



## A Systemic Functional Analysis of Metaphors of Modality in Selected Scientific Texts

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### Abstract

This study is aimed at analyzing the metaphors of modality in selected scientific texts. Metaphors of modality are expressed via the explicitly subjective and explicitly objective forms of modality. A Systemic Functional Linguistics perspective is adopted to pinpoint and analyze metaphors of modality. The model of analysis is based on the ideas of Halliday (1985/1994), Martin, Matthiessen and Painter (1997), Eggins (2004), Thompson (2014), and Halliday and Matthiessen (2004). Data selected for the study include a chapter from a scientific textbook and one issue of a scientific journal. The results show that metaphors of modality are realized through explicit subjective forms and explicit objective forms of modality. They affect the interactiveness of the texts and are employed to establish connections and relations between the writers of scientific texts and the readers of those texts.

**Key Words:** Metaphors of Modality, Systemic Functional Linguistics, Scientific Texts.

### المستخلص

تهدف هذه الدراسة إلى تحليل الاستعارات الأسلوبية في نصوص علمية مختارة. ويعبر عن الاستعارات الأسلوبية من خلال الصيغ الذاتية الصريحة والموضوعية الصريحة للأسلوبية. وقد اعتمدت هذه الدراسة المنهج اللغوي النظامي الوظيفي لتحديد وتحليل الاستعارات الأسلوبية. ويستند نموذج التحليل على أفكار هاليداي (١٩٨٥/١٩٩٤)، مارتن وآخرين (١٩٩٧)، إيجينز (٢٠٠٤)، تومسون (٢٠١٤)، وهاليداي وماتيسن (٢٠٠٤). وتشمل البيانات المختارة للدراسة فصلا من كتاب علمي وطبعة من مجلة علمية. وأظهرت نتائج هذه الدراسة أن الاستعارات الأسلوبية تتحقق من خلال صيغ ذاتية صريحة وصيغ



موضوعية واضحة للاسلوبية. وهي تؤثر على التفاعلية في النصوص ويتم استخدامها لاقامة علاقات بين كتاب النصوص العلمية وقرء تلك النصوص.

**الكلمات الدالة:** الاستعارات الاسلوبية، علم اللغة النظامي الوظيفي، النصوص العلمية.

## **1. Introduction**

Scientific language is by some means different to ordinary language. The language of science is typically considered impersonal, abstract and over condensed. Stevens (1976: 64) states that scientific language is simply language used by scientists or for the purposes of those engaged in science. It has the same grammar, pronunciation and spelling as are found in non-scientific language. Stevens (1977:153) also claims that when compared with the rest of 'normal' language, scientific discourse employs a lot of words, roots and affixes of Greek and Latin origin, numbers and symbols. Scientific discourse is also characterized by the use of rather long sentences that are complex and contain many clauses, frequent use of passives to present the important ideas, and the employment of long complicated nominal groups (Ibid, 154).

Halliday remarks that the language of science is "a form of ritual, a way of claiming status and turning science into the prerogative of an elite." These rituals, according to him, serve to create a distance between the writer and the reader to depersonalize the discourse (Halliday & Martin, 2005: 93). Scientific discourse is typically held to be impersonal. Scientific facts are accepted by scientists only if they are objective and impersonal statements. Scientific language can be seen as a 'depersonalized' language isolating a message from its sender and receiver. It uses impersonal forms; i.e. avoids the first and second person and avoids making explicit authorial presence in the texts (Widdowson, 1974: 288). Notwithstanding, researches have shown that in scientific writing writers may choose to announce their presence in the discourse by means of the use of first person pronouns. This rhetorical strategy is frequently used by scientists to promote and gain accreditation for research claims (see Basal & Bada 2012).



The presence of metaphor in scientific discourse has always been problematic. There are two struggling perspectives. Some simply incorrectly accept as true that scientific discourse contains no metaphors, while others have advocated that metaphorical modes of expression play a significant role in scientific discourse. On the one hand, those who reject the presence of metaphor in the discourse of science provide as justification that science is "supposed to be characterized by precision and the absence of ambiguity, and the language of science is assumed to be correspondingly precise and unambiguous – in short, literal." (Ortony, 1993:1). In addition, it is rhetoric that is characterized by the use of metaphors due to their vagueness, not scientific discourse. Consequently, metaphors rarely occur in scientific discourse. On the other hand, the opposing viewpoint to this contends that metaphor is "an essential characteristic of the creativity of language" (Ibid, 2). Metaphors play an important role in scientific discourse, serving as one of the main ways for structuring scientific texts and creating better understanding (Ibid).

Thus, figurative language in general and metaphors in particular are used to dissolve the complexity and ambiguity of scientific texts. They are also used to represent the scientific ideas and theories in a different form. It is known that the place of metaphor in the discourse of science has always been problematic as the study of metaphor has been traditionally correlated with the study of literature. Nevertheless, metaphors play a significant role in scientific discourse particularly in scientific texts. Their main aim is to create a better understanding and to structure scientific texts.

Metaphors are seen as important tools of communication both in scientific writing and in scientific thinking (Johnson, 2010: 39). In addition to that, Kuhn (1993: 539) takes metaphor to have "an essential role establishing links between scientific language and the world."

Metaphor is an important component of scientific texts. Metaphor in these texts is a process that results in obtaining new knowledge about the world through the use of already existing language phenomena. Writers of scientific discourse generally utilize metaphors of different types like the grammatical metaphor, the lexical metaphor, etc.



## **2. Systemic Functional Linguistics**

In systemic functional grammar, a grammar model developed by Michael Halliday, the study of language is seen from a different perspective. According to Halliday (1994: 15), language is “a network of systems, or interrelated sets of options for making meaning”. This means that language is ‘systemic’ where ‘system’ is concerned with the way in which these functions are organized. The term ‘functional’ is used to show that the approach is concerned with meaning since in Systemic Functional Linguistics (henceforth SFL) language is a ‘system of meanings’. Hence, the grammar is “a study of how meanings are built up through the choice of words and other grammatical resources such as singular or plural, negative or positive, and other linguistic forms such as tone and emphasis.” (Bloor & Bloor, 2004: 2). In other words, functional grammar treats the language differently from other grammar models. It is not a grammar of etiquette. It provides us with a “tool for understanding why a text is the way it is”, for it is concerned with language in context (Martin, Matthiessen & Painter, 1997: 3).

Moreover, SFL is a functional theory of language focusing on the idea of ‘language as a social semiotic’. This means that language is viewed in terms of its functions in the human lives. This is simply due to the fact that “the value of a theory lies in the use that can be made of it.” (Halliday, 1985: 7). Thus, language is seen as “a reason for making meaning” (Halliday, 1994: 16). Language is constructed to produce and exchange meanings within a social and cultural context. It plays a central role in human lives. As Halliday (2002: 89) puts it, a functional theory of language “attempts to explain linguistic structure, and linguistic phenomena, by reference to the notion that language plays a certain part in our lives”.

Egins (2004: 3) remarks that SFL considers language as functional, semantic, contextual and semiotic that represents, in her own words, four main theoretical claims about language. She states that:



1. language use is functional
2. its function is to make meanings
3. these meanings are influenced by the social and cultural context in which they are exchanged
4. the process of using language is a *semiotic* process, a process of making meanings by choosing. (Ibid.)

SFL linguists see that the ultimate aim of language use by speakers and writers is to create meaning. In SFL theory, language is observed in use and a systemic view of how language functions is provided. Thus, SFL attempts to shed light on the different ways of language use, the different contexts in which it is used, and the different functions for which it is used (Sowayan, 2009: 29).

As its name implies, SFL focuses on the functions of language. Egging (2004: 2) remarks that SFL concentrates on how language is used by people to facilitate their everyday social life. She (Ibid, 2) remarks that the functional approach tries to find answers for two big questions: a) how language works, and b) how language is structured for use. Thus, language is used to fulfil the functions of making meaning, which is influenced by the social and cultural contexts. That is why the SFL approach is described as a functional semantic approach. Halliday and Matthiessen (2004: 29) indicate that all aspects of human experience can be transformed into meanings, i.e. expressed by language. Furthermore, the process of using language is a semiotic one. This means that it makes meanings by choice (Ibid). In other words, language use involves both lexical and grammatical choices. Besides, language use involves not only the linguistic level but also an extra linguistic level. This last level involves the social, situational, and cultural contexts.

Halliday argues that the functioning of language in human lives is in terms of three functions or as he prefers to call them ‘metafunctions’ rather than mere functions (Halliday, 2006: 1062). According to Halliday (1994: xiii), language is construed to make three simultaneous meanings or metafunctions: ideational, interpersonal, and textual. These three metafunctions have an integral collaboration with themselves and with the outside world. Halliday and Matthiessen (2004: 61) indicate that each of the metafunctions has its



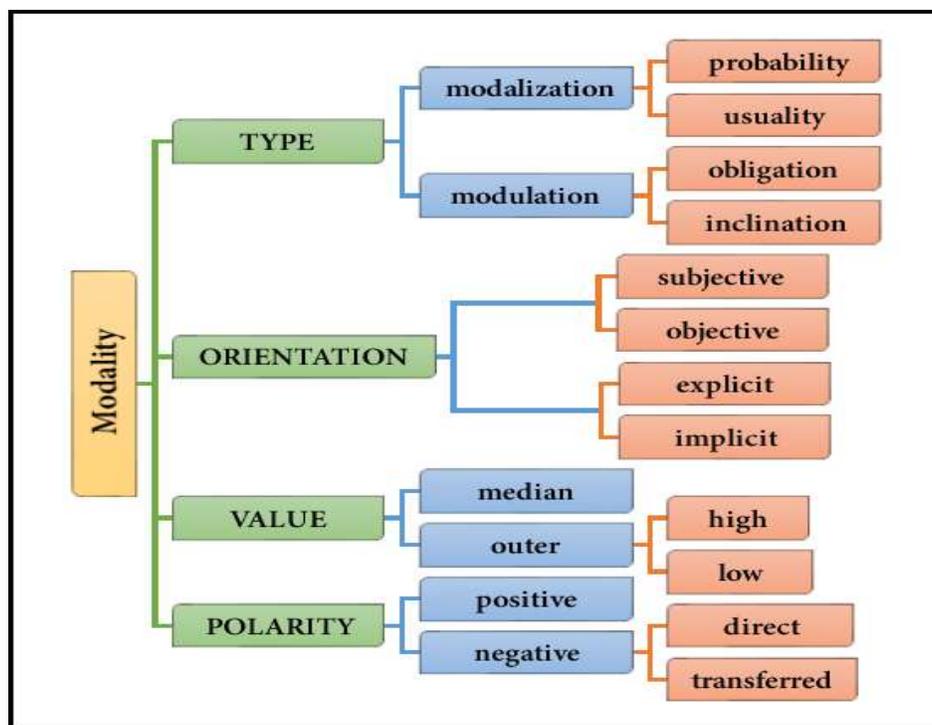
specific purpose that is differentiated from others. The ideational meaning is related to the function of language of representing the experience of outer and inner world. The interpersonal meaning is construed when speakers enact their interpersonal relations. In addition, the textual meaning refers to the organization of the text message.

### **3. Modality**

Eggs (2004: 172) states that modality is a complex area of English grammar. It is concerned with the different ways in which a language user can intrude on a message and express attitude and various kinds of judgments.

According to Butt et al. (2001: 113), the term modality refers to all positioning by speaker about possibility, usuality, typicality, obviousness, obligation and inclination. There are three ways to do modality: by modal finite, by an adverbial group or prepositional phrase identified as mood adjunct and by the interpersonal grammatical metaphor.

In systemic-functional grammar, modality is made up of four sub-systems: type, orientation, value and polarity. According to Halliday (1994: 354), modality can be expressed in a wide range of categories. The set of these categories can be shown in the figure below, adopted from (Ibid, 360):



**Figure 1: Systems of Modality**

Type is the first variable in modality. There are two types of modality: modalization and modulation. The two main types, modalization and modulation, can be identified in accordance with their relation to two kinds of clause: proposition or proposal (Halliday & Matthiessen, 2004: 147). When the clause is employed to exchange information, it is named proposition. Consequently, when modality is employed to argue about the probability or frequency of propositions, it is regarded as modalization. In addition, when the clause is employed to exchange goods-&-services, it is termed proposal. Thus, when modality is employed to argue about obligation or inclination of proposals, it is regarded as modulation (Eggins, 2004: 172):

- 1- Modalization (also called 'deontic modality') is concerned with the meaning ranging between the positive and negative poles, between asserting and denying: positive (*it is so*); negative (*it isn't so*) (Halliday, 1994: 89). Modalization serves to present speaker's judgment on the probability and frequency of statements,



incorporating rank of probability (*possibly/ probably/ certainly*) and rank of usuality (*sometimes/ usually/ always*) (Matthiessen, Teruya & Lam, 2010: 144).

- 2- Modulation (also called 'epistemic modality') is concerned with the meaning of a proposal in the positive and negative poles in prescribing and proscribing: between positive ('do it') and negative ('don't do it') polarity (Halliday, 1994: 89). Modulation serves to present speaker's judgment on the expectability of a suggestion, incorporating rank of obligation (*allowed to/ supposed to*) and rank of inclination (*willing to/ determined to*) (Matthiessen, Teruya & Lam, 2010: 146).

Each of those two types is also divided into two types. Modalization is divided into probability and usuality, whereas modulation is divided into obligation and inclination (Halliday & Matthiessen, 2004: 147) or, more specifically, readiness: inclination and readiness: ability (Martin, Matthiessen & Painter, 1997: 70).

The second variable in modality is orientation. It refers to subjective or objective realizations of modality, with speakers explicitly or implicitly expressing the source of conviction (Halliday & Matthiessen, 2004: 149). Modality orientation is related to the speaker's modal responsibility that is how much explicit responsibility the speaker takes for his attitudes (Thompson, 2014: 75). Modality orientation determines how each modality meaning is expressed. Orientation shows the distinction between subjective and objective modality, and between the explicit and implicit variants (Halliday, 1994: 357; Halliday & Matthiessen, 2004: 620). For instance, in obligation, the congruent realization of modality such as *must* and *necessarily* are implicitly subjective, realized by finites, and implicitly objective forms of realization, realized by adjuncts. Alternatively, the metaphorical realization that covers mental processes of cognition such as *I expect* and attributive processes such as *it is expected* are explicitly subjective and explicitly objective forms of realization (Martin, Matthiessen & Painter, 1997: 68). The relationship between orientation and the types of modality is shown in the following table adopted from Halliday (1994: 357).



**Table 1: Orientation and Types of Modality**

	Metaphor of modality	Non-metaphorical modality	Non-metaphorical modality	Metaphor of modality
<b>ORIENTATION</b> <b>TYPE</b>	<b>Subjective:</b>		<b>Objective:</b>	
	<b>explicit</b>	<b>implicit</b>	<b>implicit</b>	<b>explicit</b>
<b>Modalization: Probability</b>	<i>I think (in my opinion) Mary knows</i>	<i>Mary'll know</i>	<i>Mary probably knows</i>	<i>It isn't likely Mary knows</i>
<b>Modalization: Usuality</b>		<i>Fred'll sit quite quiet</i>	<i>Fred usually sits quite quiet</i>	<i>It's usual for Fred to sit quite quiet</i>
<b>Modulation: Obligation</b>	<i>I want John to go</i>	<i>John should go</i>	<i>John's supposed to go</i>	<i>It's expected that John goes</i>
<b>Modulation: Inclination</b>		<i>Jane'll help</i>	<i>Jane's keen to help</i>	

Value is the third variable in modality. It is related to the evaluation of modality: high, median, and low, as illustrated in the following table adapted from Halliday (1994: 358):

**Table 2: Values of Modality**

<b>Value</b> <b>Type</b>	<b>High</b>	<b>Median</b>	<b>Low</b>
<b>Probability</b>	Certain	Probable	Possible
<b>Usuality</b>	Always	Usually	sometimes
<b>Obligation</b>	Required	Supposed	Allowed
<b>Inclination</b>	Determined	Keen	Willing

Halliday (1985: 335) maintains that modality refers to a semantic area that extends between positive and negative poles depending on speech function as follows:

Information clause realized as indicative means:



- either yes or no, i.e. may be
- both yes and no, i.e. sometimes

Some degree of probability or of usuality is found.

A 'goods-&-services' clause realized as imperative means:

- is wanted to (command)
- wants to (offer)

Some degree of obligation or of inclination is found.

These four types of modality have varying degrees of polarity, i.e. they assume differing semantic spaces between the positive and the negative extremes (Ibid, 336).

#### **4. Metaphors of Modality**

Halliday and Matthiessen (2004: 613) remark that the metaphorical realization of modality is coded as a projecting clause in a hypotactic clause complex. The projection clauses can be either mental or attributive resulting in mental projection and relational projection, respectively. Modality clauses are considered metaphorical because of the "alternative forms of expression" as the meaning extension of the semantic domain.

Significantly, Halliday (1994: 362) maintains that to give a complete account of the metaphors in modality, we need to go back to the categories of orientation, as modality represents the speaker's view. Definitely, both explicit subjective and explicit objective orientations concern metaphoricity because they represent modality as being the substantive proposition. In other words, the explicitly subjective and explicitly objective forms of modality are all metaphors. In view of that, congruent realizations or implicit orientations express modality implicitly whilst metaphorical realizations express modality explicitly. To this, Martin, Matthiessen and Painter (1997: 68) add that the metaphorical



realizations for modality can be formed by "expanding the range of modal meanings beyond those realized by modal verbs as Finite and mood Adjuncts." Consider the following table:

**Table 3: Metaphorical Realizations of Modality**

Type of Modality	Congruent Realizations			Metaphorical Realizations	
	Finite	Adjunct (mood)	Predicator	mental clause	attributive clause
	implicitly subjective	implicitly objective	implicitly objective	explicitly subjective	explicitly objective
<b>Probability</b>	can/ could, may/ might,	possibly, probably, certainly ...		[cognitive:] I guess, I think, I know	it is possible... it is probable... it is certain...
<b>Usuality</b>	will/ would, should,	sometimes, usually, always ...		—	It is unusual (for him to leave)
<b>Obligation</b>	ought to, must	necessarily ...	be allowed to, be supposed to, be obliged to	[affective:] I'm willing for... I expect... I want... (him to leave)	it is permitted it is expected it is necessary (... for him to leave)
<b>Readiness: inclination</b>		willingly, eagerly ...	be willing to, be keen to, be determined to	[verbal group complex:] I'd like to leave I want to leave	it'd be lovely to leave
<b>Readiness: ability</b>	can/ could		be able to	—	it is possible for him to leave

From this table which is adopted from Martin, Matthiessen and Painter (1997: 70), it is possible to recognize that modality is congruently realized by modal finite, e.g. *can*, *may*, *should*, *ought to* and mood adjuncts, e.g. *possibly*, *probably*. These instances are implicit ways of realizing speech function in grammar and regarded as congruent. By contrast, speech function might be projected in a clause complex explicitly, e.g. *I think ...* (explicit subjective), *it is possible to ...* (explicit objective).

## 5. Research Methodology



The methodology of the current study comprises the research design, data description and selection, and the procedures required for conducting the analysis. They are presented in the following subsections.

## **5.1. Research Design**

Halliday (1994: 342) maintains that all adult discourses are characterized by the use of metaphorical modes of expression. Various metaphorical expressions can be found in different registers and they vary from register to another in types and degrees. In addition, any text of more than minimal length would certainly encompass some metaphorical element that needs to be taken into consideration. Halliday proposed some of the functions realized by grammatical metaphor in spoken and written language. He also applies his theory to the analysis of scientific texts. He postulates that grammatical metaphors exist necessarily in scientific texts.

This study will apply Halliday's theory of Systemic Functional Linguistics as the principal theoretical framework to the study of metaphors of modality in scientific texts. It aims at:

1. identifying and describing the interpersonal grammatical metaphors of modality in scientific texts; and
2. exploring their functions in these texts accordingly.

The analysis has to do with the interpersonal grammatical metaphors of modality in the selected scientific texts. They are analysed through the identification of clauses with metaphors of modality, and their interpretation. Finally, the discussion of their functions in scientific texts is carried out.

With the purpose of examining metaphors of modality in scientific texts, this study employs a combination of the descriptive and analytic method. To analyse metaphors, clause is used as the unit of analysis. The analysis is done in terms of interpersonal grammatical metaphors of modality in particular by its view of semantic and lexicogrammatical realizations of functions employed in scientific texts.



As a model of analysis, the Hallidayan Systemic Functional Linguistics model of text analysis is utilized as a point of reference to analyse the types of grammatical metaphor in scientific texts. The model of analysis is based on the ideas of Halliday (1985/1994), Martin, Matthiessen and Painter (1997), Eggins (2004), Thompson (2014), and Halliday and Matthiessen (2004).

## **5.2. Data Description**

In this study, the data are chosen haphazardly for the analysis. They include scientific texts from various sources such as textbooks and journals:

- a. Text No.1 – a textbook that is entitled *A Universe from Nothing*. For the present study, part of this book is chosen for the analysis.
- b. Text No.2 – a journal entitled *Biomedical Journal* (2017).

## **5.3. Data Selection**

As mentioned in the data description, the data are scientific texts relating to diversified scientific topics. These scientific texts are utilized as the corpus in order to identify and analyse the metaphors of modality in these texts depending on Halliday's theory of Systemic Functional Linguistics.

For ease of analysis, texts in diagrams, tables and figures found in the textbook or in the journal articles are excluded from the analysis. Also, the list of references found in the journal articles are also excluded.

## **6. Analysis and Discussion of Metaphors of Modality in the Selected Scientific Texts**

As mentioned earlier, modality has two types: modalization that includes probability and usuality, and modulation that involves obligation and inclination. The interpersonal grammatical metaphor of modality is expressed via the explicitly subjective and explicitly objective forms of modality. They both represent the modality as being the substantive proposition.



In order to analyse metaphors of modality, the clauses that contain modality metaphors are extracted at first. Then, the type of modality and the orientation are categorized. Finally, they are examined and elaborated.

**Table 4: Metaphors of Modality in Text No.1**

No.	Metaphorical realization	Modality type	Orientation
1	You just won't <b>believe</b> how vastly, hugely, mind-bogglingly big it is.	Modalization: Probability	Explicitly subjective
2	One out of two isn't bad, <i>I suppose</i> .	Modalization: Probability	Explicitly subjective
3	We cosmologists <i>had guessed</i> ... that the universe is flat	Modalization: Probability	Explicitly subjective
4	the departure from the density <i>expected</i> for a flat universe increases with time.	Modulation: obligation	Explicitly objective
5	the density of the universe was not almost exactly that <i>expected</i> of a flat universe	Modulation: obligation	Explicitly objective
6	researcher at Stanford University, Alan Guth, <i>was thinking about</i> the Flatness Problem	Modalization: Probability	Explicitly subjective
7	Guth ... <i>was thinking</i> about processes that could have occurred in the early universe	Modalization: Probability	Explicitly subjective
8	The pattern of density fluctuations that result after inflation arising, <i>I should stress</i> , from the quantum fluctuations in otherwise empty space	Modalization: Probability	Explicitly subjective
9	This is so remarkable <i>I want to stress</i> it again.	Modulation: obligation	Explicitly subjective
10	<i>the possibility</i> that positive energy stuff, like matter and radiation, can be complemented by negative energy configurations	Modalization: Probability	Explicitly objective



11	This facet of gravity allows for <i>the possibility</i> that positive energy stuff	Modalization: Probability	Explicitly objective
12	How do <i>we know</i> when the ball will escape?	Modalization: Probability	Explicitly subjective
13	<i>This allows</i> us a marvellous bookkeeping tool to determine how fast one needs to throw something up in the air	Modulation: Obligation	Explicitly objective
14	<i>it is possible to show</i> that we can rewrite the simple Newtonian equation	Modalization: Probability	Explicitly objective
15	<i>you may think</i> it's a long way down the road to the chemist's	Modalization: Probability	Explicitly subjective
16	Including the effects of gravity in thinking about the universe <i>allows</i> objects to have – amazingly–‘negative’ as well as ‘positive’ energy	Modulation: Obligation	Explicitly subjective

**Table 5: Metaphors of Modality in Text No.2**

No.	Metaphorical realization	Modality type	Orientation
1	We <i>know</i> that entosis is genetically controlled form of cell death	Modalization: Probability	Explicitly subjective
2	Although it is <i>unlikely</i> to be the only context in which entosis occurs, it is by far the best studied.	Modalization: Probability	Explicitly objective
3	that it <i>should be considered</i> a biomarker for risk stratification in combination with existing prognostic markers like age.	Modalization: Probability	Explicitly subjective
4	many patients with metabolic syndrome or obesity have hypothyroidism and vice versa although <i>it is not clear</i> which causes which.	Modalization: Probability	Explicitly objective



5	Among these processes, the macroautophagy, which <i>is believed</i> to be more important, is initiated by the formation of autophagosome,	Modalization: Probability	Explicitly objective
6	<i>It is now obvious</i> that there are sophisticated interconnections and overlaps between different types of cell death	Modalization: Probability	Explicitly objective
7	<i>it is still uncertain</i> whether this phenomenon could be used for therapeutics applications.	Modalization: Probability	Explicitly objective
8	<i>It is still not clear</i> whether alterations in thyroid hormones are a cause or an effect of obesity	Modalization: Probability	Explicitly objective
9	From the above study, <i>it is clear</i> those thyroid dysfunctions are independent risk factor for the metabolic syndrome.	Modalization: Probability	Explicitly objective

The above tables illustrate samples of metaphors of modality used in scientific texts found in Text No.1 and Text No.2. From these tables, it is possible to realize that metaphors of modality are employed in scientific texts.

Interpersonal grammatical metaphors of modality can be realized through explicitly subjective forms of modality. The subjective form of modality is embedded in a projected clause expressing a mental process of cognition. There is the following example of a metaphorical realization of modality in a projected clause:

1. *We cosmologists had guessed ... that the universe is flat* [metaphorical probability]

The congruent form of this can be ‘*the universe is probably flat*’. Here, modality is expressed through modal adjunct in a clause.

The explicitly subjective modalization type of modality is found in scientific discourse mainly in the form of probability. Usuality has no explicit subjective forms to



express metaphorical modality. Consider the following samples taken from Text No.1 and Text No.2:

2. *One out of two isn't bad, I suppose.*
3. *You just won't believe how vastly, hugely, mind-bogglingly big it is.*
4. *The pattern of density fluctuations that result after inflation arising, I should stress, from the quantum fluctuations in otherwise empty space*
5. *We know that entosis is genetically controlled form of cell death*

Obligation is the explicitly subjective modulation type of modality found in scientific discourse. Consider the following:

6. *Including the effects of gravity in thinking about the universe allows objects to have –amazingly– ‘negative’ as well as ‘positive’ energy*

In the above examples, the writer's opinion is expressed metaphorically in a projecting clause, such as *I suppose, we had guessed, we know*, etc. and not with modal elements. The personal pronouns (*I, we*) indicate that the opinion is subjective. The mental verbs (*suppose, guess, think, know, believe*, etc.) show different values. To some extent, the writers of scientific texts present their perspectives and views. This subjectivity gives their views and perspectives more clarity and assertiveness. Accordingly, with explicit subjective modality, interpersonal grammatical metaphor is used to construe the writers' responsibility for their views.

Interpersonal grammatical metaphors of modality can also be realized through explicitly objective forms of modality. The objective form of modality is embedded in a projected clause. In explicit objective modality, the clause is relationally projected. By means of the explicit objective modality, interpersonal grammatical metaphor is used to account for the evaluation as a fact not as opinion.

The explicitly objective modalization type of modality is found in scientific discourse mainly in the form of probability as shown below:



7. *it is possible to show* that we can rewrite the simple Newtonian equation
8. many patients with metabolic syndrome or obesity have hypothyroidism and vice versa although *it is not clear* which causes which.
9. *It is now obvious* that there are sophisticated interconnections and overlaps between different types of cell death
10. *it is still uncertain* whether this phenomenon could be used for therapeutics applications.

Here, the explicit objective probability is expressed using a relational projected clause.

Furthermore, interpersonal grammatical metaphors of modality are sometimes realized through nominalization which is "the process by which non-nominal structural elements are made to function as nominal elements." (Heyvaert, 2003: 69). Modalization and modulation can be nominalized to express the explicitly objective orientation. Nouns, such as possibility, probability, certainty, obligation, etc., are often applied to express probability and inclination. These can be shown as follows:

11. *the possibility* that positive energy stuff, like matter and radiation, can be complemented by negative energy configurations
12. This facet of gravity allows for *the possibility* that positive energy stuff ...

In these examples, the modal meaning is constructed as a Thing in order to objectify opinions.

## 7. Conclusions

In terms of the presence of interpersonal grammatical metaphor of modality in scientific discourse, the findings reveal that metaphors of modality can be found in scientific texts. The interpersonal grammatical metaphors of modality are found in the collected data.



Consequently, the interpersonal grammatical metaphors of modality do exist in the scientific texts. Metaphors of modality are realized through explicit subjective forms and explicit objective forms of modality. Through the system of modality, interpersonal grammatical metaphors affect the interactiveness of the texts. They are employed to establish connections and relations between the writers of scientific texts and the readers of those texts. They affect the interaction between the writer and the reader via linguistic choices made by the writer.

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