in the material and method section (0 modal verbs, 16 modality adverbials) as opposed to the data from research articles written by native speakers with the lowest number of the examined expressions in the abstract section (20 items). The only similarity was in the highest occurrence of modal verbs and modality expressions in the discussion section (184 items).

On the other hand, the difference in the total number of modality expressions is dramatic (892 versus 352). This fact may suggest the cross-cultural differences in the use of modality expressions by native English and Slovak speakers. It appears that Slovak scientists tend to use modality expressions less frequently than their English colleagues. We believe it is determined by the influence of scientific writing in Slovak, which apparently employs less modal verbs as well as modality adverbials. It is likely that many Slovak scientists write their research articles first in Slovak and then have them translated into English or translate them themselves.

Research articles written by Slovak speakers	MODAL VEBS	MODALITY ADVERBIALS
ABSTRACT	2	18
INTRODUCTION	28	64
MATERIAL AND METHODS	0	16
RESULTS	0	40
DISCUSSION	58	126
TOTAL	88	264

Table 2 *Total number of modal verbs and modality adverbials per section of research articles written by Slovak researchers*

Table 3 presents the occurrence of modal verbs per each section of research articles. The analysis revealed that *may* is the most frequently used modal verb in the selected ten biomedical research articles written by native speakers. Its number of uses in the research articles reached 108 with the most frequent use in the discussion section (75). This finding corresponds with the one reported by Hoyer (2005: 1494) that “*may* is very common in academic prose yet comparatively rare in conversation.” Frequency of other modal verbs was remarkably lower, *could* appeared 36 times, *can* 24 times, *would* 22 times, *might* 10 times, *must* and *should* 5 times.

Research articles written by native speakers	Abstract	Introduction	Material and Methods	Results	Discussion	Total
MAY	9	16	2	6	75	108
COULD	2	3	5	4	22	36
CAN	0	4	1	1	18	24
WOULD	1	4	3	1	13	22
MIGHT	0	1	0	0	9	10
SHOULD	0	0	0	0	5	5
MUST	0	0	0	0	5	5
WILL	0	1	1	0	2	4
NEED	0	0	0	0	1	1
BE ALLOWED TO	0	0	0	0	1	1
Total	12	29	12	12	151	216

Table 3 *Occurrence of modal verbs per section of research article written by native speakers*

The analysis of the research articles written by Slovak scientists revealed the highest occurrence of the modal verb *can* (39 times) as opposed to the above described research articles written by native speakers. Interestingly, the use of *could* (14) was slightly higher than that of *may* (11). It may also be hypothesised that it is due to conventions accepted within the Slovak scientific community and other reasons stated above.

Research articles written by Slovak speakers	Abstract	Introduction	Material and Methods	Results	Discussion	Total
CAN	1	8	0	0	30	39
COULD	0	6	0	0	8	14
MAY	1	2	0	0	8	11
WILL	0	6	0	0	6	12
MIGHT	0	2	0	0	2	4
MUST	0	0	0	0	4	4
WOULD	0	2	0	0	0	2
SHOULD	0	2	0	0	0	2
Total	2	28	0	0	58	88

Table 4 Occurrence of modal verbs per section of research article written by native speakers

Since the use of *may* was highly prevalent in the research articles written by native speakers, we would like to describe its most frequent meaning and the combinations with other modality expressions. Quirk (1985: 221) distinguishes the following meanings of the most frequent modal verb in the research articles written by native speakers *may* – possibility and permission. *May* might have the meaning of epistemic possibility (Quirk, 1985: 223); “i.e. it denotes the possibility of a given proposition’ s being or becoming true.” The prevalent meaning of the most frequent modal verb in the corpus from the research articles written by native speakers *may* was that of epistemic possibility. This may be illustrated by several excerpted examples:

- (1) Considering the fact that 46 per cent of women in the cohort used vitamin supplements, it may at least in part explain the lack of associations between fruit and vegetable consumption and the risk of breast cancer in that study.
- (2) That NK cells were so influenced by exposure to melatonin, may reflect, at least in part, the fact that NK cells are exquisitely sensitive to cytokines produced by melatonin-stimulated T helper cells.
- (3) Its hypersecretion may also result in depressed mood.

Another interesting observation has been made concerning modal-adverb combination, that is modal synergy, or modal texture (Hoye, 2005) in the selected research articles. *May* was the most frequently found in combinations with *at least*, *in part*, *partially*, *also*. When *may* occurred in a complex sentence, another verb with the modal meaning found usually in the first part of the complex sentence was the verb *suggest* and *indicate* e.g.:

- (1) The convergence of this endocrinological research suggests that the measurement of cortisol, DHEAS, and melatonin may be important to understand the mechanisms underlying the physiological effects of these psychosocial interventions.

- (2) Our findings indicate that consumption of fruits and vegetables modifies endogenous oxidants and antioxidant capabilities and may impact breast cancer risk through gene/diet interactions.
- (3) Consequently, it has been suggested that lymphocytes in the spleen and peripheral blood immune compartments may differentially be regulated by stress factors.

May also commonly followed the modality items *it is possible, it seems possible, it is plausible*, e.g.:

- (1) It is possible that this nitrosated melatonin conjugate may be an even more potent antiproliferative molecule either NO or melatonin alone.
- (2) it is plausible to hypothesize that CAT polymorphisms may influence breast cancer risk.
- (3) However, it is plausible that fruit and vegetable consumption, particularly dietary sources of antioxidants, may interact with endogenous sources of pro- and antioxidants, and that such consumption may modify the effects of genetic factors related to oxidative stress.

The above cited excerpted examples indicate that the use of *may* in scientific writing particularly in the above combinations is context-sensitive and these language items occur “in precisely those areas where speakers have something to gain or lose by their addressee’s acceptance or rejection of what they are saying” (Hoye, 1997: 212-216, in Hoye, 2005: 1484). Surprisingly, no similar combinations were found in the research articles written by Slovak speakers.

Further and more extensive research is required to evaluate the remaining modal verb-adverb combinations in scientific articles. Taking into account the number of other modal verbs *could* (36), *can* (24), *would* (22), *might* (10), *must* and *should* (5) it appears that the excerpted combinations are insufficient for reliable and significant assessment.

3. Conclusions

To summarise, the comparison of the biomedical research articles written by native speakers and Slovak speakers revealed the following differences in the use of modal verbs and modality adverbs:

1. The total number of modal verbs as well as modality adverbs was remarkably higher in the research articles written by native speakers.
2. The preference for the use of certain modal verb and modality adverbs markedly differed. Native speakers tended to use most frequently the modal verb *may* while the Slovak speakers favoured the use of *can*. The same applies to the use of modality adverbs.
3. The combinations of modal verbs with modality adverbs and other modality expressions were observed almost exclusively in the research articles written by native speakers.

The results also clearly indicate that the above described differences are associated with the translation from Slovak into English and the writing conventions commonly accepted within the Slovak research community (cultural differences). It follows that the translators (either the authors themselves or professional translators) should be aware of the use of modal verbs and modality adverbs, namely because these language devices contribute to the native-like character of research articles. Moreover, modality expressions help to sell the scientific results convincingly, which may be crucial at the point of the acceptance of a submitted research article. It has been proved that writing conventions valid within the Slovak scientific community should be contrasted with those accepted within the global (at present equal to English) scientific community because only the use of appropriate language devices makes scientific writing effective.

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