A Comparative Study of Metadiscoursal Features in English Research Article Abstracts in Hard Disciplines

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Abstract

This study investigates how L1 Chinese scholars in hard science disciplines use metadiscourse in their English academic writing, by comparing the deployment of metadiscoursal resources written by L1 Chinese and L1 English scholars. Hyland's (2005) interpersonal model of metadiscourse was adopted for the analysis. We found that L1 Chinese scholars used less metadiscoursal resources than L1 English scholars on the whole. In the two dimensions of interaction, L1 Chinese scholars made more use of interactive devices, while L1 English scholars used more interactional items. This reflects that L1 Chinese scholars made greater efforts to guide the readers through their papers, and that L1 English scholars are more concerned with creating author identity and engaging their readers. The t-tests confirmed that L1 Chinese scholars used significantly more code glosses in interactive metadiscourse and less self-mentions in interactional metadiscourse. An in-depth analysis reveals two functions of code glosses and five functions of self-mentions in RA abstracts.

***Keywords**:* Metadiscourse, English research article abstracts, hard disciplines, L1 Chinese scholars, L1 English scholars

Introduction

Metadiscourse refers to the linguistic resources that writers use to organize their texts and involve their readers and in the meantime convey their position and attitudes towards their writing and audience (Hyland & Tse, 2004, p. 156). The choice of certain metadiscoursal items over others reflects "the writers' evaluation of the readers' need for elaboration and involvement" (Hyland, 2010, p. 141), and their efforts made to "facilitate communication, support the writers' position, and build a relationship with the audience" (Hyland, 1998, p. 438). Therefore, the analysis of metadiscourse provides a valuable means of exploring academic writing, by comparing how scholars of different disciplinary communities, and of different linguistic and cultural communities, use metadiscoursal resources as rhetorical skills to present their research, make their cases, develop a relationship with their readers and manage writer visibility (Ädel, 2006, p. 4).

Studies reveal that scholars in humanities and social sciences (the soft disciplines)[1] interact more with readers than their counterparts in natural sciences and engineering (the hard sciences) as they employ more metadiscoursal resources on the whole (Hyland, 2010; Hyland & Tse, 2004). They make greater efforts to involve the reader in the text by using more hedges (Hyland, 2010), attitude markers (Hyland, 2010; Lafuente-Millán, 2012), self-mentions (Hyland, 2010), and stance nouns (Jiang & Hyland, 2015), which shows that scholars in the soft disciplines favor more explicit personal interpretation than their counterparts in hard sciences. It is also reported that the scholars in the soft fields tend to elaborate by reformulation and favor argument by exemplification (Hyland, 2007). More recent studies found that even within soft disciplines, scholars use metadiscourse differently (Cao & Hu, 2014; Hu & Cao, 2015; Khedri, 2013; Kim & Lim, 2013; Li & Wharton, 2012), but disciplinary influence on the use of metadiscourse is not

[1] In this study, we use terms such as "hard sciences", "hard fields" and "hard disciplines" to refer to natural sciences, and terms such as "soft sciences", "soft fields" and "soft disciplines" to refer to humanities and social sciences.

as strong as contextual factors (Li & Wharton, 2012), or paradigmatic factors (Cao & Hu, 2014; Hu & Cao, 2015).

Increased international contacts in the academic world, on the other hand, have aroused interests in how metadiscourse is deployed in different languages and how the scholars of these languages use it in English. Studies show that English academic writing is more reader-friendly, with more use of metadiscoursal resources on the whole to help readers understand their line of argumentation with transitions, endophorics, evidentials (Bloch & Chi, 1995; Kim & Lim, 2013; Lee & Casal, 2014; Ruan & Xu, 2016), evaluative strategies (Giannoni, 2005; Lafuente-Millán, 2012; Loi, Lim & Wharton, 2016; Mur-Dueñas, 2010), cause-effect metadiscourse signals (Moreno, 1997), premise-conclusion relationships (Moreno, 2004), hedges (Hu & Cao, 2011; Ruan & Xu, 2016),than academic writing in languages such as Spanish, Italian, Chinese, and Finnish. The Arabic academic writing is, however, an exception, where it is found that Arab scholars used significantly more metadiscourse markers than their English counterparts (Alharbi & Swales, 2011; Alotaibi, 2015; Sultan, 2011). Similar results were reported in most comparative studies of English academic writing by non-native English speaking scholars and native English speaking scholars. Non-native English speaking scholars' use of metadiscoursal resources in their English academic writing reflects a preference for rhetorical strategies of indirectness (Mauranen, 1993a, 1993b; Valero-Garcés, 1996), which is less reader-friendly, by placing the responsibility to manage successful communication on the reader. For example, they tend to underuse frame markers or connector (Marandi, 2002), and rely excessively on a limited set of devices "which seems to be [...] haphazard and monotonous" (Ventola, 1992, p. 209). In addition, non-native English speaking scholars don't seem to know how to give a credible representation of themselves and their work through proper use of hedges, boosters, attitude markers, or self-referential pronouns (Abdollahzadeh, 2003; Sun & Tong, 2015; Vassileva, 2001; Wu, 2013; Yakhontova, 2002; Zhang, 2008; Zhang & Li, 2011). The only study that has different findings is Geng and Wharton's (2016) investigation reporting no significant differences in the evaluation strategies used in the discussion sections in doctoral

dissertations in applied linguistics, which indicates that the writer's first language may not play a major role in metadiscourse choices at advanced levels.

The literature reviewed above points to research gaps that need to be addressed. First, not much research has been done to investigate how the use of metadiscourse may vary from within hard science disciplines, which is also worth studying as the classification of knowledge domains as hard or soft tends to leave out "the evident differences between and within their constituent subjects" (Becher & Trowler, 2001, p. 39), and hard sciences have their own dominant "knowledge structures" (Bernstein, 1999, p. 162) that feature in different "discursive practices for constructing and validating knowledge claims" (Hu & Cao, 2015, p. 13).Furthermore, there has not been sufficient research focusing on how scholars whose native language is Chinese use metadiscourse in their English academic writing, the study of which would contribute to a more comprehensive understanding of how scholars' linguistic backgrounds may influence their use of meta discourse when they present in English their academic findings. Therefore, in the present study, we intend to investigate how native-Chinese speaking scholars in hard science disciplines use metadiscoursal resources in their English academic writing, by comparing the use of metadiscourse in hard sciences research article (RA) abstracts in English written by scholars whose native language is Chinese (L1 Chinese scholars) and published locally in the People's Republic of China (P.R.C.), with English RA abstracts by native-English speaking scholars (L1 English scholars) and published internationally. The main objective of this study is to achieve a comprehensive and thorough view of how L1 Chinese scholars in hard sciences use interactive and interactional metadiscoursal resources to interact with their readers in their academic writing.

Research design

Corpus

For this study, we used two sets of comparable corpora. The first corpus comprised three sub-corpora of 60 English RA abstracts from biology (Bio), chemistry (Chem) and physics (Phy), published in prestigious academic journals in China, written by L1 Chinese

scholars. The first corpus was compared against a second corpus of 60 English RA abstracts from the same three disciplines published in international prestigious academic journals, written by L1 English scholars. The selection of the academic journals was based on disciplinary expert nominations and compound influence factors provided by Chinese Academy of Sciences (2015) for Chinese academic journals, and impact factors provided by ISI Web of Science (2015) for their English counterparts. The RAs were selected from these academic journals, published between January, 2015 and March, 2016.

We took the following procedures to determine whether a paper is written by native speakers of English:

(1) Locate the first paper in one issue by author or authors affiliated with institutions in countries where English is the most commonly spoken language, i.e., United Kingdom, the United States, Canada, Australia, Ireland and New Zealand (Crystal, 2003, pp. 108–109);

(2) write emails to the authors to confirm whether they are native speakers of English: In case there are more than two authors, write to the first two authors; in case the corresponding author is not among the first two authors, write to the first two authors and the first corresponding author, as corresponding authors can have great influence on the manuscript. A copy of the email can be found in Appendix A;

(3) if positive confirmation is obtained from the required number of authors, the abstract of the paper goes into English native speaker corpus; if not, procedures 1 and 2 are repeated until we receive the required number of positive confirmations from the authors of 60 papers.

The abstracts in L1 Chinese corpus are all English abstracts for Chinese papers written by Chinese scholars from Chinese universities or research institutions, published in Chinese academic journals.

Table 1 presents the descriptive statistics for the corpora, and the details of the distribution of the corpora and the source RAs from which the abstracts were taken can be found in Appendix B and Appendix C respectively.

Table 1

Descriptive statistics for the two corpora

	L1 Chinese corpus			L1 English corpus		
	Abstract	No. of words	*Mean*	Abstract	No. of words	*Mean*
Bio	20	4585	229.25	20	4216	210.80
Chem	20	4524	226.2	20	3652	182.60
Phy	20	4199	209.95	20	3126	156.30
Total	60	13308	221.80	60	10994	182.13

Analytical framework

Hyland's (2005) taxonomy of metadiscourse, which is "perhaps the most comprehensive and theoretically well-grounded model of metadiscourse" (Thompson, 2008, as cited in Jiang & Hyland, 2016, p. 3) was adopted as the analytic framework. Based on a functional approach which regards metadiscourse as ways that writers relate themselves to their material and audience, Hyland's model comprises two dimensions of interaction: The interactive and the interactional. The interactive resources reflect the writers' evaluation of the readers' prior knowledge of the subject, their ability to comprehend, and their need for elaboration, and are used to "organize propositional information in ways that a projected target audience is likely to find coherent and convincing" (Hyland, 2005, p. 50); the interactional resources, on the other hand, help manage writer visibility and build writer-reader relationship by expressing doubt or certainty, as well as attitudes, towards propositions (Hyland, 2005, p. 52).

Table 2 presents the main types and subcategories of the interactive and interactional metadiscourse.

Procedure

We used the following procedures in the analysis of the RA abstracts:

(1) Identifying and marking the interactive and interactional metadiscoursal markers in each abstract;

(2) recording each interactive and interactional metadiscoursal marker;

(3) counting the raw numbers of different types of interactive and interactional metadiscoursal marker, normalizing the occurrences to 1,000 words, and calculating the proportion of the metadiscoursal resources; and

(4) conducting descriptive analyses and independent t-test analyses.

Table 2

Hyland's Interpersonal model of metadiscourse (Hyland, 2005, p. 49)

Category	Function	Examples
Interactive	Help to guide the reader through the text	Resources
Transitions	expressive relations between main clauses	in addition; but; thus; and
Frame markers	refer to discourse acts, sequences or stages	finally; to conclude; my purpose is
Endophoric markers	refer to information in other parts of the text	noted above; see Fig; in section 2
Evidentials	refer to information from other texts	according to X; Z states
Code glosses	elaborate propositional meanings	namely; e.g.; such as; in other words
Interactional	Involve the reader in the text	Resources
Hedges	withhold commitment and open dialogue	might; possible; perhaps; suggest
Boosters	emphasize certainty or close dialogue	in fact; definitely; it is clear that
Attitude markers	express writer's attitude to proposition	unfortunately; I agree; surprisingly
Self-mentions	explicit reference to author(s)	I; we; my; me; our
Engagement markers	explicitly build relationship with reader	consider; note; you can see that

The Statistical Package for Social Sciences (SPSS) software was used for procedures (3) and (4). A p-value≤0.05 was considered statistically significant for the independent t-tests.

Both authors independently coded 20% of the data (i.e., 24 RA abstracts; four abstracts from each of the six sub-corpora), and inter-coder agreement was assessed with Cohen's kappa statistics for the ten types of metadiscoursal resources separately. The obtained kappa statistics were .95 for code glosses, .96 for endophoric markers, .98 for evidentials, .97 for frame markers, and .96 for transitions, .89 for attitude markers, .73 for boosters, .98 for self-mentions, .92 for engagement markers, and .82 for hedges. Based on

guidelines proposed by Landis and Koch (1977), these kappa values indicated substantive agreement. As inter-coder reliability was acceptable, the first author coded all the remaining data after resolving disagreements between the two coders through discussion.

Table 3
Interactive and interactional metadiscourse

	L1 Chinese		L1 English	
Category	Item per 1,000 words	% of total	Item per 1,000 words	% of total
Interactive	22.70	61.01	20.21	48.78
Code glosses	16.68	44.83	10.82	22.74
Endophoric markers	0.08	0.21	0.00	6.31
Evidentials	0.38	1.02	0.63	1.32
Frame markers	2.93	7.87	3.91	8.22
Transitions	2.63	7.07	4.85	10.19
Interactional	14.51	38.99	27.37	57.52
Attitude markers	0.83	2.23	1.91	4.01
Boosters	5.49	14.75	8.28	17.40
Self-mentions	4.51	12.12	13.73	28.86
Engagement markers	0.00	0.00	0.18	0.38
Hedges	3.68	9.89	3.27	6.87
Totals	37.21	100.00	47.58	100.00

Findings and Discussion

Our analysis shows that on the whole, L1 Chinese scholars used less metadiscoursal resources than L1 English scholars, with 37.21 cases per thousand words in L1 Chinese corpus and 47.58 cases per thousand words in L1 English corpus (Table 3). As for the two dimensions of interaction, L1 Chinese scholars made more use of interactive devices, while L1 English scholars used more interactional ones. This reflects that L1 Chinese scholars made greater efforts to guide the readers through their papers by explaining, elaborating and organizing their writing, while L1 English scholars were more concerned with creating author identity and engaging their readers by expressing their judgment towards their materials and speaking to their readers.

Interactive metadiscourse

T-tests were performed to determine whether the use of the five types of interactive metadiscoursal resources was significantly different between the two corpora. As shown in Table 4, L1 Chinese scholars (M=3.68, SD=5.43) used more code glosses than L1 English scholars (M=1.98, SD=2.39), and this difference was confirmed to be statistically significant by the t-test: t(118)=2.22, p=.03. The magnitude of the differences in the means was small (eta squared=0.04)[2].

Code glosses provide "additional information by rephrasing, explaining or elaborating what has been said" (Hyland, 2005, p. 52), to help readers "grasp the appropriate meaning of elements in texts" (Vande Kopple, 2012, p. 39). A further analysis of the abstracts demonstrates that code glosses used in the two corpora mainly serve two functions: Reformulation and exemplification, which are the important features of academic writing, and are more common in academic discourse as compared to other genres (Biber et al., 1999; Hyland, 2007). As can be seen in Table 5, both L1 Chinese and L1 English scholars used significantly more reformulation markers than exemplification markers.

This finding is in line with Hyland (2007), who found that two-thirds of the code glosses in the hard sciences signaling reformulations, while two-thirds of those in the soft fields indicating exemplifications. This difference was explained by the different ways that hard and soft disciplines mediate reality: Hard sciences tend to be cumulative and tightly structured, while soft disciplines use examples to engage and involve readers (Hyland, 2007, p. 272).

Table 4

Mean scores and t-test results for interactive metadiscourse

Category	Type	N	Mean	SD	t	df	Sig
Code glosses	L1 Chinese	60	3.68	5.43	2.22	118	.03
	L1 English	60	1.98	2.39		118	
Endophoric markers	L1 Chinese	60	.02	.13	1.00	118	.32

[2] The guidelines (Cohen, 1988, as cited in Pallant, 2010) for interpreting eta squared are: .01=small effect, .06=moderate effect, .14=large effect.

	L1 English	60	.00	.00		118	
Evidentials	L1 Chinese	60	.08	.28	-.46	118	.64
	L1 English	60	.12	.50		118	
Frame markers	L1 Chinese	60	.65	.76	-.56	118	.57
	L1 English	60	.72	.52		118	
Transitions	L1 Chinese	60	.58	1.27	-1.44	118	.15
	L1 English	60	.88	1.01		118	

Table 5

Code gloss markers

	L1 Chinese		L1 English	
Category	Item per 1,000 words	% of total	Item per 1,000 words	% of total
Reformulation	16.08	96.43	8.71	89.98
Exemplification	.60	3.57	1.00	10.02
Totals	16.68	100	9.71	100

Reformulation occurs when a writer explains and elaborates an idea in a different way to facilitate comprehension. The complete list of reformulation markers found in the two corpora (Table 6) shows that parentheses occur overwhelmingly more often than other forms of reformulation markers: 96.70% of the reformulation markers in L1 Chinese scholar corpus and 92.54% of the reformulation markers in L1 English scholar corpus are parentheses.

Table 6

Reformulation markers

	L1 Chinese		L1 English	
Category	Item per 1,000 words	% of total	Item per 1,000 words	% of total
parenthesis	15.55	96.70	8.06	92.54
known as	0.00	0.00	0.30	3.44
i.e.	0.11	0.68	0.06	0.69
means	0.18	1.12	0.00	0.00
which is	0.06	0.37	0.14	1.61
Or	0.13	0.81	0.00	0.00
in fact	0.05	0.31	0.00	0.00
understood as	0.00	0.00	0.05	0.57
appositive	0.00	0.00	0.05	0.57
specifically	0.00	0.00	0.05	0.57

Totals	16.08	100	8.71	100

Parentheses serve to place certain information in a separated area from the main sentence, "allowing writers to signal that the enclosure provides background or illustrative information rather than main ideas" (Hyland, 2007, p. 273). The analysis reveals that parentheses mainly perform three types of function as reformulation markers in the two corpora: Introducing acronyms or abbreviations for academic/technical terms, providing clarification for academic/technical terms, and presenting statistical values. The majority of the parentheses are used forgiving acronyms or abbreviations for academic/technical terms upon their first use, and then used in place of the full term in the remainder of the abstract:

(1) AKT-interacting protein (AKTIP) is a kind of membrane protein, involving in the regulation of P13K/PDK1/Akt pathway. (C. Bio)[3]

Batch experiments and XAD resin were used to investigate dissolved organic matter (DOM) adsorption by ferrallitic soils. (C. Chem)

A tilted transversely isotropic (TTI) medium is a good approximation for anisotropic problems. (C. Phy)

Another function is to provide clarification which elaborates the meaning of a preceding concept to make it more accessible to the reader:

(2) [...] Under the function of 1-ethy1-3 (3-dimethylaimin-opropyl) carbodiimide hydrochloride, followed by a hydration process. (C. Chem)

Here we show that two closely related bis-rhodium hexaphyrins (R26H and R28H) containing [26] and [28] π-electron peripheries, respectively, exhibit properties consistent with Baird's rule. (E. Phy)

Phylogenies and dating analyses were reconstructed with molecular data from seven genes (mitochondrial and nuclear) for 117 species (plus 12 outgroups). (E. Bio)

The third function of the parentheses found in the two corpora is to present

[3] The L1 Chinese sub-corpora are referred to as C. Chem, C. Bio, and C. Phy, and the L1 English sub-corpora are referred to as E. Chem, E. Bio, and E. Phy.

statistical values:

(3) Among all the trait-related markers, TC1A02 (P<0.001) had the highest rate of phenotypic explanation and contained 21 alleles, which was associated with the trait of pod number per plant. (C. Bio)

For example, it was found that the cyclometalated iridium catalyst modified by BINAP and m-nitro-p-cyano-benzoic acid delivered adduct 1 with the highest levels of enantiomeric enrichment (94%), whereas the corresponding SEGPHOS-modified catalyst gave a comparable yield but lower ee(91%). (E. Chem)

L1 Chinese scholars used more parentheses for acronyms/abbreviations (7.96 per 1,000 words vs. 4.48 per 1,000 words) and statistics (5.41 per 1,000 words vs. .47 per 1,000 words), but less for elaboration (2.18 per 1,000 words vs. 3.11 per 1,000 words), than L1 English scholars, as shown in Table 7.

Table 7

Parentheses

	L1 Chinese		L1 English	
Category	Item per 1,000 words	% of total	Item per 1,000 words	% of total
acronym/abbr.	7.96	51.21	4.48	55.68
elaboration	2.18	14.01	3.11	38.64
statistics	5.41	34.78	.47	5.68
Totals	15.55	100	8.06	100

Another form of code glosses is exemplification, with which the author clarifies what is written with examples. Exemplification reflects the writer's anticipation of the readers and helps their processing of the text by presenting data or experience to make the abstract more concrete. However, in hard sciences, the use of exemplification is not common (Cao & Hu, 2014; Hyland, 2007; Rahimpour, 2013), as "scientific knowledge tends to be cumulative and tightly structured", and soft disciplines use examples to index a known and recoverable reality to "encourage the readers to recognize phenomena through recoverable experiences and to become involved in the unfolding text" (Hyland, 2007, p. 272). Examples in the corpus were signaled in a limited number of

ways, by just three markers: S*uch as*, *parenthesis*, and *for example*. Table 10 shows the details for the distribution of exemplification markers.

On the whole, L1 Chinese scholars used less exemplification markers than L1 English scholars (.60 per 1,000 words vs. 1.00 per 1,000 words), as they used less *such as* (.45 per 1,000 words vs. .64 per 1,000 words), *parenthesis* (.15 per 1,000 words vs. .27 per 1,000 words), or *for example* (0 per 1,000 words vs. .09 per 1,000 words).

Table 8

Exemplification markers

	L1 Chinese		L1 English	
Category	Item per 1,000 words	% of total	Item per 1,000 words	% of total
such as	.45	75	.64	64
parenthesis	.15	25	.27	27
for example	0	0	.09	9
Totals	.60	100	1.00	100

Interactional metadiscourse

T-tests were run to determine whether the use of the five types of interactional metadiscourse was significantly different between the two corpora. As shown in Table 9, L1 Chinese scholars (M=.98, SD=1.38) used less self-mentions than L1 English scholars (M=2.52, SD=1.69), and this difference was confirmed to be statistically significant by the t-test: t(118)=-5.43, p=.00. The magnitude of the differences in the means was large (eta squared=.20).

Table 9

Mean scores and t-test results for interactional metadiscourse

Category	Type	N	Mean	SD	t	df	Sig
Attitude markers	L1 Chinese	60	.18	.47	-1.37	118	.17
	L1 English	60	.35	.82			
Boosters	L1 Chinese	60	1.22	1.11	-1.41	118	.16
	L1 English	60	1.52	1.22			
Self-mentions	L1 Chinese	60	.98	1.38	-5.43	118	.00
	L1 English	60	2.52	1.69			
Engagement markers	L1 Chinese	60	.00	.00	-1.43	118	.16
	L1 English	60	.03	.18			
Hedges	L1 Chinese	60	.82	1.19	1.16	118	.25

L1 English	60	.60	.83

Self-mention manifests the explicitness of author presence by the use of first-person pronouns and possessive adjectives such as *I*, *my*, *me*, *mine*, exclusive *we*, *us*, *our* and *ours* (Hyland, 2005, p. 53). In bothL1 Chinese and L1 English scholars' RA abstracts, self-mentions were only in the form of exclusive *we*, *us* and *our*, which could be partly explained by patterns of authorship: All the RAs were multiple-authored. However, it cannot be assumed that the opposite would be true, i.e., first person singular pronouns would be used in single-authored papers. As pointed out by Hyland (2001, p. 217), writers of single-authored articles often decide to use *we* out of the intention to reduce personal attribution.

Chinese authors used significantly less self-mentions probably because of the long-time held conception that academic papers should be "objective reporting of an independent and external reality" (Hyland, 2001, p. 207), and that any explicit author presence would undermine this objectivity. In Chinese academic circles, this convention of impersonal reporting is proposed in textbooks and lectures (Ren, 2016; Wu, 2013; Yan & Luo, 2015; Zhang, 2011). Not only did scholars claim that first-person pronouns such as *I* and *we*, should be avoided in academic papers (Li, 1989; Liu, 2005; Zheng, 2003), some prestigious academic journals (e.g., Chinese Critical Care Medicine) and official organizations such as General Administration of Press and Publication of the People's Republic of China[4] specifically made it clear that first-person pronouns in academic papers should not be used (Chinese Critical Care Medicine, 2005; Zhang, 2008) or be used as less as possible (Wen, 2005). Another possible explanation for Chinese scholars' shunning the use of self-mention is face saving strategy. By avoiding using self-reference, they avoided speaking directly to their readers and made their writing appear objective and impersonal so as to avoid criticism or refutation from the audience, thus saving authors' face.

[4] General Administration of Press and Publication of the People's Republic of China is the administrative agency responsible for regulating and distributing news, print and Internet publications in China. This includes granting publication licenses for periodicals and books.

Table 10 shows the details of the distribution of self-mentions in the two corpora. L1 Chinese scholars used less *we* (3.30 per 1,000 words vs. 10.89 per 1,000 words), *us* (.08 per 1,000 words vs. .18 per 1,000 words), and *our* (1.05 per 1,000 words vs. 1.92 per 1,000 words) than L1 English scholars.

The t-tests (Table 11) confirmed that Chinese scholars (M=.77, SD=1.14) used significantly less *we* as self-mention markers thanL1 English scholars (M=2.02, SD=1.27); t(118) =-5.68, p = .00; and the magnitude of the differences in the means was large (eta squared = .21).

Table 10

Self-mentions

	L1 Chinese		L1 English	
Category	Item per 1,000 words	% of total	Item per 1,000 words	% of total
We	3.30	75.00	10.89	83.80
Us	.08	1.67	.18	1.41
Our	1.05	23.33	1.92	14.79
Totals	4.51	100	12.99	100

Table 11

Mean scores and t-test results for the use of we, us, and our

Category	Type	N	Mean	SD	t	df	Sig
we	L1 Chinese	60	.77	1.14	-5.68	118	.00
	L1 English	60	2.02	1.27			
us	L1 Chinese	60	.00	.00	-1.35	118	.18
	L1 English	60	.05	.29			
our	L1 Chinese	60	.22	.492	-.93	118	.36
	L1 English	60	.32	.68			

The analysis shows that self-mentions in the two corpora mainly perform five types of function: Providing research background, stating research purpose, describing methodology, reporting findings, and interpreting findings.

Self-mention establishes the scholar as the "Opinion-Holder" and Originator'' of new ideas (Tang & John, 1999, p. 28–29) through identifying research questions and commenting on the relevant literature.

(4) The ubiquitin-like molecule ATG12 is required for the early steps of autophagy. Recently, we identified ATG3, the E2-like enzyme required for LC3 lipidation during autophagy, as an ATG12 conjugation target. Here, we demonstrate that cells lacking ATG12–ATG3 have impaired basal autophagic flux, accumulation of perinuclear late endosomes, and impaired endolysosomal trafficking. (E. Bio)

A second function of self-mention is to state the research purpose, summarize the goals of the research, and give the readers a picture of what the research will cover and what they can gain from reading it:

(5) Here we examine how geometric frustration in itinerant antiferromagnetic compounds can enhance the barocaloric effect. (E. Chem)

Using self-mention markers to provide research background and state the research purpose is an effective self-promotional device "to underscore the novelty of the work in question by stressing that there are gaps in the literature which need plugging" (Harwood, 2005, p. 1217).

Self-mentions also help the writer to describe the research process, which is not just a straightforward reporting of procedures, but also a means to highlight their own contributions to the study. By recounting the rationale for using certain procedures or techniques to identify the research question and analyze relevant information, writers are "advertising their worth as researchers" (Harwood, 2005, p. 1213):

(6) We compare forward features of 3 second-order difference equations of pseudo P waves based on Hooke's law, elastic wave projection and dispersion equation, respectively. (C. Phy)

Self-mentions are used very often for reporting findings without bias or interpretation, to underscore the groundbreaking aspects of one's research work:

(7) We found that the PST population across the United Kingdom (UK) underwent a major shift in recent years. (E. Bio)

Finally, self-mentions can also be used to explain the significance of research findings:

(8) Our approach offers diffraction-limited resolution, potentially at arbitrarily-low intensity levels and with 100 THz bandwidth, thus promising new applications in space-division multiplexing, adaptive optics, image correction, processing and recognition, 2D binary optical data processing and reconfigurable optical devices. (E. Phy)

Table 12 provides details for the distribution of the functions performed by self-mentions in the two corpora. It is quite obvious that L1 Chinese scholars are less likely to use first person pronouns to describe methodology, report findings or interpreting their findings, probably because they want to remain impersonal and make their research to appear more objective.

Table 12

Self-mentions

Category	L1 Chinese		L1 English	
	Item per 1,000 words	% of total	Item per 1,000 words	% of total
Providing research background	0.23	5.00	0.09	0.70
Stating research purpose	0.30	6.67	0.18	1.41
Describing methodology	1.58	35.00	4.85	37.32
Reporting findings	2.33	51.67	7.23	55.63
Interpreting findings	0.08	1.67	0.64	4.93
Totals	4.51	100	12.99	100

The t-tests confirmed that L1 Chinese scholars used significantly less self-mentions for describing methodology, reporting findings, or evaluating one's research (Table 13): They (M=.35, SD=.63) used less self-mentions for describing methodology than L1 English scholars (M=.88, SD=1.00); t(118)=-3.47, p=.00; and the magnitude of the differences in the means was moderate (eta squared=.09). They (M=.52, SD=.93) also used less self-mentions to report findings than L1 English scholars (M=1.32, SD=.99); t(118)=

-4.54, p=.00; and the magnitude of the differences in the means was large (eta squared=.15). L1 Chinese scholars are reluctant to use self-mentions to evaluate their research: They (M=.02, SD=.13) used less self-mention markers in this function than L1 English scholars (M=.12, SD=.32); t(118)= -2.22, p=.03; and the magnitude of the differences in the means was small (eta squared=.04).

A qualitative analysis of the L1 Chinese scholar corpus shows that they tend to use alternative ways to fulfill functions by self-mentions, such as passive voice, metadiscursive nouns (Jiang & Hyland, 2016; Jiang & Hyland, 2017) such as *this research*, *this study*, *the results,* impersonal phrase such as *it is believed*, or other phrases that can hide the identity of the scholar:

Table 13

Mean scores and t-test results for self-mention functions

Category	Type	N	Mean	SD	t	df	Sig
Providing research	L1 Chinese	60	.05	.22	1.01	118	.31
background	L1 English	60	.02	.13			
Stating research purpose	L1 Chinese	60	.07	.25	.83	118	.41
	L1 English	60	.03	.18			
Describing methodology	L1 Chinese	60	.35	.63	-3.47	118	.00
	L1 English	60	.88	1.00			
Reporting findings	L1 Chinese	60	.52	.93	-4.54	118	.00
	L1 English	60	1.32	.99			
Interpreting findings	L1 Chinese	60	.02	.13	-2.22	118	.03
	L1 English	60	.12	.32			

(9) By the temperature gradient method, the gem-diamond single crystals with B2O3-added in the synthetic system of the FeNiMnCo-C are synthesized under 5.3-5.7 GPa and 1200-1600℃. The P-T phase diagram of diamond single crystal growing in the synthesis system of the FeNiMnCo-C-B2O3, is obtained. (C. Phy)

(10) The research revealed that AKTIP gene involved in C. semilaevis immune response. (C. Bio)

(11) It is observed that the sharp Raman bands of synthetic jadeite samples are consistent with those of the natural jadeite. (C. Phy)

(12) Cell toxicity experiments show that both two kinds of gold nanoclusters have no cytotoxicity even at the high concentration of 100 mg/L. (C. Chem)

The above analysis shows that L1 Chinese scholars used significantly more code glosses and self-mentions than L1 English scholars. In code glosses, L1 Chinese scholars used significantly more reformulation markers than exemplification markers. L1 Chinese scholars' using significantly less self-mentions shows their intention to appear more objective and impersonal in their presentation of their research findings.

Conclusion

This study compared the use of metadiscoursal resources in English RA abstracts by L1 Chinese and L1 English scholars in hard disciplines, which sheds light on how non-native English-speaking scholars interact with their academic peers worldwide.

We found that L1 Chinese scholars used more interactive but less interactional metadiscourse resources than L1 English scholars on the whole. The t-tests confirmed that L1 Chinese scholars used significantly more code glosses in interactive metadiscourse and less self-mentions in interactional metadiscourse. The analysis showed that code glosses in RA abstracts in this study mainly serve two functions: Reformulation and exemplification, and both L1 Chinese and L1 English scholars used significantly more reformulation markers than exemplification markers, which is in line with the findings from previous studies. L1 Chinese scholars used significantly less self-mentions probably because they want to remain objective and impersonal about their research, and to avoid criticism and refutation by refraining from direct communication with their readers. We also proposed three types of functions that parentheses perform as reformulation markers in the two corpora: Introducing acronyms or abbreviations for academic/technical terms, providing clarification for academic/technical terms, and presenting statistical values, and five types of functions that self-mentions mainly perform: Providing research background, stating research purpose, describing methodology, reporting findings, and interpreting findings.

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Appendices

Appendix A Email to the authors

Dear Professor _____,

My name is Jing Wei, and I am an associate professor at Southwest University, China; I hold a PhD in applied linguistics. I am now conducting a research comparing the use of metadiscourse in English research article abstracts in hard disciplines by L1 Chinese and L1 English scholars. I would like to include the abstract of your paper entitled "…", in my corpus for native speaker of English, and would like to ask for you permission. If you give me the permission to use your abstract, I would also like to confirm whether you are a native speaker of English. A native speaker of English acquires English as her/his first language since s/he is a baby, using English as the primary means of concept formation and communication.

Thank you very much for taking the time to read my email, and I look forward to your reply.

Yours sincerely,

Jing

Southwest University, Chongqing, China

Appendix B Distribution of the two corpora

Table 1

L1 Chinese scholars' abstracts

	Source	Abstracts	Words	Words per abstract
Biology corpus	*Bulletin of Botany*	5	861	172.2
	Biodiversity Science	5	1431	286.2
	Chinese Journal of Biotechnology	5	851	170.2
	Acta Hydrobiologica Sinica	5	1442	288.4
Chemistry corpus	*Acta Chimica Sinica*	5	1673	334.6
	Journal of Chemical Industry and Engineering(China)	5	945	189.0
	Environmental Chemistry	5	804	160.8
	Chinese Journal of Analytical Chemistry	5	1102	220.4
Physics corpus	*Acta Physica Sinica*	5	1802	360.4
	Acta Geophysica Sinica	5	978	195.6
	Chinese Journal of High Pressure Physics	5	780	156.0
	Nuclear Fusion and Plasma Physics	5	639	127.8

Table 2

L1 English scholars' abstracts

	Source	Abstracts	Words	Words per abstract
Biology corpus	*Genome Biology*	5	1035	207
	Molecular Systems Biology	5	953	190.6
	Systematic Biology	5	1499	299.8
	Nature Cell Biology	5	729	145.8
Chemistry corpus	*Nature Materials*	5	791	158.2
	Nature Chemistry	5	758	151.6
	Journal of the American Chemical Society	5	1149	229.8
	Chemical Science	5	962	192.4
Physics corpus	*Nature Nanotechnology*	5	788	157.6
	Ultramicroscopy	5	784	156.8
	Nature physics	5	779	155.8
	Light: Science & Applications	5	792	158.4

Appendix C Research articles from which abstracts were taken

Biology (L1 Chinese)

Bi, M.J., Shen, M.W., Zhou, K.X., Mao, L.F., Chen, SH.B. & Peng, P.H. (2016). Geographical variance of ladybird morphology and environmental correlates in China. *Biodiversity Science*, *23*(6), 775-783.

Li, D.M., Wang, L.Y., Zhang, L.Y., Tie, Z.Y. & Mao, H.P. (2016). Mechanism of Arabidopsis Short Peptide Hormones PROPEP Gene Family in the Root Growth. *Bulletin of Botany, 51*(2), 202-209.

Li, H., Zhang, G.C., Xie, H.CH., Xu, J.W., Li, CH.R. & Sun, J.W. (2016). The Effect of Phenol Concentration on Photosynthetic Physiological Parameters of Salix babylonica. *Bulletin of Botany, 51*(1), 31-39.

Li, SH.SH., Wang, ZH.W., Yang, J.J. (2016). Changes in soil microbial communities during litter decomposition. *Biodiversity Science, 24*(2), 195-204.

Liu, Y., Xu, Y., Shi, S.L., Peng, P.H. & Shen, Z.H. (2016). Quantitative classification and environmental interpretations for the structural differentiation of the plant communities in the dry valley of Jinshajiang River. Biodiversity Science, 24(4), 407-420.

Luo, J.Y., Zhang, SH., Zhu, X.ZH., Wang, CH.Y. Lü, L.M., Li, CH.H. & Cui, J.J. (2016). Insect community diversity in transgenic Bt cotton in saline and dry soils. *Biodiversity Science, 24*(3), 332-340.

Qin, Y.J., Zhang, T.H.& Ye, X. (2016). Preparation and detection of anti-influenza A virus polymerase basic protein 1 polyclonal antibody. *Chinese Journal of Biotechnology, 32*(1), 105-113.

Shao, J.G., Jiang, H.J., Chang, J.X., Zhang, B.J., Li, SH.CH. & Su, Y. (2016) Prokaryotic expression and immunogenicity of IgG-binding protein of Streptococcus equi subspecies equi. *Chinese Journal of Biotechnology, 32*(5), 577-583.

Sun, L.M., Yu, M.J., Chen, Y.D., Chen, X.J., Liu, Y., Qiu X.M. & Sha ZH.X. (2016). Akt-interacting protein gene cloning and its expression profile in response to pathogen infection in half smooth tongue sole (cynoglossus semilaevis). *Acta Hydrobiologica Sinica, 40*(3), 467-473.

Wang, J.Y., Wang, W.SH., Zhao, H. & Yang, K.Q. (2016). The modified bacterial two-hybrid system. *Chinese Journal of Biotechnology, 32*(2), 231-240.

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Wu, W.T, Ju, M.T., Liu, J.P & Liu, B.Q. (2016). Effect of ensilage on bioconversion of

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Xiong, Q., Huang, L.CH., Ye, SH.W., Li, L. Song, L.R. & Wu, Y. (2016). The seasonal variations and spatial distribution of the primary productivities of phytoplankton in the three gorges reservoir. *Acta Hydrobiologica Sinica, 39*(5), 853-860.

Xu, X.J., Zha, X.D., Che, Y.Y., Ma, L.J., Wu, S.Q., Yang, P.L., & Yao, B. (2016). Expression of Pleurocidin from winter flounder in Escherichia coli and optimization of culture conditions. *Chinese Journal of Biotechnology, 32*(3), 365~374.

Xue, J.H., Jiang, L., Ma, X.L., Bing, Y.H., Zhao, S.CH. & Ma, K.P. (2016). Identification of lotus cultivars using DNA fingerprinting. *Biodiversity Science, 24(1)*, 3-11.

Yan, H.L., Chun, W.Y., Wang J.H., Liu, X.Y. & Zhang, J.SH. (2016). Circadian rhythmicity of clock genes in liver and heart of mandarin fish (siniperca chuatsi). *Acta Hydrobiologica Sinica, 40*(2), 243-251.

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Zhou, R., Wang, B., Yang, R., Li, SH., Fan, L.L., Zeng, Q.CH. & Luo, Q. (2016). Quantitative Trait Loci Analysis of Rice Blast Resistance in Japonica Rice Variety Ziyu44. *Bulletin of Botany, 50(6)*, 691-698.

Biology (L1 English)

Brackley, C. A., Brown, J. M., Waithe, D., Babbs, C., Davies, J., Hughes, J. R., & Marenduzzo, D. (2016). Predicting the three-dimensional folding of cis-regulatory regions in mammalian genomes using bioinformatic data and polymer models. *Genome biology, 17*(1), 59.

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Diner, B. A., Li, T., Greco, T. M., Crow, M. S., Fuesler, J. A., Wang, J., & Cristea, I. M. (2015). The functional interactome of PYHIN immune regulators reveals IFIX is a sensor of viral DNA. *Molecular systems biology*, *11*(2), 787.

Gerdes, P., Richardson, S.R., & Faulkner, G. J. (2016). TET enzymes: Double agents in the transposable element–host genome conflict. *Genome biology*, *17*(1), 259.

Giarla, T.C., & Esselstyn, J.A. (2015). The Challenges of Resolving a Rapid, Recent Radiation: Empirical and Simulated Phylogenomics of Philippine Shrews. *Systematic biology*, *64*(5), 727–740.

Greulich, P., Scott, M., Evans, M.R., & Allen, R.J. (2015). Growth-dependent bacterial susceptibility to ribosome-targeting antibiotics. *Molecular systems biology, 11(3),* 796.

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Pagan, J.K., Marzio, A., Jones, M.J.K., Saraf, A., Jallepalli, P.V., & Pagano, M. (2015). Degradation of Cep68 and PCNT cleavage mediate Cep215 removal from the PCM to allow centriole separation, disengagement and licensing. *Nature cell biology*, *17*(1), 31-43.

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