

Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades

Abstract

This study examines an under-explored interactive register of discipline-specific online academic forum posts in higher education. 881 academic forum posts written by postgraduate students were analysed, using an additive multi-dimensional (MD) analysis. Four dimensions of linguistic variation were compared across the two first language backgrounds (L1 Chinese and L1 English), three subregisters (application design, business scenario, and discussion), and grades. The results indicated that the forum posts written by two L1 backgrounds, three subregisters, and grades significantly differed in terms of dimensions of linguistic variation. The findings have important implications for writing instruction and assessment in higher education. One of the significant implications of the present study is that both first and second language writers need to have mastery of informational and elaborated discourse features (nouns, phrasal coordination) to write successful academic forum posts at graduate level. Writing instructors may provide successful model texts for relatively new registers so that L2 writers can meet the multiple demands of online academic forum posts, including interacting with peers and supporting their ideas with academic literature.

Keywords: second language writing; multi-dimensional analysis; academic discussion posts; online forum posts; writing assessment; corpus linguistics.

1. Introduction

The proliferation of online and distance learning has created demand for online and alternative assessments in higher education (HE) (e.g. Kim and Maloney, 2020). Both first language (L1) and second language (L2) writers are expected to learn to write new and

professionally-oriented registers, especially at graduate/postgraduate level, to improve their employability (Nesi and Gardner, 2012). Online discussions, which enable asynchronous communication between participants/peers, have become an alternative assessment form that requires students to engage with each other's ideas (e.g. Thomas and Thorpe, 2019). In a recent study, Lim and Polio (2020) identified online discussion posts as one of the assignments that undergraduate students need to complete as part of their degree programmes in the US and called for research on linguistic characteristics of these assignments. Previous research has examined online discussion posts written for learning English (e.g. Ädel, 2011; Culpeper and Kan, 2019) and non-assessed discussion posts at undergraduate level (e.g. Coffin et al., 2012). However, assessed discipline-specific academic discussion posts have not been explored in terms of their linguistic characteristics. Therefore, it is necessary to identify writers' needs through research on the linguistic characteristics of academic discussion posts, and the current study responds to the call for research on this area and fills important gaps in our understanding of a relatively new interactive register. The findings of this study will thus be of particular importance for both students and writing instructors to develop their awareness of the linguistic characteristics of the online academic discussion posts, and this increased awareness has the potential to improve participation and writing in online discussions, especially for L2 writers. In this study, 'online academic forum posts', sometimes referred to as online discussion boards or online discussion forums in the literature (Thomas and Thorpe, 2019), use a dialogic interactive register whose main purpose is discussion between the participants. The term 'online academic forum posts' is used to refer to the corpora of students' online academic discussion posts in this paper.

The present study contributes to the understanding of under-explored discipline-specific academic forum posts written as part of degree requirements at a university. The aims

of this study are twofold. First, it reveals linguistic characteristics of academic forum posts, written by postgraduate students, studying education at a UK university, by using a multi-dimensional (MD) analysis and how these characteristics vary across two L1 backgrounds, three subregisters, and grades. MD analysis, described in Section 2, is advantageous over a collective examination of individual linguistic features, since it provides a “parsimonious holistic description” (Biber et al., 2016: 649) of variation that is “linguistically well motivated and interpretable” (Biber et al., 2016: 649). Second, this study provides an empirical representation of the linguistic characteristics of successful academic forum posts, operationalised as highly rated by lecturers, by modelling the grades, using dimensions of linguistic variation. In this study, both L1 English and L2 English writers’ academic forum posts were investigated, and these groups were both conceptualised as novice writers (see Römer, 2009) of these relatively new registers; hence, L1 English writers’ posts were not used as a reference corpus. The aim is to explore the linguistic characteristics of the forum posts written by the student writers of two L1 backgrounds.

A register is “a variety associated with a particular situation of use (including particular communicative purposes)” (Biber and Conrad, 2019: 6), and it is described by analysing its “situational context, linguistic features, and the functional relationships between the first two components” (Biber and Conrad, 2019: 6). Although the term ‘genre’ has also been used to describe varieties associated with particular communicative purposes (see Biber and Conrad, 2019), Biber and Conrad (2019) make a distinction between the register and genre perspectives and note that “the genre perspective often focuses on the rhetorical organization of texts from a variety, especially the rhetorical conventions of written varieties” (Biber and Conrad, 2019: 17). In the present study, the register of ‘online academic forum posts’ is examined, and these forum posts constitute one register. Within this register, there

are three subregisters (application design, business scenario, and discussion) in this study, named using Nesi and Gardner (2012)'s classification of student writing in UK HE. It should be noted that Nesi and Gardner (2012) use the term 'genre' in their study. Since this study analyses forum posts from a register perspective, the term 'register' is used to refer to the online academic forum posts, and the term 'subregisters' is used to refer to discussion, business scenario and application design posts (see Table 3 for their situational characteristics). Building on the previous research (e.g. Nesi and Gardner, 2012; Gardner et al., 2019) that examined registers of student writing, the present study reveals the linguistic characteristics of a relatively new and increasingly important interactive register of 'online academic forum posts', by taking the register perspective, and uses an additive MD analysis in order to examine whether there is register variation within the online academic forums across three subregisters, two L1 backgrounds, and grades. An additive MD analysis "does not require the extraction of factors, unlike a 'full' MD analysis; instead, it enables researchers to apply existing dimensions of variation (e.g., Biber, 1988) to 'new' registers" (Berber Sardinha and Veirano Pinto, 2019: 4). In this way, an additive MD analysis provides valuable information on the linguistic and functional characteristics of the registers, enabling us to compare them with those in previous studies.

2. Multi-dimensional analysis

MD analysis, developed by Biber (1988), is based on the premise that linguistic co-occurrence patterns in texts reflect their underlying communicative functions. First, frequencies of linguistic features in each text are computed, and then linguistic co-occurrence patterns are analysed to identify dimensions of variation, using factor analysis. Then, each dimension of variation that constitutes a set of co-occurrences of linguistic features, is examined to reveal underlying communicative functions. In his seminal work, Biber (1988)

identified six dimensions of linguistic variation that describe the characteristics of written and spoken registers in a general corpus, as shown in Table 1.

Table 1. Biber's (1988: 122) dimensions of variation and linguistic features loaded to the dimensions (Biber, 1988: 102-103; Crosthwaite, 2016; Nini, 2019)

Dimensions	Description	Linguistic features loaded to the dimensions (see Biber, 1988: 102-103)
D1. Involved versus informational discourse	High D1 scores: involved, interactive; low D1 scores: informationally dense	Involved discourse features: “private verbs, that-deletion, contractions, present tense verbs, second person pronouns, DO as pro-verb, analytic negation, demonstrative pronouns, emphatics, first person pronouns, pronoun IT, BE as main verb, causative subordination, discourse particles, indefinite pronouns, hedges, amplifiers, sentence relatives, wh-questions, possibility modals, non-phrasal coordination, wh-clauses, stranded prepositions Informational discourse features: nouns, word length, prepositions, type/token ratio, attributive adjectives
D2. Narrative versus non-narrative concerns	High D2 scores: narrative, past events; low D2 scores: non-narrative	Narrative concerns features: past tense verbs, third person pronouns, perfect aspect verbs,

D3. Explicit versus situation-dependent reference	High D3 scores: elaborated reference; low D3 scores: context-dependent	public verbs, synthetic negation, present participial clauses Explicit reference features: wh-relative clauses on object positions, pied-piping relatives, wh-relative clauses on subject positions, phrasal coordination, nominalisations Situation-dependent features: time adverbials, place adverbials, adverbs
D4. Overt expression of persuasion	High D4 scores: persuasive, argumentative	Overt expression of persuasion features: infinitives, prediction modals, suasive verbs, conditional subordination, necessity modals, split auxiliaries.
D5. Abstract versus non-abstract information	High D5 scores: impersonal/technical; low D5 scores: concrete/non-impersonal	Abstract information features: conjuncts, agentless passives, past participial clauses, by-passives, past participial WHIZ deletions, other adverbial subordinators
D6. On-line informational elaboration	High D6 scores: informationally elaborate produced under time constraints	On-line informational elaboration features: that clauses as verb complements, demonstratives, that relative clauses on object positions, that clauses as adjective complements”

2.1. Multi-dimensional analysis of discipline-specific student writing

MD studies have uncovered the linguistic characteristics of discipline-specific university students' writing at different levels in UK and US HE (Gardner et al., 2019; Hardy and Friginal, 2016; Hardy and Römer, 2013; Nesi and Gardner, 2012). Gardner et al. (2019) used the British Academic Written Corpus (BAWE) corpus, which includes undergraduate and postgraduate successful disciplinary writing of 13 genre families (see Nesi and Gardner, 2012) and employed a new MD analysis to identify linguistic variation in student writing across disciplines, year of study, and genres. Graduate-level writing had higher Dimension 1 scores of compressed procedural writing and higher Dimension 4 scores of informational density than lower-level writing, and texts of social science disciplinary group had the highest Dimension 4 scores. This suggests that successful graduate-level writing involved the co-occurrence of nouns, passives, nominalisations, attributive adjectives and longer words that fulfilled the function of information presentation in an elaborate manner.

Hardy and Römer (2013) identified four linguistic dimensions of variations, using the Michigan Corpus of Upper-level Student Papers (MICUSP). The discipline of education was represented with 46 papers; however, only 11 of them were written by first-year graduate students. The texts of the education discipline had the second-highest dimension scores of “‘involved, academic narrative’, ‘expression of opinions and mental processes’ and ‘production of possibility statements and argumentation’” (Hardy and Römer, 2013: 204), followed by the texts of philosophy discipline. Successful student writing was operationalised as assignments that received high grades awarded by lecturers in both the BAWE corpus (merit and distinction grades) and MICUSP (A-graded), and both corpora included L1 and L2 writing.

2.2. The relationship between dimensions of linguistic variation in L2 writing and writing scores

A growing body of literature using an MD analysis has revealed linguistic variation in L2 writing (e.g. Crosthwaite, 2016; Friginal and Weigle, 2014), between L1 and L2 undergraduate writing (Goulart, 2021) and in high-stakes L2 writing assessment, including the Test of English as a Foreign Language (TOEFL) iBT essays (e.g. Biber and Gray, 2013; Biber et al., 2016) and essays of the Examination for the Certification of Proficiency in English (ECPE) (Yan and Staples, 2020). Previous studies have also linked writing scores to linguistic dimensions of variation in L2 essays (e.g. Biber et al., 2016; Biber and Gray, 2013; Friginal and Weigle, 2014; Staples et al., 2018; Weigle and Friginal, 2015; Yan and Staples, 2020). It was consistently found that L2 essays that had more informational discourse style, manifested through nouns and longer words, etc. (Dimension 1) received higher scores than those that reflected more involved/oral styles of writing, manifested through first and second person pronouns, verbs, etc. (Biber et al., 2016; Biber and Gray, 2013; Friginal and Weigle, 2014; Weigle and Friginal, 2015; Yan and Staples, 2020). Weigle and Friginal (2015) found significant effects of writing scores on all four dimensions in that higher-rated TOEFL iBT essays involved more informational, impersonal, procedural, and decontextualized style than lower-rated ones.

In addition to the abovementioned studies on MD analyses, previous studies used cluster analysis, a multivariate method to groups texts based on their shared similarities across a number of linguistic characteristics, to explore multiple profiles of highly rated writing (Crossley et al., 2014; Jarvis et al., 2003; Friginal et al., 2014). Although these studies identified multiple profiles of successful student writing, they were not based on dimensions of linguistic variation derived from MD analysis. There are also a number of studies that have

investigated the relationship between the linguistic characteristics of L1 and L2 writing and writing scores (see Crossley, 2020 for a review). Crossley (2020: 416) acknowledges that “text length is likely the strongest predictor of writing development and quality”, though it is not considered as a linguistic feature. This study does not provide a review of those studies in L1 and L2 writing, since the focus of this study is on MD analysis and linking linguistic dimensions to grades in discipline-specific postgraduate student writing.

To date, the examination of linguistic features in student writing has largely been limited to non-interactive registers (e.g. essays). The linguistic characteristics of assessed discipline-specific academic forum posts have yet to be examined. Given that online/distance learning has been proliferating due to increasing demand in HE (Kim and Maloney, 2020), academic forum posts are likely to play an important role at universities internationally (Thomas and Thorpe, 2019). This necessitates an examination of the linguistic characteristics of academic forum posts from an MD perspective, since “analyses based on linguistic co-occurrence patterns will be more robust than analyses based on consideration of individual linguistic features” (Biber et al., 2016: 664). The linguistic characteristics of highly rated academic forum posts and whether dimensions can predict grades in discipline-specific academic writing also remain unknown; therefore, grades were modelled, using the dimensions of linguistic variation, subregisters, L1 background, and text length. The research questions addressed in this study are as follows:

1. To what extent is there linguistic variation in academic forum posts across the two L1 backgrounds, three subregisters, and grades?
2. To what extent, if any, do the dimensions, subregisters, L1 background, and text length predict the grades?

3. Methods

This section describes the corpora and their situational characteristics. Then, the procedures for multi-dimensional analysis and statistical analyses are outlined.

3.1. Corpora

The corpora consisted of online academic forum posts written by L1 English and L1 Chinese postgraduate students studying in the discipline of education at a university in the UK. The students allowed their posts to be used for research purposes. The terms ‘L1 English’ and ‘L1 Chinese’ denote the students’ first language, and the language ‘Chinese’ refers to a range of dialects, including Mandarin and Cantonese. Data from these two groups were collected, since the L1 Chinese students and L1 English students constituted the two largest groups of students in this programme, respectively. This is consistent with the general trend in UK HE in which Chinese students represent the largest group of international students (HESA, 2020). The L1 Chinese sub-corpus included the posts written by 37 students, whereas 22 L1 English students contributed to the L1 English sub-corpus. The writers wrote multiple texts in each subcorpus. The majority of the writers were female in both groups in that female writers constituted 64% ($n= 14$) and 73% ($n= 27$) of the L1 English and L1 Chinese writers, respectively. This gender distribution reflects the high percentage of female students studying education at postgraduate level at UK universities (HESA, 2020). The mean (M) and standard deviation (SD) of the number of posts for all subregisters written by the L1 Chinese writers were 12.19 and 3.05, respectively. These figures were 19.55 (M) and 4.83 (SD) for the posts written by the L1 English writers.

Before beginning their MA study at a UK university, the L1 Chinese students had scored at least 6.5 overall in IELTS, with a minimum writing score of 6.5; however, their

Citation: Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>

IELTS scores were not associated with their forum posts in the present study, since it was beyond the scope of this study. As seen in Table 2, the corpora of L1 Chinese (n= 451) and L1 English students' posts (n= 430) were fairly comparable, regarding the number of texts, tokens, and text length. This balanced distribution enhanced rigour for MD analysis (e.g. Staples et al., 2017). There was no suggested word count for the forum posts, and the mean text length was similar across the subcorpora. The minimum text length was 100 words (only one text included 100 words) in the corpora. As Biber and Gray (2013: 20-21) notes, "it is possible to obtain reliable measures for the rates of occurrence of most grammatical features in texts that are longer than 100 words", and this makes the corpora of this study suitable for an additive MD analysis. Previous studies on MD analysis have recommended to remove only texts that are shorter than 100 words (e.g. Biber et al., 2016).

Citation: Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>

Table 2. Characteristics of the corpora.

	Subregisters	Number of texts	Tokens	Mean text length	Standard deviation of text length	Minimum text length	Maximum text length	Mean grade	Standard deviation of grade	Minimum grade	Maximum grade
L1	Discussion	128	27,216	212.63	90.96	102	498	5.57	1.18	3	8.5
Chinese	Business scenario	156	37,284	239	101.89	101	588	5.45	1.14	3	8
	Application design	167	36,718	219.87	101.08	102	558	5.16	1.06	2	8
	Subtotal	451	101,218	224.43	99	101	588	5.38	1.14	2	8.5
L1	Discussion	97	25,559	263.82	105.59	105	630	6.04	0.97	4	8.0
	Business scenario	204	45,420	222.65	90.08	100	487	5.75	1.20	3	8.5
English	Application design	129	32,325	250.58	104.25	107	509	5.55	1.11	3	8
	Subtotal	430	103,304	240.32	99.41	100	630	5.76	1.14	3	8.5
	Total	881	204,522								

The academic forum posts were further categorised into three specific subregisters (see the prompts in S1 in supplementary material) according to their communicative purposes, using the classification of the BAWE corpus (Nesi and Gardner, 2012): 1) Discussion; 2) Business scenario; 3) Application design. In the discussion subregister, students were asked to discuss their understanding of technological knowledge in education. For the business scenario subregister, students were asked to provide a strategic solution to issues of e-learning environment (simulation). In the application design subregister, students were asked to propose a design for an educational application in order to enhance two museums that they selected. Although Nesi and Gardner's (2012) classification was used to categorise student writing, there are important differences in participants, audience, and interactivity between the academic forum posts and genres in the BAWE corpus. Academic forum posts were dialogic, interactive with peers as participants. The genres in the BAWE corpus, on the other hand, were non-interactive, although the students probably had a hypothetical reader in their mind and lecturers/graders as audience. Each subregister in the corpus of academic forum posts constituted a single thread in which each student was required to reply to the previous post, although they were free to refer to any previous posts within the thread. The first post within each subregister was the assignment prompt written by the lecturer and was not included in the corpus. In order to construct the corpora of the online academic forum posts, the forum threads were disassembled, and each post was saved as a text file tagged with the writer's ID and subregister.

The online academic forum posts formed a part of the course assessment. In this paper, the term 'grade' is used to refer to the marks given by the lecturers for the students' posts. These posts were given grades by two lecturers independently according to the holistic scoring rubric on a ten-point scale (see S2 in supplementary material), separately for each

subregister for research purposes, and that grade was recorded for each forum post of the writer within the same subregister for statistical analyses. The grades were assigned for the development of ideas with reference to academic literature, and there was no reference to linguistic features in the scoring rubric. The final grades that were shown in Table 2 were calculated by taking the mean grades of the two lecturers' grades. The mean grade of the L1 Chinese posts were 5.4, while this figure was 5.8 for the L1 English posts. Cohen's Kappa, an inter-rater reliability index, was .82 (very good) (95% CI, .77, -.84) for the grades of L1 Chinese posts, and this figure was .83 (very good) (95% CI, .77-.85) for the grades of L1 English posts. The holistic scoring rubric had been made available to all the students before their first assignments.

Situational characteristics (see Biber et al., 2016; Biber and Conrad, 2019; Gray, 2015 for frameworks for situational characteristics of registers) of the subregisters of the forum posts are summarised in Table 3. Although the common purpose of the forum posts was to exchange ideas on the given topic with peers, by supporting the ideas with academic literature, the topics and communicative purposes of the subregisters differed, as shown in Table 3. The communicative purposes of discussion, business scenario and application design posts were determined by examining the assignment prompts and informed by the taxonomy that Nesi and Gardner (2012) proposed for student writing in UK HE. The audience of the forum posts in this study were primarily other students/peers and secondarily lecturers who graded the posts. It should be noted that there were reading lists of all the modules that the postgraduate students of this study were taking; however, the prompts for the posts were not explicitly linked with specific readings. Hence, the postgraduate students were expected to identify relevant literature and/or select appropriate readings from their reading lists in order to support their ideas and contribute to the ideas previously put forward by their peers. It is

also worth noting that no instructions on academic style or language use were provided to the students.

Table 3. Situational characteristics of the subregisters investigated

	Discussion	Business scenario	Application design
Writer roles/participants	MA students	MA students	MA students
Mode of production	Online written (asynchronous)	Online written (asynchronous)	Online written (asynchronous)
Planning/editing time	Considerable planning and editing time	Considerable planning and editing time	Considerable planning and editing time
Support from external resources	Yes	Yes	Yes
Relations among participants	Mostly symmetrical (peers); interaction between peers	Mostly symmetrical (peers); interaction between peers	Mostly symmetrical (peers); interaction between peers
Setting	Shared online platform	Shared online platform	Shared online platform
Topics	Technological knowledge in education	E-learning strategies	Educational applications of digital technologies
Communicative purpose	To demonstrate understanding and develop ideas with peers; to develop arguments with peers	To offer solutions to the business problem with peers	To propose a design for an educational application with peers

3.2. Multi-dimensional analysis

This study used an additive MD analysis to investigate linguistic variation in the online academic forum posts, using Biber's (1988) original dimensions of variation, in order to provide generalisable linguistic interpretations, since the corpora of the present study were not "internally stratified enough" (Nini, 2019: 70) to extract new interpretable dimensions. The use of Biber's (1988) dimensions for the additive MD analysis of this study was motivated by two reasons: 1) First, the interactive register of online academic forum posts was relatively new; therefore, the aim was to explore their linguistic characteristics across their subregisters, L1 backgrounds, and grades. The use of Biber's (1988) dimensions provided an opportunity to both situate the register of this study and its subregisters within the registers of the English language and to compare them with university student writing that used Biber's (1988) dimensions in a previous study (see Nesi and Gardner, 2012); (2) The situational characteristics of the online academic forum posts (peer interactions and a shared online platform between the writers) motivated the use of Biber's (1988) dimensions, since such situational characteristics were different from those of university student writing that was examined in previous studies of MD analyses (Gardner et al., 2019; Hardy and Römer, 2013), and the dimensions extracted from university student writing in earlier studies may not be applicable to the registers of the present study.

All the texts were tagged by using Nini's (2019) Multidimensional Analysis Tagger v.1.3 (MAT). Nini tested the reliability of the MAT for the L1 data and reported that the "MAT can replicate Biber's (1988) analyses as well as assign dimension scores that are reliable" (2019: 77). The MAT tagged 67 lexico-grammatical features (see Nini, 2019 and S3 in supplementary material) in texts and normalised the occurrences of each feature per 100 words for each text. Type-token ratio was calculated based on the first 100 words for each

text to control for different text lengths. The MAT uses the part-of-speech tags of the Stanford parser, which had “a high accuracy (96.1%)” (Geertzen et al., 2013: 247) of tagging a large L2 corpus of different proficiency levels. Since tagging ‘that’, present and past participles was problematic in L2 data (see Biber and Gray, 2013), the accuracy of tagging for these features was assessed in 20% (n= 90) of the L2 texts in this study (see S4 in supplementary material). Then, the scores on Biber’s (1988) original dimensions that the MAT calculated for each text were used for further statistical analysis and interpretation.

3.3. Statistical analyses

Following an additive MD analysis, four linear mixed-effects models were fitted in order to investigate whether subregisters, L1 backgrounds, and grades had any significant effects on the first four dimension scores. Mixed-effects models are models that incorporate both fixed effects (independent variables) and random effects (variables that account for idiosyncratic variation in the sample, such as a random effect for a writer when there are multiple texts from writers in a study) in a single analysis. Instead of a traditional ANOVA, which requires balanced data sets, mixed-effects models were used, since they robustly handle unbalanced data like that in the present study and quantify group-level patterns, while accounting for random variation in the data and increasing the generalisability of the findings (e.g. Linck and Cunnings, 2015). Since multiple texts belonged to the same writers in this study, it was necessary to use mixed-effects models in order to take into account the variation that could stem from individual writers. Four models were fitted for each dimension separately, using *lme4* package (Bates et al., 2015) in R (R Core Team, 2020). Each model included dimension scores as a dependent variable, L1 background (two levels - L1 English and L1 Chinese); subregister (three levels - discussion; business scenario; application design); grades and their interactions as the fixed effects variables. The grades were mean-centred so

that the intercept would predict each dimension score for average grade; otherwise, the intercept would have predicted the dimension scores when the grade would be zero, which was non-existent in the data. Also, random intercepts for writers (a random intercept for by-writer variance) were added as the random effect variables.

In order to address the second research question on the prediction of grades using dimension scores, subregisters, L1 backgrounds, and text length, one mixed-effects model was fitted. The dependent variable was grades, and independent variables were L1 background; subregister; text length; dimension 1, dimension 2, dimension 3 and dimension 4 scores and their interactions. Random intercepts for writers were also added as the random effect variables. Text length was also included as one of the variables, since it significantly predicted writing scores (Crossley, 2020 for a review; Yan and Staples, 2020), though it is not considered as a linguistic feature.

For all the models, all these variables were entered into the models initially, and then backward model selection was followed. The final models were selected using Akaike information criterion (AIC) values (see Zuur et al., 2009). The complexity of the models was reduced until a further reduction showed a bigger AIC value, since the smaller the AIC value is, the better the model fits to the data (Zuur et al., 2009). The AIC values of all the models reported in the next section were smaller than their null models (models with no fixed effects). The package *lmerTest* was used to derive *p* values (Kuznetsova et al., 2017). The pseudo R^2 values were provided as effect sizes and were obtained using *MuMIn* package (Bartoń, 2019) in R. The assumptions of linear mixed-effects models, which were checked using the package *performance* (Lüdtke et al., 2019) in R, were satisfied for all the models.

4. Results

4.1. Linguistic variation in online academic forum posts across subregisters, L1 backgrounds, and grades

The following sections report the linguistic variation in online academic forum posts across subregisters, L1 backgrounds, and grades in terms of Biber's (1988) dimensions. Due to the space limitations, the present study focuses on the first four dimensions in the next section (see S5 in supplementary material for descriptive statistics for dimension scores). The mean dimension scores of online academic forum posts and their subregisters were visualised in comparison to the following registers investigated in previous studies of additive MDs: 1) Academic prose in Biber's (1988) study; (2) the closest subregister in Biber's (1988) study, written in italics in Figures 1, 2, 3, and 4, to the online academic forum posts, as revealed by Nini's (2019) MAT; (3) postgraduate student writing (master's level) in UK HE in Nesi and Gardner's study (2012) that examined linguistic variation in student writing, using Biber's (1988) dimensions.

4.1.1. Dimension 1: Involved versus informational discourse

Dimension 1 distinguishes between conversational registers produced in real time and written, edited registers (Biber and Conrad, 2019). The involved features, including private verbs, contractions, present tense verbs, amplifiers, hedges, first and second person pronouns mark involvement, affective and interactional style, whereas the negatively loaded features, including nouns, prepositions and attributive adjectives reflect informational density in written registers (e.g. Biber, 1988; Gray, 2015). As shown in Figure 1, the online academic forum posts were overall unmarked, and prepared speeches in Biber's (1988) study were closest to the forum posts on this dimension. The online academic forum posts were markedly different from academic prose (Biber, 1988) and postgraduate student writing with regard to

mean Dimension 1 scores. It is worth noting that there was a great deal of variation in terms of Dimension 1 scores with a high standard deviation of 9.75 within the online academic forum posts, suggesting that there were a number of posts that conveyed both informational and involved discourse.

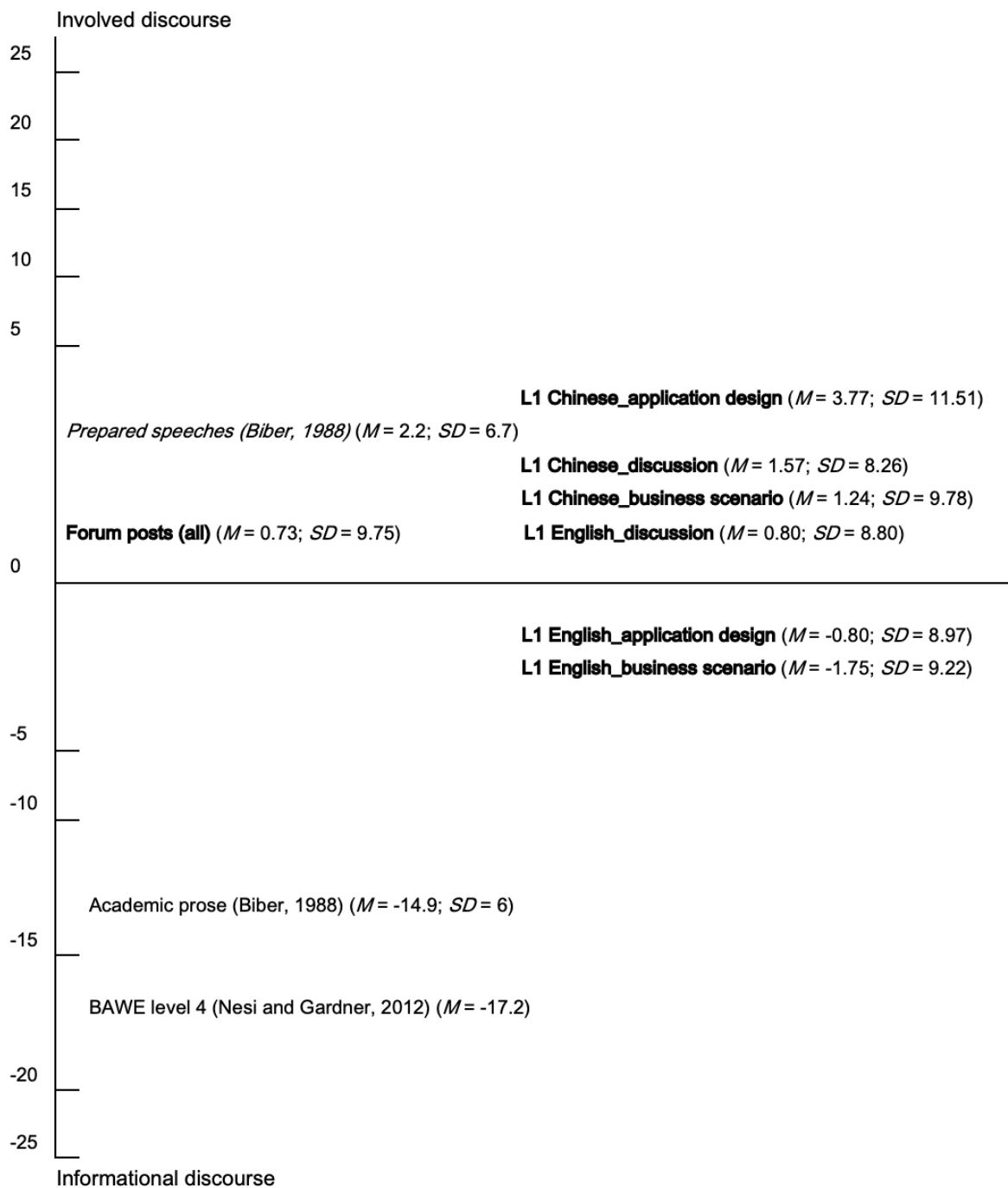


Figure 1. Dimension 1 mean scores for registers.

The positive features of Dimension 1 expressed personal involvement and interaction with the use of first person pronouns (*I, we, our*) and conveyed immediate nature of the discourse through the present tense verbs (*agree*), as shown in Example 1. Additionally, private verbs (*think*) and *that* deletion, in Example 1, characterised interactional style that is typically found in oral registers.

(1) ... **I totally agree** that **we can find** out ways of increasing **our** budget but **I think** we need to **think** about finding the root cause of their dissatisfaction with the VLE first.

(Dimension 1 score: 27.79)¹

Example 2 illustrates informational discourse which is rich in attributive adjectives (e.g. *attainable*) and nouns (e.g. *problems*) that often involve long words and lexical variety. The combinations of these linguistic features were used to present ideas and information with their attributes in the online academic forum posts.

(2) One attainable method is to develop smartphone apps with innovative functions for the visually impaired and individuals with hearing problems. (Dimension 1 score: -24.42)

The model results found a significant interaction between the subregister ‘discussion’ and ‘grades’, $t = 2.39, p = .02$. This indicates that the higher-rated discussion posts represented significantly greater involved and interactional discourse than the higher-rated application design posts, as shown in Table 5. The post-hoc tests showed that there was no significant difference in Dimension 1 scores between the application design and business scenario posts ($t = -0.97, p = .59$) or the business scenario and discussion posts ($t = -1.82, p =$

¹ The example extracts were selected from one of the most extreme dimension scores in order to represent their functional characteristics clearly. Dimension scores written within parentheses reflected the scores of the whole text.

.16). Importantly, the post-hoc tests also revealed that the higher-rated posts for each subregister had significantly greater informational discourse (lower Dimension 1 scores) than the lower-rated posts ($p < .001$ for each subregister). These effects were observed irrespective of the L1 background. The variable ‘L1 background’ was dropped from the model, since it did not improve the goodness of model fit according to AIC values. Regarding the random effects, there was a considerable inter-writer variation that accounted for variance in Dimension 1 scores. This model reported a marginal R^2 (variance explained by fixed effects only) of .20 and a conditional R^2 (variance explained by both fixed and random effects) of .38.

Table 5. Mixed-effects model for Dimension 1 scores.

Fixed effects	Estimate	Standard error (SE)	<i>t</i>	<i>p</i>
(Intercept)*	0.68	0.85	0.80	.43
Business scenario	-0.18	0.60	-0.29	.77
Discussion	0.56	0.69	0.82	.41
Grade	-3.75	0.42	-9.03	< .001
Business scenario x Grade	0.70	0.53	1.33	.19
Discussion x Grade	1.47	0.61	2.39	.02
Random effects	Variance	SD		
ID	21.66	4.65		
$R^2_{\text{marginal}} = .20$; $R^2_{\text{conditional}} = .38$				

*Intercept estimate of 0.68 represents the mean Dimension 1 scores for application design subregister when the grade has the mean value.

4.1.2. Dimension 2: Narrative versus non-narrative concerns

The positive pole of Dimension 2 is marked by only positive features, including past tense verbs, third person pronouns, perfect aspect verbs and public verbs that report past

events and depict narrative discourse (Biber, 1988; Nini, 2019). Narrative discourse is typically found in fiction registers, such as novels (Biber, 1988). As seen in Figure 2, the online forum posts and their subregisters were non-narrative, close to both academic prose in Biber’s study (1988) and postgraduate student writing in Nesi and Gardner’s study (2012).

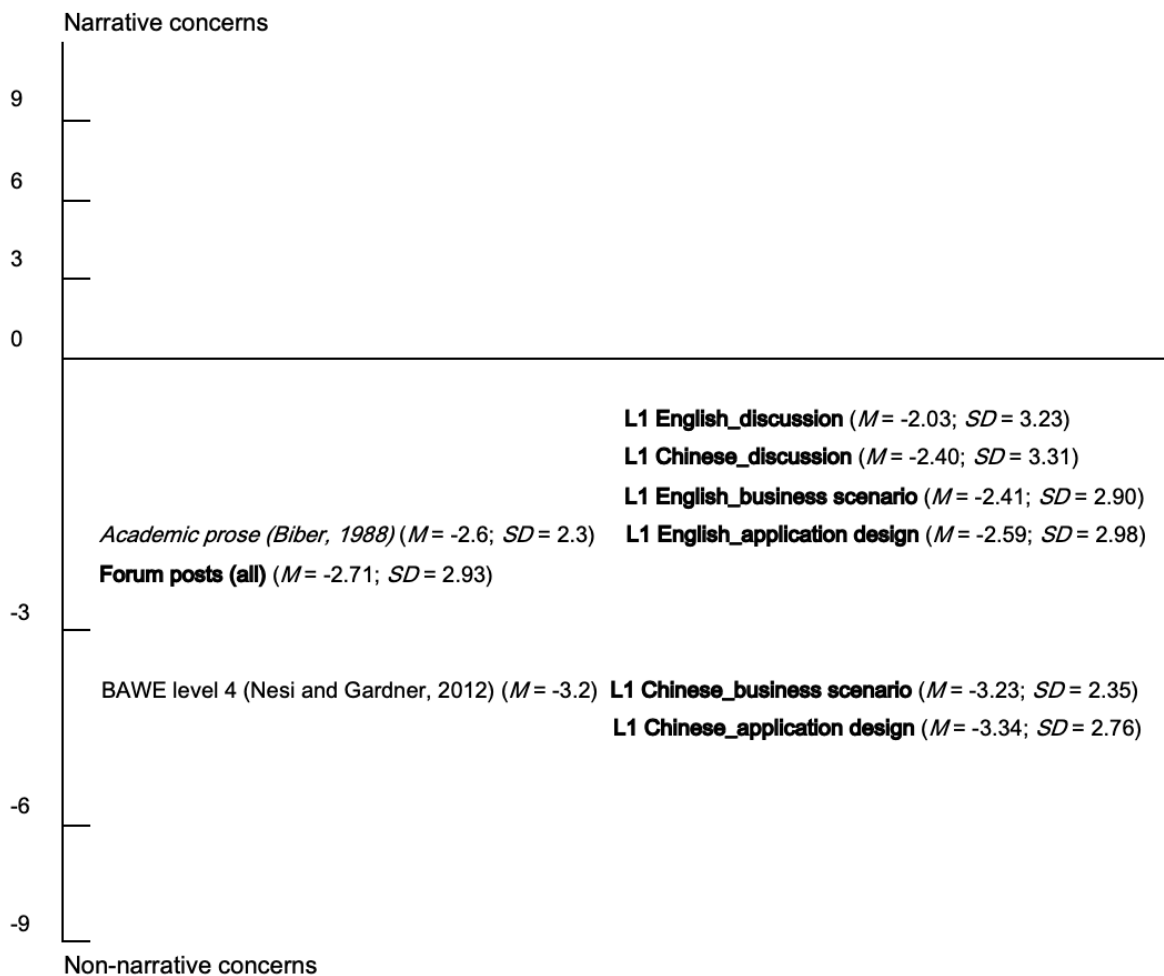


Figure 2. Dimension 2 mean scores for registers.

Example 3 illustrates the writer’s use of a perfect aspect verb (*have discussed*) and past tense verbs (*found, developed*) in order to report what has been discussed in the forum. Interestingly, this narrative discourse had a text-organising function in that the writer summarised the key topics of the discussion in Example 3.

(3) I **have discussed** what is TK and we **found** out what are TPCK, TPK and so on.

We also **developed** the idea that TK is similar to Technology Literacy. (Dimension 2 score: 11.35).

Non-narrative concerns are marked by present tense verbs (*think*), attributive adjectives (*specific*), as Example 4 shows. In the example, there was a lack of narrative concerns, and the extract fulfilled interactive function in which the writer made a recommendation for the application design and expressed their idea in the present tense.

(4) ...I also think, if we go down this path, that we should focus on a specific story (for example, a specific ship) rather than trying to turn the whole whaling exhibit into a narrative... (Dimension 2 score: -7.38)

The model revealed that the posts written by the L1 English writers reflected significantly greater narrative discourse than those written by the L1 Chinese writers, irrespective of the subregisters, as shown in Table 6. Also, the discussion posts exhibited narrative discourse significantly greater than those of the application design. The pairwise comparisons showed that there was no statistical difference in Dimension 2 scores between the application design and business scenario subregisters ($t = -0.97, p = .59$) and that the business scenario posts were significantly less narrative than the discussion posts ($t = -2.39, p = .04$). These main effects were found irrespective of the grades. The variable ‘grades’ and interactions between the variables were dropped, since they did not improve the goodness of the model fit according to AIC values.

Table 6. Mixed-effects model for Dimension 2 scores.

Fixed effects	Estimate	SE	<i>t</i>	<i>p</i>
(Intercept)*	-3.39	0.23	-14.65	< .001
L1_English	0.65	0.29	2.22	.03
Business scenario	0.22	0.23	0.98	.33

Citation: Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>

Discussion	0.81	0.26	3.20	.001
Random effects	Variance	SD		
ID	0.46	0.68		
$R^2_{\text{marginal}} = .02$; $R^2_{\text{conditional}} = .07$				

*Intercept estimate represents the mean Dimension 2 scores for the application design subregister written by the L1 Chinese writers.

4.1.3. Dimension 3: Explicit versus Situation-Dependent Reference

The positive pole of Dimension 3 is characterised by elaborated reference to content, through the co-occurrence of nominalisations, phrasal coordination, wh-relative clauses and pied piping constructions (e.g. Biber, 1988). The negative pole of Dimension 3, on the other hand, signals context-dependent reference in discourse that involves a frequent use of adverbs, time and place adverbials. Interestingly, the academic forum posts and their subregisters involved explicit reference discourse, as illustrated in Figure 3, despite the shared online platform among the student writers. In terms of Dimension 3 scores, the forum posts were similar to graduate student writing in Nesi and Gardner's (2012) study and closest to official documents in Biber's study (1988).

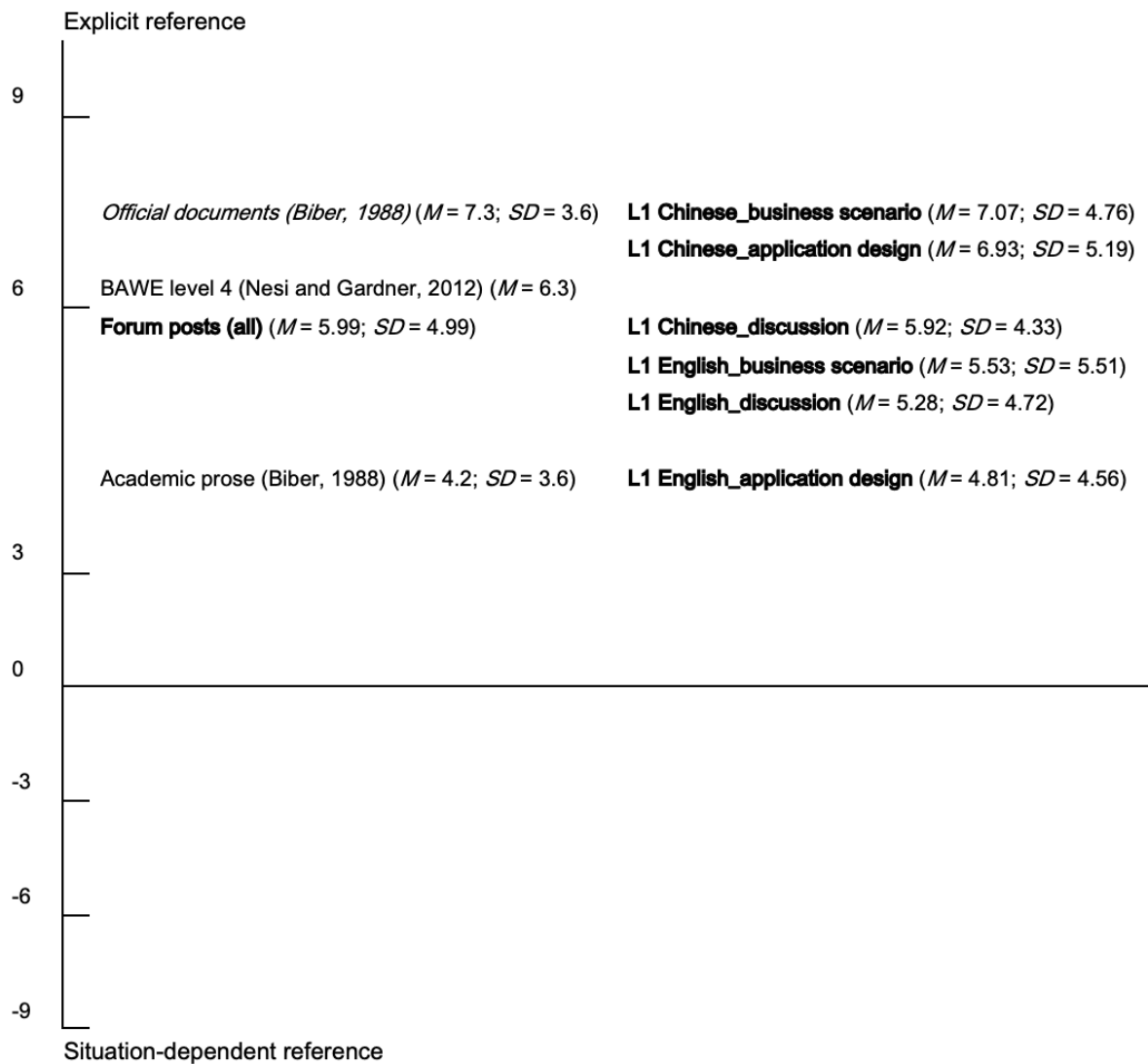


Figure 3. Dimension 3 mean scores for registers.

Explicit reference, also referred to as ‘elaborated reference in the literature (Biber et al., 2002), was realised through the use of nominalisations (e.g. *creativity*) and a *wh*-relative clause, as illustrated in Example 5. The extract placed the emphasis on elaboration of the term ‘participatory culture’ in an explicit manner, and a great deal of information on that term was provided, using phrasal coordination and nominalisations.

(5) According to Jenkins (2006), social media could be referred to as ‘participatory culture’ **which** allows ordinary people to express **and** share their **creativity and** mundane cultural **engagement** through digital formats. (Dimension score 3: 25.31)

Example 6 shows a highly context-dependent discourse that included a place adverbial (*above*) and time adverbial (*tomorrow*). The postgraduate writer referred to a peer’s previous post, by stating ‘above’, since the writers shared the same online forum space.

(6) I think multisensory approaches are great as you suggest above... I will see if I can find some more information on multisensory approaches tomorrow! (Dimension 3 score: - 7.19)

The model results indicated that the L1 Chinese writers’ posts represented elaborated reference to a significantly greater extent than the L1 English writers’ posts, as shown in Table 7. This was observed irrespective of the subregisters and grades. There was a significant interaction between the ‘grades’ and ‘business scenario’, suggesting that the higher-rated business scenario posts included more elaborated reference to content than the higher-rated application design posts (see Table 7). The post-hoc tests revealed that the higher-rated posts for each subregister had more explicit reference than the lower-rated posts ($p < .001$ for each subregister). Additionally, the business scenario posts included more elaborated reference to content than the discussion posts ($t = 3.78, p < .001$), as the post-hoc tests showed. On the other hand, there was no difference in Dimension 3 scores between the application design and discussion posts ($t = 1.86, p = .15$). Three-way interactions between the variables were removed, as they did not improve the goodness of the model fit, according to AIC values.

Table 7. Mixed-effects model for Dimension 3.

Fixed effects	Estimate	SE	<i>t</i>	<i>p</i>
(Intercept)*	7.23	0.36	19.90	< .001
L1_English	-2.01	0.45	-4.43	< .001
Business scenario	0.02	0.36	0.06	.95
Discussion	-0.99	0.41	-2.44	.02
Grade	1.29	0.24	5.31	< .001
Business scenario x Grade	0.86	0.31	2.77	.006
Discussion x Grade	-0.28	0.36	-0.77	.44
Random effects	Variance	SD		
ID	1.035	1.018		
$R^2_{\text{marginal}} = .17; R^2_{\text{conditional}} = .21$				

*Intercept estimate represents the mean Dimension 3 scores for the application design subregister by the L1 Chinese writers when the grade has the mean value.

4.1.4. Dimension 4: Overt Expression of Persuasion

The positive pole of Dimension 4 marks persuasive and argumentative discourse, since the features, including suasive verbs (e.g. *recommend*), prediction and necessity modals are used to put forward arguments and persuade the reader to agree with the author's perspective (Biber et al., 2002). Although professional letters and editorials were found to be overtly persuasive, most of the registers in previous MD studies have been unmarked for Dimension 4 scores (Biber et al., 2002). Dimension 4 has no negatively-loaded features in Biber's (1988) study. As illustrated in Figure 4, the academic forum posts and their subregisters were highly persuasive, and they were closest to professional letters in Biber's study (1988) in terms of Dimension 4 scores, suggesting that persuasiveness was a distinguishing feature of the online academic forum posts. Academic prose in Biber's study (1988) and postgraduate student writing (Nesi and Gardner, 2012) were considerably different from the academic forum posts with regard to mean Dimension 4 scores.

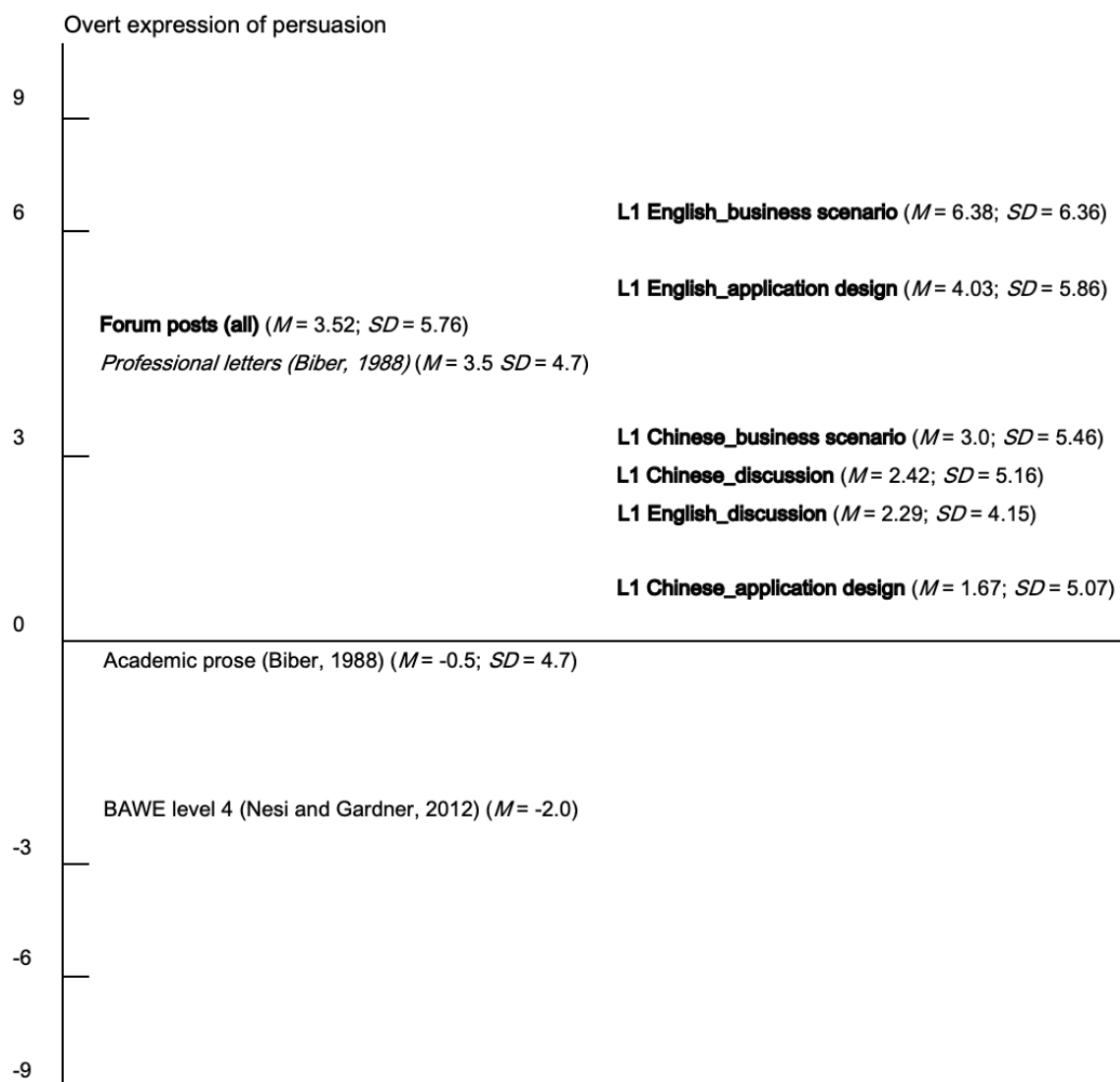


Figure 4. Dimension 4 mean scores for registers.

Example 7 shows persuasive, argumentative discourse in which the writer used a suasive verb (*agree*) to agree with a proposal that was put forward and employed a necessity modal (*must*) and an infinitive verb (*to increase*) to build their argumentation and signal their own assessment of the proposal. This argumentative style could be seen as an effort to persuade peers to agree on the proposal presented.

(7) I totally **agree** with LearnOnline being the best option at the moment. However,

you are right that we **must** change something **to increase** student satisfaction. (Dimension 4 score: 34.22)

The model identified a significant main effect of grades, indicating that the higher-rated posts were significantly less persuasive than the lower-rated posts, irrespective of the L1 backgrounds and subregisters, as shown in Table 8. A significant interaction between the L1 English background and application design subregister as well as the L1 English background and business scenario subregister showed that application design and business scenario posts written by the L1 English writers included significantly more persuasive discourse than those written by the L1 Chinese writers. The post-hoc tests showed that there was no significant difference in Dimension 4 scores between the L1 English writers' discussion posts and L1 Chinese writers' discussion posts ($t = -0.58, p = .99$). Additionally, the post-hoc tests revealed that the business scenario posts were significantly more persuasive than the application design posts ($t = -2.64, p = .02$ for the L1 Chinese writers; $t = -4.23, p < .001$ for the L1 English writers) and discussion posts ($t = -5.4, p < .001$ for the L1 English writers). No significant differences were found between the L1 Chinese writers' discussion and application design posts ($t = -1.65, p = .22$) or their discussion and business scenario posts ($t = -0.84, p = .68$), as the post-hoc tests showed. Three-way interactions between the variables were dropped during the model selection process, as explained before.

Table 8. Mixed-effects model for Dimension 4.

Fixed effects	Estimate	SE	<i>t</i>	<i>p</i>
(Intercept)*	2.34	0.52	4.50	< .001
L1_English	0.48	0.81	0.59	.56
Application design	-1.05	0.63	-1.66	.10
Business scenario	0.54	0.64	0.85	.40
Grade	-0.79	0.17	-4.77	< .001

Citation: Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>

L1_English x Application design	2.24	0.96	2.33	.02
L1_English x Business scenario	3.20	0.93	3.42	< .001
Random effects	Variance	SD		
ID	1.22	1.11		
$R^2_{\text{marginal}} = .12$; $R^2_{\text{conditional}} = .15$				

*Intercept estimate represents the mean Dimension 4 scores of the discussion subregister by the L1 Chinese writers when the grade has the mean value.

4.2. Predicting grades using dimensions of linguistic variation

The model results revealed that the L1 background had a main effect on the grades of the online academic forum posts in that the L1 English writers' posts received significantly higher grades than the L1 Chinese writers' posts, as seen in Table 9. This was observed across the subregisters and dimension scores. There was also a main effect of Dimension 1 scores in that the academic forum posts that included more informational discourse received significantly higher grades than those with involved discourse. This effect was identified, irrespective of the L1 backgrounds and subregisters. Additionally, a significant main effect of Dimension 3 scores indicated that the forum posts that had elaborated/explicit reference to content received significantly higher grades than those with context-dependent discourse, irrespective of the L1 backgrounds and subregisters.

There was a significant interaction between the text length and business scenario texts, as Table 9 shows. The post-hoc tests revealed that the longer online forum texts received significantly higher grades than the shorter ones ($p < .001$ for all the subregisters). However, the longer business scenario texts were significantly higher-rated than the longer application design posts ($t = -2.80$, $p = 0.01$), as the post-hoc tests showed. There was no significant difference in grades between the longer discussion posts and longer business scenario posts ($t = -0.2$, $p = .99$). On the other hand, the discussion posts received higher grades than the

application design posts ($p < .001$ across different text lengths). The variables Dimension 2 and Dimension 4 scores and interactions between the other variables were dropped, following the backward heuristic model selection, using AIC values. The whole model explained 46% variance in the grades of the online academic forum posts. Table 9 also shows the standardised coefficients for fixed effects, which are used to represent the magnitude of fixed effects in the literature (see Lorah, 2018). Accordingly, Dimension 1 scores as a main effect were relatively more important than the L1 background, which, in turn, was more important than Dimension 3 scores in predicting the grades.

Table 9. Mixed-effects model for grades

Fixed effects	Estimate (<i>b</i>) (Unstandardised)	<i>b</i> (Standardised)	SE	<i>t</i>	<i>p</i>
(Intercept)*	4.21	-0.27	0.15	27.87	< .001
L1_English	0.28	0.24	0.11	2.45	.02
Dimension_1	-0.03	-0.27	0.004	-8.61	< .001
Dimension_3	0.05	0.21	0.006	7.50	< .001
Business scenario	-0.18	0.15	0.17	-1.03	.30
Discussion	0.21	0.37	0.19	1.08	.28
Text_length	0.003	0.29	0.0005	6.74	< .001
Business scenario x Text_length	0.002	0.13	0.0007	2.23	.03
Discussion x Text_length	0.0009	0.08	0.0008	1.24	.21
Random effects	Variance	SD			
ID	0.09	0.30			
$R^2_{\text{marginal}} = .40; R^2_{\text{conditional}} = .46$					

*Intercept estimate represents the mean grade for the application design subregister written by the L1 Chinese writers.

As seen in Example 8, an extract of a highly rated text with one of the lowest Dimension 1 scores and a high Dimension 3 score, the co-occurrences of informational density and elaborated reference features (underlined) enabled the writer to present information and elaborate on their ideas with detailed descriptions. The constellation of these features also helped the writer develop an argument.

(8) ...Loughran (1996) discussed Dewey's 1993 work on the enhancement of a teacher's professional knowledge and student learning. As Loughran (1996) states, reflection in teaching and learning encourages one to view problems from different perspectives...

(Dimension 1 score: -17.89; Dimension 3 score: 10.36)

The L1 English writers received higher grades than the L1 Chinese writers. A closer look at the texts revealed important qualitative differences between the L1 English and L1 Chinese writers' posts. As shown in Extract 9, taken from a text which had a positive Dimension 3 score (elaborated reference) and a positive Dimension 1 score (involved), the L1 English writers tended to refer to literature when they interacted with their peers. The L1 Chinese writers, on the other hand, tended to present their ideas without any support from literature when they contributed to the online academic forums, as shown in Example 10 that received a low grade, even though the text included elaborated reference features (written in bold). This may partly explain the L1 Chinese writers' lower grades than the L1 English writers, since citing literature to support ideas was part of the assessment criteria.

(9) I have found this article above an interesting read. Authors conclude that learning agendas are seen as more worthy than sightseeing or social ones and that we should not make value judgments about visitors' motivations and intentions. I think that this is something that we must be mindful of in a museum. (Dimension 1 score: 5.90; Dimension 3 score: 4.09)

(10) We manage schools indirectly, but we are also serving the school. In order to manage better, we must be clear about the school's **situation**... We need to consider the ideas from students **and** teachers and get **information and** feedback from them. (Dimension 1 score: -0.73; Dimension 3 score: 5.30)

5. Discussion

The findings are discussed in relation to the situational characteristics of the academic forum posts and previous studies of MD analysis on student writing reviewed in Section 2.1 and 2.2.

5.1. The role of L1 backgrounds and subregisters in linguistic variation of the online academic forum posts

The online academic forum posts written by the postgraduate writers with different first languages differed on three dimensions. The L1 Chinese writers' posts exhibited significantly greater elaborated discourse (Dimension 3) than the L1 English writers' posts. In terms of Dimension 4 scores, there was a significant interaction between the subregisters and L1 backgrounds in that the L1 English writers' posts were significantly more persuasive than those written by the L1 Chinese writers, except for the discussion subregister posts. This suggests that the L1 Chinese writers may have avoided being persuasive or argumentative when they interacted with their peers. Xu, Huang and You (2016: 68) argued that Chinese students' writing seemed to be shaped by "national, professional-academic, and instructional cultures". Therefore, the L1 Chinese postgraduate students of this study might have been under the influence of their previous experiences in their academic and instructional contexts (e.g. Xu et al., 2016) that valued elaboration over explicit persuasion, which might explain the greater elaborated discourse of the L1 Chinese writers' posts. Interestingly, Crosthwaite (2016) found that Chinese undergraduate students became less overtly persuasive in their

writing after English for Academic Purposes training. This may also explain why the L1 Chinese graduate writers were less argumentative and persuasive than the L1 English writers in this study. The L1 English writers' texts were more narrative (Dimension 2) than the L1 Chinese writers' texts. Those narrative features functioned to provide a summary of main points in the online forum posts. However, the variables explained a very small amount variance (see Table 6) in Dimension 2 scores, with a negligible effect size (see Cohen, 1988); therefore, the findings of Dimension 2 should be treated with caution.

It is surprising that there was no significant difference in Dimension 1 scores between the L1 English and L1 Chinese writers' posts. This could be attributed to the relatively advanced English proficiency (B2/C1 level) of the L1 Chinese writers, who were able to use informational features, such as nouns and diverse vocabulary in their writing. Overall, the register of online academic forum posts was unmarked in terms of Dimension 1 involved versus informational discourse. Although these posts were written for academic purposes, citing the academic literature, they were, in general, less informational than other disciplinary student writing in the UK context in previous studies (see Nesi and Gardner, 2012; Gardner et al., 2019) and academic prose in English (Biber, 1988). This difference in language use may be attributable to the online mode of production, symmetrical relationship between the participants, and the multiple demands of the online academic forum posts, including interacting with peers and presenting ideas.

Subregisters differed on all four dimensions, since there was a significant interaction between at least one subregister and the grades (Dimension 1 and 3) and between at least one subregister and the L1 backgrounds (Dimension 4). There was also a main effect of subregister on Dimension 2 scores in that the discussion posts were significantly more narrative than the other two subregisters. Similarly, higher-rated discussion posts were more

involved (Dimension 1) than the higher-rated application design posts. These may be due to the characteristics of the discussion subregister, since discussion includes students' "own individualized arguments and positions" (Gardner and Nesi, 2013: 42). On the other hand, business scenario texts involved more elaborated discourse (Dimension 3) than discussion posts, since business scenario may require explanation of the hypothetical scenario and detailed justifications behind the decisions that would be undertaken to solve professional problems (see Nesi and Gardner, 2012). This may also explain the reason why the higher-rated business scenario posts were more referentially explicit than the higher-rated application design texts. Similarly, business scenario texts were more persuasive than application design posts, since business scenario texts would necessitate argumentative discourse that justifies how professional problems would be addressed (Nesi and Gardner, 2012).

5.2. The role of grades in linguistic variation of the online academic forum posts

The holistic grades of the forum posts significantly predicted the scores of linguistic dimensions of variation, except for Dimension 2, even though there was no reference to linguistics features in the scoring rubric. The finding that the higher-rated forum posts had more informational (Dimension 1) and elaborated (Dimension 3) discourse than the lower-rated posts supports the findings of earlier studies in non-interactive student writing (Biber et al., 2016; Biber and Gray, 2013; Friginal and Weigle, 2014; Weigle and Friginal, 2015; Yan and Staples, 2020). These results confirm Biber et al.'s (2011) hypothesised grammatical complexity in writing development, which posits that complexity in student writing is characterised by phrasal complexity features, such as prepositional phrases as noun post-modifiers rather than clausal complexity features, such as finite dependent clauses. This hypothesis has been confirmed in several studies that investigated student writing that included no peer-to-peer interactions (e.g., Ansarifard et al., 2018; Parkinson and Musgrave,

2014; Staples et al., 2016). For example, Staples et al. (2016) found that as L1 English writers' academic level (years of study) increased, the use of phrasal complexity features increased, suggesting the importance of phrasal complexity features in writing development. The relationship between high grades and more informational (Dimension 1) and elaborated discourse (Dimension 3) in the academic forum posts of the present study revealed that the significance of phrasal complexity features in writing could be extended to interactive registers of both L1 and L2 writing at graduate level at universities.

It seems counterintuitive that the higher-rated posts were significantly less persuasive (Dimension 4) than the lower-rated posts. However, it should be noted the online academic forum posts were overall highly persuasive with a mean Dimension 4 score of 3.52 given that the most persuasive register (professional letters) in Biber's (1988) study had a mean Dimension 4 score of 3.5. A qualitative examination revealed that most of the highly-rated forum posts still had a persuasive nature (positive Dimension 4 score). Hence, moderate persuasion/argumentation in the online academic forum posts seemed to be valued by lecturers.

5.3. Dimensions of variation, subregisters, L1 background, and text length that predict grades

This study identified that both dimension 1 and dimension 3 were significant predictors of the grades of the forum posts in that the texts with more informational and elaborated reference features were rated higher than those with involved and situation-dependent features. This may be attributed to the writers' level of study, since all the forum posts were written by the graduate students in this study. This is in line with the findings of Gardner et al. (2019) who reported that successful graduate-level writing was more procedural and informationally dense than successful lower-level writing. The features of highly rated

academic forum posts, especially informational discourse, show similarities with Friginal et al.'s (2014: 11) cluster 4 essays interpreted as “informational focus”, Crossley et al.'s (2014: 196) cluster 2 (“academic”) of argumentative essays, and Jarvis et al.'s (2003) cluster 2 profile of essays that frequently contained nouns and nominalisations. This suggests that informational and elaborated discourse is one of the core characteristics of successful L1 and L2 writing in both interactive and non-interactive registers.

The longer business scenario posts received higher grades than the longer application design posts. This suggests that business scenario texts require detailed explanations of students' responses to a simulation and demonstration of thinking about other possible alternative solutions to a simulation. Overall, the application design posts received lower grades than the discussion posts, since social science students may not be familiar with the application design subregister, which is used more often in physical sciences (Gardner and Nesi, 2013). Therefore, the expectations of these relatively new subregisters (business scenario and application design) in terms of both content and linguistic features should be made explicit to both L1 and L2 writers in social sciences. In accordance with the results of the previous research on L1 and L2 writing (e.g. Crossley, 2020 for a review), longer texts received higher grades than shorter texts for all the subregisters in this study. Hence, it may be useful for subject lecturers to suggest minimum and maximum word counts for these online assessments.

It is striking that the L1 English writers received higher grades than the L1 Chinese writers. A qualitative examination revealed that L1 Chinese writers used no or little literature to support their ideas when their posts were highly involved and interactive. This suggests that L2 writers of English may find it challenging to meet the multiple demands of academic forum posts, including interaction with peers, the presentation and justification of ideas, and

use of academic sources at the same time. Given that Nesi (2021) found that citations overall increased in undergraduate student writing in the social sciences across levels of study in the BAWE corpus, it is likely that graduate students are expected to cite more sources in their assignments. Therefore, tailored advice on citations and their communicative functions could be given to L2 writers in order to enable them to cite sources when they respond to their peers' posts.

It should be noted that all these five variables (Dimension 1 scores, Dimension 3 scores, subregister, L1 background, and text length) explained 46% variation in the grades of the online academic forum posts. The development of ideas and arguments with reference to the literature arguably necessitates the use of informational features, including nouns and prepositions as well as the use of elaborated reference features, including phrasal coordination and nominalisations in written academic registers (e.g. Biber, 1988; Gray, 2015). However, there are possibly many other factors, including linguistic and non-linguistic factors (content knowledge and criticality) that play a role in grades of the online academic forum posts.

6. Limitations and future research

The present study was limited by its relatively small corpus, which included writers from only two language backgrounds and three subregisters. Further, this corpus was collected at one university from a single discipline. Future research is necessary to examine dimensions of variation in a larger corpus of both L1 and L2 writers' forum posts from multiple institutions and disciplines. It is also important to note that the MAT (Nini, 2019), which was used to tag the lexico-grammatical features of the students' texts, only includes 67 features and that Biber's recent work (see Gardner et al., 2019) uses more features related to stance and evaluation. Therefore, the analysis might have missed these features in the students' texts in this study.

Possible text-internal variations of academic forum posts were beyond the scope of the present study. Although this study gives empirical evidence for the potential of dimensions of linguistic variation to predict grades in discipline-specific writing, it was not intended to establish a construct for writing quality, as that would involve non-linguistic and other linguistic features that were beyond the scope of this study. It is also recommended that future studies collect a wide variety of writer background variables. However, it is worth noting that Zhao (2019) found that L2 writers' age, gender, or cultural background had almost no impact on their voice construction, operationalised as the use of authorial self-mention and reader reference markers, among other features, in L2 essays. Hence, the findings of this study may be extended to the online academic posts of L1 English and L1 Chinese writers with different background characteristics. Finally, the online academic forum posts of this study were written for academic purposes as part of the students' degree requirements at university. Therefore, the results cannot be generalised to online discussion forums found on the web (see Biber and Egbert, 2018 for the linguistic analysis of everyday online registers).

7. Conclusion and implications

This study focused on the under-researched interactive register of online academic forum posts, which are likely to play an increasingly important role at universities in the context of growing demand for online/distance learning. Overall, the register of online academic forum posts was characterised as unmarked for Dimension 1, non-narrative (Dimension 2), referentially explicit/context-independent (Dimension 3), and highly persuasive (Dimension 4). The academic forum posts showed extensive linguistic variation, especially in terms of the dimension of 'involved versus informational discourse', partly due to the relationships between participants and multiple purposes of these subregisters.

The new findings of this study provide important implications for writing instruction and assessment for both L1 and L2 writing at international universities. The grades of the academic forum posts significantly predicted the three dimension scores of linguistic variation, and the two dimensions (Dimension 1 and 3) were significant predictors of the grades, although the holistic scoring rubric made no reference to any linguistic features. This suggests that a MD analysis can be useful to provide an empirical representation of linguistic features in discipline-specific student writing, in addition to high-stakes L2 assessment (Biber et al., 2016; Yan and Staples, 2020). Hence, the results of the MD analysis and its functional interpretations can be used to develop scoring rubrics, especially for new registers. Additionally, it may be useful for the developers of automated feedback to use the functional and linguistic characteristics of the results of the MD analysis to complement lecturers' feedback on disciplinary student writing.

This study also showed that highly rated academic forum posts involved informational and elaborated discourse; therefore, it would be beneficial to focus on the form-function relationships in writing classes that these dimensions revealed. For example, informational and elaborated discourse consisting of the features, including nouns, nominalisations, phrasal coordination as well as attribute adjectives, enabled the presentation of information/ideas and construction of arguments. Hence, writing instructors could demonstrate that there is a relationship between the presentation of information/ideas and use of the constellation of informational and elaborated discourse features. This can be done through successful model texts (see Polio, 2019) and corpus-based activities in which students can analyse the form-function relationships of linguistic features by examining the concordance outputs. Model texts would also be particularly helpful for relatively new registers that students may not be familiar with. L2 writers tended not to refer to literature when they wrote highly

Citation: Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>

involved/interactive posts, unlike their L1 counterparts, although reference to academic literature was part of the assessment rubric. Hence, special attention in writing classes could be devoted to the assessment rubric, especially when L2 writers encounter relatively new registers. Additionally, writing support may be necessary not only to enhance linguistic repertoires of students, but also to support students' academic skills, including the use of academic literature, especially for L2 writers who may grapple with the multiple demands of assessed online interactive registers.

References

- Ädel, A., 2011. Rapport building in student group work. *J. Pragmat.* 43, 2932–2947.
<https://doi.org/10.1016/j.pragma.2011.05.007>
- Ansarifar, A., Shahriari, H., Pishghadam, R., 2018. Phrasal complexity in academic writing: A comparison of abstracts written by graduate students and expert writers in applied linguistics. *J. English Acad. Purp.* 31, 58–71.
<https://doi.org/10.1016/j.jeap.2017.12.008>
- Bartoń, K., 2019. MuMIn: Multi-Model inference. R package version 1.43.15.
<https://CRAN.R-project.org/package=MuMIn>
- Bates, D.M., Mächler, M., Bolker, B.M., Walker, S., 2015. Fitting linear mixed-effects models using lme4. *J. Stat. Softw.* 67, 1–48. <https://doi.org/10.18637/jss.v067.i01>
- Biber, D., 1988. *Variation across Speech and Writing*. Cambridge University Press, Cambridge, UK.
- Biber D., Conrad, S., 2019. *Register, Genre, and Style* (2nd ed.). Cambridge University Press, Cambridge, UK.

- Citation:** Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>
- Biber, D., Conrad, S., Reppen, R., Byrd, P., Helt, M., 2002. Speaking and writing in the university: A multidimensional comparison. *TESOL Q.* 36, 9–48.
<https://doi.org/10.2307/3588359>
- Biber, D., Egbert, J., 2018. *Register Variation Online*. Cambridge University Press, Cambridge, UK.
- Biber, D., Gray, B., 2013. Discourse characteristics of writing and speaking task types on the TOEFL iBT Test: A lexico-grammatical analysis (TOEFL iBT Research Report iBT-19). Princeton, NJ: Educational Testing Service. <http://dx.doi.org/10.1002/j.2333-8504.2013.tb02311.x>
- Biber, D., Gray, B., Poonpon, K., 2011. Should we use characteristics of conversation to measure grammatical complexity in L2 writing development? *TESOL Q.* 45, 5–35.
<https://doi.org/10.5054/tq.2011.244483>
- Biber, D., Gray, B., Staples, S., 2016. Predicting patterns of grammatical complexity across language exam task types and proficiency levels. *Appl. Linguist.* 37, 639–668.
<https://doi.org/10.1093/applin/amu059>
- Coffin, C., Hewings, A., North, S., 2012. Arguing as an academic purpose: The role of asynchronous conferencing in supporting argumentative dialogue in school and university. *J. English Acad. Purp.* 11, 38–51. <https://doi.org/10.1016/j.jeap.2011.11.005>
- Cohen, J., 1988. *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Lawrence Erlbaum, Hillsdale, NJ.
- Crossley, S., 2020. Linguistic features in writing quality and development: An overview. *J. Writ. Res.* 11, 415–443. <https://doi.org/10.17239/jowr-2020.11.03.01>
- Crossley, S.A., Roscoe, R., McNamara, D.S., 2014. What is successful writing? An investigation into the multiple ways writers can write successful essays. *Writ. Commun.* 31, 184–214. <https://doi.org/10.1177/0741088314526354>

- Citation:** Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>
- Crosthwaite, P., 2016. A longitudinal multidimensional analysis of EAP writing : Determining EAP course effectiveness. *J. English Acad. Purp.* 22, 166–178. <https://doi.org/10.1016/j.jeap.2016.04.005>
- Culpeper, J., Kan, Q., 2020. Communicative styles, rapport, and student engagement: An online peer mentoring scheme. *Appl. Linguist.* 41, 756–786. <https://doi.org/10.1093/applin/amz035>
- Friginal, E., Li, M., Weigle, S.C., 2014. Revisiting multiple profiles of learner compositions: A comparison of highly rated NS and NNS essays. *J. Second Lang. Writ.* 23, 1–16. <https://doi.org/10.1016/j.jslw.2013.10.001>
- Friginal, E., Weigle, S.C., 2014. Exploring multiple profiles of L2 writing using multi-dimensional analysis. *J. Second Lang. Writ.* 26, 80–95. <https://doi.org/10.1016/j.jslw.2014.09.007>
- Gardner, S., Nesi, H., 2013. A classification of genre families in university student writing. *Appl. Linguist.* 34, 25–52. <https://doi.org/10.1093/applin/ams024>
- Gardner, S., Nesi, H., Biber, D., 2019. Discipline, level, genre: Integrating situational perspectives in a new MD analysis of university student writing. *Appl. Linguist.* 40, 646–674. <https://doi.org/10.1093/applin/amy005>
- Geerzten, J., Alexopoulou, T., Korhonen, A., 2013. Automatic linguistic annotation of large scale L2 databases: The EF-Cambridge Open Language Database (EFCAMDAT). In *Proceedings of the 31st second language research forum (SLRF)*. Cascadilla Press.
- Goulart, L., 2021. Register variation in L1 and L2 student writing. *Regist. Stud.* 1–29. <https://doi.org/10.1075/rs.20012.gou>
- Gray, B., 2015. *Linguistic variation in research articles: When discipline tells only part of the story* (Vol. 71). John Benjamins, Philadelphia.
- Hardy, J.A., Friginal, E., 2016. Genre variation in student writing: A multi-dimensional analysis. *J. English Acad. Purp.* 22, 119–131. <https://doi.org/10.1016/j.jeap.2016.03.002>

- Citation:** Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>
- Hardy, J.A., Römer, U., 2013. Revealing disciplinary variation in student writing: A multi-dimensional analysis of the Michigan Corpus of Upper-level Student Papers (MICUSP). *Corpora* 8, 183–207. <https://doi.org/10.3366/cor.2013.0040>
- HESA. 2020. Higher education student statistics: UK, 2018/19. <https://www.hesa.ac.uk/news/16-01-2020/sb255-higher-education-student-statistics/location>
- Jarvis, S., Grant, L., Bikowski, D., Ferris, D., 2003. Exploring multiple profiles of highly rated learner compositions. *J. Second Lang. Writ.* 12, 377–403. <https://doi.org/10.1016/j.jslw.2003.09.001>
- Kim, J., Maloney, E., 2020. *Learning Innovation and the Future of Higher Education*. JHU Press, Maryland.
- Lim, J., Polio, C., 2020. Multimodal assignments in higher education: Implications for multimodal writing tasks for L2 writers. *J. Second Lang. Writ.* 47, 100713. <https://doi.org/10.1016/j.jslw.2020.100713>
- Lorah, J., 2018. Effect size measures for multilevel models: definition, interpretation, and TIMSS example. *Large-Scale Assessments Educ.* 6. <https://doi.org/10.1186/s40536-018-0061-2>
- Kuznetsova, A., Brockhoff, P.B., Christensen, R.H.B., 2017. lmerTest package: Tests in linear mixed effects models. *J. Stat. Softw.* 82. <https://doi.org/10.18637/jss.v082.i13>
- Linck, J.A., Cunnings, I., 2015. The utility and application of mixed-effects models in second language research. *Lang. Learn.* 65, 185–207. <https://doi.org/10.1111/lang.12117>
- Lüdtke, D., Makowski, D., Waggoner, P., 2019. *performance: assessment of regression models performance. R package version 0.4.0.* <https://CRAN.R-project.org/package=performance>
- Nesi, H., 2021. Sources for courses: Metadiscourse and the role of citation in student writing. *Lingua* 103040. <https://doi.org/10.1016/j.lingua.2021.103040>

Citation: Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>

- Nesi, H., Gardner, S., 2012. *Genres across the Disciplines: Student Writing in Higher Education*. Cambridge University Press, Cambridge, UK.
- Nini, A., 2019. The multi-dimensional analysis tagger. In: Sardinha Berber, T., Pinto Veirano, M. (Eds.), *Multi-Dimensional Analysis: Research Methods and Current Issues*. Bloomsbury Academic, London/New York, pp. 67-94.
- Parkinson, J., Musgrave, J., 2014. Development of noun phrase complexity in the writing of English for academic purposes students. *J. English Acad. Purp.* 14, 48–59. <https://doi.org/10.1016/j.jeap.2013.12.001>
- Polio, C., 2019. Keeping the language in second language writing classes. *J. Second Lang. Writ.* 46, 100675. <https://doi.org/10.1016/j.jslw.2019.100675>
- R Core Team. 2020. R: A language and environment for statistical computing. Vienna: R Foundation for Statistical Computing. Retrieved from <http://www.R-project.org>
- Römer, U., 2009. English in academia: Does nativeness matter? *Anglistik Int. J. English Stud.* 20, 89–100.
- Sardinha Berber, T., Pinto Veirano, M. 2019. Introduction In: Sardinha Berber, T., Pinto Veirano, M. (Eds.), *Multi-Dimensional Analysis: Research Methods and Current Issues*. Bloomsbury Academic, London/New York, pp. 1-8.
- Staples, S., Biber, D., Reppen, R., 2018. Using corpus-based register analysis to explore the authenticity of high-stakes language exams: A register comparison of TOEFL iBT and disciplinary writing tasks. *Mod. Lang. J.* 102, 310–332. <https://doi.org/10.1111/modl.12465>
- 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. *Writ. Commun.* 33, 149–183. <https://doi.org/10.1177/0741088316631527>

- Citation:** Candarli, D. (2022). Linguistic characteristics of online academic forum posts across subregisters, L1 backgrounds, and grades. *Lingua*, 267, 103190. <https://doi.org/10.1016/j.lingua.2021.103190>
- Staples, S., Laflair, G.T., Egbert, J., 2017. Comparing language use in oral proficiency interviews to target domains: Conversational, academic, and professional discourse. *Mod. Lang. J.* 101, 194–213. <https://doi.org/10.1111/modl.12385>
- Thomas, G., Thorpe, S., 2019. Enhancing the facilitation of online groups in higher education: a review of the literature on face-to-face and online group-facilitation. *Interact. Learn. Environ.* 27, 62–71. <https://doi.org/10.1080/10494820.2018.1451897>
- Xu, M., Huang, C., You, X., 2016. Reasoning patterns of undergraduate theses in translation studies: An intercultural rhetoric study. *English Specif. Purp.* 41, 68–81. <https://doi.org/10.1016/j.esp.2015.09.002>
- Yan, X., Staples, S., 2020. Fitting MD analysis in an argument-based validity framework for writing assessment: Explanation and generalization inferences for the ECPE. *Lang. Test.* 37, 189–214. <https://doi.org/10.1177/0265532219876226>
- Weigle, S.C., Friginal, E., 2015. Linguistic dimensions of impromptu test essays compared with successful student disciplinary writing: Effects of language background, topic, and L2 proficiency. *J. English Acad. Purp.* 18, 25–39. <https://doi.org/10.1016/j.jeap.2015.03.006>
- Zhao, C.G., 2019. Writer background and voice construction in L2 writing. *J. English Acad. Purp.* 37, 117–126. <https://doi.org/10.1016/j.jeap.2018.11.004>
- Zuur, A. F., Ieno, E. N., Walker, N. J., Saveliev, A. A., Smith, G. M., 2009. *Mixed effects models and extensions in ecology with R*. Springer, New York.