

An Analysis of Interpersonal Meaning of Modal Verbs in Abstracts from Scientific Papers: Case Study of Progress in Aerospace Sciences

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Abstract:

The aims of this study are to explore the distribution features of modal verbs in abstracts from scientific papers, analyze the reasons for those features and figure out the role modal verbs play in achieving interpersonal meaning. The study has selected 60 abstracts randomly from Progress in Aerospace Sciences from 2015 to 2019 as research samples. It combines Halliday's value of modality with Biber et al.'s two classifications to process modal verbs. The instruments adopted in this research are AntConc 3.2.4, manual sorting and SPSS Statistics 21. Based on the results, the study finds that: firstly, the overall occurrence of modal verbs in 60 abstracts is 59 times, among which low-value modal verbs are the most frequently distributed (74.6%), median-value modal verbs the second (22.0%) and high-value modal verbs the least (3.4%); secondly, the achievement of interpersonal meaning relies on value of modality, and when the value of modality is lower, a better degree of interpersonal meaning can be achieved; thirdly, high-value modal verbs achieve tough interpersonal meaning, median-value modal verbs achieve comfortable interpersonal meaning, and low-value modal verbs achieve harmonious interpersonal meaning.

Keywords:

scientific papers; modal verbs; interpersonal meaning

I. Introduction

Scientific papers usually impress readers as objectivity and authority [Cecchetto, 1997]. However, although scientific papers often contain a large amount of certain information, such as data and experimental procedures, it is more than just a simple description of scientific facts or findings, but a social process conducted by authors in order to make their opinions easier to be understood and accepted [Swales, 1990]. Technically, such a social process performs the interpersonal function, which helps authors interact with readers in discourse, maintain this relationship and influence readers' behaviors and judgments [Halliday, 1994]. Some pragmatic devices preferred by authors of scientific papers have been given attention. For instance, Qin and Lang [2013] explore the potential interpersonal meaning of the first person pronoun we in research articles and find that we can strengthen interpersonal solidarity and the reader's presence in research articles, and also alleviate face threatening behavior brought by new findings etc. Qin and Chen [2013] also conduct a study of interaction in research articles among Chinese engineering graduate students from the perspective of interpersonal meaning and find that students are inclined to being a solitary author, with their attentions on propositional contents, neglecting reader-orientation.

As one of the devices to achieve interpersonal meaning, researches on modal verbs are nothing new [He, 2009; He et al., 2017; Wang, 2005...]. However, researches on the role modal verbs play in scientific papers to achieve interpersonal meaning are few, let alone those on a specific discipline. In hope of enriching researches on modal verbs, this paper attempts to explore how writers achieve interpersonal communication by modal verbs in the abstract part from a particular subject of scientific papers, the aviation field, with one aerospace journal *Progress in Aerospace Sciences* as language samples. Like some researches which focus on college students [Phillips, 2020; Rahmi, 2020 etc.], this paper also attempts to enlighten students, especially in the aspect of thesis writing.

II. Research Methods

2.1 Research Corpus

The study has selected 60 abstracts randomly from a scientific journal *Progress in Aerospace Sciences* published from 2015 to 2019 as research samples. This journal is a monthly peer-reviewed journal covering all areas of aerospace and aerospace engineering, included in Science Citation Index with the highest impact factor among the same genus of journals in 2019, which is 6.814. The tokens in the corpus are 11589.

Table 1. Information about the selected abstracts

Year	Number	Tokens
2015	12	2159
2016	12	2296
2017	12	2701
2018	12	2018
2019	12	2415
Total	60	11589

2.2 Operational Definition of Modal Verbs

Indeed, there are several ways to define and classify modal verbs [e.g. Quick, 1985; Palmer, 2001]. As for this paper, value of modality [Halliday, 1994] and the other two ways to classify modal verbs [Biber et al., 1999] are adopted. Halliday [1994] believes that modal judgments embody three values - high, median and low, as the table below shown:

Table 2. Value of modality [Halliday, 1994: 358]

	Probability	Usuality	Obligation	Inclination
High	certain	always	required	determined
Median	probable	usually	supposed	keen
Low	possible	sometimes	allowed	willing

Besides, Biber et al. also propose two ways to categorize modal verbs from different perspectives.

Table 3. The first classification of modal verbs [Biber et al., 1999: 73]

Central modal auxiliaries	can, could, may, might, must, ,shall, should, will, would
Marginal auxiliaries	dare (to), need (to), ought to, used to
Semi-modals	have to, (had) better, (have) got to, be supposed to, be going to

The first way is to classify modal verbs into central, marginal and semi modals [1999: 73].

Table 4. The second classification of modals [Biber et al., 1999: 485]

Permission/possibility/ability	<i>can, could, may, might</i>
Obligation/necessity	<i>must, should, (had) better, have (got) to, need to, ought to, be supposed to</i>
Volition/prediction	<i>will, would, shall, be going to</i>

The other way is to classify modal verbs into permission/possibility/ability, obligation/necessity, and volition/prediction [Biber et al., 1999: 485], according to the meaning they imply. Speaking of this paper, it combines the above three classifications to process modal verbs, which forms the peculiar operational definition of modal verbs in the following figure.

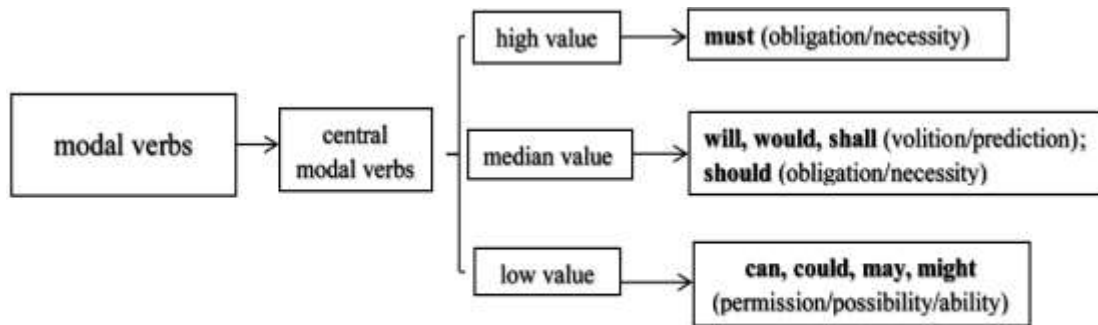


Figure 1 Operational definition of modal verbs

2.3 Research Questions

Since this paper is aimed at analyzing the interpersonal meaning of modal verbs in abstracts from scientific papers through discussing their distribution features, there are mainly three research questions:

- (1) What are the features of modal verbs used in the 60 abstracts of scientific papers?
- (2) What are the reasons for different frequencies of modal verbs in 60 abstracts?
- (3) How do writers use modal verbs to achieve interpersonal meaning?

2.4 Research Instruments

The instruments adopted in this research are three. The first one is AntConc 3.2.4. We mainly use its Concordance and Concordance Plot functions to retrieve central modal verbs. The second one is manual sorting that may work as a supplement to the result of AntConc 3.2.4 when there is something uncertain and manual confirmation is required. Besides, the third instrument is SPSS Statistics 21, one of whose functions, referring to Chi-Square Goodness-of-Fit Test, can be used to judge whether or not there is significant difference among the frequencies of modal verbs with different value and further judge whether the achievement of interpersonal meaning bears any relationship to value of modality.

2.5 Research Procedures

Research procedures can be divided into four stages. The first stage is to build the corpus and retrieve modal verbs in corpus through AntConc and manual sorting. The second stage is to classify the selected modal verbs by reference to the chosen theories. Then, the third stage is sample processing by SPSS. After that, the results obtained are used to answer research questions and we come to the conclusion.

III. Results and Discussion

3.1 Distribution of Modal Verbs in 60 Abstracts

a. The Overall Frequency of Modal Verbs

As mentioned before, the tokens in the corpus is 11589. After the sorting, the occurrences of each central modal verb are collected in Table 5.

Table 5. Occurrences of modal verbs in the corpus

Modal verbs	Occurrences
can	24
could	5
may	13
might	2
must	2
shall	1
should	1
will	8
would	3
Total	59

According to the above table, it is found that the total occurrence of modal verbs is 59 times. Besides, we can also find that the order from the highest number of occurrence to the lowest is *can*, *may*, *will*, *could*, *would*, *might*, *must*, *shall* and *should*. Here, *can* is the most frequently used while *shall* and *should* are the least frequently used.

b. Frequencies of Modal Verbs with Different Value

In this section, we tend to regard the 59 occurrences as a whole and discuss the frequencies of modal verbs with different value. By reference to the operational definition, we can see that only *must* possesses high value of modality, *will*, *would*, *shall*, and *should* possess median value of modality, and *can*, *could*, *may* and *might* possess low value of modality. The frequencies are show below:

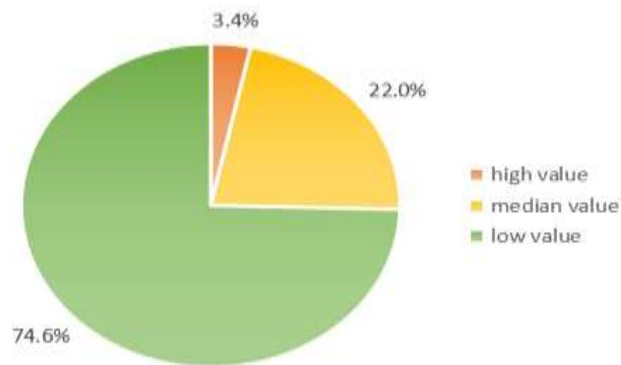


Figure 2 Frequencies of modal verbs with different value

In the above figure, it is intuitive that modal verbs with low value are the most frequently used with the proportion of 74.6%, modal verbs with median value are the second most frequently used with the proportion of 22.0%, while modal verbs with high value are the least frequently used with the proportion of 3.4%. It finds that low-value modal verbs occupy the largest proportion.

c. The Significant Differences on Frequencies of Modal Verbs

In accordance with the above section, it is clear that the frequencies of different modal verbs are different, and so are those of modal verbs with different value. Hence, this section attempts to analyze the reasons for different frequencies of modal verbs with the assistance of results from Chi-Square Goodness-of-Fit Test which focuses on exploring the relationship between the achievement of interpersonal meaning and value of modality. The test results are shown below:

Table 6. Results of Chi-Square Goodness-of-Fit Test

	Observed frequencies	Expected frequencies	Residual	P-value
High	2	19.7	-17.7	.000
Median	13	19.7	-6.7	
Low	44	19.7	24.3	
Total	59			

Table 6 presents the observed frequencies, expected frequencies, the residuals (i.e. the difference between observed frequencies and expected frequencies for each value of modality), and also p-value. It can be noticed that for high value of modality and median value of modality, the observed frequencies are less than expected frequencies, while for low value of modality, the observed frequencies are higher than expected frequencies. Besides, by calculation, it is found that p-value, a decisive factor on whether the difference between observed frequencies and expected frequencies is statistically significant, is .000, less than 0.05. Hence, the differences on frequencies of different modality value are significant.

3.2 Reasons for Different Frequencies of Modal Verbs in 60 Abstracts

Based on 3.1.3, it is known that p-value is less than 0.05, thus, we can infer that the differences among the frequencies of modal verbs with different value are significant. It indicates that the achievement of interpersonal meaning is dependent of value of modality, and writers intentionally use different value of modal verbs to achieve different degrees of interpersonal meaning. Then, in order to figure out the exact relationship between the achievement of interpersonal meaning and value of modality, we tend to compare observed frequencies with expected ones in Table 6. After reviewing its statistics, it is found that when the value of modality is lower, the interpersonal meaning is better achieved.

3.3 Interpersonal Meaning Achieved By Modal Verbs in 60 Abstracts

Based on the above part, it is known that the achievement of interpersonal meaning depends on value of modality, and there must be a one-to-one match between value of modality with the degree of interpersonal meaning. Besides, Table 6 proves that the lower value of modality is, the better interpersonal meaning can be achieved. Hence, corresponding to the three levels of value of modality - high, median and low, interpersonal meaning can be divided into three degrees, which are summarized, from lowest to highest, as tough, comfortable and harmonious. Here, how those degrees of interpersonal meaning are achieved by modal verbs with different value is elaborated with cases.

a. The Tough Interpersonal Meaning of High-Value Modal Verbs

Among the nine central modal auxiliaries, only *must* has the high value of modality. Remarkably, *must* usually suggests that the judgement is based on evidence and conveys the speaker's confidence in the truth of what he is saying, based on a deduction from facts known to him [quoted from Palmer, 2001 and Coates, 1983]. According to Halliday [1994], the high value

expresses the meaning as “certain” in probability, “always” in usuality, “required” in obligation, and “determined” in inclination. Apart from that, *must* indicates obligation/necessity [Biber et al., 1999]. For example:

Example 1

*To make a material that can be used for a long time and whose performance is not changed in the space environment, its ability to resist environmental factors **must** be excellent (from Abstract 21).*

In Example 1, the high-value modal verb *must* expresses the certain attitude of the writers who are exactly sure about the requirement standard for the subject mentioned in the abstracts. Indeed, high value of modality mostly conveys an absolute certainty of writers. They express the meaning of threatening and may affect interpersonal solidarity [Hyland, 2005]. The tough attitude may make readers feel uncomfortable. Therefore, on one hand, high-value modal verbs show the writer’s confidence on what he says, which may bring credibility; on the other hand, they may give offence and be harmful to the interpersonal relationship between writers and readers. In a conclusion, modal verbs with high value overwhelmingly achieve tough interpersonal meaning in academic papers.

b. The Comfortable Interpersonal Meaning of Median-Value Modal Verbs

Modal verbs with median value among the study objects are *will*, *would*, *shall* and *should*. According to Halliday (1994), median value can be regarded as “probable” in probability, “usually” in usuality, “supposed” in obligation and “keen” in inclination. Besides, *will*, *would* and *shall* often indicate volition/prediction, while *should* often indicates obligation/necessity [Biber et al., 1999]. The roles they play in academic discourse are discussed associated with the following examples:

Example 2

*Some basics of solar sailing which **would** be very useful for a new investigator in the area are also presented (from Abstract 23).*

In Example 2, *would* is used here to make an assumption. In fact, *will* and *would* are commonly used to mark logical prediction. In the case of *would*, the meaning is past or hypothetical [Biber et al., 1999]. Here, *would* expresses a more euphemistic tone than *will*. It involves readers as participants and tries to emphasize the advantage of “basics of solar sailing” by way of prediction.

In fact, the use of median-value modal verbs helps information presented as an opinion rather than accredited fact [Hyland, 2002]. With the help of those words, writers convert a stiff way of stating facts to a polite way of sharing opinions. Furthermore, they can be used to make predictions and directives, through which, readers are influenced unconsciously to follow the writers’ thoughts and agree with them step by step. Hence, readers may feel comfortable with the help of median-value modal verbs and the interpersonal relationship is relatively good.

c. The Harmonious Interpersonal Meaning of Low-Value Modal Verbs

It is known that low-value modal verbs in this research specifically refer to *can*, *could*, *may* and *might*. According to Halliday [1994], the low value of modality means “possible” in probability, “sometimes” in usuality, “allowed” in obligation, and “willing” in inclination. Besides, in academic discourse, *can*, *could*, *may* and *might* are often used to express permission/possibility/ability [Biber et al., 1999]. For example:

Example 3

*As such, in this paper, key unsteady aerodynamic parameters are also reviewed and considered prior to deriving potential control solutions that **could** help MAVs fly well in turbulence (from Abstract 48).*

Example 3 shows that *could* expresses the writer's politeness. Frankly speaking, low-value modal verbs can express not only possibility but also permission. They have a better degree of tentativeness than other two values of modality. It seems that low-value modal verbs serve as a communicative bridge between writers and readers, or the negotiating table, by use of which, writers think ahead the readers' responses and choose a gentle and polite way to state their views or new discoveries so as to avoid disputes and gain readers' recognition. Hence, there exists a positive interaction between writers and readers. As a result, readers are nicely brought into the discourse. The interpersonal relationship between writers and readers thus becomes the greatest. That is to say, low-value modal verbs contribute to the harmonious interpersonal meaning in academic discourse.

IV. Conclusion

In general, the study explores the interpersonal meaning of modal verbs with different value in scientific papers and finds that modal verbs with different value are distributed differently and intentionally, by using which writers attempt to achieve different degrees of interpersonal meaning, and they usually prefer median and low value of modal verbs. There is an interrelation between value of modality and degree of interpersonal meaning, that is when the former is lower, the latter is better. Besides, high-value modal verbs often achieve tough interpersonal meaning because of their absolute certainty, median-value modal verbs usually achieve comfortable interpersonal meaning because they provide possibility and show the writers' politeness, and low-value modal verbs mostly achieve harmonious interpersonal meaning because they make the claims the most tentative and leave the largest space of possibility. The significance of this study lies in both academic writing and pedagogy. For one thing, students are encouraged to use more median and low value of modal verbs, interact with readers consciously in their research articles and also balance the degree of interpersonal meaning and writers' authority. For another, teachers can consider modal verbs as a strategy to not only instruct students' writing but also adjust their communicative ways with students by using different value of modality.

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