An Exploratory Study of Epistemic Modal Verbs in Results and Conclusions Sections of the Three Sub-corpora of Humanities & Social Sciences: Implications for L2 Academic Writing [1]

Pınar Karahan[2] ID

Abstract

In this study, the use of epistemic modality in the category of modal verbs was comparatively examined in the results and conclusions sections of journal articles written in the discipline of Humanities & Social Sciences. For this purpose, the Corpus of Journal Articles (CJA) 2014, which is a collection of 760 articles from high-impact journals in 38 disciplines, was used. The articles written in the discipline of Humanities & Social Sciences have further been divided into three sub-corpora: Research articles, Review articles and Theoretical articles. The CJA 2014 corpus consists of 6,015,063 words in total. The aim of the study was to explore professional academic writers' versatility and overall rhetorical awareness with regards to the use of epistemic modal verbs for academic argumentation in the three sub-corpora. In line with this aim, this study investigated in quantitative terms the frequency analysis of the modal verbs "could, may, might, should, will, would, couldn't, wouldn't, shouldn't" for the above-stated three sub-corpora in the Humanities & Social Sciences discipline. Log-likelihood tests were also performed to determine any significant differences among the three sub-corpora. Findings of the study indicated that the most frequently used modal verbs in the results and conclusions section of the Research Articles sub-corpus are "may, would, could", respectively; while the most frequently used modal verbs in the Theoretical sub-corpus are "will, would, may", respectively. Lastly, the most frequently used modal verbs in the Review Articles sub-corpus are "may, will, would". Qualitative examples from the corpora were also provided in the manuscript. This study is expected to have important implications for academic writing in English for different research disciplines and different types of articles.

Keywords: academic writing; epistemic modality; modal verbs; journal articles; research disciplines

Beşerî Bilimler ve Sosyal Bilimlerin Üç Alt Derleminin Bulgular ve Sonuç Bölümlerindeki Bilgi Kip Belirteçlerinin Kullanımı Üzerine Keşifsel Bir Çalışma: İkinci Yabancı Dilde Akademik Yazma Üzerine Çıkarımlar

Özet

Bu çalışmada, Beşerî Bilimler ve Sosyal Bilimler disiplinlerinde yazılan dergi makalelerinin bulgular ve sonuç bölümlerinde yer alan bilgi kip belirteçlerinin kip fiiller kategorisinde kullanımı karşılaştırmalı olarak incelenmiştir. Bu amaçla, 38 disiplinde yüksek etki faktörüne sahip olan dergilerden 760 makalenin yer aldığı Dergi Makaleleri Derlemi (CJA) 2014 kullanılmıştır. Beşerî ve Sosyal Bilimler disiplinlerinde yazılan makaleler ayrıca üç alt gruba ayrılmıştır: Araştırma makaleleri, İnceleme makaleleri ve Teorik makaleler. CJA 2014 derlemi toplamda 6.015.063 sözcükten oluşmaktadır. Çalışmanın amacı, profesyonel akademik yazarların çok yönlülüğünü ve genel retorik farkındalığını, üç alt derlemde akademik argümanlarını sunabilmek için bilgi kip belirteçlerini nasıl kullandıklarını ortaya çıkarmaktır. Bu amaç doğrultusunda, bu çalışmada yukarıda belirtilen üç alt derlem için "could, may, might, should, will, would, couldn't, wouldn't, shouldn't" kip fiillerinin frekans analizi nicel olarak yapılmıştır. Beşerî Bilimler ve Sosyal Bilimler disiplinlerinde yer alan üç ayrı alt derlem arasında herhangi bir anlamlı farklılık olup olmadığını belirlemek için ayrıca log-likelihood olasılık testleri de yapılmıştır. Araştırmanın bulguları, Araştırma Makaleleri alt derleminin bulgular ve sonuç bölümlerinde en sık kullanılan kip fiillerin sırasıyla "may, would, could"; Teorik Makaleler alt derleminde en sık kullanılan kip fiillerin ise sırasıyla "will, would, may". Son olarak, Derleme Makaleleri alt derleminde en sık kullanılan kip fiillerin ise sırasıyla "may, will, would" olduğunu göstermiştir. Manuel analizler kapsamında alt derlemlerden seçilen nitel örnekler de çalışmada sunulmuştur. Bu çalışmanın, farklı araştırma disiplinleri ve farklı makale türleri için İngilizce akademik yazma bağlamında önemli çıkarımlara sahip olması beklenmektedir.

Anahtar Kelimeler: akademik yazma, bilgi kip belirteçleri, kip fiiller, dergi makaleleri, araştırma disiplinleri

Introduction

The conventions of writing academic texts have been capturing an increasing attention of both English as a Foreign Language (EFL) researchers and Native English Speakers (NS) researchers. Research articles as a particular genre in academic discourse seems to be one of the most popular research subject areas. Mastering and gaining experience in academic writing is very important since the international publishing of research articles requires writers to use

---

academic discourse effectively in scientific communities. Therefore, it is crucial for academic writers to be well-equipped with the commonly accepted conventions, rhetorical patterns and strategies of academic writing.

This paper deals mainly with the role of epistemic modality in academic discourse. Academic writers tend to make modal judgments by using the concepts of possibility, necessity and probability. The use of these concepts varies depending on the linguistic background of the writer, the genre and the target readers of the text (Pastor, 2012). In this vein, the main aim of this paper is to analyze how professional academic writers use epistemic modality, specifically, modal verbs.

Language can be considered as an individual choice which is used in different ways by different writers or speakers. For instance, the same ideas can be expressed in many different ways so that the target audience feel sympathy for the writers' stance based on the rhetorical devices employed. Therefore, language choices and linguistic variation can be observed even in the same language (Ozturk, 2007), and in writers or speakers from different linguistic backgrounds (Hinkel, 2009; Salager-Meyer et al., 2003). In this vein, the main aim of this paper is to identify variations in the use of epistemic modality in academic English.

In terms of their epistemic use, modal verbs can be interpreted as indicating inference, reasoning, or evidence. However, besides these interpretations, epistemic modals are also used to indicate the weakening of the speaker or writer's commitment toward the truth value of the utterance or proposition. In this study, this description of epistemic modality is taken into account.

Contrastive approach is adopted in this study due to the fact that academic language varies in the way it is transmitted based on different writers from different language backgrounds and different types of academic articles. Keeping in mind that these possible variations may exhibit both similarities and differences, modal verbs that express epistemic modality in academic research are identified; then, the frequencies of these modals are contrasted in the three types of articles and the possible causes of variations in the use of epistemic modality (if significant variations are observed) are discussed.

The purpose of this study is therefore to investigate the use of epistemic modality in the category of modal verbs that appear only in results and conclusions sections of the journal articles written in the discipline of Humanities & Social Sciences and to explore their relative frequencies in the discipline of Humanities & Social Sciences with respect to the overall incidence of epistemic modal verbs in each of the three sub-corpora: Research articles, Review articles and Theoretical articles. Another aim of the study is to explore professional academic writers' versatility and overall rhetorical awareness about the use of epistemic modal verbs for making academic argumentation in the three sub-corpora. In line with these aims, this study addresses two main research questions below:

1.   What is the relative frequency of epistemic modal verbs that appear in the results and conclusions sections of the articles written in the discipline of Humanities & Social Sciences with respect to the overall incidence of epistemic modal verbs in each of the three sub-corpora? Research articles, Review articles and Theoretical articles.

2.   Is there meaningful difference among the 3 different types of articles in terms of epistemic modal verb use?

Literature Review

Modal Verbs Used as Stance-Taking
Stance-taking is one of the most effective and fundamental human activities realized through language. People observe the world around them and express their emotions and beliefs, agree or disagree with other people in social interaction (Orta, 2010). According to Biber et al., 1999), stance can be defined as the expression of personal feelings, attitudes, value judgments, and assessments based on the propositional content. Some other researchers refer to the expression of opinions as "evaluation" (Hunston & Thompson (eds.), 2000), "appraisal" (White, 2001), and "modality" (Halliday, 1994).
Expressions of stance can be linguistically conveyed by employing various grammatical and lexical devices. Grammatical stance devices include two categories of linguistic components: one of them presents the stance and the other one presents the proposition that is framed by that stance (Orta, 2010).
Modal verbs are used in two ways in terms of modality. They either express the degree of certainty of a proposition which we define as "epistemic modality" or they convey meanings such as necessity, obligation or permission which we define as "deontic modality". The main concern of the present study is epistemic modality which is conveyed by modal verbs.

Modality as a Semantic Category
Modal verbs convey a wide range of meanings, such as permission, obligation, necessity and ability, etc. This means that a writer can express a particular situation in terms of these above-stated meanings. All of these meanings express the subjective attitude or opinion of the writer in relation with reality. Two different kinds of modal meanings can also be expressed by using modal verbs and they are referred to as "epistemic" and "deontic" modality. The former one expresses the degree of possibility, which includes the logical possibility, beliefs and predictability. The latter, on the other hand, expresses permission, volition, and obligation (Orta, 2010).
Biber and Finnegan's (1989) stance framework is the first attempt to reveal the writer attitudes toward academic texts. According to this framework, stance is defined as the grammatical and lexical expression of attitude, feelings, commitments or judgments about the propositional content of the utterance. Based on this definition, "evidentiality" and "affect" are the two components of stance (Orta, 2010). Following the model proposed by Biber and Finegan (1989), Hyland (1999) put forward a more detailed model and this model included three components of stance: "evidentiality", "affect" and "relation".
The term "evidentiality" refers to the writer's commitment to the truth value of the propositions s/he puts forward. Epistemic comments are often achieved by using epistemic modal verbs through which writers express their personal views on a particular proposition (Orta, 2010). The term "affect" refers to the overt expression of a variety of personal attitudes by the writer and the last term "relation" has to do with "the extent to which writers choose to engage with their readers, their degree of intimacy or remoteness, and the ways they represent themselves in the discourse" (Hyland, 1999: 101). Following this model, Hyland (2005a) presented a more comprehensive model of "stance and engagement" so that the new model can cover all of the interpersonal resources that are employed in writing academic texts.

Previous Related Studies

Epistemic modality markers in scientific texts have been investigated in many other previous studies. For instance, Vold (2006) investigated the epistemic modality usages in English, French and Norwegian research articles in the disciplines of linguistics and medicine. Whether there were gender differences in terms of epistemic modality usage have also been investigated within the scope of this study. Findings revealed that markers of epistemic modality used by the Norwegian and English researchers were significantly more than those of French researchers. Moreover, findings showed that gender does not have much influence on the frequency of epistemic modality devices used in academic articles, but significant differences were found between the two disciplines in terms of epistemic modality use. It was ultimately concluded that language and nationality were the two crucial factors affecting epistemic modality use rather than disciplinary variations. Epistemic modality devices were not only investigated in written academic texts but also in spoken texts. For instance, Letica (2009) investigated the use of epistemic modality devices in the spoken texts produced by Croatian speakers both in their mother tongue and English. Findings of this study indicated that the Croatian speakers used a limited range of epistemic devices in both languages. However, the frequency of epistemic devices was relatively higher in Croatian, which is the participants' mother tongue, compared to English. The lower frequency of epistemic devices were claimed to result from the low proficiency of the participants in English and their consequent failure in conveying epistemic modality.

Orta (2010) investigated the use of modal verbs as the expression of epistemic stance in both Spanish and English research articles. Findings of the study revealed that there were significant differences between the English writers (NS) and Spanish writers (NNS) in terms of their use of modal verbs as expressing epistemic stance. Spanish writers were found to exhibit a deviant handling of hedging and boosting resources, and hence, the establishment of a proper tenor. According to Orta (2010), this was related to the mismatch that was observed in the expression of epistemic meaning between some modal verbs. Similarly, He and Wang (2013) investigated the use of epistemic markers in Chinese research articles and they compared these articles with English, French and Norwegian articles. Findings of their study revealed that the relative frequency of epistemic markers used in Chinese research articles were not influenced by the disciplinary conventions and limitations. Another important finding was that the cultural values had a significant effect on the frequency of epistemic markers used in scientific texts as statistical differences were found between the western and Chinese research articles in their employment of hedges.

Sameri and Tavangar (2013) examined a corpus of English and Persian research articles in the sub-corpora of hard and soft sciences written by writers from different linguistic and cultural backgrounds. The researchers attempted to find out whether there were cultural and disciplinary variations in terms of epistemic modality use. Findings of the study demonstrated that the writers of soft sciences research articles employed epistemic modality markers more frequently compared to their hard sciences counterparts. It was also found out that hard sciences articles contained more certainty markers than possibility markers, while the soft science texts contained more possibility markers than certainty markers. Moreover, the researchers also reported that there were statistically significant differences between the English and Persian writers in terms of their epistemic modality use. That is, English writers were found to be using more possibility and certainty markers than their Persian counterparts. Yang et al. (2015) examined the use of epistemic modal expressions in medical research articles. 25 English-medium medical research articles written by native speakers were

examined by the researchers. The study adopted a systematic functional perspective. Results showed that "writers tend to use low or median value epistemic modal expressions and epistemic modal expressions with implicitly subjective/objective or explicitly objective orientations" (Yang et al., 2015: 9). This finding indicated that native-speaker medical research writers exhibited a tentative and objective manner when presenting their claims and they refrained from being subjective. By adapting the frameworks of Hyland (2005a; 2005b) and Biber (2006), Poole et al. (2019) investigated the epistemic stance in the corpus of biochemical research. There were research articles written between 1971 and 2017 within the corpus and they were divided into five time periods. Results of their study showed that the frequencies of 'can' and 'will', increased over time and these two modal verbs were found to express the highest commitment and certainty. Also, these two core modals had higher fluctuations compared to the modals 'would', 'should' and 'might'. Similarly, Doğan&Akbaş (2021) examined epistemic stance in medical research articles. The study aimed to explore how the writers of these articles convey their degree of certainty towards their propositions by using modal auxiliaries, hedges and boosters in the results and discussion sections of their articles. Results demonstrated that there was very frequent use of modal auxiliaries by the writers in the field of medicine to express their epistemic stance Another important and interesting finding was that medical researchers did not use a greater number of boosters to amplify their commitment toward their propositions.

Karahan (2022) comparatively examined the use of epistemic modality in the category of modal verbs in the abstract and introduction section of journal articles written in the discipline of Humanities & Social Sciences. The articles written in the discipline of Humanities & Social Sciences within the Corpus of Journal Articles (CJA) 2014 were further divided into three sub-corpora: Research articles, Review articles and Theoretical articles. Findings of the study showed that the most frequently used epistemic modal verbs varied depending on the nature of each article type. Karahan (2022) suggested that this issue should be further investigated in some other sections of the different types of journal articles apart from the abstract and introduction sections.

In line with the findings of these above-stated previous studies, the present study was designed to investigate the use of epistemic modality within the category of modal verbs in the results and conclusions sections of the journal articles written in the discipline of Humanities & Social Sciences in order to explore the professional academic writers' versatility and overall rhetorical awareness about the use of epistemic modal verbs for making academic argumentation.

Methodology

Sample

Within the scope of this present study, the employment of epistemic modality in the category of modal verbs has been comparatively examined in the results and conclusions sections of journal articles written in the discipline of Humanities & Social Sciences. For this purpose, the Corpus of Journal Articles (CJA) 2014 was used. This corpus includes a collection of 760 articles from high-impact journals in 38 disciplines. The Humanities & Social Sciences discipline, which is used in this study, includes 23 sub-disciplines. The articles written in this particular discipline have further been divided into three sub-corpora: Research articles (RA), Review articles (RVA) and Theoretical articles (TA). The total number of words in the CJA 2014 corpus consists of 6,015,063 words.

Whether the authors writing these articles were native speakers of English or not was not taken into account in this study. The focus was rather on the different types of articles: Research articles, Review articles and Theoretical articles. The main objective was to find out whether there are statistically significant differences among these different types of articles in terms of epistemic modality use. Much of previous research on epistemic modality has focused on the native/ non-native and professional/novice writers' distinction. As far as I know, there is not much research regarding the different types of articles in terms of epistemic modality usage. The present study therefore aims to fill this gap. All of the articles used in this study were selected from the discipline of Humanities & Social Sciences of (CJA) 2014. The reason of investigating only the results and conclusions sections of these articles is because these are the two sections in which the writer is expected to evaluate findings and present claims or views based on them. Table 1 shows the disciplines included in the Humanities and Social Sciences.

Table 1. Disciplines included in the Humanities & Social Sciences

Humanities and Social Sciences	
1	Accounting and Finance
2	Anthropology
3	Applied Social Sciences
4	Archaeology
5	Building and Real Estate
6	Communication
7	Design
8	Economics
9	Education
10	Geography
11	History
12	History of Art
13	Hotel and Tourism Management
14	Law
15	Linguistics
16	Literature
17	Logistics
18	Management and Marketing
19	Music
20	Philosophy
21	Politics
22	Psychology
23	Sociology

Instruments

As a data collection instrument, the Corpus of Journal Articles (CJA) 2014 was used in this study. This corpus includes a collection of 760 articles from high-impact journals in 38

disciplines. The Humanities & Social Sciences discipline, which is used in this study, includes 23 sub-disciplines.

Data Collection Procedures

Both qualitative and quantitative analyses were adopted as a methodology in order to conduct an in-depth investigation of epistemic devices. Since corpora provide authentic contexts of language (real data) and these samples of language is made available for access, retrieval, and analysis via computer, corpus analysis has been a very popular and preferred methodology by researchers in the study of epistemic modality. Along with the frequency analyses of epistemic modal verbs (quantitative analyses), qualitative analyses of data was also used in this study as an important methodological tool so that the various meanings and functions of epistemic linguistic forms could be detected through an exploratory approach.

In the searching procedure for epistemic modal verbs in the three sub-corpora of research articles (RAs), previous studies were consulted (Hyland and Milton, 1997; Rizomilioti, 2006) in order to determine a list of modal verbs with potential epistemic value. A total of 10 forms were derived: could, couldn't, may, might, must, should, shouldn't, would, wouldn't, will. The forms can and can't/cannot were not included in the analysis because they are rarely used epistemically and they have not been previously listed as epistemic forms (see i.e. Coates, 1983; Collins, 2009).

Due to the fact that modal verbs have both deontic (Deontic means basic meaning) and epistemic meanings, this distinction was also taken into consideration during the contextual and manual analyses of articles. The concordance lines for each occurring modal were examined in detail to determine epistemic over non-epistemic occurrences. The detailed reading of concordance lines is important since it is quite possible that modal verbs could be performing contextually some other functions rather than epistemic meanings. Therefore, when non-epistemic uses were detected, they were deleted and not included for analysis; rather, genuine epistemic occurrences were recorded. Deontic cases were excluded from the analysis, as can be seen in Sentence (1) below:

(1)   No one yet knows what reforms will be enacted… (TA, 54919)

Will in the sentence above taken from the Theoretical Articles (TA) sub-corpus is used as deontic modality because it refers to volition. Volition is about the intention and willingness to do something in future time. Therefore, this volition in here is related to the futurity. This occurrence can be given as an instance of deontic modality. Instances like this one were therefore excluded from the analyses.

Another occurrence, which is also excluded from the analysis, is given in Sentence (2) below:

(2)   These fluctuations, which must have been a source of social friction in an alliance maintained, in part, by the exchange of gifts, would at times have led to wars, as one side or both came to see an alliance as less desirable than expected and felt sufficiently aggrieved to use force. (RVA, 108952)

Would in the above sentence taken from the Review Articles (RVA) sub-corpus is also used as deontic modality as it is used as the past tense of will and this usage refers to past prediction or past futurity. This instance was also excluded from the data analyses. After excluding all of the other non-epistemic occurrences, the overall distribution of epistemic modal verbs (together with their normalised frequencies of per 10,000 tokens) in each of the three sub-corpora was calculated in the quantitative analysis.
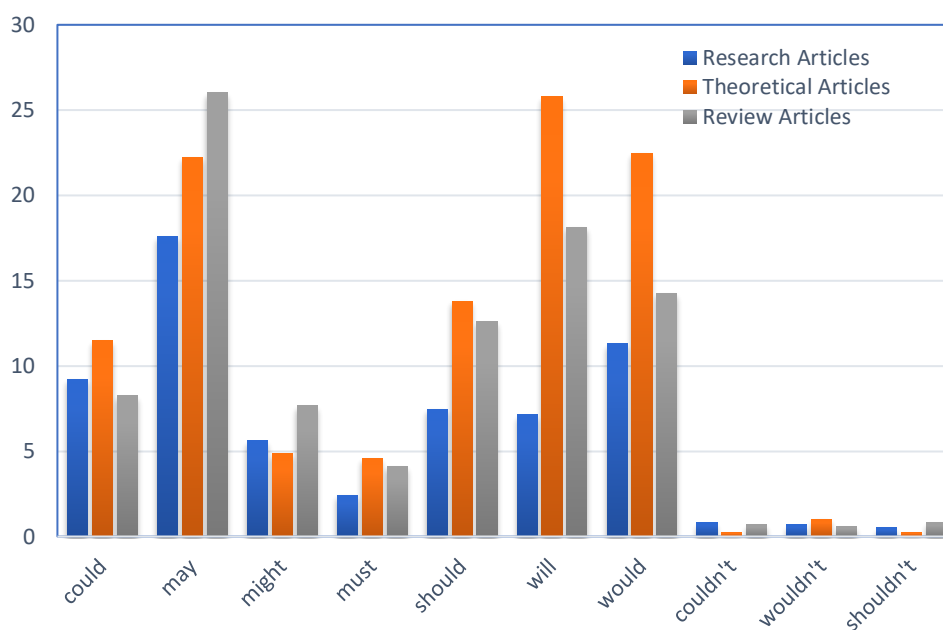
Results

Overall Frequency of Epistemic Modal Verbs in The Three Types of Articles
Table 2 gives the overall distribution of epistemic modal verbs (together with their normalised frequencies of per 10,000 tokens) in the results and conclusions sections of the three types of articles in the Humanities & Social Sciences discipline of the CJA (2014). Figure 1 shows the graphical representation of this normalised distribution.

Table 2. Overall distribution of epistemic modal verbs in the Results & Conclusions sections of three types of articles

Item	Research Articles	Theoretical Articles	Review Articles
could	9.21	11.50	8.25
may	17.60	22.23	26.04
might	5.61	4.85	7.66
must	2.43	4.60	4.12
should	7.46	13.80	12.61
will	7.15	25.80	18.14
would	11.30	22.48	14.25
couldn't	0.81	0.26	0.71
wouldn't	0.68	1.02	0.59
shouldn't	0.51	0.26	0.82

As both Table 2 and Figure 1 demonstrates, may, will and would are the most commonly used epistemic modal verbs in the results and conclusions sections of each of the three article types. Following may, will and would, should, could and might are most frequently used in the three types of articles. The most frequently used epistemic modal verb in the research articles (RA) sub-corpus is may (17.60); in the theoretical articles (TA) sub-corpus is will (25.80); and in the review articles (RV) sub-corpus is may again (26.04). The negative forms couldn't, wouldn't, shouldn't are least frequently used in their epistemic sense in each of the three article types.

Figure 2 below shows the graphical representation of the overall distribution of epistemic modal verbs in the Results and Conclusions sections of Research Articles (per 10,000 tokens).
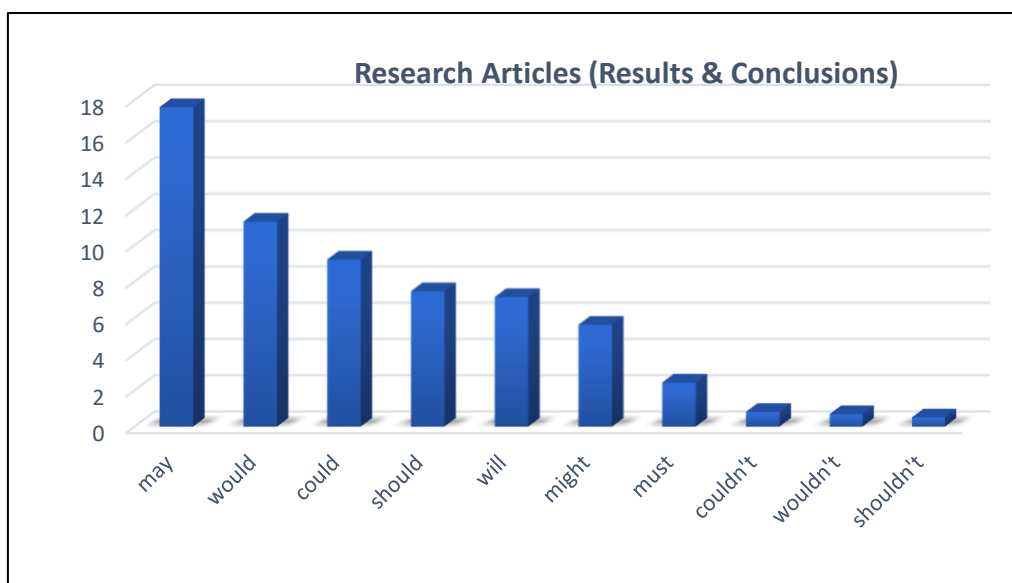

Figure 2. Overall distribution of epistemic modal verbs in the Results and Conclusions sections of Research Articles (per 10,000 tokens)

Figure 2 above indicates that the most frequently used three epistemic modal verbs in the results and conclusions sections of research articles are may, would and could, respectively. Couldn't, wouldn't and shouldn't are the least frequently used three epistemic modal verbs.

Figure 3 below demonstrates the graphical representation of the overall distribution of epistemic modal verbs in the results and conclusions sections of Theoretical Articles (per 10,000 tokens).
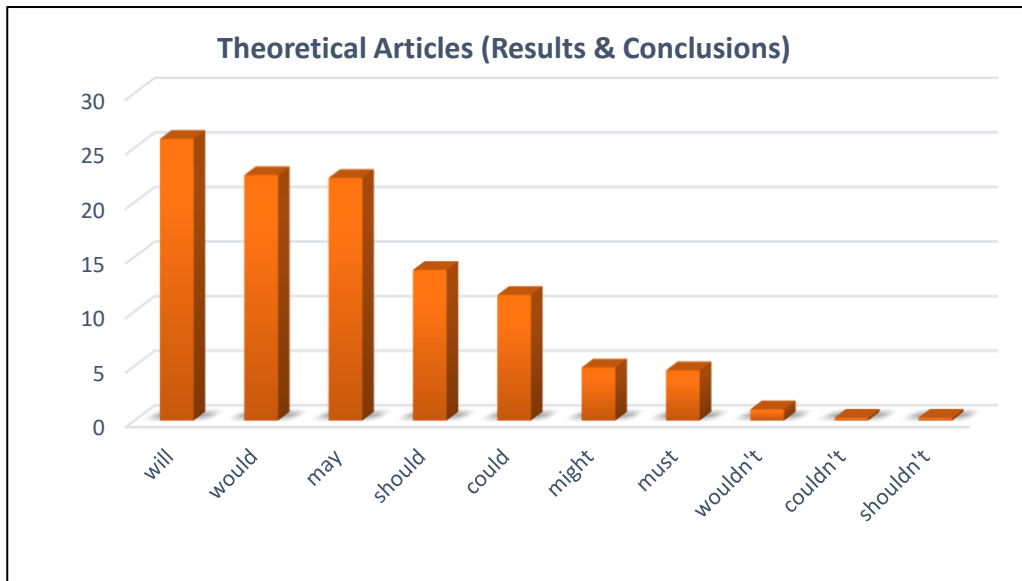

Figure 3. Overall distribution of epistemic modal verbs in the Results and Conclusions sections of Theoretical Articles (per 10,000 tokens)

As can be seen from Figure 3, the most frequently used three epistemic modal verbs in the results and conclusions sections of theoretical articles are will, would and may, respectively. Wouldn't, couldn't and shouldn't are the least frequently used three epistemic modal verbs.

Figure 4 below shows the graphical representation of the overall distribution of epistemic modal verbs in the results and conclusions sections of Review Articles (per 10,000 tokens).
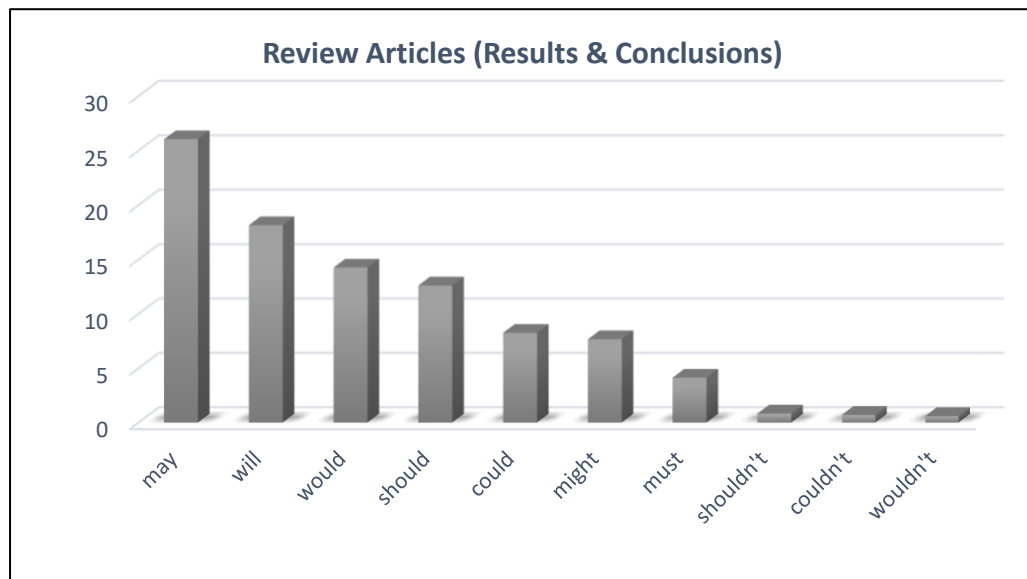

Figure 4. Overall distribution of epistemic modal verbs in the Results and Conclusions sections of Review Articles (per 10,000 tokens)

As shown in Figure 4 above, the most frequently used three epistemic modal verbs in the results and conclusions sections of review articles are may, will and would, respectively. Shouldn't, couldn't and wouldn't are the least frequently used three epistemic modal verbs.

Results of the Log-Likelihood Tests for epistemic modal verbs across the Results and Conclusions sections of the three sub-corpora (Research, Theoretical and Review Articles)

In this section, results of the Log-Likelihood Tests for epistemic modal verbs across the results and conclusions sections of the three sub-corpora (Research, Theoretical and Review Articles) are presented.

Table 4 below shows the Log-Likelihood (LL) values for the epistemic modal verbs between the results and conclusions sections of Research and Theoretical articles.

Table 4. LL values for epistemic modal verbs between the results and conclusions sections of Research and Theoretical articles

Item	Observed frequencies		Expected frequencies			Significance
	Research	Theoretical	Research	Theoretical	LL	level: $p<0.05$
could	9.21	11.50	10.35	10.35	0.25	
may	17.60	22.23	19.92	19.92	0.54	
might	5.61	4.85	5.23	5.23	0.05	
must	2.43	4.60	3.51	3.51	0.68	
should	7.46	13.80	10.63	10.63	1.91	
will	7.15	25.80	16.48	16.48	11.21	Sig.
would	11.30	22.48	16.89	16.89	3.88	Sig.
couldn't	0.81	0.26	0.53	0.53	0.30	
wouldn't	0.68	1.02	0.85	0.85	0.07	
shouldn't	0.51	0.26	0.38	0.38	0.08	

As Table 4 demonstrates above, the log-likelihood tests carried out to compare epistemic modal verbs between the results and conclusions sections of research and theoretical articles returned significant differences for will (LL 11.21) and would (LL 3.88) This difference turned out to be statistically significant at the $p<0.05$ level.

Table 5 below reveals the Log-Likelihood (LL) values for the epistemic modal verbs between the results and conclusions sections of Research and Review articles.

Table 5. LL values for epistemic modal verbs between the results and conclusions sections of Research and Review articles

Item	Observed frequencies		Expected frequencies			Significance
	Research	Review	Research	Review	LL	level: $p<0.05$
could	9.21	8.25	8.73	8.73	0.05	
may	17.60	26.04	21.82	21.82	1.64	
might	5.61	7.66	6.63	6.63	0.32	
must	2.43	4.12	3.28	3.28	0.44	
should	7.46	12.61	10.03	10.03	1.33	
will	7.15	18.14	12.64	12.64	4.94	Sig.

would	11.30	14.25	12.78	12.78	0.34
couldn't	0.81	0.71	0.76	0.76	0.01
wouldn't	0.68	0.59	0.64	0.64	0.01
shouldn't	0.51	0.82	0.67	0.67	0.08

As Table 5 shows above, the log-likelihood tests carried out to compare epistemic modal verbs between the results and conclusions sections of research and review articles returned significant differences for only will (LL 4.94). This difference turned out to be statistically significant at the p<0.05 level.

Table 6 below demonstrates the Log-Likelihood (LL) values for the epistemic modal verbs between the results and conclusions sections of Theoretical and Review articles.

Table 6. LL values for epistemic modal verbs between the results and conclusions sections of Theoretical and Review articles

Item	Observed frequencies		Expected frequencies			Significance level: $p < 0.05$
	Theoretical	Review	Theoretical	Review	LL	
could	11.50	8.25	9.87	9.87	0.54	
may	22.23	26.04	24.13	24.13	0.30	
might	4.85	7.66	6.26	6.26	0.63	
must	4.60	4.12	4.36	4.36	0.03	
should	13.80	12.61	13.20	13.20	0.05	
will	25.80	18.14	21.97	21.97	1.34	
would	22.48	14.25	18.37	18.37	1.86	
couldn't	0.26	0.71	0.48	0.48	0.22	
wouldn't	1.02	0.59	0.81	0.81	0.12	
shouldn't	0.26	0.82	0.54	0.54	0.32	

As demonstrated on Table 6 above, the log-likelihood tests carried out to compare epistemic modal verbs between the results and conclusions sections of theoretical and review articles returned statistically no significant differences for any of the epistemic modal verbs at the p<0.05 level.

Epistemic meanings of the most commonly used epistemic modal verbs across the sub-corpora: "may, would, will and could"

The modal verb may was found to be most commonly used in both the research and review articles sub-corpora for expressing epistemic possibility, weakened prediction sense, speculation on a cause, interpretation of a result. Would was found to be the most commonly used modal verb in the theoretical articles sub-corpora. Writers seemed to use would in its epistemic sense when they wanted to be more tactful and polite towards their claims, since the epistemic meaning of would, compared to will, "is less assured and forthright" and "is often used to reduce the [writer's] level of confidence in the truth of the proposition" (Collins 2009: 142). In the case of epistemic will, however, a prediction that is stronger and more direct was observed to be expressed, and this modal verb was used in its epistemic sense where writers had enormous confidence in the evidence and knowledge that warranted their claims.

Could may also be frequently used as the past form of can, though in many cases, it can also be used to express politeness or some other indirect speech with pragmatic considerations. Could to express epistemic possibility is much more related to the remoteness in time and reality (Zhang, 2019).

Instances of most commonly used epistemic modal verbs in research articles sub-corpus: "may, would, could"
Such challenges may be unavoidable in the Taiwanese EFL context. (RA, 2108876)
This indicates that missing or unpublished studies would actually increase, rather than decrease, the overall effect size. (RA, 608551)
The relatively small effect of trust on governance network performance compared with previous research could be of importance here. (RA, 665146)

Instances of most commonly used epistemic modal verbs in theoretical articles sub-corpus: "will, would, may"
A richer internalization theory of the MNE will also allow management scholars as well as economists to talk meaningfully about the sources and persistence (or lack thereof) of firm-level competitive advantage and associated superior financial performance. (TA, 160226)
If the Japanese economy can exceed these forecasts and resume growth in the second half of 2014, this would be very good news for Abenomics. (TA, 54638)
Of course, future performance is highly uncertain, and it is quite possible that Abenomics may exceed (or underperform) our expectations and those of professional forecasters. (TA, 52813)

Instances of the most commonly used epistemic modal verbs in review articles sub-corpus: "may, will, would"
Each of these approaches has its legitimacy and may be appropriate in a specific situation. (RV, 2427)
The results [of this study] indicate that the balance of traffic between the 'spinal' routes and the peripheral parkways will be more heavily oriented to the spines than to the parkways than was anticipated in the General Plan Concept. (RV, 136003)
Thus, the adoption of a more central, autonomous, and nonpoliticized role for the IAEA would enhance the value of any negotiated agreement. (RV, 393009)

Discussion of Overall Findings
The findings of this exploratory study on the use of epistemic modal verbs in the results and conclusions sections of journal articles written in the discipline of Humanities & Social Sciences revealed that may, will and would are the most commonly used epistemic modal verbs in the results and conclusions sections of each of the three article types. The most frequently used epistemic modal verb in the research articles (RA) sub-corpus is found to be may (17.60); will (25.80) in the theoretical articles (TA); and may again (26.04) in the review articles (RV) sub-corpus. The negative forms couldn't, wouldn't, shouldn't are found to be the least frequently used epistemic modal verbs in each of the three article types. Comparing these findings with Karahan (2022) who comparatively examined the use of epistemic modality in the category of modal verbs in the abstracts section of journal articles written in the discipline of Humanities & Social Sciences, may was found to be the most commonly used epistemic modal verb in the abstract sections of each of the three article types. However, in this study the most commonly used epistemic modal verbs show variation depending on each article type. The observed

variations could also be related to the different sections of the articles that were analyzed in both studies. While Karahan (2022) investigated the use of epistemic modal verbs in the abstracts and introductions sections of journal articles, the present study focused on epistemic modal verbs occuring in the results and conclusions sections of journal articles.

As for the similarities, the negative forms couldn't, wouldn't, shouldn't were found to be the least frequently used modal verbs in Karahan (2022), which is in line with the findings of this study.

In Karahan's (2022) study, the use of epistemic modality in the category of modal verbs in the introductions section of journal articles written in the discipline of Humanities & Social Sciences were also comparatively examined, and the most frequently employed modal verb in the research articles (RA) was found to be may (14.97); in the theoretical articles (TA) would (17.80); and in the review articles (RV) should (10.02), with the frequencies indicated in parantheses. In line with the findings of Karahan (2022), the present study also found out that the most frequently employed epistemic modal verb in the research articles (RA) sub-corpus is may (17.60). However, the findings show variations in the other two sub-corpora. While Karahan (2022) found would as the most frequently employed modal verb in its epistemic sense in the theoretical articles (TA) sub-corpus, according to the findings of the present study, will appears as the most frequently employed modal verb in its epistemic sense in the theoretical articles (TA) sub-corpus. As for the review articles (RV) sub-corpus, Karahan (2022) found should as the most frequently employed modal verb. However, according to the findings of this study, may appears as the most frequently employed modal verb in its epistemic sense in the review articles (RV) sub-corpus.

The present study also conducted Log-likelihood tests to compare epistemic modal verbs between the results and conclusions sections of research and theoretical articles and this analysis returned significant differences for will (LL 11.21) and would (LL 3.88) This difference turned out to be statistically significant at the $p<0.05$ level. The log-likelihood tests were conducted again this time to compare epistemic modal verbs between the results and conclusions sections of research and review articles and this analysis returned significant differences for only will (LL 4.94). This difference turned out to be statistically significant at the $p<0.05$ level. Lastly, the log-likelihood tests were conducted for the third time to compare epistemic modal verbs between the results and conclusions sections of theoretical and review articles. The findings returned statistically no significant differences for any of the epistemic modal verbs at the $p<0.05$ level. Comparing these findings with Karahan (2022), the log-likelihood tests carried out to compare epistemic modal verbs between the abstract sections of research and theoretical articles returned significant differences for should (LL 4.37) and will (LL 9.45) This difference turned out to be statistically significant at the $p<0.05$ level. The log-likelihood tests carried out to compare epistemic modal verbs between the abstract sections of research and review articles returned significant differences for will only (LL 3.88). This difference turned out to be statistically significant at the $p<0.05$ level. However, the log-likelihood tests carried out to compare epistemic modal verbs between the abstract sections of theoretical and review articles returned statistically no significant differences for any of the epistemic modal verbs at the $p<0.05$ level. As for the log-likelihood tests carried out to compare epistemic modal verbs between the introduction sections of research and theoretical articles, the analysis returned significant differences for would (LL 6.55), which is statistically significant at the $p<0.05$ level. However, the log-likelihood tests carried out to compare epistemic modal verbs between the introduction sections of research and review articles returned statistically no significant differences for any of the epistemic modal verbs at the

p<0.05 level. Lastly, the log-likelihood tests carried out to compare epistemic modal verbs between the introduction sections of theoretical and review articles returned significant differences for would (LL 3.86), which is statistically significant at the p<0.05 level.

Whether all of the above-stated variations stem from the different types of articles should be further investigated. It could be hypothesized that all these three types of articles (Research articles, theoretical articles and review articles) have some different discourse functions and communicative purposes. These potential differences might affect the epistemic modal verb preferences of professional writers depending on the type of article they write.

Discussing the epistemic meanings of of the most commonly used epistemic modal verbs across the sub-corpora, the modal verb may was found to be most commonly used in both the research and review articles sub-corpora for expressing epistemic possibility, weakened prediction sense, speculation on a cause, interpretation of a result. Similarly, the findings of Yang et al. (2015) showed that "writers tend to use low or median value epistemic modal expressions and epistemic modal expressions with implicitly subjective/objective or explicitly objective orientations" (Yang et al., 2015, p. 9). In their investigation of epistemic stance in medical research articles, Doğan&Akbaş (2021) also aimed to explore how the writers of these articles convey their degree of certainty towards their propositions by using modal auxiliaries, hedges and boosters in the results and discussion sections of their articles. Results of their study demonstrated that there was very frequent use of modal auxiliaries by the writers in the field of medicine to express modality; however medical researchers did not use a greater number of boosters to amplify their commitment toward their propositions.

As for would, it was found to be the most commonly used modal verb in the theoretical articles sub-corpora. Writers seemed to use would in its epistemic sense when they wanted to be more tactful and polite towards their claims, since the epistemic meaning of would, compared to will, "is less assured and forthright" and "is often used to reduce the [writer's] level of confidence in the truth of the proposition" (Collins 2009, p.142). In the case of epistemic will, however, a prediction that is stronger and more direct was observed to be expressed, and this modal verb was used in its epistemic sense where writers had enormous confidence in the evidence and knowledge that warranted their claims. In a similar vein, Poole et al. (2019) investigated the epistemic stance in the corpus of biochemical research. There were research articles written between 1971 and 2017 within the corpus and they divided into five time periods. Their results showed that the frequencies of 'can' and 'will', increased over time and these two modals express the highest commitment and certainty. Also, these two core modals had higher fluctuations than the modals 'would', 'should' and 'might'.

Could may also be frequently used as the past form of can, though in many cases, it can also be used to express politeness or some other indirect speech with pragmatic considerations. Could to express epistemic possibility is much more related to the remoteness in time and reality (Zhang, 2019).

Overall, the epistemic meanings of the most commonly used epistemic modal verbs across the sub-corpora in this study are similar to the meanings identified in Karahan (2022), Poole et al. (2019), and Yang et al. (2015), Doğan & Akbaş (2021).

Conclusion and Implications

This study has comparatively examined the use of epistemic modality in the category of modal verbs in the results and conclusions sections of journal articles written in the discipline of Humanities & Social Sciences. The articles written in the discipline of Humanities & Social

Sciences have further been divided into three sub-corpora for detailed analysis and also to identify any statistically significant differences among the three types of articles in terms of epistemic modal verb usage: Research articles (RA), Review articles (RVA) and Theoretical articles (TA).

Findings of this study might have several important implications relating to both theory and practice. However, the diversity of epistemic modal verb use among the different types of articles should be further investigated in some other academic disciplines and corpora in future studies. It has been revealed throughout this paper that writers employ a variety of modal verbs in order to convey epistemic meaning. They communicate with their potential readers in this way either by weakening their claims or by making strong arguments towards their propositions. This knowledge of epistemic meanings may be crucial for especially non-native and novice writers mastering in specific academic disciplines so that they can write their own conventionally well-developed academic texts (Doğan & Akbaş, 2021; Akbaş & Hardman, 2018). When they can present their claims in a safe and convincing way, then their target readers will most likely to be able to make more accurate logical inferences from their claims. It is therefore important that academic writing classes may be re-designed taking into consideration the expression of epistemic modality in different types of articles in various academic disciplines. Specific writing activities focusing on the epistemic uses of target linguistic devices can be prapared. Teachers can also equip their learners with the basics of epistemic modality by introducing these linguistic items to them through different kinds of texts. In this way, learners can also be made aware of the different linguistic functions of modal verbs (Karahan, 2022).

Many other variables such as the age range of the academic writers, years of academic experience and gender may also affect the employment of epistemic modality devices in academic writing (Khoshsima, Baghsiahi & Moafian, 2016). Within the scope of this study, these variables were not taken into account since these information were not available. Therefore, further research might focus on these variables. Due to the importance of epistemic modality devices in academic writing, specific focus on each variable could shed more light on the various functions of these devices in academic discourse.

References

Akbaş, E., & Hardman, J. (2018). Strengthening or weakening claims in academic knowledge construction: A comparative study of hedges and boosters in postgraduate academic writing. *Educational Sciences: Theory and Practice, 18*(4), 831-859.

Almakrob, A. Y. (2020). Culture-specific aspects of turn-taking: An analysis of conversations in a Saudi context. Available at SSRN 3621264.

Biber, D. & E. Finnegan (1989). "Styles of stance in English: Lexical and grammatical marking of evidentiality and affect". Text 9: 93-124.

Biber, D. (2006). Stance in spoken and written university registers. *Journal of English for Academic Purposes, 5*(2), 97–116.

Biber, D., Stig J. Geoffrey L., Susan C. and Edward F. (1999) *Longman Grammar of Spoken and Written English*. London: Longman.

Carrió Pastor, M. (2012). A contrastive analysis of epistemic modality in scientific English. *Revista de Lengua Para Fines Específicos, 18*, 115-132.

Coates, J. (1983). *The Semantics of the Modal Auxiliaries*. London: Croom Helm.

Collins, P. (2009) *Modals and Quasi-modals in English*. Amsterdam: Rodopi.

Crompton, P. (2012). *Characterising hedging in undergraduate essays by Middle Eastern students. The Asian ESP Journal, 8*(2), 55-78.

Doğan, Z. N., & Akbaş, E. (2021). An exploratory study of epistemic stance in results and discussion sections of medical research articles. *Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 25*(3), 1132-1150.

Halliday, M.A.K. (1994). *An Introduction to Functional Grammar*, 2nd ed. London: Arnold

He, Y., & Wang, H. (2013). *A corpus-based study of epistemic modality markers in Chinese research articles.* In Workshop on Chinese Lexical Semantics (pp. 199-208). Springer, Berlin, Heidelberg.

Hinkel, E. (2009). The effects of essay topics on modal verb uses in L1 and L2 academic writing. *Journal of Pragmatics, 41(*4), 667-683.

Hunston, S., Thompson, G. (Eds.). (2000). *Evaluation in text: authorial stance and the construction of discourse.* Oxford: Oxford University Press.

Hyland, K. (1999). *Disciplinary discourse writer stance in research articles.* in C. Candlin & K. Hyland (eds.), Writing: Texts, Processes and Practices, 99-121. London: Longman.

Hyland, K. (2005a). *Metadiscourse: Exploring Interaction in Writing*. Continuum.

Hyland, K. (2005b). Stance and engagement: A model of interaction in academic discourse. *Discourse Studies, 7*(2), 173-192.

Hyland, Ken and Milton J. (1997). Qualification and certainty in L1 and L2 students' writing. *Journal of Second Language Writing 6*(2), 185–205.

Karahan, P. (2022). Comparative analysis of epistemic modal verbs in the three sub-corpora of humanities & social sciences. *International Journal of Educational Spectrum, 4* (1), 43-63. DOI: 10.47806/ijesacademic.1070806

Khoshsima, H., Talati-Baghsiahi, A., & Moafian, F. (2016). A Cross-linguistic and Cross-cultural Study of Epistemic Modality Markers in Linguistics Research Articles.

Letica, S. (2009). *Use of epistemic modality by non-native speakers of English.* In R. Lugossy, J. Horváth and M. Nikolov (Eds.). UPRT 2008: Empirical studies in English applied linguistics (pp 119-134). Pécs: Lingua Franca Csoport.

Nunn, R., & Dhabi, A. (2014). Holistic learning, first-person voice and developing academic competence. *Asian EFL Journal, 74*, 19-32.

Orta, I. V. (2010). A contrastive analysis of the use of modal verbs in the expression of epistemic stance in Business Management research articles in English and Spain. *Iberica, 19*, 77-96.

Ozturk, I. (2007). The textual organisation of research article introductions in applied linguistics: Variability within a single discipline. *English for Specific Purposes, 26*(1), 25-38

Poole, R., Gnann, A., & Hahn-Powell, G. (2019). Epistemic stance and the construction of knowledge in science writing: A diachronic corpus study. *Journal of English for Academic Purposes, 42*.

Rizomilioti, V. (2006). Exploring epistemic modality in academic discourse using corpora. *Information Technology in Languages for Specific Purposes. 73*, 53-71.

Salager-Meyer, F., Ariza, M. Á. A., & Zambrano, N. (2003). The scimitar, the dagger and the glove: Intercultural differences in the rhetoric of criticism in Spanish, French and English medical discourse (1930–1995). *English for Specific Purposes, 22*(3), 223-247.

Sameri, M. and Tavangar, M. (2013). Epistemic modality in academic discourse: A cross-linguistic and cross-disciplinary study. *Iranian EFL Journal, 9(*4), 127-147.

Vold, E. T. (2006). Epistemic modality markers in research articles: a cross-linguistic and cross-disciplinary study*. International Journal of Applied Linguistics, 16*(1), 61-87.

White, P.R. (2001). "Appraisal: An Overview". URL: http://www.grammatics.com/appraisal/ AppraisalGuide/Framed/Appraisal-Overview.htm [10/05/2009]

Yang, A., Zheng, S., & Ge, G. (2015). Epistemic modality in English-medium medical research articles: A systemic functional perspective. *English for Specific Purposes, 38*, 1-10.

Zhang, S., Liu, Q., & Cai, Z. (2019). Exploring primary school teachers' technological pedagogical content knowledge (TPACK) in online collaborative discourse: An epistemic network analysis. *British Journal of Educational Technology, 50*(6), 3437-3455.