Syntactic Complexity and Communicative Moves of Applied Linguistics Research Article Abstracts: A Function-first Approach

Rajab Esfandiari[1*], Mohammad Ahmadi[2], Aynur Ismayilli Karakoç[3]

[1*]Department of English Language, Faculty of Humanities, Imam Khomeini International University, Qazvin, Iran, e*sfandiari@hum.ikiu.ac.ir*
[2]Department of English Language, Faculty of Humanities, Imam Khomeini International University, Qazvin, Iran, *ahmadi.m8362@gmail.com*
[3]Centre for Research in English Language Learning and Assessment (CRELLA), Putteridge Bury Campus, University of Bedfordshire, Luton, UK.
aynur.ismayillikarakoc@beds.ac.uk

Article Info	ABSTRACT
	There is currently a growing tendency to a meaning-based approach to the analysis of syntactic complexity in academic writing. While previous studies have offered illuminating insights into linguistic realizations of rhetorical structures in relation to syntactic complexity, they have typically analyzed lexicogrammatical features in a decontextualized manner. Drawing on a corpus-based cross-sectional design, this study takes a function-first approach to investigating the rhetorical functions of syntactically complex structures in research article (RA) abstracts in applied linguistics. To that end, a corpus of 270 texts from leading applied linguistics journals was constructed. Based on the model proposed by Pho (2008), we manually annotated the texts for the moves, and measured their syntactic complexity using phrasal, clausal, and global metrics. SPSS (version 25) was run for the analysis of data. Results of one-way MANOVA (multivariate analysis of variance) and Chi-square tests revealed significant variations among rhetorical moves in terms of clausal and phrasal complexity measures. The findings also showed that academic writers varied the complexity of their written structures according to their rhetorical goals. The results establish form-meaning mappings between syntactically complex structures and rhetorical functions. The findings carry pedagogical implications for student writers to adjust their prose using functionally appropriate complex structures following expert writers through comparing their own writing with that of expert writers to notice the gaps. ***Keywords***: Applied Linguistics, Function-first approach, Research article abstracts, Rhetorical moves, Syntactic complexity

1. Introduction

Syntactic complexity (SC) is commonly referred to as the degree to which the features that surface a language are different, sophisticated and elaborated (Bulte & Housen, 2014; Lu, 2011). Ortega (2003) argues that syntactic complexity is of great significance since development involves increasing the learners' syntactic complexity resources and employing them a different context. It is argued that L2 complexity is increased as interlanguage develops; the more advanced a learner is, the more sophisticated his/her syntactic complexity structures become (Ortega, 2015).

Previous studies on SC have largely focused on lexicogrammatical realizations of complex academic texts and compared them to their counterparts in other groups. These studies take the form-first approach (as opposed to function-first approach) to text analysis in terms of syntactic complexity for determining proficiency, performance and development (See Bulté & Housen, 2014). In form-first approach the lexicogrammatical features of interest are found mainly automatically and then they are analyzed in a decontextualized manner (Lu et al., 2020). Although this research trend has provided us with useful information about written language complexity and particularly into characteristics of academic writing register, they fail to provide a clear picture of form-function mapping in academic corpora with regard to syntactically complex structures.

The second drawback of form-first approach to investigating SC is concerned with pedagogical considerations (Durrant & Mathews-Aydınlı, 2011). What language curricular and pedagogic practices need to emphasize is not a fragmented picture of academic writing complexity that is reflected through purely automatic corpus-based investigations; rather, they need to focus on a meaning-based approach to investigating second language complexity that may affect second language learners' writing competence (Ryshina-Pankova, 2015). Pallotti (2009) cautioned that a great proportion of research on language complexity tend to focus on language forms presented out of context and expression of communicative functions. While previous research has witnessed some studies adopting function-first approach for investigating multi-word combination (e.g., Omidian et al., 2018), there has been little research on SC. The gap is particularly significant when we consider the role of SC in academic writing (See Biber at al., 2011; Biber & Gray, 2016). One particular exception is the study which was conducted by Fauzan et al., (2020) who investigated rhetorical moves of RA abstracts in terms of their linguistic retaliations. Although that study shares some similarities with the present study, there are considerable differences. That study focused on the general notion of linguistic complexity (lexical density, verb tense and voice, etc.) but the present study investigates the construct of SC and its different dimensions at phrasal, clausal and sentential levels. Unlike the current research, the bottom-up

approach in that study included no clear statistical procedures for identifying form-function relationship within the moves.

Our study contributes to the existing literature on meaning-based corpus studies by adopting a functional view of SC in academic writing through examining the syntactically complex realizations of rhetorical organization of RA abstracts. To this end, we take a function-first approach in which different rhetorical moves of the abstracts are manually annotated and then the lexicogrammatical features aligned with each rhetorical function are identified. This research study, therefore, places emphasis on the research questions.

1. How do rhetorical moves of RA abstracts differ in syntactic complexity measures?
2. What communicative functions do the most syntactically complex structures perform in RA abstracts?

2. Literature Review

2.1. Syntactic Complexity

Syntactic Complexity is conceptualized as the range and sophistication of language features which surface language production (Ortega, 2015). In the same vein, Ellis (2003) noted that syntactic complexity is referred to "the extent to which the language produced in performing a task is elaborate and varied" (p.340). Previous studies have shown than SC is positively associated with language proficiency and development (Youn, 2014). However, due to multidimensional and developmental nature of the construct (Norris & Ortega, 2009), not all studies report similar results in terms of the link between complexity measures and language development. The inconsistency could be partly attributed to the inadequacy of quantitative complexity measures that are frequently used as indicators of proficiency e.g., the use of clausal metrics in the cases where phrasal indices should have been used (Biber et al., 2011).

Some studies focused on this issue with the purpose of delineating the theoretical validity and operational problems. Although the majority of studies aiming at measuring syntactic complexity use clausal metrics, the term is often properly defined and used with different connotations (Pallotti, 2015). The need for comparability, reliability and validity of the results obtained from complexity studies issue the call for more dynamic and valid measures of complexity measures (Norris & Ortega, 2009).

Until fairly recently, SC was measured in terms of the ability to subordinate clauses, as identified by T-unit length (Nesi & Gardner, 2019). Many of the studies in writing used the construct of complexity to describe the learners' produced texts. However, the definition, operationalization, and measurement of the construct remain a major concern. The studies adopt a production perspective on complexity on the ground that the language the learners produce becomes more complex as they move away from preliminary language skills to more advanced ones (Biber, et. al., 2011). Bulte´ and Housen

(2014) argue that the vast majority of the studies have used complexity measures under the assumption that more language elements like morphemes, lengthier language unites like texts, more embedded elements, like subordinate clauses, more varied language structures, and more sophisticated and marked language features imply more complex language.

Given the fact that a clause includes only a subject and a verb, any addition or modification to it results in complex or elaborated grammar (Biber & Gray, 2016). Based on this view, researchers have used measures like T-unit, C-unit, mean length of clause and so forth to assess syntactic complexity. In general, the measures which have been used to assess syntactic complexity are categorized into five major groups, which are presented in Table 1.

Table 1

Lu's (2010) Classification of SC Measures

Measure	Code
Type 1: Length of production	
Mean length of clause	MLC
Mean length of sentence	MLS
Mean length of T-unit	MLT
Type 2: Sentence complexity	MLC
Clauses per sentence	C/S
Type 3: Subordination	
Clauses per T-unit	C/T
Complex T-units per T-unit	CT/T
Dependent clauses per clause	DC/C
Dependent clauses per T-unit	DC/T
Type 4: Coordination	
Coordinate phrases per clause	CP/C
Coordinate phrases per T-unit	CP/T
T-units per sentence	T/S
Type 5: Particular structures	
Complex nominals per clause	CN/C
Complex nominals per T-unit	CN/T
Verb phrases per T-unit	VP/T

The first category, as Table 1 shows, includes those measures based on length of production. The three measures in this category comprise MLC, MLS, and MLT. They resemble one another in terms of the numerator, that is, they all have the mean number of words or morphemes which are averaged across different units of production in the text (clause for MLC, sentence for MLS, and T-unit for MLT). In a synthesis research study, Ortega (2003) revealed that the majority of the studies investigating writing development in L2 (25 of 27) included MLT for measuring writing complexity. The credibility of MLT in the literature can be attributed to its relative predictive power of writing proficiency development and the easiness with which the measure can be assessed compared to other measures (See Kyle & Crossley, 2018). L2 complexity researchers did not incorporate subordination and *t*-unit based measures into

their studies in spite of their poor theoretical bases, after Hunt (1965) had proposed *t*-unit as an appropriate measure of grammatical complexity in writing.

However, a common criticism of the measures in the first category is that their interpretive usefulness of scores is opaque (Norris & Ortega, 2009), because they merely provide a rough indication of complexity in the text, and they give little information about the units' internal structure. Similarly, Wolfe-Quintero et al. (1998) suggested lengthening *t*-unit by means of both subordinate clauses and longer clauses which are the property of the construct of fluency, not complexity.

The second category explores sentence complexity which encompasses only one measure of C/S. It is measured by counting the number of clauses and dividing them by the total number of sentences in the text. Bardovi-Harlig (1992) suggests that sentence-based measures may better represent the writing complexity of adult second language learners. Although the relative advantages of sentence-based analyses have been discussed in the literature, they have been normally abandoned by the researchers due to their poor theoretical bases.

The third category contains four measures that examine subordination in the text. The rationale behind extensive use of subordination measures in the literature is that strong reliance on subordination characterize development in writing (Biber et al., 2011). Although the literature is replete with the studies investigating writing complexity through amount of subordination (e.g., Beers & Nagy, 2011; Frear & Bitchener, 2015; Wolfe-Quintero et al., 1998), some researchers cast doubt on the suitability of the subordination as the indicator of syntactic development across all proficiency levels (Ortega, 2003; Norris & Ortega, 2009). One of the limitations of subordination measures is that they reflect a narrow linguistic scope, because they do not tap into other sources of complexity such as coordination, nominalization, and modification at the phrasal level (Bulté & Housen, 2012). Similarly, Norris and Ortega (2009) argue that subordination measures may not be appropriate for gauging the writing complexity of early English learners. They may only be suitable at intermediate stages.

The fourth category includes those measures that capture the amount of coordination in the text. Coordination metric was proposed by Bardovi-Harlig (1992), who suggested that T-unit metrics do not represent real language use because the sentence units that were produced by language learners are artificially divided into uniform T-units that do not characterize original language sample. She further claims that coordination index more accurately reflects the learner's knowledge. However, in an extensive investigation of syntactic complexity measures using a written corpus of Chinese learners of English, Lu (2011) reported that increased coordination and subordination did not correlate with the learners' proficiency levels.

The last category involves such measures as CN/C, CN/T, and VP/T. Only the first component is concerned with what Biber et al., (2011) called

elaboration through noun phrase postmodification features. In a longitudinal study of ESL learners, Bulte and Housen (2014) reported that the learners' writing complexity developed significantly in noun phrase complexity during one semester but not in subordination. Similar results were found by Mazgutova and Kormos (2015), who revealed that writing development affected through short-term instruction can be best measured by noun phrase metrics.

Lu's (2010) classification of syntactic complexity measures was a comprehensive overview of the measures commonly employed to capture multidimensionality of syntactic complexity. The first category includes those measures which are based on length of production. The three measures in this category comprise MLC, MLS, and MLT. The second category explores sentence complexity which encompasses only one measure of clauses per sentence. The third category contains four measures that examine subordination in the text. The fourth category includes those measures that capture the amount of coordination in the text. Coordination metric was proposed by Bardovi-Harlig (1992), who suggested that T-unit metrics do not represent real language use because the sentence units that were produced by language learners are artificially divided into uniform T-units that do not characterize original language sample. Finally, the last category involves such measures as CN/C, CN/T, and VP/T.

2.2. The Need to Shift to Rhetorical Functions of SC

Over the past few years SC has been used as framework for the study of academic writing performance and proficiency (e.g., Parkinson & Musgrave, 2014), disciplinary variations (e.g., Staples et al., 2016), writing quality (Kyle & Crossley, 2018), and writing development (e.g., Bulté & Housen, 2018). These studies typically adopted form-first analytical approach where syntactically complex structures were singled out for further analyses based on frequency distribution. While frequency-based view of SC allows the researchers to uncover lexicogrammatical features specific to a given register/discipline in a reliable way, it cannot be used as a means to how well a given structure is associated with its communicative function (Durrant & Mathews-Aydınlı, 2011). Lu et al. (2020) noted that overemphasis on decontextualized analysis of SC can be counterproductive in terms of pedagogical implications as the learners may overuse functionally inappropriate structures to complexify their writing productions. Thus, what is worth further attention in SC investigations is examination of rhetorical features of complex lexicogrammatical features in academic register.

The study of rhetorical organization of texts in genre-based writing was motivated by Swales (1981) as an attempt to probe into the underlying schematic structure (moves and steps) of different written registers (Basturkmen, 2012). Move is discoursal unit which seeks to accomplish a given

aim in the text (Henry & Rosenberry, 2001). On the other hand, "a step is a text fragment containing new propositional meaning from which a specific communicative function can be inferred at a low level of generalization" (Moreno & Swales, 2018, p. 20). In genre analysis, a text is assumed to have a number of moves and steps each of which fulfills the function of facilitating the texts as a whole to perform its communicative function. As Lan et al. (2019) pointed out language teacher should not provide a diverse list of grammatical features that are of little or no pedagogical values with the learners; rather, they need to focus on how these lexicogrammatical features could be embedded into a larger context of discourse.

There has been a growing trend in recent years to fill the "function-form gap" in Moreno and Swales' (2018) terms. Omidian et al. (2018) analysed multi-words combinations in rhetorical moves of RA abstracts across several fields of study. The results indicated that the writers in different disciplines had different priorities for representing their academic works. In a similar study, Saricaoglu et al. (2021) focused on the introduction sections of learner-generated papers in terms of their complexity features contextualized in moves and steps. They found that different complexity measures (e.g., phrasal, clausal or length-based) are primed to occur in particular steps of a given move. They finally concluded explicit instruction could be effective way of presenting these features in academic registers. In line with these studies, our study has added to this line of research by exploring RA writes' use of complex lexicogrammatical features within the framework of RA abstracts' rhetorical conventions.

3. Methodology

3.1. Corpus Design

The corpus of the current study was comprised of the texts selected from peer-reviewed scholarly journals in applied linguistics (Table 2). The inclusion of the journals was motivated by the criterion of *h*-index (Hirsch, 2005) and publication history. *H*-index is assumed to overcome the limitations of the previous metrics used for rating journals. Harzing and van der Wal (2008) suggested that there are at least two problems associated with traditional metrics such as *Journal Impact Factor* (JIF). The first problem of JIF is concerned with the index used for the citation of the articles. That index may be biased by high number of citations (over-citations) as well as self-citations. The second problem is statistical or technical one by which JIF is calculated. Accordingly, as a result of inappropriate computation method employed by JIF, "journals with a lively letter/correspondence section (such as for instance Nature) will show inflated JIFs" (P. 4). *H*-index, on the other hand, is robust to over-citations, as it is not based on mean scores (Harzing & Van der Wal, 2008). In Hirsch's (2005) words,

>A scientist has index *h* if *h* of his/her N_p papers have at least *h* citations each, and the other (N_p - *h*) papers have ≤ *h* citations each', where N_p = the number of papers published over n years. (Hirsch, 2005, p. 16569)

Table 2

Overview of Journals Included in the Corpus

Journal	Years of Publication	H Factor
Language Learning	1948-1953, 1955-1956, 1958-ongoing	38
Applied Linguistics	1980-ongoing	38
TESOL Quarterly	1981-ongoing	36
Modern Language Journal	1916-1996, 1998-2001, 2005-ongoing	36
English for Specific Purposes	1980-1981, 1986-ongoing	25

The abstracts were all extracted from empirical studies following IMRD (Introduction-Methods-Results-Discussion) format. When selecting RAs, it was important to choose a range of recently published papers as they reflect modern scientific prose (Biber & Gray, 2016). As a result, only the papers that were published between 2018 and 2020 were chosen to conduct the analysis of the present study. Stratified sampling technique was utilized to select the abstracts. That is, texts were selected according to strata of journal types, years and issues of publication. The decision to choose the abstracts in this study was based on the following considerations: (a) they have suitable size in terms of word counts making them an interesting part-genre for corpus-based comparative studies (b) they appear as the first section that journal gate- keepers examine and they affect the editors' decision significantly (Abrahamson, 2008). Thus, they are becoming an important venue for corpus-based studies. Two hundred and seventy RA abstracts amounting to 57,983 words represent our study corpus.

3.2. SC Analysis

We employed Lu's (2010) syntactic complexity analyzer (SCA) to measure SC in this study, an automated complexity assessment system, which can compute 14 SC indices. We chose SCA in the present study because: (1) it is freely available on the internet to automatically analyze the texts (2) it covers a range of complexity metrics which are assumed to constitute the construct of SC (Norris & Ortega, 2009) (3) it demonstrates high reliability indices (Lu & Ai, 2015).

Given the multidimensional nature of the construct of SC, we decided to choose different measures each of which analyzes one particular dimension. According to Lu's (2010) classification, five types of complexity measures are commonly used to measures the construct of SC. Each category is supposed to measures one dimension of the construct. Since each category in Lu's (2010) classification contains a number of measures, we set two criteria of multidimensionality and redundancy (distinctness) for choosing the appropriate measures (See Norris & Ortega, 2009).

In deciding the measures of syntactic complexity, we considered the inclusion of those that could capture multidimensionality of the construct but at the same time consider the issue of redundancy and distinctness (Norris & Ortega, 2009). As Norris & Ortega put it some indices are just superficially different; yet, they actually capture the same underlying construct. As a result, we chose five indices of MLT, MLC, C/S, DC/T, and CN/T for analysis in our study.

3.3. Annotation of the Rhetorical Moves

The corpus of the current study was analyzed for identification of moves. Inspired by the study carried out by Pho (2008), we did not divide the moves further into sbumoves (steps) as subdivision of the moves in the previous studies (such as Santos, 1996) "was mainly based on Swales' (1990) CARS model for the Introduction" (Pho, 2008, p. 234) which may not be directly applicable to the abstracts. A top-down approach was employed (Biber & Barbieri, 2007; Jiang & Hyland, 2017), where the abstracts were first annotated for their communicative functions and then the annotated moves were assessed in terms of syntactic functions they performed. We adopted the model proposed by Pho (2008), Ebrahimi and Chan (2015), and Jiang and Hyland (2017) to extract the moves, where the abstracts, as shown in Table 3, include a five-move organization of Introduction, Purpose, Methods, Results and Conclusion. The model has been investigated by several studies and have been shown to be quite consistent across time and text types (Gillaerts, 2013; Jiang & Hyland 2017). In addition, the labels of the moves are more meaningful than those in other studies (Pho, 2008). In this study, we followed a coding scheme as suggested by Lu et al. (2020) where sentence was taken as the unit of annotation. In cases where rhetorical sections were not consistent with the

sentence boundaries, the problem was resolved by identifying the dominant rhetorical moves.

Table 3

Categorization of the Rhetorical Moves in RA Abstracts (Adapted from Hyland, 2004; Pho, 2008)

Move	Rhetorical Function
Introduction	Situating the research: Providing background information and generalizing the topic.
Purpose	Presenting the research: Indicating the purpose, stating the research questions and hypotheses.
Methods	Describing the methodology: Providing information on the materials, subjects, design, data analysis, etc.
Results	Summarizing the findings: Reporting the results of the study.
Conclusion	Discussing the research: Interpreting the main findings and extending them to other similar studies, making inferences, and discussing the implications.

The moves were manually annotated by a team of three experienced linguists (annotators) independently. Initially, 10 percent of the texts was annotated by the annotators to identify the moves. Afterwards, the inter-annotator agreement was calculated at 0.8523. Then after resolving uncertain cases, we came up with the final agreement of almost 93%. Other discrepancies were also negotiated to have a complete inter-annotator agreement.

3.4. Data Analysis

As for the first research question, the identified moves in the abstracts were analyzed for syntactic complexity measures as computed by SCA. That is, five SC measures were compared across the moves of the abstracts. Thus, one-way Multiple Analysis of Variance (MANOVA) was run. One-way ANOVA with post-hoc multiple comparisons were performed for comparing significant features identified in MANOVA. We drew on Bonferroni post-hoc correction to adjust the *p*-values.

For the second research question, we followed the analytical procedures employed by Lu et al. (2020) where a complexity threshold was run for all five measures under study. To this end, the third quartile was adopted where the sentences at or beyond that value were taken as statically complex sentences.

Then the proportion of complex sentences to total number of sentences in each move was calculated. Eventually, a Chi-square test was employed for identifying the cases (the moves) with greater or lower proportion of complex sentences for each measure.

4. Results and Discussion

4.1. Results

4.1.1. Move Frequency of the Abstracts

Rhetorical analysis of the moves in the abstract sections of RAs indicated that a significant proportion of the abstracts had at least four moves (80%) with move 2 (presenting the research) being the most commonly used rhetorical convention ($\cong$ %96) and move 1 (situating the research) the least frequent one (= 60%). Table 4 presents the results in more details.

Table 4

Descriptive Statistics of the Data in the Abstracts and their Identified Moves

Moves	Mean number of words	Number of abstracts containing move	proportion
Situating the research	44.56	162	60%
Presenting the research	32.35	258	96%
Describing the methodology	52.63	228	84%
Summarizing the findings	56.62	252	93%
Discussing the research	28.59	198	73%

4.1.2. Syntactic Complexity in Different Moves

The rhetorical moves in each abstract, which were manually annotated, were analyzed for syntactic complexity indices as measured by global, clausal, and phrasal indices of MLTU, MLC, DC/T, C/S, and CN/T. The selection of the measures was based on the assumptions that syntactic complexity is a multidimensional construct. That is, each measure represents one important dimension of the construct as characterized by Lu (2010).

Table 5

Descriptive Statistics of Syntactic Complexity Measures across Abstract Moves

Measure	Move	Number of Texts Containing moves	Mean	Std. Deviation
Mean length of T-unit (MLTU)	1	162	27.13	5.12
	2	258	23.15	4.15
	3	228	19.87	5.13
	4	252	18.22	2.21
	5	198	29.14	3.67
Mean length of clause (MLC)	1	162	20.48	4.61
	2	258	17.14	3.67
	3	228	15.23	3.91
	4	252	14.89	4.15
	5	198	21.71	3.61
Clauses per sentence (C/S)	1	162	1.31	0.63
	2	258	1.16	0.54
	3	228	2.35	0.78
	4	252	2.23	0.83
	5	198	1.14	0.69
Dependent clauses per T-unit (DC/T)	1	162	0.54	0.12
	2	258	0.42	0.23
	3	228	0.79	0.15
	4	252	0.83	0.11
	5	198	0.49	0.17
Complex nominals per T-unit (CN/T)	1	162	4.98	1.12
	2	258	3.89	0.96
	3	228	2.67	1.45
	4	252	2.59	1.03
	5	198	5.23	1.23

As shown in Table 5, academic writers performed differently in the rhetorical moves of the abstract section of RAs in terms of five complexity measures. Comparatively, the authors used more phrasal features in Move 4 and Move 5 than Move 3 and 4. However, Move 3 and Move 4 are characterized by more frequent incidences of clausal features as measured by DC/T, and C/S compared to other moves.

Table 6

Tests of Between-Subjects Effects

Dependent Variables	df	F	Sig.	Partial Eta Squared
MLT	2	19.45	0.003	0.14
MLC	2	21.67	0.001	0.17
C/S	2	17.87	0.004	0.13
DC/T	2	31.14	0.000	0.23
CN/T	2	64.82	0.000	0.36

*The results are significant at the $p < 0.01$ level.

The results obtained from one-way MANOVA showed significant differences in moves, F (5, 173) = 8.73, p = 0.000; Pillai's Trace = 0.531 partial eta squared = 0.289. As shown in Table 6, using a Bonferroni adjusted alpha level of 0.01, MLT (p = 0.003), MLC (p = 0.001), CN/T (p = 0.000), C/S (p = 0.004), and DC/T (p = 0.000) reached statistical significance.

Separate analyses for significant dependent variables were conducted by employing ANOVA and post-hoc Tukey HSD test. As for CN/T, and MLC the differences between Move 1, and Move 5 on the one hand and Move 3 and Move 4 on the other hand were significant at p = 0.000 and p = 0.001 respectively. CN/T, and MLC measures in Move 2 were between those of Move 3 and Move 4 and Move 1 and Move 5. Academic writers used more DC/T and C/S on average in Move 3 and Move 4 than other Moves and the results were significant at p = 0.000.

The second phase of our study is concerned with the communicative functions of the most complex sentences with regard to five global, clausal and phrasal complexity measures. Initially the sentences were analyzed for their complexity indices where those at or beyond the third quartile for each measure were considered complex. The results are based on Chi-square test in a way that the proportion of the complex sentences to total number of sentences in every move was calculated. Then the moves that that reached statistical significance were further investigated for their pedagogical values.

Table 7

Rhetorical Moves that Differ Significantly from other Moves

Measures	Significantly high	Significantly low
MLT	None	None
MLC	Move 1, Move 5	Move 4
C/S	Move 3	None
DC/T	Move 3, Move 4	Move 1
CN/T	Move 1, Move 5	Move 4

According to Table 7, with regard to the measures of MLC, and CN/T (Figures 1 and 2), two moves reached statistical significance in terms of the proportion of the sentences exceeding the threshold, namely Move 1 (Introduction), and Move 5 (Conclusion). On the other hand, one move contained statistically lower proportion of sentences reaching the threshold than expected, namely, Results. A closer look at the sentences containing greater length in the unit of clause, and more complex nominals in the unit of T-unit could reveal more insight into form-function relationship. As for C/S, one move showed statistical significance, namely Move 3. Finally, Move 3 and Move 4 displayed significantly more complex sentences in terms of DC/T than other Moves.

4.2. Discussion

This study employed a function-first approach to investigating syntactic complexity in published RA abstracts. Initially, the rhetorical Moves of RA abstracts were annotated for their communicative functions. Then complexity measures of the Moves were calculated and associated to each Move. This practice avoids the problems commonly associated with form-first approach to corpus analysis such as circularity of reasoning (See Durrant & Mathews-Aydınlı, 2011). The results revealed that Move 2 was the most commonly used rhetorical section in RA abstracts while Move 1 was the least frequently used rhetorical strategy adopted by academic writers. This finding confirms that of Pho (2008), who found that almost all abstracts selected from the journals in TESOL Quarterly and Modern Language Journal contained Move 2 (situating the research). On the other hand, nearly half of the RA abstracts form the same journals contained Move 1 (presenting the research).

It was also found that rhetorical moves of RA abstracts are complex in different ways. While Introduction and Conclusion (Moves 1 and 5) tended to employ phrasal complexity features, Methodology and Results (Moves 2 and 4) were characterized by more frequent clausal features. Move 2, was between the Moves in high and low ends. The finding is in keeping with those of Lu et al. (2020), who noted that "particular rhetorical claims do not appear to be 'more complex' than others in an absolute manner, but rather writers advance rhetorically similar claims through particularized forms of sophisticated constructions" (p. 12).

The fact that academic writers made more frequent use of phrasal features in Move 1 and 5 than Move 3 and Move 4 lends support to the presence of form-function mapping between syntactically complex structures and their rhetorical functions. Although Introduction and Discussion tend to be evaluative, Methods and Results are more straightforward and explicit (Esfandiari & Ahmadi, 2022). Frequent use of clausal features contributes to the explicitness of expression, which is a preferred discourse style in Methods and Results. "Clausal forms of expression are considerably more explicit than phrasal features, because they grammatically specify the meaning relationships among elements" (Biber & Gray, 2016, p. 18). On the other hand, because there is a lack of function words between phrasal elements, it will be more difficult to decipher meaning for non-specialists (Biber et al., 2011). Example 1 illustrates how academic writers made frequent use of clausal features to establish explicit meaning relationship in Move 3 or 4 (Methods or Results) (relative pronouns are bold underlined).

(1) "A total of 33 reports were identified **which** included 17 studies **that** investigated interactional relationships **that** examined the effectiveness of treatments **which** generated 309 effect sizes. (27 words)"

Move 3 (Methods) tends to relate the methodology of the study with those of previous literature as well as with Introduction and Results (Lim, 2006). However, in Move (4) the results are given in a straightforward manner. Given the empiricist nature of these two moves, information needs to be communicated in a maximally explicit manner. As Biber and Gray (2016) pointed out meaning relationships in academic writing "can be made explicit through the use of relative clauses or other forms of clausal modification" (p. 225).

The present study indicated that Move 1 and Move 5 are more complex than other moves in terms of phrasal modification features. The similar frequency of occurrence of phrasal modifiers in Move 1 and Move 5 is associated with the rhetorical features they are supposed to offer. Introduction and Discussion are interrelated and the writers commonly regard it as a useful way to employ the same terminologies to echo the study's aim in the Discussion (Bavdekar, 2015). Accordingly, noun phrase modifiers facilitate the link between the two.

RA abstracts are a compact genre (Jiang & Hyland, 2017). This compressed discourse style encourages the writers to embed as much information as possible in as fewest words as possible. This is particularly crucial in Move 1 and Move 5 where the authors need to "set the scene for the current research", generalize the topic, "interpret the findings, give recommendations, and suggest applications" (Pho, 2008, p. 234). Embedded phrasal features allow academic writers to communicate great amount of meaning through concise and compact structures which are motivated by "economy of expression" (Biber & Gray, 2016). Example 2 illustrates how RA writers employed phrasal features to communicate as much information as possible (noun phrases are bold underlined).

"The article discusses the **effectiveness** of **EFL teacher preparation programs** for **pre-service teachers' performance on PCK** as well as **possible interpretations** and **research suggestions**. (25 words)"

Example 2 includes only one verb (discuss) and no relative clauses are embedded in the main clause. However, ideas are embedded through frequent use of noun pre- and postmodifiers e.g. *effectiveness of EFL teacher preparation program*. In comparison, example 1 includes relatively the same number of words, but it contains four dependent and relative clauses.

This study also indicated that communicative functions of abstract moves determined the extent to which academic writers varied the complexity of the sentences they produced. A closer look at the sentences linked to the moves with significantly higher or lower proportion of syntactically complex sentences (Moves 1 and 5) with regard to phrasal measures (MLC and CN/T) imply that the sentences draw heavily on specialized research nominalizations defined as "nouns that are formed from verbs or adjectives by the addition of a suffix" (Biber & Gray, 2016, p. 7) such as *examination*. Examples 3, 4, and 5 represent the use of nominalizations in Move 1 and 5 (nominalization instances are bold underlined).

(2) "Overall, the study calls for a more systematic **investigation** of L1 frequency effects within usage-based perspectives on second language **acquisition**."

(3) "This study suggests that a close **examination** of laughter provides rich **information** about task-based **interactions** that may otherwise be overlooked."

(4) "Current quantitative methods in second language (L2) **acquisition** have proven useful in examining how phraseological unit **production** changes over time."

As for DC/T, two moves (Move 3 and 4) displayed higher proportion of sentences meeting the thresholds than the other Moves. The use of nonfinite dependent clauses in Move 4 (Results) seems to reflect the condition under which the relationship between the variables exist (example 6). However, mean length of T-unit is consistent across the moves. This suggest that academic writers do not vary the length of their production in terms of clausal features across the moves to fulfill a particular rhetorical function.

(5) "Analysis of the narrations and the results of a series of one-way ANOVA revealed that while the participants who performed the structured task under the careful online planning condition produced more complex, accurate and fluent language, those who performed the unstructured task under the pressured online planning condition obtained the lowest scores in all three areas of oral production."

5. Conclusion and Implications

We examined how academic syntactic complexity measures are influenced by rhetorical organization of RA abstracts. The findings revealed significant variations among the rhetorical moves and the proportion of syntactically complex sentences employed by academic writers to fulfill communicative functions. The results also provide further evidence of form-function mapping between syntactically complex structures and their communicative functions.

Overall, the results stress the significance of function-based approach to teaching syntactic complexity in academic writing. Accordingly, any pedagogical focus on syntactic complexity must include the consideration of context. In other words, investigation and instruction of complexity "must start with the analysis of the genre and situational context of the tasks that an L2 writer must complete" (Ryshina-Pankova, 2015, p. 8). In the same vein, writing assessment tools should take into account genre-appropriate syntactically complex structures rather than purely frequency-based metrics.

Syntactic variations among the moves of the abstracts in the current study imply an obvious form-function relationship between syntactically complex language and rhetorical functions in academic register (See Lu et al., 2020). One implication is that form-fist approach to SC in academic writing might not be a promising venue for corpus-based syntactic studies, as they may provide us with unclear picture of the distribution and reliance of different syntactically complex structures in the texts. Differences among the texts in terms of SC may not be as a result of the writers' un/familiarity with particular lexicogrammtical features; rather, they may be due to the presence/absence of certain move(s) which are linguistically realized through complex syntactic features.

One particular finding of this study was that expert academic writers varied the complexity of their sentences according to their rhetorical functions. Thus, explicit instruction on how to use syntactically complex structures in different rhetorical units could help the learners develop a functionally appropriate complex prose. Particularly, students' writing productions can be compared to those of expert writers in terms of prominent syntactic features (e.g., MLC, DC/T, etc.), and any loosely-organized syntactic structures could be collaboratively adjusted to meet the requirements of expert academic writing.

This study is not without its drawbacks. First, the corpus of the present study represented solely one area of academic writing (i.e., RA abstracts in accredited international journals in applied linguistics). It might be useful to see whether there is a relationship between functionally appropriate syntactic structures and L2 writing quality which is operationalized as human judgement of writing proficiency by instructor assigned grades (see Casal & Lee, 2019). The findings would suggest whether syntactically and/or functionally complex

structures would also lead to more advanced writing in the eyes of writing instructors.

Second, given laborious process of qualitative analysis of the texts, which was a separate phase of data analysis in the present study, we complied a relatively small corpus in size. Future studies may construct larger corpora and integrate automatic corpus tools, such as UAM Corpus Tool (Wang & Beckett, 2017), into data collection procedures (in addition to manual analysis of the texts). Investigating syntactic complexity across large corpus of texts would shed further light into form-function relationship among different academic part-genres such as Abstracts, Introductions, etc. and also among different disciplines.

Finally, complexity measures that were employed in the current study were relatively narrow. Thus, future research might make use of broader range of finer-grained syntactic complexity measures particularly those which assess phrasal complexity (as phrasal features, as opposed to clausal features, are assumed to be the prominent characteristic of advanced academic writing (see Biber et al., 2011) such as total number of dependents per NP (see Kyle & Crossley, 2018).

Regardless of these limitations, the present study shows that communicative functions of syntactically complex structures should be considered when researchers evaluate the proficiency level of language learners, because at higher levels of language proficiency rhetorical functions of language structures are closely related to sophisticated grammatical structures.

References

Abrahamson, E. (2008). 22 things I hate: Mini rants on management research. *Journal of Management Inquiry, 17*(4), 422-425.

Bardovi-Harlig, K. (1992). The relationship of form and meaning: A cross-sectional study of tense and aspect in the interlanguage of learners of English as a second language. *Applied Psycholinguistics*, *13*(3), 253-278.

Basturkmen, H. (2012). A genre-based investigation of discussion sections of research articles in dentistry and disciplinary variation. *Journal of English for Academic Purposes, 11*(2), 134-144.

Bavdekar, S. B. (2015). Writing Introduction: Laying the foundations of a research paper. *Journal of the Association of Physicians of India, 63*(7), 44-6.

Beers, S. F., & Nagy, W. E. (2011). Writing development in four genres from grades three to seven: Syntactic complexity and genre differentiation. *Reading and Writing, 24*, 183-202.

Biber, D., & Barbieri, F. (2007). Lexical bundles in university spoken and written registers. *English for Specific Purposes, 26*(3), 263-286.

Biber, D., & Gray, B. (2016). *Grammatical complexity in academic English: Linguistic change in writing*. Cambridge University Press.

Biber, D., Gray, B., & Poonpon, K. (2011). Should we use characteristics of conversation to measure grammatical complexity in L2 writing development? *TESOL Quarterly*, *45*(1), 5-35.

Bulté, B., & Housen, A. (2012). Defining and operationalizing L2 complexity. In A. Housen, F. Kuiken, & I. Vedder (Eds.), *Dimensions of L2 performance and proficiency: Complexity, accuracy and fluency in SLA* (pp. 21-46). John Benjamins Publishing Company.

Bulté, B., & Housen, A. (2014). Conceptualizing and measuring short-term changes in L2 writing complexity. *Journal of Second Language Writing*, *26*(1), 42-65.

Bulté, B., & Housen, A. (2018). Syntactic complexity in L2 writing: Individual pathways and emerging group trends. *International Journal of Applied Linguistics, 28*(1), 147-164.

Bulté, B., & Housen, A. (2012). Defining and operationalizing L2 complexity. In A. Housen, F. Kuiken, & I. Vedder (Eds.), *Dimensions of L2 performance and proficiency: Complexity, accuracy and fluency in SLA* (pp. 21-46). John Benjamins Publishing Company.

Casal, J. E., & Lee, J. J. (2019). Syntactic complexity and writing quality in assessed first-year L2 writing. *Journal of Second Language Writing, 44*, 51-62.

Durrant, P., & Mathews-Aydınlı, J. (2011). A function-first approach to identifying formulaic language in academic writing. *English for Specific Purposes, 30*(1), 58-72.

Ebrahimi, S. F., & Chan, S. H. (2015). Research article abstracts in applied linguistics and economics: Functional analysis of the grammatical subject. *Australian Journal of Linguistics, 35*(4), 381-397.

Esfandiari, R., & Ahmadi, M. (2022). A corpus-based analysis of noun phrase complexity in research article part-genres in applied linguistics and clinical medicine. *Language Related Research*, 13(3), 139-173.

Ellis, R. (2003). *Task-based language learning and teaching*. Oxford University Press.

Fauzan, U., Lubis, A., & Kurniawan, E. (2020). Rhetorical moves and linguistic complexity of Research article abstracts in international Applied Linguistics Journals. *Asian ESP Journal, 16*(5), 2020.

Frear, M. W., & Bitchener, J. (2015). The effects of cognitive task complexity on writing complexity. *Journal of Second Language Writing, 30*, 45-57.

Gillaerts, P. (2013). Move analysis of abstracts from a diachronic perspective: A case study. In N. L. Johannesson, G. Melchers, & B. Björkman (Eds.), *Of butterflies and birds, of dialects and genres* (pp. 49-60). Acta Universitatis Stockholmiensis.

Harzing, A. W. K., & Van der Wal, R. (2008). Google scholar as a new source for citation analysis. *Ethics in Science and Environmental Politics, 8*(1), 61-73.

Henry, A., & Rosenberry, R. L. (2001). A narrow-angled corpus analysis of moves and strategies of the genre: 'Letter of Application'. *English for Specific Purposes, 20*, 153–167.

Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences, 102*(46), 16569-16572.

Hunt, K. W. (1965). *Grammatical structures written at three grade levels*. National Council of Teachers of English.

Hyland, K. (2004). Disciplinary interactions: Metadiscourse in L2 postgraduate writing. *Journal of Second Language Writing, 13*(2), 133-151.

Jiang, F. K., & Hyland, K. (2017). Metadiscursive nouns: Interaction and cohesion in abstract moves. *English for Specific Purposes, 46*, 1-14.

Kyle, K., & Crossley, S. A. (2018). Measuring syntactic complexity in L2 writing using fine-grained clausal and phrasal indices. *The Modern Language Journal, 102*(2), 333-349.

Lan, G., Lucas, K., & Sun, Y. (2019). Does L2 writing proficiency influence noun phrase complexity? A case analysis of argumentative essays written by Chinese students in a first year composition course. *System, 85*, 102116.

Lim, J. M. H. (2006). Method sections of management research articles: A pedagogically motivated qualitative study. *English for Specific Purposes, 25*(3), 282-309.

Lu, X. (2010). Automatic analysis of syntactic complexity in second language writing. *International Journal of Corpus Linguistics, 15*(4), 474-496.

Lu, X. (2011). A corpus-based evaluation of syntactic complexity measures as indices of college level ESL writers' language development. *TESOL Quarterly, 45*(1), 36-62.

Lu, X., & Ai, H. (2015). Syntactic complexity in college-level English writing: Differences among writers with diverse L1 backgrounds. *Journal of Second Language Writing*, *29*(1), 16-27.

Lu, X., Casal, J. E., & Liu, Y. (2020). The rhetorical functions of syntactically complex sentences in social science research article introductions. *Journal of English for Academic Purposes, 44*, 1–16.

Mazgutova, D., & Kormos, J. (2015). Syntactic and lexical development in an intensive English for Academic Purposes programme. *Journal of Second Language Writing, 29*, 3-15.

Moreno, A. I., & Swales, J. M. (2018). Strengthening move analysis methodology towards bridging the function-form gap. *English for Specific Purposes, 50*, 40-63.

Nesi, H., & Gardner, S. (2019). Complex, but in what way? A step towards greater understanding of academic writing proficiency. In *Online Proceedings of the 51st Annual Meeting of the British Association for Applied Linguistics: Taking Risks in Applied Linguistics, York St John University 6-8 September, 2018* (pp. 83-85). British Association for Applied Linguistics.

Omidian, T., Shahriari, H., & Siyanova-Chanturia, A. (2018). A cross-disciplinary investigation of multi-word expressions in the moves of research article abstracts. *Journal of English for Academic Purposes, 36*, 1-14.

Ortega, L. (2003). Syntactic complexity measures and their relationship to L2 proficiency: A research synthesis of college-level L2 writing. *Applied Linguistics*, *24*(4), 492-518.

Ortega, L. (2015). Syntactic complexity in L2 writing: Progress and expansion. *Journal of Second Language Writing, 29*, 82-94.

Pallotti, G. (2009). CAF: Defining, refining and differentiating constructs. *Applied Linguistics*, *30*(4), 590-601.

Pallotti, G. (2015). A simple view of linguistic complexity. *Second Language Research, 31*(1), 117-134.

Parkinson, J., & Musgrave, J. (2014). Development of noun phrase complexity in the writing of English for Academic Purposes students. *Journal of English for Academic Purposes*, *14*(1), 48-59.

Pho, P. D. (2008). Research article abstracts in applied linguistics and educational technology: A study of linguistic realizations of rhetorical structure and authorial stance. *Discourse Studies, 10*(2), 231-250.

Ryshina-Pankova, M. (2015). A meaning-based approach to the study of complexity in L2 writing: The case of grammatical metaphor. *Journal of Second Language Writing, 29*, 51-63.

Santos, M.B.D. (1996). The textual organization of research paper abstracts in Applied Linguistics. *Text, 16*(4), 481-499.

Saricaoglu, A., Bilki, Z., & Plakans, L. (2021). Syntactic complexity in learner-generated research paper introductions: Rhetorical functions and level of move/step realization. *Journal of English for Academic Purposes, 53*, 101037.

Staples, S., Egbert, J., Biber, D., & Gray, B. (2016). Academic writing development at the university level: Phrasal and clausal complexity across level of study, discipline, and genre. *Written Communication*, *33*(2), 149-183.

Swales, J. (1981). *Aspects of article introductions*. The University of Aston, Language Studies Unit.

Swales, J. (1990). *Genre analysis: English in academic and research settings*. Cambridge University Press.

Wang, S., & Beckett, G. H. (2017). "My Excellent College Entrance Examination Achievement"-Noun Phrase Use of Chinese EFL Students' Writing. *Journal of Language Teaching and Research, 8*(2), 271.

Wolfe-Quintero, K., Inagaki, S., & Kim, H. (1998). *Second language development in writing: Measures of fluency, accuracy and complexity*. University of Hawaii at Manoa.

Youn, S. J. (2014). Measuring syntactic complexity in L2 pragmatic production: Investigating relationships among pragmatics, grammar, and proficiency. *System, 42*, 270-287.