Comparative Study of Conclusion Section of Aerospace Research Article (RA) in the Use of Interactional Metadiscourse

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Abstract—**This study provides a comparative corpus-based analysis of interactional metadiscourse between Chinese scholars and English native speakers' conclusion section of aerospace research articles. For this purpose, based on Hyland's (2005) interactional metadiscourse taxonomy, 52 aerospace conclusions writing pieces from two high-profile journals were selected for analysis. Results indicate that the discrepancy in total number and frequency lies in the use of hedges, boosters, and attitude markers. Linguistic features, sociocultural factors, and rhetoric functions are responsible for these discrepancies. This work may shed lights on academic writing and pedagogy.**

Index Terms—**Metadiscourse, interactional metadiscourse, conclusion, research article, aerospace**

I. INTRODUCTION

With the increasing interaction of the international academic community, how can scholars efficiently report, evaluate and spread academic ideas on the international academic stage and construct international academic identity are in the spotlight. Research Article (RA) is a key media, which plays an increasingly important role in spreading academic ideas. Besides, the aerospace industry develops by leaps and bounds in China, which attracts attention worldwide. In order to meet the demand of the development of the aviation industry, aerospace researchers need to improve their academic literacy and English proficiency.

However, it has been said that non-native scholars find it difficult to publish academic articles in international journals because of the difference in academic writing styles and strategies [1]. In this regard, it's necessary to pay attention to the structure and linguistic features of academic writing for some pedagogical purposes.

Kopple [2] points out that "when we write, we usually write at two levels". The first level contains propositional content that is the subject of the text, while the second level is metadiscourse that helps readers read, organize, understand and interpret the writing". Metadiscourse in his statement is a resource referring to a kind of social and communicative engagement between writer and reader, by using metadiscourse, writers can express their attitude through texts, and pave the way for them to make connections with their readers. In this process, writers do not simply report research findings in an objective or impersonal way, but actively draw from a range of rhetorical strategies rooted in their own disciplines and sociocultural milieus to organize

arguments, provide evidence, and evaluate claims to convince readers and build a bridge with them[3], which not only shows the pivotal role of metadiscourse but also indicates that the research of academic discourse is developing from a superficial level that describes linguistic feature into a deeper level.

The importance of metadiscourse to academic communication has received scholars' attention over the past decades [4]. Previous researches show that scholars were keen to investigate the different use of metadiscourse across different languages, disciplines, and genders from the perspectives of functional, cognitive, and pragmatic.

However, previous study still remains a gap. First and foremost, most studies in metadiscourse have paid more attention to abstracts, introduction, and discussion sections of research articles than the conclusion section. The conclusion section of a research article is worth investigating, which not only provides an instructive summary of the research result but also serves as an advertising function to promote the research [5]. Second, Previous studies only investigate the subset of the interactional metadiscourse markers, only scantly studies give a comprehensive and systematic analysis of all metadiscourse markers. The next issue is that there is a lack of research putting metadiscourse into classroom practice, especially in academic writing classes related to students' majors. This study suggests language educators need to incorporate metadiscourse knowledge into academic writing teaching classroom. Hopefully, the present study can contribute to the teaching of English for Academic Purposes (EAP) and provide useful cues for scholars in publishing a successful article and producing a reader-friendly article.

II. LITERATURE REVIEW

A. Definition and Classification of Metadiscourse

The term "metadiscourse" was first put forward by Harries, which derived from the Greek word "beyond" and "discourse", it offers a way of understanding the language in use [6]. Then, Williams formally used this term in his writing [7]. Metadiscourse has maintained a steady interest among scholars for twenty years [8]. Due to its vagueness, scholars have different definitions of "metadiscourse". Kopple [2] defines metadiscourse as "discourse about discourse, communication about communication", indicating metadiscourse as a linguistic material that does not add propositional information but signals the presence of an author. When we write on the level of metadiscourse, we supply cues that help readers organize, interpret, and evaluate the propositional content of the text. Similarly, Crismore [3]

distinguished primary discourse from metadiscourse coming from the perspective of pragmatic rhetoric. Swales' [9] definition becomes more specific, "writing about the evolving text rather than referring to the subject matter".

Later, Hyland [4] completes the definition of metadiscourse and defines it from interpersonal function. He thinks that the primary discourse cannot be separated from metadiscourse. Thus, he defines metadiscourse as "self-reflective linguistic material referring to the evolving text and to the writer and imagined readers to that text", which not only deals with the relationship between writers and their texts as well as writers and readers [4].

From the definitions given by different scholars, common points can be found that metadiscourse can be used as important means to facilitate and achieve effective communication, support the writer's position and build a relationship with readers. As the research progress, the investigation of metadiscourse delves from theoretical concepts to categorical models.

Williams [7] was a leading figure in metadiscourse. He argues that metadiscourse is the way in which an author directly or indirectly tells the reader how to understand his or her ideas. He treats metadiscourse as stylistic variants, which can be divided into three main categories, each of which is divided into two sub-categories that occur in pairs, which are hedges and emphatic, sequencers and tropicalized, attributors and narrators.

Later, Kopple [2] was the first to comprehensively delineate metadiscourse from a functional perspective. Referring to Williams' study, his classification included four types of textual markers, which include text connectives, code glosses, illocution markers, and narrators. Three types of interpersonal markers, including validity markers, attitude markers, and commentaries. But this taxonomy was found to be vague in that it was very difficult for the researchers to put it into practice [4].

Then, Crismore and his colleague tried to further improve Vande Kopple's taxonomy. They distinguished between seven types of textual markers and five types of interpersonal markers [3]. Despite some changes that Crismore and his associates had done in the previous classification system, some problems of vagueness still remain.

To remove the existing problems, Hyland and Tse [10] proposed a new model for the classification of metadiscourse and complete the definition and make clear the function of metadiscourse. This model assumes two main categories: interactive and interactional. The interactive part includes the strategies of transitions, frame markers, endophoric markers, evidential and code glosses. The interactional metadiscourse consists of hedges, boosters, attitude markers, self-mentions, and engagement markers. This intended model is specifically named "a model of metadiscourse in academic texts" [11].

B. Hyland's Taxonomy of Metadiscourse

Influenced by Halliday's three communicative functions [12], Hyland put forward his interpersonal metadiscourse model in 2005. According to Hyland's model, metadiscourse can be traditionally classified into interactive and interactional metadiscourse, which are also called metatextual items and each type can be further divided into five sub-types respectively. The former refers to the writer's

management of the information flow to guide readers through a text, which can help manage and construct the basic structures of text, in this sense, the function of metadiscourse is more like a coherent device. The interactional metadiscourse refers to the writer's intentions to comment on material, which helps authors to establish their authoring stance or communicate with their potential readers. Therefore, metadiscourse can not only organize text but also can manage social relationships through text [4].

Hyland's taxonomy lends certain theoretical respectability and has long been one of the most widely acknowledged metadiscourse models. The detailed model is explained as follows (Table I):

TABLE I: HYLAND TAXONOMY OF METADISCOURSE [4]

Category	Function	Example
Hedges	Withhold writer's full commitment to proposition	Might/perhaps/possible/about
Boosters	Emphasise force or writer's certainty in proposition	In fact/definitely/ it is clear that
Attitude markers	Express writer's attitude to proposition	Unfortunately/I agree/surprisingly
Engagement markers	Explicitly refer to or build relationship with reader	Consider/note that/you can see that/should
Self-mention	Explicit reference to author(s)	Explicit reference to author(s)

C. Previous Research in Metadiscourse of Research Article

The above expectation has been supported by a large body of research on the academic genre. The study of "metadiscourse" in China began in the late 1990s. Chinese scholars conduct the research from the perspective of interpersonal metadiscourse, philosophy of language and academic writing, etc. Jiang Feng and Hyland [13] adopt an interpersonal perspective to examine the changes in interactive metadiscourse markers over 50 years (1965–2015) in academic papers from different disciplines over time. This reflects the fact that academic debate and discursive practices change in response to socio-cultural and other contextual changes. More specifically, Cao and Hu [14] have done a lot of research on metadiscourse of research articles, their research realm includes the study on hedges and boosters in abstracts of applied linguistics articles, this article examines the different use between applied linguists published in Chinese and English medium journals. They also conducted a comparative study on disciplinary and paradigmatic influences on interactional metadiscourse in research articles. Their research gradually gets improved in posting a comprehensive analysis of metadiscourse analysis.

Empirical research abroad has focused on pedagogy and intercultural communication. Based on a corpus of 240 doctoral and master's dissertations by Hong Kong students, Hyland examines the purpose and distribution of the metadiscourse. His analysis suggests how academic writers use metadiscourse to offer a credible representation of themselves and their work in different fields [15]. As for the cross-language investigation, Joseph Lee and Elliott Casal investigate the cross-linguistic variation of metadiscourse in the results and discussion sections of engineering master's

theses written in English and Spanish. The results show that interpersonal features of writing are inexorably linked to the specific lingua-cultural contexts in which texts are produced [16]. Moreover, Crismore and his fellows compared the differences in metadiscourse use between American and Finnish university students based on cultural and gender differences [3].

Previous studies of metadiscourse have been expanding in the application, and show great value for pedagogical purposes. However, only a few sporadic studies concentrate on the conclusion section of research articles. The conclusion section plays an integral part in RA, which summarizes and evaluates the whole study and draws deductive inferences from the previous section, including pointing out the importance and limitations of the study and providing recommendations for future research [5], this requires writers to consider carefully the choice of language in order to conclude in a concise and powerful manner. The high-stakes nature of the conclusion sections of research articles calls for further research in the conclusion section of research article. In this regard, this study attempts to analysis aerospace RA's conclusion.

III. METHODOLOGY

A. Data Collection

This study compiled a corpus that includes 2 sub-corpora, corpus A and corpus B. Corpus A contain Chinese scholars' writing. In order to ensure the accuracy of this research, the total words of the two corpora are similar. Due to the general length of Corpus A's conclusion section being short, so, more pieces are selected, which have 32 conclusion sections of research articles, the total number of the word is 7196, corpus comes from the top Journal in China, Chinese Journal of Aeronautic. The impact factor of the journal is 4.061. Corpus B is the comparative corpus, including 20 texts written by English native speakers, the total word is 7224, all these 20 articles come from a high-profile international journal: Aerospace Science and Technology. The impact factor is 5.107.

Research Article (RA) is chosen for the present research because of its importance for the circulation of academic knowledge. Besides, All the research articles in the corpora were empirical ones with important sections, such as introduction, methodology, results, and conclusion sections. It is also worth noticing that this study examined the conclusion section of journal articles in a single discipline so as to tease apart cultural effects on the use of metadiscourse from disciplinary ones.

More significantly, it is important to note that all the articles were selected randomly in order to increase the reliability of the research. Random sampling does a lot of help in controlling the particularity and idiosyncrasy of the writers' styles. So, according to three criteria proposed by Nwogu, which are representativeness, reputation, and accessibility [17], the corpora were randomly selected with the restriction of the year 2022.

Since the size of the conclusion section in each group and across individual theses is inevitably unequal, following Crismore *et al.*, to make the length of the texts consistent, it was decided to calculate the frequency of metadiscourse markers per 1000 words of each text to ensure comparability of the results [3].

B. Research Procedure

The research procedure of this study can be divided into three stages:

In the beginning, corpus collection is based on the above criteria.

Then, in order to investigate the distribution of interactional metadiscourse markers in the two corpora, a manual corpus tagging based on Hyland's taxonomy and previous studies was carried out primarily to provide a quantitative and comprehensive picture of how metadiscourse markers are used in the two corpora [4].

We use manual coding as the main method, with the help of the corpus search tool Antconc 4.0.1. The study goes on three rounds of the coding process, preliminary data coding started with the coding scheme of Hyland [4] and also with the reference of previous studies, because Hyland's model is by no means exhaustive. In this regard, a miscellaneous category was added to the coding scheme because some RAs in the target pool did not provide sufficient information to allow a confident decision. So, in the second round of tagging, manual tagging according to the context is needed in order to ensure they function as metadiscourse because whether a linguistic form is an instance of metadiscourse depends crucially on the context in Which it occurs.More importantly, in the final round of tagging, in order to reduce statistical discrepancy and improve the reliability of the study, the metadiscourse codingprocess was carried out jointly by the first author and other researchers and experts. The coding result reached an average agreement rate of approximant 95%. Finally, all the metadiscourse markers in the studied corpus are collected and have a comprehensive analysis.

C. Instruments

Based on Hyland [4] and previous studies' taxonomy, the whole corpora were examined word by word, BFSU Standford Pos Tagger 1.1 was used to tag the metadiscourse features in the corpus. Additionally, concordance software, AntConc.4.0.1 was also used to retrieve the variety, frequency, and collocation of types of metadiscourse marker. Besides, CLAWS Tagger was also used to facilitate tagging the part of speech of words.

D. Research Questions

This research aims to answer the following three questions:

1. What is the distribution of interactional metadiscourse in Chinese scholars' conclusion writing?
2. What is the distribution of interactional metadiscourse in English native speakers' conclusion writing?
3. Are there any similarities and differences in using interactional metadiscourse between the two corpora?

IV. RESULTS

To address the research questions, both statistical and textual analyses were conducted. The following Tables II and III provide descriptive statistics in two corpora, a total of 283 metadiscourse markers were identified, of which 136

markers were in corpus A and 147 markers were in corpus B. Two tables show that every type of interactional metadiscourse shown in both corpora, among which, hedges, boosters, and attitude markers are by far the most frequent markers overall, followed by engagement markers and self-mention. Regard to this, it can be concluded that Englishnative speakers have more awareness than Chinese writers in applying metadiscourse in their academic writing, which is consistent with previous studies since the use of metadiscourse is closely related to its socio-rhetorical contexts, it is not surprising to find variations across the two corpora [10].

TABLE II: DESCRIPTIVE STATISTICS FOR METADISCOURSE IN THE CONCLUSION SECTION OF RA OF AEROSPACE, CORPUS A (CHINESE JOURNAL OF AERONAUTICS)

Type of Metadiscourse	Number	Frequency	Frequency Per 1000 words
Hedges	46	34%	6
Boosters	23	17%	3
Attitude markers	54	40%	7
Engagement marker	1	0.7%	0.1
Self-mention	12	9%	2

TABLE III: DESCRIPTIVE STATISTICS FOR METADISCOURSE IN THE CONCLUSION SECTION OF RA OF AEROSPACE, CORPUS B (AEROSPACE SCIENCE AND TECHNOLOGY)

Type of Metadiscourse	Number	Frequency	Frequency Per 1000 words
Hedges	28	19%	4
Boosters	42	29%	6
Attitude markers	67	46%	9
Engagement marker	6	4%	0.8
Self-mention	4	3%	0.5

A. Hedges

Referring to the above Tables II and III, show that hedge is one of the most frequently used markers in both corpora. But, the frequency of hedges per 1000 words was markedly higher in corpus A (46.34%) than in corpus B (28.19%). The most used hedges in the original text can be decomposed into three categories: modal words like "could", "should" (see example one), adverbs like "merely", "relatively", and "approximately" (see example two), and some adjectives, like "possible" (see example three). Hedges are frequently shown when authors state research results, the underlying reasons for such results, and the evaluation of their study.

Comparative analysis of hedges indifferent languages and cultures remains limited and the results are mixed [18]. There are three other reasons that caused such discrepancy between the two corpora. First of all, in other studies, phraseological hedges appear more in Chinese scholars' writing, this may be related to the Chinese collective culture, which favors modesty and self-effacing rather than disputation [18]. Apart from the hedge's epistemic function, Strauss also suggests that hedges have two other functions, one is for politeness concerns, and the other is for cultural standing concerns [19]. In this regard, Chinese writers use more hedges as a way to protect authors' stances and provide opportunities for readers to acknowledge authors' claims, this kind of humble attitude and politeness strategy make them speak indirectly, especially not to mention or critically comment on the previous studies, this feature also shows in other section of

Chinese scholars' research articles. While western culture proves to be different, they regard the academy as "dialogue in nature", they follow Socratic and Aristotelian philosophical traditions, they question one's own or others' ideas and beliefs, and debate must include in their articles [18]. Last but very important is that Hyland [20] said a complicated process involved in using and selecting hedges, scientific practice is a social tradition that guides researchers to behave in conformity to its norms and values, yet such norms and values are usually not clearly prescribed. Researchers cannot make every research extremely reliable, therefore hedges can be used to moderate such circumstances in academic research.

Example 1: Future work should also focus on integrating the propulsor configuration and control system reliability calculation to allow a systematic concept definition and design exploration.

Example 2: The modular nature of the current hardware enables the integration of other immersed models or cavity geometries into the flow path at relatively low cost.

Example 3: The resulting tunnel blockage and thermal loads are addressed with the use of contoured wall geometries and forced convection cooling made possible by AM with Inconel 718 alloy.

B. Boosters

According to Hyland, hedges and boosters are a set of opposing categories, boosters not only emphasize the certainty of cognitive judgments but also express certainty and emphasize the force of propositions, which makes research more reliable [21]. Besides that, Prelli [22] said that "a scientific opinion is only valid if it is convincing". In this regard, boosters increase authorial commitment to knowledge claims so as to make their research more convincing, which is a crucial writing strategy in convincing readers [23].

In this study, the frequency and the total number of boosters in Corpus B (42.29%) far surpassed corpus A (23.17%). Referring to the text, boosters include verbs and adverbs that are the most frequently used in the corpus, verbs such as "demonstrate" (see example four), adverbs like "extremely" (see Example 5), other phrases like "the research also provide evidence" also function as boosters. Boosters appear when researchers state the uniqueness and contributions of their studies or when authors compare their research with other studies.

This finding can be traced back to the use of hedges, Chinese writers use more hedges and fewer boosters than their English counterparts. Because Chinese scholars may lack the awareness in applying boosters to confirm their research, and recognize their contributions, more importantly, Chinese scholars may not be able to manipulate boosters in English articles with ease.

Example 4: All parameters used *by the POINT method have been tuned and a validation test has been performed*

*to **demonstrate** the accuracy and global validity of the optimal solutions found.*

*Example 5: while obtaining these results using the numerical solutions might be **extremely** time-consuming*

C. Attitude Markers

Attitude markers occupy a large proportion in both corpora, attitude markers in native speakers' writing are denser per1000 words than in Chinese scholars. But there is no significant statistical difference between the two corpora.

Authors not only try to "sell" their research by evaluating their results as important and necessary, on the other hand, they also state the limitations of their research by using attitude markers. Some attitude adverbs and adjectives like "perfectly", "necessary" (see example six), and promising (see example seven) are heavily used in two corpora. It is worth noticing that attitude markers enable authors to express their attitudes and convey strong positive or negative judgments toward their experiments or research results, showing their contribution, uniqueness, or the limitation of the research, which has the effect of "selling their research achievements" and getting their work published [4]. While, on the contrary, when they describe research data, authors prefer to use more objective and data-supported assurance.

*Example 6: In addition, the rebuilt regression rates **perfectly** follow the regression rate law found in the first part of the work, which further proves the capability of the CFD model to capture scale effects.*

*Example 7: UAV communications are considered as a **promising** technique for future 6G networks.*

D. Engagement Marker

Engagement marker in this study ranks behind those of other metadiscourse markers. Corpus B (6.4%) uses slightly more than Corpus A (1.0.7%). Sentences like "It is notable that" in the text function as engagement markers (see Example 8).

Although Hyland pointed out that engagement markers enable writers to explicitly step into the text to focus readers on a particular aspect of the data or argument and guide their interpretations [21], engagement marker is not frequently used in this study. The genre of the conclusion section of the research article confines the use of engagement markers. The conclusion section is the representation of content information of the research. Writers prefer to present propositional information and their stance towards research results. In view of this, less space is left for engagement markers in the conclusion section [24].

*Example 8: However, **it is noted that** reduced enthalpy flows, or those approaching blowout and low flame stability conditions may see a greater difference in ignition and flame holding capability.*

E. Self-Mention

Hyland describes self-mention as "the powerful rhetorical strategy for emphasizing a writer's contribution" [25], while self-mention seem not that frequently used in both corpora, which is in line with previous research. Chinese authors initially employ slightly more self-mentions than English native speakers. Referring to the original text, we found that, the most used self-mention in corpus A is "we" (see Example 9).

Previous literature is not hard to find that academic writing aims at being objective in its expressions, and thus avoids specific reference to personal opinions, especially "I believe", and "it is my opinion" [25]. Another reason is that in such a hard discipline like aerospace, writers are now taking a more objective, less personal stance in describing their research in order to make their research more scientific [21]. Besides, articles from hard disciplines, like aerospace usually have more than one author, explaining why such discipline does not use self-mention, especially, "I". Moreover, the Chinese spirit and self-effacing of collectivism make the author emphasize the whole team's efforts in conducting research instead of individual contribution. More importantly, second language learners are always taught to avoid using first-person pronouns because it will conflict with the objectivity and formality of academic writing since writing is "very much shaped by the educational system in a writer's native culture" [26].

*Example 9: Finally, **we** profiled the methodology for underactuated multirotor concepts.*

V. Conclusion

This article compares the distribution of metadiscourse markers of 52 conclusion sections of research articles in the field of aerospace between Chinese scholars' and English native speakers' writing. Results show that the discrepancy in number and frequency between the two groups lies in boosters, hedges, and attitude markers. The significance of this research lies in two perspectives: practical and pedagogical implications.

First, this study drew a comprehensive picture of metadiscourse analysis in the conclusion section of the research article in the field of aerospace, which enriches the empirical research of metadiscourse use in the aerospace corpus. Second, this study suggests that metadiscourse knowledge should be incorporated into the academic English teaching curriculum as part of the construction of academic English proficiency [27]. More importantly, training students to be aware of the disciplinary and cultural differences in academic writing is of paramount significance. Besides, these differences are not only superficial in terms of linguistic paradigms, but also at the deeper level of rhetorical processes governed by disciplinary identity. Although the corpus of this study is small, but it does can shed some light on the writing and teaching of aerospace academic writing of conclusion section. In the future, more corpus can be used in conducting the further research.

Conflict of Interest

The author declares no conflict of interest.

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