

SYNTACTIC COMPLEXITY IN ACADEMIC WRITING:
A COMPARATIVE ANALYSIS OF L1 TURKISH AND L1 ENGLISH WRITERS

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Syntactic Complexity in Academic Writing:
A Comparative Analysis of L1 Turkish and L1 English Writers

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DECLARATION OF ORIGINALITY

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ABSTRACT

Syntactic Complexity in Academic Writing:

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This study examines syntactic complexity features in applied linguistics research articles authored by L1 Turkish and L1 English writers. Using a corpus-based approach, the study incorporates both large-grained and fine-grained measures to compare clausal and phrasal complexity. The analyses are based on two self-compiled corpora, each consisting of 50 internationally published research articles. One corpus represents writers who are native speakers of English, while the other represents writers who share Turkish as a common L1 and have published research articles in English. The corpora comprise a total of 100 articles (718,105 words) drawn from ten high ranking journals in the field of applied linguistics. The findings of comparative analyses indicate that L1 English writers tend to use longer sentences, exhibit greater use of subordination and employ more adjective complements, reflecting a preference for layered syntactic structures. In contrast, L1 Turkish writers rely more on intra-clausal elaboration, including frequent use of coordinate phrases and adjectival modifiers, particularly in noun phrases. While both groups demonstrate genre-specific features of academic writing, the study highlights distinct stylistic preferences and complexities in their syntactic choices. The results contribute to a nuanced understanding of how linguistic background influences academic writing and offer practical implications for English for Academic Purposes (EAP) instruction, particularly for L1 Turkish writers aiming to publish in international academic journals.

ÖZET

Akademik Yazında Sözdizimsel Karmaşıklık:

Anadili Türkçe ve Anadili İngilizce Olan Yazarların Karşılaştırmalı Analizi

Bu çalışma, anadili Türkçe ile anadili İngilizce olan yazarlar tarafından yazılmış uygulamalı dilbilim araştırma makalelerinde görülen sözdizimsel karmaşıklık özelliklerini incelemektedir. Çalışma, sözdizimsel karmaşıklığı kıyaslamak amacıyla, genel ve ayrıntılı ölçütler içeren derlem tabanlı bir yaklaşım kullanmaktadır.

Analizler, araştırmacı tarafından oluşturulmuş, her biri 50 adet uluslararası yayımlanmış araştırma makalesinden oluşan iki derlem kullanılarak yapılmıştır. Derlemler anadili Türkçe ve İngilizce olan yazarları temsil etmektedir. Derlemler uygulamalı dilbilim alanındaki yüksek dereceli on dergiden seçilmiş 100 makaleden (718.105 kelime) oluşmaktadır. Karşılaştırmalı analiz sonuçları, anadili Türkçe olan yazarların, özellikle isim öbeklerinde olmak üzere, eşdizimli ifadeler ve sıfat belirteçleri gibi tümce içi genişletmelerini daha sık kullandıklarını ortaya koymuştur. Buna karşın, sonuçlar anadili İngilizce olan yazarların daha uzun cümleler, daha yüksek sıklıkta yan tümce (alt cümlecik) ve daha fazla sıfat tümleci tercih ettiğini göstermiştir ve bu gruptaki yazarların katmanlı sözdizimsel yapıları daha çok tercih ettiğini yansıtmıştır. Her iki yazar grubu akademik yazımın türe özgü özellikleri sergilerken, sözdizimsel tercihler ve karmaşıklık açısından belirgin üslup farklılıkları dikkat çekmektedir. Çalışmanın bulguları, anadilin akademik yazı üzerindeki etkisini daha derinlemesine anlamaya katkıda bulunmakta ve uluslararası akademik dergilerde yayın yapmayı hedefleyen anadili İngilizce olmayan yazarlar için Akademik Amaçlar için İngilizce eğitimi bağlamında pratik çıkarımlar sunmaktadır.

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ABBREVIATIONS

CLIL: Content and language integrated learning

EAP: English for academic purposes

EFL: English as a foreign language

ELF: English as a lingua franca

ERPP: English for research publication purposes

L1: First language

L2: Second language

L2SCA: L2 Syntactic complexity analyzer

MAT: Multidimensional analysis tagger

NW: Native writer

NNW: Non-native writer

RA: Research article

TAASSC: Tool for automatic analysis of syntactic sophistication and complexity

CHAPTER I

INTRODUCTION

Syntactic complexity is an extensively researched aspect of academic writing, as it is a vital indicator of expertise in structural sophistication and variation. It has long been established as an important pillar of writing proficiency, with a special focus on academic writing and various academic genres (Biber & Gray, 2011; Norris & Ortega, 2009). Traditionally, complexity was primarily associated with clausal subordination and analyzed through the use of subordinate and coordinate clauses, which were seen as key indicators of sophisticated academic prose (Bulté & Housen, 2012). In the last two decades, large-scale corpus studies (Biber & Gray, 2010; Kyle, 2016; Staples et al., 2016) have been quite influential in paving the way for a major change in perspective, drawing attention to the role of phrasal structures, including noun-phrase constructions and other phrasal elements, in academic writing. This new approach has been supported by many studies that have highlighted the growing importance of phrasal complexity and further consolidated the argument that complex noun phrases are key features of scientific prose (e.g., Biber et al., 2011; Lu, 2011; Parkinson & Musgrave, 2014; Yoon & Polio, 2017).

Considering these developments, the research article (RA) as a genre has attracted significant attention and has become the focus of many studies, as it is highly valued for its compressed linguistic features and serves as an excellent example of elaborate and sophisticated language (Biber & Gray, 2016). Another major change has occurred in the way syntactic complexity is measured, as corpus linguistics has transformed the way data are analyzed. Unlike studies in the past that had to limit their measures and the size of data (e.g., Beers & Nagy, 2007; Ellis &

Yuan, 2004; Ortega, 2003; Stockwell & Harrington, 2003), the development of computational tools has changed the way syntactic complexity is measured and has allowed researchers to apply a variety of syntactic complexity measures to very large data sets.

As a result of these developments, a growing body of research has employed corpus linguistics as a methodology to explore grammatical complexity in language. With the continuous addition of new corpora and the availability of automated analysis tools, it is now possible to use a large number of measures to analyze syntactic complexity. Corpus linguistics has also made it possible to compare a variety of aspects of language, ranging from diachronic changes to variations in language use based on discipline, register, genre, and language background (e.g., Li, 2021). Corpus-based comparative studies have been particularly useful in exploring developmental variations both between native and non-native speakers of a language and among non-native speakers with different L1 backgrounds.

Until more recently, studies mainly focused on learner language. However, as mentioned at the beginning of this chapter, advanced levels of academic writing have garnered much attention, and many studies have explored academic language through corpus linguistics. Comparing native and non-native writers has been a popular line of research, exploring various aspects of language. Some of these areas of research include lexical complexity through bundles and formulaic elements, as well as the use of specific lexical items (e.g., Appel & Murray, 2020; Esfandiari & Barbary, 2017; Gao, 2016; Long et al., 2024); syntactic complexity (clausal and phrasal) in various written genres ranging from learner-written argumentative essays to academic genres such as MA theses, PhD dissertations, and published academic work (e.g., Ansarifard et al., 2018; Dong et al., 2023; Kuiken & Vedder, 2019; Li &

Yang, 2022; Lu & Ai, 2015; Nasser, 2021; Ziaeeian & Golparvar, 2022; Wu et al., 2020); as well as other rhetorical features of academic writing, such as citation and reporting practices, authorial presence/stance, and rhetorical moves (Çandarlı et al. 2015; Chan, 2015; Gao, 2016; Gong et al., 2024; Hu & Wang, 2013; Marti et al., 2019; Moradi & Montazeri, 2024; Rowley-Jolivet & Carter-Thomas, 2013).

Similarly, there is a growing body of research that employs corpus-based analyses to explore a wide range of written and spoken discourse elements of Turkish EFL learners and a number of studies have explored lexical features by comparing Turkish EFL speakers to English native speakers or speakers with different L1 backgrounds (e.g., Badem & Şimşek, 2021; Bozdağ & Badem, 2017; Demirel & Kazazoğlu, 2015; Kızıl, 2021; Önalın & Çakır, 2018; Römer & Yılmaz, 2019). Although not necessarily comparative in nature, a few researchers have conducted corpus-based error analyses (Can, 2017; Demirel, 2017) to identify the most frequent errors made by Turkish EFL learners. Another line of research has studied the syntactic and lexical complexity of Turkish students' spoken and written discourse at tertiary levels (Kaya & Yüksel, 2022; Atak & Sarıcaoglu, 2021). Different from cross-sectional studies, Polat et al. (2020) have documented Turkish learners' syntactic complexity development through a longitudinal study by analyzing a corpus of 852 writing samples collected over a period of three semesters. Another relatively longitudinal study, which extended over a semester, investigated the development of complexity in student writing by comparing the impact of two types of instruction: CLIL (Content and Language Integrated Learning) and EFL, an intensive integrated skills English as a Foreign Language program (Köylü & Dikilitaş, 2023) and reported findings that called for more attention to how CLIL programs are implemented.

With the growing popularity of research on academic genres and the impact of relatively recent concepts such as ELF and World Englishes, several studies have shed light on how Turkish expert writers navigate in the field linguistically, in comparison to other members of the discourse community (e.g., Bayyurt & Yilmaz, 2015; Isik-Tas, 2017; Marti et al., 2019; Yilmaz, 2016). These are relatively understudied fields of research and are the main motivation behind the current analysis undertaken in this study. Although there are a number of studies that have specifically explored syntactic complexity in research articles, whether part-genre-oriented or holistic (Casal et al, 2021; Li & Yang, 2022; Lu et al., 2019; Wu et al., 2020), there is a call for more studies that compare syntactic complexity across research articles written by authors of various linguistic backgrounds, proficiency levels, and disciplines (Ansarifar et al., 2018; Casal et al., 2021). Furthermore, comparative studies in which non-native writers are represented by heterogeneous groups of L1 backgrounds (Wu et al., 2020; Lu & Ai, 2015) have shown that some linguistic features might be difficult to detect. For instance, Lu and Ai's (2015) study compared argumentative essays written by native speaker university students and non-native EFL learners from seven different L1 backgrounds. While initial analyses between the groups as a whole resulted in few significant differences, analyses with native speakers and non-native speakers grouped by their L1 provided significant differences that were not captured in the initial analyses. Lu and Ai (2015) emphasized this potential drawback and suggested that comparative studies could also benefit from comparisons where non-native populations share a single L1 background (Lu & Ai, 2015). In light of these factors mentioned above, the present study aims to analyze phrasal and clausal complexity in research articles written by

native and non-native Turkish L1 writers to explore how the two groups of expert writers compare in terms of syntactic complexity.

1.1 Background of the study

Comparative studies that have specifically explored research articles as a genre and their rhetorical and linguistic features demonstrated how linguistic and rhetorical choices differ across cultural and linguistic backgrounds. The area of research that explores syntactic complexity examines how writers use linguistic features to organize and layer information while simultaneously attending to specific genre demands. A substantial amount of research has employed traditional large-grained indices to investigate complexity in both L1 and L2 academic writing. These studies aim to understand the complexities of the language used by specific groups of writers and gain insights into the developmental aspects of academic writing. Complexity analyses have also been instrumental in assessing writing proficiency, genre conventions, and cross-linguistic influences (Housen & Kuiken, 2009; Ortega, 2003). In academic writing, clausal and phrasal complexity are core elements and research articles, in particular, require a masterful use of these features, as such texts must be both information-rich and concise (Biber et al., 2011; Casal & Lee, 2019). To better capture these linguistic features, a number of studies have employed fine-grained indices that focus on forms of structural compression (e.g., Lan et al., 2019; Ziaeeian & Golparvar, 2022). One line of research is specifically interested in the impact of language background and studies that compare native and non-native writers (e.g., Casanave, 1998; Hinkel, 2002; Lu, 2015; Wu et al., 2020) have yielded varying results suggesting that writers from different language backgrounds can exhibit different preferences in the use of complex structures. Scholars have also argued that

comparing heterogeneous groups of writers may impede the ability of comparative analyses to identify specific variations between native and non-native writers sharing the same L1 background (Ansarifar et al., 2018; Lu & Ai, 2015). While some of the studies on linguistic variation have identified significant differences between native and non-native writers, some have yielded inconclusive results. A study by Cao & Xiao (2013), for instance, demonstrates that native English writers exhibit greater use of intensifying devices, whereas Chinese writers favor passive structures, and abstract noun phrases. These patterns were consistent across the 12 academic disciplines incorporated in the study, suggesting fundamental stylistic and structural differences in academic writing between the two groups. Differences between native and non-native writers have also been reported by other studies which specifically examined syntactic complexity in academic writing (Nasseri, 2021; Wu et al., 2020). On the other hand, while analyses identified cross-disciplinary differences in complexity patterns, L1 differences were minimal and not conclusive (Ziaieian & Golparvar, 2022). Such conflicting results attract attention to cross-linguistic analyses that demonstrate, in Pallotti's (2015) terms "the stylistic complexity" reflected in writers' choices of structures (p. 120).

1.2 Aims of the study

The current study examines syntactic complexity in internationally published research articles authored by L1 English and L1 Turkish EFL writers. Through a corpus-based approach, using both large and fine-grained complexity measures it explores frequently occurring clausal and phrasal complexity structures. The aim is to identify patterns of variation and similarity between the two groups of writers and

get an understanding of the overall distribution of complex syntactic features in applied linguistics research articles.

In this investigation, syntactic complexity is operationalized using both large-grained measures which are calculated based on sentence length, T-unit length, and clause length, and fine-grained indices that separately examine clausal and phrasal complexity in a more detailed manner. By integrating large and fine-grained metrics, the study adopts a multidimensional approach to complexity (Bulté & Housen, 2012; Norris & Ortega, 2009, Pallotti, 2015) and aims to provide a more detailed description of the complex structures used by L1 Turkish, also referred to as non-native writers (NNW), and L1 English writers, also referred to as native writers (NW) throughout the study. The study aims to find answers to the following research questions:

1. How does syntactic complexity in research articles written by L1 Turkish and L1 English expert writers vary with respect to global complexity measures?
2. How does syntactic complexity in research articles written by L1 Turkish and L1 English expert writers vary with respect to fine-grained clause and noun phrase complexity indices?
3. How are prominent linguistic features manifested in the research articles written by L1 Turkish and L1 English expert writers?

1.3 Significance of the study

Inspired in part by studies that have explored writers from various backgrounds, the current analysis of a self-compiled corpus of research articles aims to contribute to syntactic complexity research by showcasing the most common linguistic features in the writing of L1 English and L1 Turkish writers, as well as the variations in their

use of clausal and phrasal elements. The majority of studies exploring differences that stem from the writers' L1 have focused on learner language, however, the current study aims to shed light on how expert writers who are familiar with genre requirements compare in terms of their use of syntactic complexity elements in their research articles. In addition to the comparative analysis, the overall study results derived from the comparative analyses will contribute to a deeper understanding of academic writing and its characteristics specific to the field of applied linguistics.

Another significance of this study is the contribution it may have in the field of writing pedagogy, specifically targeting novice writers and postgraduate students. The findings of the analysis can be of use to educators and material development in English for Academic Purposes (EAP) programs as they can address specific syntactic features that can help students, novice writers prepare for the demands of academic publishing. Finally, the study will contribute to the growing body of research on English as a global and academic lingua franca by documenting how Turkish L1 writers contribute to the diversity of English academic writing. As English has now become the primary language for academic communication worldwide, understanding these contributions and the variation in the characteristics of academic writing highlights its inclusiveness and further emphasizes the role of non-native writers.

CHAPTER 2

LITERATURE REVIEW

Written academic discourse has been a widely explored field of research in the past few centuries with specific interest in its linguistic characteristics that make it stand out from other spoken and written registers (Biber & Gray, 2016, p.72). Biber has described academic writing as one of the most challenging registers to master and has suggested a set of characteristics that differentiate it from spoken discourse and other forms of written language. Academic language is highly informative and is targeted towards people with common shared knowledge, making it meaningful for the specific groups of readers. He further suggests that it has its own linguistic characteristics making it different from spoken discourse and many other forms of written language (Biber & Gray, 2016, p. 68). He also points at differences among different subtypes of written academic registers which can have differing linguistic features depending on the degree of specialized knowledge the audience has. At the very high end of his spectrum lies the research article, which is addressed towards a 'highly specialized audience' and is written with the aim of delivering conceptually demanding information (Biber & Gray, 2016, p.70). New concepts like 'writing for research publication' have also emphasized the importance of research reporting as it is one of the most important means to stay relevant in the modern academic system (Omidian et al., 2021).

A myriad of studies have explored various aspects of written academic genres like research articles, PhD dissertations, master theses and a variety of reports and reviews published for international or local communities. Swales (1990) played a key role in shaping the study of research articles as a genre through his CARS (Create a

Research Space) model. This approach examines how authors establish the relevance of their academic work and convey the purpose of their study in the Introduction section. The model has become a cornerstone for analyzing rhetorical strategies used in research articles, especially in highlighting the originality and importance of a study.

A number of studies that have explored abstract from a disciplinary standpoint were interested in finding out whether abstracts in disciplines like engineering (e.g., Hyland, 2004), medicine (e.g., Kang et al., 2024; Salager- Meyer, 1990), applied linguistics (e.g., Santos, 1996), social and behavioral sciences (e.g., Khany & Malmir, 2019) exhibit different rhetorical and linguistic features. Other parts of the research article were also added to the equation and over time research revealed that different sections of research articles tend to exhibit distinct linguistic features that are more frequently used in those specific sub-sections of research articles (Casal et al., 2021; Cortes, 2013; Le & Harrington, 2015; Lu et al., 2020; Parkinson, 2011; Ruiying & Allison, 2003). For example, sections like ‘Introduction’ and ‘Discussion’ proved to be more complex than the remaining sections of the research article as they included more complex nominals, longer sentences and T-units (Casal et al., 2021). Yin et al. (2021) have compared complexity in research article part genres by adding expert and emerging writers to the equation and found that except for Methods and Results, the remaining sections feature more complex language, however less consistency was observed in the emerging writers’ group. As all features are intertwined and are also dependent on syntactic features, complexity in that department has also been of great interest, as is the case in the present study.

The research article is considered to be the ideal representative of syntactically complex language as the genre demands a highly advanced command of

the language and an ability to express complex ideas concisely (Biber & Gray, 2016). Many studies have explored phraseological and lexical features of research articles (Cunningham, 2016; Esfandiari & Barbary, 2017; Golparvar & Barabadi, 2020; Hyland, 2008; Ren, 2021), some of them comparing these features across different organizational parts of the research article (e.g., Zare & Valipouri, 2022) or disciplines (e.g., Yin & Li, 2021).

Different sections of research articles have also attracted attention as researchers tried to identify section-specific rhetorical structures and moves in part genres by also linking them to syntactic complexity features (e.g., Lu et al., 2021). Specific discourse acts, such as exemplification and citation practices, have also been explored (Marti et al., 2016; Zhang, 2022). Another line of research has tackled genre-specific features and disciplinary differences in research articles exploring how soft and hard science articles differ and compare in terms of linguistic, lexical and rhetorical features (e.g., Hyland, 2006; Kaidan et al., 2021; Lin & Evans, 2012; Uzun, 2016; Yin et al., 2021). Diachronic analyses have also been conducted to shed light on the linguistic and stylistic changes the research article as a genre has undergone (e.g., Li, 2021; Pan & Yang, 2024; Pan & Wu, 2023; Yin et al., 2022; Zhu et al., 2024). One such study that covered a period from 1970 till 2020 was conducted by Pan & Yang (20024) and found that academic writing has grown more complex in its use of noun phrases over the last 50 years, especially in hard sciences compared to soft sciences. These studies represent only a small fraction of the research focused on analyzing academic articles, however there is growing interest in this field, as research articles play a crucial role in sharing field specific knowledge and making scholars' work visible to the academic community (Hylland, 2000).

2.1 Syntactic complexity in academic writing

Syntactic complexity, which encompasses the diversity and sophistication of grammatical structures in language use, is a critical concept in second language writing (Lu, 2011). It is a subdomain of the more general concept of ‘Linguistic Complexity’ (Kuiken, et al., 2019; Szmrecsanyi & Kortmann, 2012) and is widely explored in the fields of language development and proficiency. Although there is no single definition adopted by scholars (Bulté & Housen, 2012) definitions put forward by researchers draw attention to features like, subordination, variation and sophistication (Foster & Skehan, 1996; Wolfe-Quintero et al., 1998; Bulté and Housen, 2012; Lu, 2011). For instance, Ellis and Barkhuizen (2005) define complexity as “the use of more challenging and difficult language” and the “extent to which learners produce elaborated language”, Wolfe-Quintero et al. (1998) have depicted grammatical and lexical complexity as “a wide variety of both basic and sophisticated structures and words” that are available to a learner and Ortega (2003) defines it as the “range and forms that surface in language production and the degree of sophistication of such forms” (p.492). Bulté and Housen (2012) consider these definitions to be broad and indefinite as they use round and vague wording. To address this issue and avoid different interpretations that interfere with consistency across studies, they suggested a taxonomy of complexity constructs. Figure 1 illustrates the two main types of complexity and the way they branch out into their own sub constructs. The relative approach explores complexity through cognitive and subjective factors and emphasizes the role of personal and external factors. Such personal factors can be motivation, anxiety, or any learner related perceptions regarding the target language. External factors, on the other hand, are factors that stem from the language system itself and the cognitive challenge they pose to the

learner. This can be observed in the way language learning curricula are designed, by placing relatively simpler structures in the earlier stages of learning objectives.

Different from relative complexity, absolute complexity is more measurable as it is defined as “the number of discrete components that a language feature or a language system consists of, and as the number of connections between the different components (Bulté & Housen, 2012).

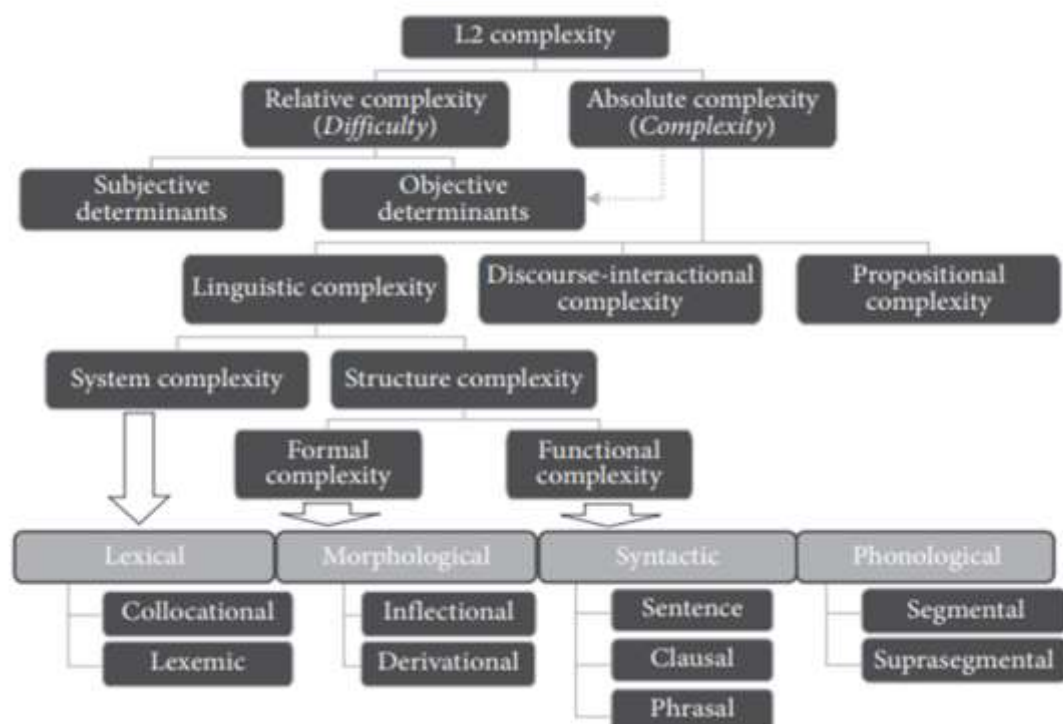


Figure 1. A Taxonomy of complexity constructs

Source: Bulté & Housen, 2012, p. 23

To reflect its multidimensional nature, the taxonomy further divides linguistic complexity into system and structure complexity where the former refers to how diverse a learner’s overall language abilities are, and the latter categorizes formal and functional complexities as two separate approaches to analyzing linguistic components like lexis, morphology, syntax and phonology. A similar approach that

views complexity as a concept that consists of multiple dimensions is put forward by Pallotti (2015) who argues that complexity should be defined in structural terms that allow empirical measurement of complexity independent of difficulty, proficiency and developmental stages. The current study is based on an analysis of syntactic complexity, a sub construct of formal complexity as illustrated in Figure 1, integrating all three constructs: sentence, clausal and phrasal complexity which are measured through empirical measures that will be explained in detail in the following sections. It also encompasses what Pallotti (2015) has identified as “stylistic syntactic complexity” which is based on the number of interconnected components within a structure identified through measurements of phrase length, the number of phrases per clause, and the number of clauses per unit.

Traditionally, clausal and phrasal complexity are considered to be the two most fundamental syntactic complexity types (Staples et al., 2016) and are regarded as important aspects of language development (Ortega, 2003). As mentioned above, both former and more recent definitions of the construct emphasize range and sophistication, linguistic complexity studies have used a wide variety of metrics to explore ways to assess and evaluate writing development and language proficiency in both L1 and L2 speakers (Wolfe-Quintero et al., 1998). In fact, apart from the challenge of defining what exactly syntactic complexity stands for, scholars have also faced the difficult task of establishing widely accepted measures of the construct. A number of studies conducted in the 1980s (e.g., Homburg, 1984; Larsen-Freeman, 1978; Bardovi-Harling & Bofman, 1989) and 1990s (e.g., Casanave, 1998, Ferris et al., 1994, Henry, 1996) that explored writers at different proficiency levels tried to develop and test measures with the aim of discriminating proficiency levels and determining developmental stages in learning (Lu, 2011). The traditional

measures that have been used for several decades center around length of production unit, amount of subordination or coordination (Ortega, 2003; Wolfe-Quintero et al., 1998). Other relatively recent studies have also employed a wide variety of global measures (Ortega, 2003) which include amount of embedding, structural sophistication, range of structural types and mean length of production units. However, the drawbacks in these studies as suggested by Lu (2011) were multifaceted: they lacked uniform selection of measures and explored a limited number of measures with relatively small sample sizes. Additionally, there were inconsistencies in how those measures were defined and calculated and the measured structures were not defined clearly.

Another problematic point was that studies conceptualized proficiency levels in different ways and made it difficult to establish a reliable link between syntactic complexity measures and language proficiency levels (Lu, 2011). With the impact of novel approaches to the concept of complexity, the way it is measured has also become multidimensional and more nuanced, encompassing both holistic and fine-grained measures. This shift has been evidenced by the introduction of innovative measures and tools such as the L2SCA (Lu, 2011) and TAASSC (Kyle, 2016), among many others which will be described briefly in the next section.

2.2 Measuring syntactic complexity

For a long time, syntactic complexity in L2 writing was predominantly measured by calculating clausal, sentential or T-unit length. The T-unit is among the most popular units of production and has been used since it was first introduced by Hunt in 1965 (as cited in Lu, 2011). It is different from a sentence and clause in that a T-unit, in Hunt's (as cited in Lu, 2011) words is "one main clause plus any subordinate clause

or non-clausal structure that is attached to or embedded in it”. Amount of subordination and coordination were the other two features that have been used to identify complexity in writing and longer sentences with multiple subordinate clauses were considered more complex and sophisticated (Biber et al., 2011). However, the T-unit received has also been deemed problematic as it does not reflect the number of dependent clauses in it (Biber et al., 2011, p. 14). Just as problematic seemed to be the measure of clauses per T-unit since the number of clauses might cause the sentence to be perceived as more complex while a sentence can contain fewer dependent clauses but more phrasal complexity. Such inadequacies pushed researchers to enhance the ways to gauge complexity and add more measures to capture more specific complexity features. This caused an inflation in developmental measures and a study by Wolfe-Quintero et al., (1998) reviewed a total of 39 studies which measured fluency, accuracy, grammatical and lexical complexity with over 100 different measures that mostly provided frequency counts and ratios. They have concluded that clauses and T-unit complexity (clauses per T-unit) were indeed reliable in measuring development as they became more complex in correlation with proficiency levels.

A large-scale corpus study Biber et al. (2011) revealed that complexity in speech is attained through complex clauses, while academic writing is more reliant on complex noun phrases. In addition to measures based on mean length of T-units, sentences and clauses and counts of dependent clauses, other measures of subordination and coordination were tested in studies with the search for reliable measures that match with proficiency levels or writing quality (Bardovi-Harlig & Bofman, 1989; Norris & Ortega, 2009; Ortega, 2003; Wolfe-Quintero et al., 1998;). A relatively smaller list of these measures was identified as reliable indicators of

writing complexity and were embedded in tools for automated analysis. One of the relatively older but still effectively used tools is the Biber Tagger which was originally designed for multidimensional analysis based on his work on register variations (Biber, 1988). Different from large-grained measures, the MAT tagger (Nini, 2019), which is a more advanced version of the Biber tagger released in 1988, calculates more than a hundred lexical and grammatical indices. However, it is a semi-automated tool and requires additional tools to analyze data.

One of the most widely used fully automated tools today, the L2SCA was designed by Lu (2010) and has made it easier to analyze large sets of data. It is based on a selection of indices from the studies of Wolfe-Quintero et al. (1998) and Ortega (2003) and provides frequency counts and ratios of 14 measures which tap into five dimensions of complexity. The measures have received both criticism and praise and have been used by many studies that explored syntactic complexity in L1 and L2 writing (Pérez-Guerra & Smirnova, 2023; Pan & Zhou, 2024; Saricaoglu et al., 2021; Wu et al, 2020). To mention a few, some of the studies explored the aforementioned discipline and part genre differences using these measures. The measurements resulted in significant differences across disciplines and part genres (Casal et al., 2021). Casal and Lee (2019) investigated how syntactic complexity related to writing quality by analyzing research papers written by ESL undergraduate writers that fell into three groups: high, mid and low. Clausal complexity showed little variation; however, high rated papers featured complex nominal phrases with pre and post modifiers, specifically adjectives, prepositional phrases and participles. They concluded that global (mean length of T-unit) and phrasal measures (mean length of clause, complex nominal density) rather than clausal measures are better indicators of writing quality.

Large-grained indices were also used in studies that compared academic writing across native and non-native writers ranging from undergraduate students to expert writers that have published internationally. A study by Mancilla et al. (2015) compared native and non-native undergraduate students by analyzing syntactic complexity in written discussion posts. They discovered that native speakers used more subordinate structures (higher MLS & MLT scores), and non-native speakers featured greater use of coordinate phrases and complex nominals. Another study that utilized large-grained complexity measures explored differences between native and non-native writers through a comparison of ELF (English as a Lingua Franca) and AmE (US English) research articles (Wu et al., 2020). The study found that articles in the ELF corpus contained longer sentences, more coordination (especially coordinate nouns and adjectives) and more complex nominals but fewer verbal phrases and subordinate clauses. In other words, the long sentences in the ELF corpus were the result of phrasal embedding rather than clausal embedding. The researchers attribute these features to a deliberate choice made by the writers to focus on clarity and efficient communication.

Abstracts of research articles have also been extensively investigated due to their compact but information dense nature. One such study compared the abstracts of research articles written by native speakers of Arabic and international expert writers (Alamri & Alqarni, 2024). The analyses were done based on Lu's (2011) large-grained indices using the L2SCA tool. The analysis resulted in significant differences across all complexity measures in favor of the expert writers' group. Compared to the abstracts written by L1 Arabic writers, the abstracts written by expert writers featured longer units of production, more subordination. Expert writers also used more coordinate phrases and complex nominals. They also compared the

total number of sentences per abstract to the mean length of sentences which revealed that abstracts in the expert corpus had fewer but longer sentences, further supporting the findings of the statistical analyses.

A study with Japanese students has also employed large-grained measures to analyze syntactic complexity in a corpus of 339 essays in comparison to native English writers. It has found that L1 Japanese writers, even at advanced levels produced texts that were syntactically less complex than those written by native English writers (Lyu et al. 2022). Another study that compared native-speakers (US) and non-native speakers from different L1 backgrounds focusing on a different genre of academic writing was conducted by Lu and Ai (2015). An analysis of 1600 argumentative essays resulted in mixed findings regarding syntactic complexity between native and non-native writers. While non-native writers often matched or exceeded native writers in some areas, such as phrasal sophistication (e.g., complex nominals), they lagged in others, like subordination (e.g., dependent clauses). Additionally, patterns varied widely among non-native writers' groups depending on their L1 backgrounds, with some producing more coordination or longer sentences, while others showed lower complexity. These mixed results suggest that syntactic complexity in writing is influenced by the L1 background of the non-native writers regardless of their proficiency levels.

Academic writing and different genres have also been studied in the Turkish context, through comparative and descriptive studies. Syntactic complexity in academic writing is relatively understudied with a currently growing interest in the field. Atak and Saricaoglu (2021) investigated the developmental patterns of syntactic complexity among L1 Turkish learners of L2 English, focusing on both their progression through complexity stages identified by Biber et al. (2011) and the

impact of topic variation. Their analysis of argumentative essays written by 90 intermediate-level university students revealed that most students were stages 2 and 3 on the developmental scale (which is a scale from 1 to 5, Biber et al., 2011) and the texts exhibited high reliance on finite adverbial clauses, attributive adjectives within noun phrases, and prepositional phrases as adverbials, as expected based on their proficiency level.

Another study that has focused on Turkish L1 learners of English was conducted by Polat et al. (2020). The longitudinal study explored how the written syntactic complexity of Turkish EFL learners evolves across different proficiency levels. They analyzed 852 writing samples from 284 learners over three semesters and identified prominent syntactic complexity features at elementary, pre-intermediate, and intermediate levels and how these features changed over time. The results indicated that learners at lower proficiency levels relied on simpler structures, such as phrasal coordination, while intermediate-level learners produced more varied and complex constructions. They concluded that although significant changes in syntactic complexity were recorded across levels, these changes were not always linear or predictable. Their study highlights the complexities of L2 development and emphasizes the influence of classroom instruction intensity on learning outcomes.

Selvi (2021) conducted a study that is specifically concerned with research articles written by Turkish L1 writers. A corpus of 216 research articles from different disciplines (communication, economics, education, engineering, and medicine) were analyzed and compared against a reference corpus that consisted of 163 published articles written by native speakers. The features explored were lexical diversity, syntactic complexity and errors. The analyses were carried out using the total set of 14 large-grained measures available on L2SCA (Lu, 2011). The findings

pointed to longer production units in the corpus of native writers and less syntactically complex features in the non-native corpus which applied to the articles from all five disciplines. An additional comparison within the group of articles written by the non-native writers suggested that the articles from the field of Education exhibited higher complexity in comparison to the remaining four fields with significantly higher scores for the measures of phrasal complexity, subordination, coordination. These findings demonstrate the impact of disciplinary conventions as writers from the same L1 background have employed varying levels of complexity.

A different genre, conference abstracts, were also analyzed using traditional large-grained indices with a special focus on rhetorical functions and syntactic complexity (Göktürk & Saricaoglu, 2024). The study compared two corpora of abstracts, one that consisted of abstracts written by language teachers for a national conference, and a second corpus that contained abstracts written by researchers or teacher-researchers for an international conference on applied linguistics. The corpora were not divided specifying L1 backgrounds, however, the majority of the abstracts were written by Turkish EFL speakers. The analyses based on large-grained complexity indices revealed that, overall, international abstracts featured longer sentences and T-units, more complex noun phrases and dependent clauses. Syntactic complexity in rhetorical moves within the abstract were reported separately as well.

2.3 Noun phrase complexity

As discussed in the preceding sections, Biber (2011) and his colleagues played a significant role in bringing noun phrases to the forefront, making them a topic of significant scholarly interest. In their large-scale corpus studies, Biber and Gray

(2011) documented a substantial increase in the use of nouns and phrasal noun-modifying structures in academic writing. This increase was particularly evident in the use of attributive adjectives, nominals as modifiers, prepositional phrases, noun phrases as appositives, and nominalization. These structures were highlighted for their versatility in effectively expanding meaning through modification and complementation while simultaneously compressing a substantial amount of information into compact sentence structures. Biber and Gray (2010) further classified linguistic structures as serving either structural elaboration (e.g., finite and non-finite complements, relative clauses, and finite adverbial clauses) or structural compression purposes (e.g., attributive adjectives, nouns as modifiers, prepositional phrases as postmodifiers, appositives, and similar structures).

Noun phrases have attracted growing interest, especially after Biber, Gray, and Ponpoon (2011) proposed stages of noun phrase complexity based on the types of modifiers used. These noun phrase modifiers function as elements of pre- or post-modification and comprise, adjectives, nouns, phrases as well as finite and non-finite clauses. The proposed stages are believed to reflect a developmental trajectory in L2 writing, as numerous studies have demonstrated strong correlations between the proficiency levels of writers and the hypothesized developmental stages (Biber et al., 2011, 2016; Parkinson & Musgrave, 2014; Lan & Sun, 2019).

As mentioned in the preceding sections, Biber (1999) and his colleagues played a crucial role in bringing the nominal phrase to the forefront, making it a topic of immense interest. In their large-scale corpus studies, Biber and Gray (2011) documented a significant increase in the use of 'nouns and phrasal noun-modifying structures' in academic writing. This increase has been observed specifically in the use of attributive adjectives, nominals as modifiers, prepositional phrases, noun

phrases as appositives and nominalization. They emphasized the versatility of these structures in effectively expanding meaning through modification and complementation while packing a substantial amount of information into compact sentence structures. The nominal modifiers they identified could be arranged on a continuum of compression, as outlined by Biber and Clark (as cited in ruan, 2018): “Compressed expression - premodifiers < phrasal postmodifiers < nonfinite clauses < relative clauses – Expanded Expression” (p. 39) and many studies have explored noun phrases based on the models and developmental stages proposed by Biber (2011) and his colleagues.

Ansarifar et al. (2018) explored how noun modifiers are used by expert and L1 Persian writers at different levels of expertise. They found that, in the abstracts of research articles, the most widely used noun phrase dependent types were attributive adjectives, nouns as modifiers, and prepositional phrases. There were no significant differences in clausal features; however, phrasal complexity showed a linear progression among MA, PhD, and expert writers. Similarly, Shen et al. (2023) examined the impact of language background and academic discipline by comparing L1 English and L1 Chinese university students across four years and three disciplines. Their findings revealed that L1 English students used more noun phrases as they progressed through their studies. Additionally, physical sciences employed more noun phrases, while social sciences favored clausal structures. When all factors interacted, Chinese students appeared to use more adverbial clauses, attributive adjectives, and pre-modifying nouns in the earlier years of study. Over time, nouns and adjectives as head noun modifiers are becoming increasingly common in academic writing (Biber & Gray, 2018).

2.4 Measuring noun phrase complexity

A great deal of research has been dedicated to the analysis of noun phrases using Biber et al.'s suggested developmental stages framework. The Biber tagger-based complexity indices were used in many studies to investigate L2 writing (e.g., Biber et al., 2014; Parkinson & Musgrave, 2014; Taguchi et. al., 2013). The developmental index proposed by Biber et al. (2011) includes five developmental stages that include pre and post modifiers as can be seen in Table 1.

Table 1. Biber et al.'s (2011) Hypothesized Developmental Stages of Noun Phrase Modification

Stage	Grammatical structures
2	Attributive adjectives
	Possessive noun as pre-modifiers
3	Finite relative clause (animate head noun)
	Prepositional phrase- concrete/locative meaning (of and other pps)
	Nouns as pre-modifiers
4	Non-finite relative clauses (-ing clauses / -ed clauses)
	Attributive adj+noun as pre-modifier
	Prepositional phrase (abstract meaning)
5	Prepositional phrase + non-finite complement clause
	(Prepositions + infinitive clause)
	That/to complement clause
	Appositive noun phrase

A multitude of studies have explored noun modification patterns of non-native speakers at different proficiency levels using Biber et al.'s proposed index, many of them comparing high- and low-proficiency students, as in Lan et al.'s (2019) corpus-based study. In their study, high-proficiency students used basic noun modifiers, such as adjectives and relative clauses, which correspond to stages two and three in

Biber et al.'s index, at higher rates than expected, while low-proficiency students used fewer of these than anticipated. This somewhat unexpected result was also observed in other studies, where highly rated essays featured a greater number of attributive adjectives (e.g., Casal & Lee, 2019; Taguchi et al., 2013). The same study also concluded that the use of nouns as pre-modifiers depends heavily on the topic of the written products. On the other hand, their findings regarding prepositional phrases appeared to contradict the reported high frequencies of prepositional phrases as post-modifiers in essays written by high-proficiency students (e.g., Casal & Lee, 2019). Lan et al. (2019) documented higher frequencies of prepositional phrases in essays written by low-proficiency students. They attributed this to the fact that prepositional phrases, particularly those constructed with *of*, have a wide range of functions and are used very frequently, reportedly comprising 60% of all prepositional phrases (Biber et al., 1999).

The measurement of noun phrase complexity by automated tools is strictly structural and aligns with Pallotti's (2015) approach, which advocates for clear, operationalized metrics. The automated tools used for analysis are based on complexity features determined by the number of elements and the degree of embedding. One of the most widely used tools for analyzing noun phrase complexity, in addition to global syntactic complexity, is the previously mentioned L2SCA (Lu, 2010). This tool measures complex nominals using two specific indices: complex nominals per clause (CN/C) and complex nominals per T-unit (CN/T) and has been used exclusively to measure noun phrase complexity in a number of studies (e.g., Liu & Li, 2016). These indices capture noun phrases that contain one or more premodifiers, nominal clauses, or gerunds and infinitives in subject position (Lu, 2011). However, the tool does not provide a breakdown of complex nominal phrases

but instead counts them as complete linguistic units. As a result, many studies have opted for manual analysis to capture the different modifier types included in Biber et al.'s proposed noun phrase complexity index.

The Tool for the Automatic Analysis of Syntactic Sophistication and Complexity (TAASSC), also used in the current study, was designed by Kyle (2016) and offers a wide range of indices for analyzing clauses and noun phrases in greater detail. The tool includes 31 fine-grained indices of clausal complexity, 132 fine-grained indices of phrasal complexity, and an additional set of 190 indices of syntactic sophistication. It has been widely used in research, as it is freely available online and enables researchers to work with large datasets. The L2SCA is also embedded in the current version of TAASSC, allowing researchers to analyze the same dataset using both broad and fine-grained indices. Since it is a relatively new tool, few studies have utilized it. One such study, conducted by Ziaeeian and Golparvar (2022), used fine-grained clausal and phrasal indices to analyze syntactic complexity in the discussion sections of research articles across three different disciplines, suggesting that traditional measures are insufficient for analyzing academic writing. Their analysis entailed a comparison of discussion sections from research articles in three disciplines written by native and non-native Persian writers. Although the results did not provide a clear picture regarding L1 background, they were highly revealing in terms of disciplinary variations. The findings demonstrated that articles in the fields of applied linguistics and economics scored higher on clausal complexity indices, while chemistry articles contained the most complex nominal phrases.

CHAPTER 3

METHODOLOGY

This chapter outlines the methodology in this study. It begins by detailing the objectives of the study and presents the research questions that guide the investigation. Next, it provides an overview of the content of the corpus, including the selection process. The chapter also explains the syntactic complexity indices and the tools that calculated the metrics. Finally, it briefly describes the statistical and qualitative methods used to analyze the data provided by the automatized mean and frequency calculations.

3.1 Research questions

1. How does syntactic complexity in research articles written by L1 Turkish and L1 English expert writers vary with respect to global complexity measures?
2. How does syntactic complexity in research articles written by L1 Turkish and L1 English expert writers vary with respect to fine-grained clause and noun phrase complexity indices?
3. How are prominent linguistic features manifested in the research articles written by L1 Turkish and L1 English expert writers?

3.2 Data collection procedures

The comparative analysis in the study is based on two corpora of published research articles written by native L1 English and L1 Turkish authors. The specific genre under investigation is the research article as it is accepted by many prominent scholars as a well-established medium for sharing academic work and a legitimate

ground for presenting new ideas and theories (Peacock, 2002). Wood (2001, p.74) characterizes the research article as “the prototypical type of writing produced in international English scientific writing” highlighting its significant role in academia. Furthermore, journal articles are widely regarded as high in quality, both in content and language, due to their rigorous screening process, which includes blind peer review and adherence to the specific standards set by journals (Thyer, 2008). Given these considerations and the focus of this study on the complexity of academic language, research articles are thus deemed an appropriate and valuable choice for analysis. To construct a specialized corpus, which is essential to conducting research with a particular aim (Conrad, 1996, p.303), two distinct corpora were compiled to represent each group of writers. Data collection was conducted through purposive sampling, as purely random sampling would not have produced comparable datasets aligned with the overall purpose of the study.

The completed corpora consist of one hundred published research articles, each containing 50 articles. Since one of the corpora is based on articles written by authors with a specific L1 background, Turkish in this case, purposive sampling was employed as the primary selection method. According to Farsani & Barzegar (2024), purposive sampling is the second most commonly employed method in applied linguistics research. It allows for the selection of samples aligned with the objectives of the study, hence enhancing the credibility and reliability of findings (Campbell et al., 2020).

The compilation process of the corpus consisted of two main stages, the selection of journals and the extraction of articles based on the criteria drawn from relevant literature and the guidance provided by expert academicians guiding the study. As the very initial step, journals belonging to one or more of the following

categories in the filter tool of the Journal Citation Reports dataset (Journal citation Reports, 2024), namely education, educational research, language, language and linguistics were listed based on their JIF ranking scores for the year 2023. The JIF (Journal Impact Factor) is a method for organizing journal quartiles or ranks as defined by the Web of Science. Quartiles are a means of dividing the entire spectrum of ranks into four parts where Quartile 1 (Q1) represents journals which are the top 25% high ranking journals in a specific field or subject category. The list was also limited to SSCI or/and AHCI indexed journals in the 1st quartile. A list of 192 journals were provided by the website after using its filter options. The list was later reduced to 52 journals through the guidance of experts in the field. All journals were then scanned for articles written by Turkish writers and only those that have published a minimum of five articles within the period from 2010 and 2023 were added to the final list of journals. One criterion that had to be modified during the article selection process was the number of writers per article. Due to the fact that there was a limited number of single authored articles written by Turkish writers, articles with multiple authors were included by strictly adhering to the nativeness criteria mentioned further down in this section. This approach has also been observed in other studies that have conducted comparative analyses and used multi-authored papers, particularly in cases where articles written by a specific group of authors were limited in number (e.g., Gao, 2016; Ziaeeian & Golparvar, 2022).

Five articles written by native English speakers and five articles written by Turkish writers were selected from each of the ten journals in Table 2 which offers an overview of the corpus. This was a deliberate choice that aimed to limit the number of journals and make sure that an equal number of articles were extracted from the same journals. Focusing on a small number of journals has also helped

ensure homogeneity of the data and control any variations that would stem from journal specific requirements. Although there were no restrictions regarding the number of writers per article, single authored articles were prioritized, solely for practical reasons. However, the corpus also includes articles written by multiple authors due to the relatively limited number of L1 Turkish-authored articles in the literature. A similar strategy has been employed in many other studies, with the strict condition that all authors share the same L1 background (e.g., Esfandiari & Barbary, 2017; Gao, 2016; Gong et al., 2024; Lu et al., 2019). Similarly, in the current study, articles written by Turkish authors in collaboration with writers from other L1 backgrounds were excluded from the dataset. The final list of ten journals was primarily determined by the availability of articles authored by Turkish writers.

Table 2. Distribution of Articles by Writer Group Across Ten High-Impact Journals

Corpora journals	Quartile	Impact factor (2023)	No. of articles by NWW (L1 Turkish)	No. of articles by NW (L1 English)
Assessing Writing	Q1	4.2	5	5
Computer Assisted Language Learning	Q1	6.0	5	5
Innovation in Language Learning and Teaching	Q1	3.1	5	5
Journal of English for Academic Purposes	Q1	3.1	5	5
Journal of Multilingual and Multicultural Development	Q1	2.7	5	5
Journal of Pragmatics	Q1	1.8	5	5
Language Teaching Research	Q1	3.3	5	5
ReCALL	Q1	4.6	5	5
System	Q1	4.9	5	5
TESOL Quarterly	Q1	3.0	5	5

All the articles in both corpora are empirical study reports, primarily following the conventional IMRaD (Introduction, Methods, Results, and Discussion) macrostructure (Swales, 1990). Articles that combined the Results and Discussion sections into a single section or incorporated optional sections such as Literature Review, Conclusion, or Limitations –identified by Lin and Evans (2012) as optional yet acceptable—were also included in the corpora. Some articles featured a "Methods" section instead of "Methodology," while others used section titles such as "The Study" but still provided information on the methods and data used. A small number of articles lacked an explicit "Introduction" heading; however, the initial part of these articles served the same communicative purpose, aligning with Swales's (1990) rhetorical moves for introductions.

Despite variations in article sub-sections, the adoption of “an elastic yet operational set of criteria for identifying the research article” (Van Enk & Power, 2017, p. 1) standardized the selection process, ensuring both representativeness and homogeneity within the corpus. Additionally, this structured approach to genre and organizational conventions minimized variations in linguistic and rhetorical patterns that are typical of other article types, such as book reviews, disciplinary dialogues, and discussions. Articles lacking a Discussion section were excluded, as they do not offer sufficient authorial elaboration on the results.

Determining the native-speaker status for both groups of writers was another critical step in compiling the articles. Before outlining the criteria used to select articles based on the writers' L1 backgrounds, it is essential to acknowledge that diverse definitions of the term “native speaker,” which reflect varying theoretical perspectives on its conceptualization. Some definitions, such as the one provided in the *Longman Dictionary of Language Teaching and Applied Linguistics* (as cited in

Lowe, 2020), characterize a native speaker as an individual who acquires a language from birth as a natural consequence of being born into and raised in a specific linguistic community. This definition emphasizes the speaker's ability to use the language creatively, demonstrating high communicative competence and an intuitive grasp of its structures. (Davies, 1991; Medgyes, 1992). However, defining “native speaker” remains a debated topic, as many definitions are considered inadequate for capturing the complexities of multilingualism and self-identification (Davies, 1991). Similarly, Cheng et al. (2021) argue that “nativeness” is an ideological construct that fails to reflect the intricacies of real-world language experiences.

Although clear-cut, static, categorical definitions have been widely criticized, scholars still consider it essential to identify attributes that can guide research, as numerous studies have explored native and non-native speakers of different languages. To incorporate additional factors that might impact nativeness status, Cheng et al. (2021) proposed a model that groups key linguistic experience factors relevant to identifying nativeness. These factors include nativeness as history, which is based on the order and context of acquisition as well as the age of language onset, nativeness as proficiency, which places proficiency at the center of the definition and links it to the degree and frequency of language use, and nativeness as identity, which encompasses self-perceived identity as a speaker of a given language. The nativeness status of the writers in this study was determined based on a set of criteria incorporating several of the factors mentioned above while also acknowledging that no single set of criteria can fully capture the dynamic language backgrounds of individuals or the impact of multilingualism and self-identity perception.

The process followed the commonly utilized criteria proposed by Wood (2001), which have guided numerous studies (e.g., Esfandiari & Barbary, 2017; Gao,

2016; Gong et al., 2024; Loi et al., 2016; Ruan, 2018; Xia, 2017). In addition to these widely recognized attributes — such as Anglophone names and affiliations with institutions located in core English-speaking countries, known as Kachru’s Inner Circle countries (Buschfeld & Kautzsch, 2019) — selections were also based on the writers’ educational background and/or place of birth (Marti et al., 2019). This additional criterion required a detailed examination of each writer’s profile using publicly available institutional profiles and personal data from platforms such as LinkedIn and ORCID.

The selection of articles written by L1 Turkish writers followed an adapted version of the same criteria, identifying Turkish names and affiliations with Turkish institutions or an educational background based in Türkiye. Since the language of education and the official language in Türkiye is Turkish, as stated in the *Constitution of the Republic of Türkiye*, writers who have received their primary and secondary education in the country were classified as L1 speakers of Turkish. The article selection process was primarily guided by Wood’s (2001) criterion regarding names and Marti et al.’s (2019) criterion regarding educational background. Institutional affiliations were separately identified, and academics who met the first two criteria but worked at institutions outside Türkiye were included in the corpus. More specifically, writers with Anglophone names who were educated in an English-speaking country but working at institutions in Outer Circle countries were included in the L1 English (NW) corpus. Writers with Turkish names were evaluated based on the same criteria. Since many Turkish scholars have moved abroad for academic positions or pursued their PhDs in foreign institutions before returning to Türkiye, the process allowed the inclusion of scholars who have followed this path. Foreign-born and foreign-educated writers with Turkish names, despite affiliations with

Turkish institutions, were excluded from the dataset. Finally, articles with multiple authors were included in the corpus only if all authors belonged to the same L1 background.

All articles were accessed through the university's digital journal database. They were downloaded as PDF documents and converted into plain text files (txt) for further analysis. The text files were manually cleaned and standardized by removing abstracts, keywords, headers, footers, tables, direct (verbatim) quotations, non-English text, excerpts, notes, disclosure statements, acknowledgments, appendices, and references. Although abstracts contain valuable language data, they were excluded from this study because their structure varied significantly across journals. In some articles, abstracts were written as paragraphs, while in others, they were divided into subheadings with brief explanations. The text files were manually scanned and corrected for any distortions caused during the file conversion process. Each article was assigned a unique code indicating its corpus and the journal from which it was extracted. This ensured the anonymity of the writers, particularly when citing specific excerpts in the results section to illustrate findings. The descriptive statistics of the corpus are provided in Table 3, and a complete list of all articles included in the corpus is available in Appendix A.

Table 3. Descriptive Statistics for the Corpora

Corpora	Number of RAs	Total number of words	Mean length of articles
NNW (L1 Turkish) corpus	50	356.122	7.122
NW (L1 English) corpus	50	361.983	7.239
Total	100	718.105	7.181

3.3 Data analysis

The syntactic complexity analysis undertaken in this study is two dimensional, encompassing holistic syntactic indices and fine-grained clausal and phrasal indices for a more detailed understanding of complexity in expert academic writing. The indices explored in this study are described in separate sections below.

3.3.1 Syntactic complexity measurements with SCA indices

In this study, syntactic complexity is analyzed through two different models of measurement, reflecting its multidimensional nature (Norris & Ortega, 2009).

Although the focus of the study lies on complexity at fine-grained levels, the analysis also incorporates 14 large-grained metrics widely utilized in the field to investigate L1 and L2 academic writing (Casal et al., 2021; Dong et al., 2023; Li & Yang, 2023; Lu, 2011; Pan & Zhou, 2024; Saricaoglu et al., 2021; Thi et al., 2023; Wu et al., 2020). These 14 measures were compiled by Lu (2010,2011) from previous studies on writing proficiency (e.g., Ortega, 2003; Wolfe-Quintero et al.,1998) and were critically evaluated to test their accuracy in measuring overall syntactic complexity. In a follow up study, Lu & Ai (2015) have confirmed the claim put forward by Norris and Ortega (2009) that three of the indices that measure subordination (complex T-units per T-unit, dependent clauses per clause, and dependent clauses per T-unit) and two indices measuring complex nominals could be redundant, and thus reduced to incorporate only one per group, however, in this study the whole set of 14 measurements are used since it does not explore L2 wiring development. The indices are measured automatically by the L2SCA (Lu, 2011) which provides frequency counts for each of the measures. The tagging system of the tool is based on the Stanford Parser (Klein & Menning, 2003) and works by splitting various

syntactic units to calculate clausal and phrasal complexity. The measurements are based on mean length of sentences, t-units, and clauses and provide frequencies and mean calculations for overall sentence complexity, length of production unit, amount of subordination, amount of coordination, and degree of phrasal complexity (Lu, 2010). The analyzer produces accurate identifications of production units and structures with significant ($p < 0.01$) correlations with human annotators (Lu, 2010; Yoon & Polio, 2017). It has been widely used in L2 academic writing research (Casal & Lee, 2019; Göktürk & Saricaoglu, 2024; Yin et al., 2021; Zhang & Lu, 2022).

Although L2SCA (Lu, 2011) is a separate analyzer that was created earlier, it has become a part of the Tool for the Automatic Analysis of Syntactic Complexity (Kyle, 2016) and allows simultaneous analyses of the same set of data. Table 4 provides a detailed description of the metrics and their calculation formula. Contrary to one line of opinion that classifies non-finite verbs as clauses (Bardovi-Harlig & Bofman, 1989), Lu's tool aligns with the approach of Hunt and Polio (as cited in Lu, 2010) and treats non-finite verbs as verb phrases rather than clauses. A T-unit which in Hunt's definition (as cited in Lu, 2010) stands for "one main clause plus any subordinate clause or non-clausal structure that is attached to or embedded in it" is used in its traditional form.

Complex nominals, on the other hand, are identified by Cooper (as cited in Lu, 2010) as structures that encompass all the following: (i) nouns plus adjective, possessive, prepositional phrase, relative clause, participle, or appositive, (ii) nominal clauses, and (iii) gerunds and infinitives in subject position.

Table 4. SCA Indices in TAASC (Lu, 2011)

Measure	SCA Code	Formula
Length of production unit		
Mean length of sentence	MLS	# of words / # of sentences
Mean length of T-unit	MLT	# of words / # of T-units
Mean length of clause	MLC	# of words / # of clauses
Amount of subordination		
Clauses per T-unit	C/T	# of clauses / # of T-units
Complex T-unit ratio	CT/T	# of complex T-units / # of T-units
Dependent clauses per clause	DC/C	# of dependent clauses / # of clauses
Dependent clauses per T-unit	DC/T	# of dependent clauses / # of T-units
Amount of coordination		
Coordinate phrases per clause	CP/C	# of coordinate phrases / # of clauses
Coordinate phrases per T-unit	CP/T	# of coordinate phrases / # of T-units
T-unit per sentence	T/S	# of T-units / # of sentences
Phrasal complexity		
Complex nominals per clause	CN/C	# of complex nominals / # of clauses
Complex nominals per T-unit	CN/T	# of complex nominals / # of T-units
Verb phrases per T-unit	VP/T	# of verb phrases / # of T-units
Overall sentence complexity		
Clauses per sentence	C/S	# of clauses / # of sentences

3.3.2 Clause and phrase complexity measurements with fine-grained indices

For a more refined inspection of clausal and phrasal complexity, corpus data were also analyzed using fine-grained complexity indices available in the Tool for Automatic Analysis of Syntactic Sophistication and Complexity (TAASSC) developed by Kyle (2016). Compared to SCA, TAASSC uses additional pattern matching tools that allow for a more sophisticated analysis by identifying complex clausal and phrasal structures and provides average frequencies of the measured structures. The analyzer is therefore well suited for in-depth analyses of academic texts and other written works that are exhibits of advanced proficiency in English.

TAASSC also provides two main resources that can be used for detailed analyses of target texts. The tool can effectively generate frequency databases which include comprehensive information about each clause and phrase within the texts as well as additional mod parsed XML files. These output files allow users to efficiently examine syntactic structures, relationships, and specific linguistic patterns within the texts and use them to further elaborate on analysis results by extracting relevant examples from the data. There are a total of 31 clausal complexity indices in TAASSC, 30 of which measure complexity, and one measures variety. A detailed list of all large-grained and fine-grained indices and their corresponding text names can be found in Appendix B.

While some of the studies have adopted a methodology where researchers narrow down measures through statistical models to identify the indices that effectively capture the characteristics of the target texts (Green, 2019), the current study will use a selection of indices that have been previously explored and validated to effectively reflect complex structures in writing (e.g., Goldshtein et al., 2024; Green, 2019; Kyle, 2016; Kyle & Crossley, 2018; Shen et al., 2023; Ziaeeian & Golparvar, 2022). Table 5 lists the clausal indices that are used in the current study. While most of the indices are self-explanatory some might need clarification. For instance, the index ‘open clausal complement’ refers to non-finite clausal complements as in “I *am ready to leave*.” or “Going *running* is fun.”. The index ‘adjective complements per clause’ refers to adjectives that function as complements in copular clauses as in “She looks *beautiful*.” The ‘adverbial clause’ index encompasses finite and non-finite adverbial clauses like conditionals, purpose, cause, result clauses and alike. ‘Clausal complements’ capture that-clauses preceded by

verbs, nouns and adjectives as well as wh-clauses preceded by verbs (Kyle & Crossley, 2018).

Table 5. Clausal Complexity Indices Used in the Study (adapted from Kyle, 2016; Shen et al., 2023; Ziaean & Golparvar, 2022)

No.	Index name	In-text name
1	cl_av_deps	Dependents per clause
2	cl_ndeps_std_dev	Dependents per clause (standard deviation)
3	acomp_per_cl	Adjective complements per clause
4	advcl_per_cl	Adverbial clauses per clause
5	cc_per_cl	Clausal coordinating conjunctions per clause
6	conj_per_clause	Conjunctions per clause
7	ccomp_per_cl	Clausal complements per clause
8	csbj_per_cla	Clausal subjects per clause
9	ncomp_per_cl	Nominal complements per clause
10	xcomp_per_cl	Open clausal complements per clause
11	advmod_per_cl	Adverbial modifiers per clause
12	prep_per_cl	Prepositions per clause

3.3.3 Phrasal complexity measures

The detailed indices available in TAASSC comprise 132 metrics dedicated to noun phrase complexity and nominal modification. Among these, 116 are specifically related to noun phrase complexity and the remaining 16 measure the diversity of noun phrase structures. Additionally, TAASSC includes 190 indices that measure syntactic sophistication; however, these indices fall outside the scope of the present study, as their inclusion would require a more comprehensive research framework.

Phrasal complexity indices in the tool are designed to identify seven nominal types (nominal subject, passive nominal subject, agent, direct object, object of the preposition, indirect object and nominal complement) and ten types of dependents (determiners, adjectives, prepositions, possessives, verbal modifiers, nouns as

nominals, relative clauses and non-clausal adverbial modifiers, conjunctions ‘and’ and ‘or’ as nominal dependents) (Kyle & Crossley, 2018). In alignment with the selection process for the clausal complexity indices mentioned above, the extensive range of noun phrase indices were reduced to 17 through a review of the relevant literature (Kyle, 2016; Kyle & Crossley, 2018; Golshtein et al., 2024; Ziaieian & Golparvar, 2022). Table 6 presents the final selection of the 17 indices and the structures they measure. Five of these indices measure the average number of dependents, four of which deal with specific phrase types and one that offers a general measure encompassing all nominal types. One index provides standard deviation measures of the average number of dependents per phrase.

Table 6. Noun Phrase Complexity Indices Used in the Study (adapted from Golshtein, 2024; Kyle & Crossley, 2018; Shen et al., 2023; Ziaieian & Golparvar, 2022)

No.	Index name	In text name
1	av_nominal_deps_NN	Dependents per nominal
2	av_dobj_deps_NN	Dependents per direct object
3	av_nsubj_deps_NN	Dependents per nominal subject
4	av_pobj_deps_NN	Dependents per object of the preposition
5	av_ncomp_deps_NN	Dependents per nominal complement
6	conj_and_pobj_deps_NN	Conjunction ‘and’ per object of preposition
7	det_all_nominal_deps_NN	Determiners per nominal
8	amod_all_nominal_deps_NN	Adjectival modifiers per nominal
9	amod_dobj_deps_NN	Adjectival modifiers per direct object
10	prep_pobj_deps_NN	Prepositions per object of the preposition
11	prep_all_nominal_deps_NN	Prepositions per nominal
12	poss_all_nominal_deps_NN	Possessives per nominal
13	nn_all_nominal_deps_NN	Nouns as a nominal dependent per nominal
14	vmod_all_nominal_deps_NN	Verbal modifiers per nominal
15	advmod_all_nominal_deps_NN	(Non-clausal) adverbial modifiers per nominal
16	amod_pobj_deps_NN	Adjectival modifiers per object of the preposition
17	rcmod_all_nominal_deps_NN	Relative clause modifiers per nominal

The remaining ten indices measure the frequencies of the specific dependent types mentioned above, except for conjunctions ‘and’ which is not a modifier. The reason why NN (no pronoun) indices were favored was that it helped prevent skewed results as it has been observed in previous studies that the inclusion of pronouns as nominals has the potential to distort measurements (Kyle & Crossley, 2018; Ziaeeian & Golparvar, 2022).

3.3.4 Statistical analysis

The raw data obtained from TAASSC (Kyle, 2016) were transferred to Excel sheets and each article was assigned a code indicating the corpus to which it belonged. Statistical analyses were then conducted using Statistical Package for Social Sciences (SPSS) version 30.0 to first obtain descriptive statistics on the general distribution of complexity patterns across the corpus and within both corpora.

Prior to selecting appropriate statistical tests, the data were evaluated for normality. Due to the relatively small corpus size of 50 subjects per corpus, the Shapiro-Wilk test was used to assess whether the data met the assumptions of normal distribution. For data that followed normal distribution, an independent samples t-test was conducted to compare mean differences between the two corpora and indices that were not normally distributed were analyzed using a non-parametric Mann-Whitney *U* test.

In addition to presenting the primary test results, effect size metrics were also included to enhance the interpretation of findings and better capture differences between the corpora.

3.3.5 Qualitative analysis

The last section of the results section presents examples from the corpora to further illustrate in-context uses of the investigated complexity structures. This section focuses primarily on the indices that exhibited significant differences between the groups but also includes examples of the most frequently occurring structures within the corpus as a whole. For the qualitative analysis, 10 articles were sampled from each corpus, comprising 20 percent of the data. The selected sets of articles were balanced as each set contained one article from the ten journals used in the corpus compilation process.

Qualitative analyses were partially adapted from similar studies (e.g., Wu et al., 2020; Wang & Soler, 2023) that have used traditional complexity measures to analyze research articles and reported specific examples from the texts with the purpose of illustrating actual, in-context use of the structures. Following a similar process, the current study has allocated a separate section for the purpose of exemplifying contextual usage. Example sentences and sentence fragments were extracted through a combination of different methods. To identify sentences which feature the target structures, the data sheets generated by the tool (TAASSC) were transferred onto Excel sheets for easier search options and were used as the primary source for qualitative analysis.

The corpus was also tagged using the Multidimensional Analysis Tagger (Nini, 2019) and these files were analyzed using AntConc 4.3.1. for details that are not captured by the indices in TAASSC. To be more specific, some of the noun phrase indices, despite being quite specific regarding the structure they measure, do not provide additional details that might be of interest. For instance, indices that measure frequencies of pre modifiers do not specify whether these are used in

clusters as is the case with adjective modifiers. Similarly, verbal modifiers in noun phrases encompass present and past participles and infinitive structures, however, the tool does not differentiate among them and provides a total frequency count that includes all three types of structures. To get a better understanding of how these pre and post modifiers are used, a selection of articles were analyzed using the qualitative methods mentioned above.



CHAPTER 4

RESULTS

The results are presented under three sections. The first section reports the findings for Lu's (2011) holistic measures, addressing the first research question. The second section summarizes the results from Kyle's (2016) fine-grained indices, addressing the first two questions. The third and final section presents the qualitative analysis of significant complexity differences between the corpora, addressing the third research question.

4.1 Large-grained complexity results (SCA indices)

The syntactic complexity analysis based on Lu's (2011) measures revealed significant differences between native and non-native writers across nine out of the fourteen indices analyzed. While non-native writers show higher mean values in four measures, only one of these differences is statistically significant. Table 7 summarizes the mean rank comparisons for these indices, revealing differences and similarities in how native and non-native writers construct academic prose. The higher mean ranks for native writers in seven of the indices in areas like sentence (MLS) and T-unit length (MLT), subordination (C/T, CT/T, DC/C, DC/T) and verbal phrase (VP/T) usage suggest more frequent use of subordination. Conversely, non-native writers exhibited higher mean ranks in four indices (MLC, CP/C, CP/T, CN/C), indicating slightly more reliance on coordination and phrasal elaboration (refer to Appendix B for means and standard deviations data for all 14 indices).

Table 7. Mann-Whitney U Test Results for Non-Normally Distributed Large-grained Indices

Measure	Group	Mean Rank	Sum of Ranks	U	Z	<i>p</i>
Length of production unit						
MLS (Mean length of sentence)	NNW	44.20	2210.00	935	-2.172	0.03*
	NW	56.80	2840.00			
MLT (Mean length of T-unit)	NNW	44.68	2234.00	959	-2.006	0.05*
	NW	56.32	2816.00			
MLC (Mean length of clause)	NNW	54.26	2713.00	1062	-1.296	0.20
	NW	46.74	2337.00			
Amount of subordination						
CT (Clauses per T-unit)	NNW	39.27	1963.50	688.5	-3.871	< .001***
	NW	61.73	3086.50			
DCT (Dependent Clauses per T-unit)	NNW	39.90	1995.00	720	-3.654	< .001***
	NW	61.10	3055.00			
CS (Clauses per Sentence)	NNW	39.08	1954.00	679	-3.936	< .001***
	NW	61.92	3096.00			
Amount of coordination						
CPC (Coordinate phrases per clause)	NNW	57.99	2899.50	875.5	-2.582	0.01**
	NW	43.01	2150.50			
CPT (Coordinate phrases per T-unit)	NNW	54.20	2710.00	1065	-1.275	0.20
	NW	46.80	2340.00			
Phrasal complexity						
CNT (Complex nominals per T-unit)	NNW	47.71	2385.50	1110.5	-0.962	.336
	NW	53.29	2664.50			
CNC (Complex nominals per clause)	NNW	55.74	2787.00	988.00	-1.81	0.07
	NW	45.26	2263.00			
VPT (Verb phrases per T-unit)	NNW	41.56	2078.00	803	-3.082	< 0.01**
	NW	59.44	2972.00			

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Note. NNW = 50; NW = 50

The combination of these results indicates a pattern where native writers make use of more inter-clausal subordination, while non-native writers tend to write complex clauses using more intra-clausal elements. The results indicate that seven of the indices differ significantly between the two groups of writers. The index for overall sentence complexity (C/S) with a significance value of $p < 0.001$ and a medium effect size ($r = 0.39$) suggests that the articles written by native writers used more

elaborate sentence structures. Two indices related to the amount of subordination, clauses per t-unit (C/T; $p < 0.001$) and dependent clauses per T-unit (DC/T; $p < 0.001$) further point to significant differences in subordination with native writers' more frequent use of dependent and independent clauses within individual T-units. The syntactically complex T-units in the native corpus are also complexified by frequent uses of verb phrases as is made evident by the significantly higher mean rank in the verb phrases per T-unit metric (VP/T = $p < 0.002$; $r = 0.31$).

The analysis also demonstrates that the differences between the mean length of sentences, (NW Mean rank = 56.80; NNW Mean rank = 44.20) and mean length of T-unit (MLT), there was a significant difference ($p = .045$), with native writers (MR = 56.32) also demonstrating longer T-units than their non-native counterparts (MR = 44.68M). However, these two metrics have relatively smaller size effects, calculated as $MLSr = .021$ and $MLTr = .020$, respectively.

On the other hand, the index measuring the amount of coordinate phrases per clause (CP/C) showed significant difference ($p = .010$) indicating that non-native writers (MR= 57.99) tend to use significantly more coordinate phrases per clause compared to native writers (MR = 43.01). This metric exhibits a small size effect ($s=0.25$) meaning that although being significant it is not impactful enough. In contrast, some indices showed no significant differences between the groups, despite the seemingly obvious mean rank differences. For example, the measure for mean length of clause (MLC), despite having differing mean ranks according to the descriptive data, did not significantly differentiate the groups ($p = .195$). Additionally, the mean ranks for complex phrases per clause showed slight differences, however, statistically they bear no significance ($p = .336$) implying a similar use of complex nominals per clause.

As a general observation, it can be argued that native writers have made more consistent use of subordination as indicated by the high means of production unit lengths and dependent clauses per T-unit and sentence, whereas we observe more coordination as opposed to subordination in the articles written by non-native writers. The use of complex nominals is almost at identical rates with slight variations as to the type of structure they are embedded into, which is parallel to the overall impression that non-native writers rely on intra-clausal elaboration.

For the remaining indices that showed normal distribution, an independent samples t-test provided significant results for two out of the three indices. As can be observed in Table 8, native writing demonstrates higher use of dependent clauses per clause (DC/C; $p < 0.001$), suggesting more elaborate embedded structures at clause level resulting in a high number of layered sentences per article.

Table 8. Independent Samples t-test Results for Normally Distributed Large-grained Indices

Measure	Group	Mean	SD	<i>t</i> (df)	<i>p</i>
Dependent clauses per clause (DC/C)	NNW	.39	.062	-3.45 (98)	< .001***
	NW	.43	.062		
T-unit per sentence (T/S)	NNW	1.07	0.42	-1.79 (98)	0.08
	NW	1.09	0.54		
Complex T-unit ratio (CT/T)	NNW	.46	.086	-3.28 (98)	.001***
	NW	.52	.089		

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Note. NNW = 50, NW = 50

The metric for complex T-unit ratio (CT/T) exhibits a similar pattern, with higher instances of use in the native corpus (CT/T; $p < 0.001$) suggesting more clause embedding within T-units. On the other hand, there is no significant difference regarding the number of T-units per sentence (T/S; $p = 0.076$) with a slightly higher mean in the native corpus. This shows that non-native writers produce a similar number of T- units which carry the main idea but opt for simpler T-units that are connected through coordination rather than subordination. As for complex nominals per clause (CN/C; $p = 0.062$), similar to the metric for complex nominals per T-unit reported above, there is no significant difference although non-native writers have a slightly higher mean.

The statistical tests have provided further support for the variations observed in the mean rank data and made it possible to make the generalization that native writers tend to utilize longer units of production as opposed to non-native writers who rely more heavily on intra-clausal elaboration.

4.2 Fine-grained complexity results

This section presents results regarding the fine-grained indices that measure clausal and phrasal complexity in a more refined manner.

4.2.1 Clause complexity indices

The analysis of clausal indices has resulted in two significantly varying features from among a total of 12 that have been selected from the list of TAASSC.

According to the results of normality tests, six of the indices were normally distributed, while the remaining six were not. The findings of the independent samples t-test presented in Table 9 reveal both significant and non-significant differences across six indices. According to the results, the index for average

dependents per clause (cl_av_deps) differs significantly between the two groups ($p = .015$) with non-native writers ($M = 2.57$, $SD = 0.11$) demonstrating slightly higher average scores compared to native writers ($M = 2.51$, $SD = 0.15$). This indicates that non-native writers tend to rely more on average clausal dependencies, suggesting a potentially simpler or more direct syntactic style (in the discussion section compare this finding to the use of phrasal structures. Additionally, effect size analysis (Cohen's $d = 0.495$) suggests a moderate effect, indicating that this difference is not only statistically significant but also meaningful in practical terms. This result is parallel to the findings regarding holistic indices where non-native writers used more sub-clausal elements.

Table 9. Independent Samples t-test Results for Normally Distributed Clause Complexity Indices

Index	Group	Mean	SD	t (df)	p
Dependents per clause (avg)	NNW	2.57	0.11	2.47 (98)	0.02*
	NW	2.51	0.15		
Dependents per clause (SD)	NNW	1.36	0.07	1.69 (98)	0.09
	NW	1.34	0.09		
Adjective complements per clause	NNW	0.06	0.02	- 3.49 (98)	.001***
	NW	0.08	0.02		
Adverbial clauses per clause	NNW	0.18	0.04	0.11 (98)	0.92
	NW	0.19	0.03		
Conjunctions per clause	NNW	0.09	0.03	1.51 (98)	0.14
	NW	0.08	0.03		
Open clausal complements per clause	NNW	0.08	0.02	-0.74 (98)	0.46
	NW	0.09	0.02		

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Note. NNW = Non-native writer; NW = Native writer

Another metric that varied significantly between the two groups is the one index that measures the frequency of adjective complements per clause (acompl_per_cl). Test

results indicate a highly significant difference ($p < .001$) in the usage of this structure with native writers. ($M = 0.080$, $SD = .0.022$) demonstrating greater use of adjective complements per clause than non-native writers ($M = 0.064$, $SD = 0.022$). The effect size ($d = -0.698$) highlights a strong and practically significant difference pointing to a potentially more descriptive and layered style in native writers' articles. This index measures the frequency of adjectives that function as subject predicates and follow copular verbs. This distinction is important because the index does not account for words, phrases, or clauses that complete the meaning of an adjective (i.e., adjective complements); rather, it specifically refers to the adjectives themselves. Examples of usage can be found in the section presenting qualitative data (see Section 4.3).

Table 10. Mann-Whitney U Test Results for Non-normally Distributed Clausal Complexity Indices

Index	Group	Mean Rank	Sum of Ranks	U	Z	p
Clausal coordinating conjunctions	NNW	46.60	2330.00	1055.00	-1.36	0.17
	NW	54.40	2720.00			
Clausal subjects	NNW	47.60	2380.00	1105.00	-1.00	0.32
	NW	53.40	2670.00			
Prepositions	NNW	55.10	2755.00	1020.00	-1.59	0.11
	NW	45.90	2295.00			
Clausal complements	NNW	51.98	2599.00	1176.00	-0.51	0.61
	NW	49.02	2451.00			
Nominal complements	NNW	51.40	2570.00	1205.00	-0.31	0.76
	NW	49.60	2480.00			
Adverbial modifiers	NNW	45.48	2274.00	999.00	-1.73	0.08
	NW	55.52	2776.00			

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Note. NNW = 50, NW = 50

The relatively similar means for the only standard deviation index, which measures variety, suggest that variation within each group is consistent and that writers tend to use similar clause structures. The indices for adverbial clauses per clause, clausal complements per clause, and nominal complements per clause did not reveal statistically significant differences between the groups ($p > .05$). These results suggest that both groups employ these structures with comparable frequency and complexity. The remaining six indices, illustrated in Table 10, did not meet normality assumptions and were analyzed using a Mann-Whitney U test. The analysis did not reveal statistically significant differences between the groups for any of the six indices. Both groups of writers exhibit similar patterns in their use of coordinating conjunctions, clausal subjects, prepositions in clauses, complement clauses and nominal complements. Fine-grained indices targeting clausal complexity suggest a relatively similar performance in both native and non-native writers. Apart from two indices, the remaining ten showed no significant difference in the way writers produce elaborate and sophisticated clauses.

The results highlight two key differences in the syntactic choices of native and non-native writers. Non-native writers appear to rely slightly more on clausal dependencies, which may reflect a tendency toward intra-clausal complexity as was also observed in the results of the SCA indices. The overall length of production units was shorter and there was less subordination, yet more intra-clausal coordination, achieved through coordinate phrases.

4.2.2 Noun phrase complexity indices

A total of 17 noun phrase indices were used for analysis, eight of which resulted in significantly different scores between the two groups of writers. To determine the

appropriate statistical tests the same procedure as mentioned in section 3.3.4 was applied. As a result, twelve indices were analyzed using a parametric t-test, and the remaining five were evaluated with the non-parametric Mann-Whitney U test. The independent samples t-test, as presented in Table 11, revealed significant differences in the usage patterns of three of the 12 indices, which are adjective modifiers per all types of nominals, adjective modifiers per direct object and relative clauses as noun modifiers.

None of the first five indices in Table 11 that measure the average number of dependents per five type of noun phrases (dependents per nominal, direct object, nominal subject, object of the preposition and nominal complement) resulted in significant differences between the two groups of writers suggesting that the densities of complex nominal phrases are comparable. Kyle & Crossley (2018) have defined them as the basic TAASSC phrasal indices that provide the average number of phrasal dependents per phrase type. As suggested by the means, both groups show a tendency to modify the same type of nominals to form complex nominal phrases. The rest of the indices measure the occurrences of particular modifier types per noun phrase.

According to the results in Table 11, there is a significant difference ($p = .009$, $d = 0.532$) in the use of adjective modifiers with non-native writers exhibiting a higher mean ($M = 0.315$, $SD = 0.059$) compared to native writers ($M = 0.284$, $SD = 0.058$). Similarly, a significant difference ($p = 0.003$) was found in the frequencies of adjective modifiers of direct objects again with non-native writers scoring a higher mean ($M = 0.40$) in comparison to native writers ($M = .35$). On the other hand, native writers showed a significantly ($p = .006$) higher use of relative clause modifiers ($M = 0.037$, $SD = 0.009$) compared to non-native writers ($M = 0.031$, $SD = .009$). For the

remaining indices that measure the use of determiners, prepositions and noun modifiers, the differences between the groups were not statistically significant ($p > .05$), indicating similar usage patterns in these syntactic features across both groups.

Table 11. Independent Samples t-test Results for Normally Distributed Noun Phrase Complexity Indices

Index	Group	Mean	SD	<i>t</i> (df)	<i>p</i>
Dependents per nominal	NNW	1.48	0.11	1.76 (98)	0.08
	NW	1.44	0.12		
Dependents per direct object	NNW	1.71	0.19	1.33 (98)	0.19
	NW	1.66	0.18		
Dependents per nominal subject	NNW	1.13	0.17	0.25 (98)	0.80
	NW	1.12	0.18		
Dependents per object of the preposition	NNW	1.47	0.11	1.38 (98)	0.17
	NW	1.44	0.12		
Dependents per nominal complement	NNW	2.82	0.44	-1.19(98)	0.24
	NW	2.92	0.39		
Determiners per nominal	NNW	0.33	0.05	-0.61 (98)	0.54
	NW	0.33	0.05		
Adjective modifier per nominal	NNW	0.32	0.06	2.66(98)	.009**
	NW	0.28	0.06		
Adjective modifier per direct object	NNW	0.40	0.09	3.05 (98)	.003**
	NW	0.35	0.08		
Preposition per object of the preposition	NNW	0.25	0.03	0.64 (98)	0.53
	NW	0.24	0.03		
Prepositions per nominal	NNW	0.27	0.03	1.26 (98)	0.21
	NW	0.26	0.04		
Nouns as a nominal dependent per nominal	NNW	0.18	0.05	-0.11(98)	0.91
	NW	0.18	0.05		
Relative clause modifiers per nominal	NNW	0.03	0.01	-2.79(98)	.006**
	NW	0.03	0.01		

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Note. NNW = 50; NW = 50

Overall, the results of the t-test point to distinct stylistic differences between the groups, with non-native writers using more adjectival modifiers for descriptive purposes, while native writers tend to use a higher number of relative clauses for embedding complexity. Further qualitative analyses of significantly differing structures are carried out and presented in a separate sub section (see section 4.3).

The remaining five indices that failed to meet the assumptions of normal distribution were tested for significance through a non-parametric Mann-Whitney test. Table 12 presents the mean ranks for each group and the results of the non-parametric test.

Table 12. Mann-Whitney U Test Results for Non-normally Distributed Fine-grained Indices

Index	Group	Mean Rank	Sum of Ranks	U	Z	p
Possessives per nominal	NNW	57.96	2898.00	877.00	-2.57	.010*
	NW	43.04	2152.00			
Adverbial modifiers per nominal	NNW	39.84	1992.00	717.00	-3.67	< .001***
	NW	61.16	3058.0			
Adjective modifier per object of the preposition	NNW	58.06	2903.00	872.00	-2.606	.009**
	NW	42.94	2147.00			
Conjunction 'and' per object of the prep.	NNW	57.56	2878.00	897.00	-2.43	.015*
	NW	43.44	2172.00			
Verbal modifiers per nominal	NNW	44.68	2234.00	959.00	-2.01	.045*
	NW	56.32	2816.00			

* $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$

Note. NNW = 50; NW = 50

All five indices in Table 12 demonstrate statistically significant differences between the groups. Among these, the index for verbal modifiers is close to the threshold level yet still indicates a meaningful variation between the groups ($p = 0.045$). The results also point to a significant difference ($p = .010$) in the use of possessive dependencies (e.g., “*their writing assessment, the students' knowledge, its three potential benefits*”) within noun phrases. The mean ranks suggest that non-native writers (mean rank = 57.96) have used possessives more frequently than native writers (mean rank = 43.04). Significant differences are also found in the frequency of the conjunction ‘and’ used as a dependent per object of the preposition (e.g., “

such criteria between the teacher and students” , “important implications for adult L2 and L3 acquisition”), with higher mean scores for the non-native writers (Conj. ‘and’ MR = 57.56) and much lower mean scores for the native writers (Conj. ‘and’ MR = 43.44). This indicates that non-native writers make frequent use of the conjunction ‘and’ to make additions to the objects of the preposition in complex noun phrases as illustrated in the examples. Similarly, non-native writers have scored significantly higher in the use of adjective modifiers used to modify the object of prepositions as in *“teachers’ professional development in different social and cultural contexts “ , the combination of quantitative and qualitative research methods”*.

Additionally, the test has revealed that adverbial modifiers were significantly more common in the native writers’ corpus ($p < .001$), with a higher mean rank of 61.16 compared to a mean rank of 39.84 for the non-native writers’ corpus. Lastly, test results also revealed a marginally significant difference in the use of verbal modifiers ($p = .045$), indicating that native writers (MR = 56.32) use these types of modifiers more frequently compared to their native (MR = 44.68) counterparts. Verbal modifiers are among the least used in both corpora so the relatively weak significance level might not be very meaningful in practical terms.

Despite the fact that these findings reveal distinct patterns in the way native and non-native writers utilize complex structures, conducting qualitative analyses by closely examining the usage of these specific structures provides a deeper and more comprehensive understanding of the findings. The following section presents qualitative data in the form of example sentences and sentence fragments that exemplify the significantly varying structures.

4.3 Qualitative Analysis of significantly varying structures

This section is organized into subsections addressing large-grained and fine-grained indices. The latter provides in-text examples that illustrate both clause and noun phrase complexity indices.

4.3.1 Large-grained measures

This section presents qualitative data to complement the quantitative findings of this study and present snippets of the actual use of the structures that differ significantly between native and non-native writers. As reported in the previous section, holistic metrics that measure complexity mainly based on production units have suggested that the articles written by native writers contain longer sentences and T-units. However, although not significantly different, the clause as a production unit had an overall higher mean length in the non-native corpus. The results for subordination and coordination are in alignment with what was observed in the length of production units as they indicate that the long T-units and sentences in the native writers' corpus are the result of the higher number of dependent clauses. On the other hand, non-native writers have used more intra-clausal embedding, with more frequent use of coordinate phrases within clauses. In this study, the higher frequency of coordinate phrases within clauses is a parallel pattern to that observed in ELF articles, where coordinate nouns, noun phrases and adjectives were quite common in the non-native corpus (Wu et al., 2020)

The examples below show how dependent clauses and coordinate phrases are used to create complex clauses. Dependent clauses are underlined, and coordinate phrases, both noun and verb, are italicized.

1. “Closer analysis of the comments made during the interviews revealed that, whilst parents made more positive comments than the students, they were considerably more critical of certain aspects of language learning, notably the perceived difficulty of the subject and language options available to their children in school.” (NW11)
2. “These findings also suggest that phonetically-reduced negative tags are not simply indicators associated with particular groups, but they are in fact sociolinguistic markers, as they are stigmatized and have been shown here to vary on both social and stylistic dimensions.” (NW26)
3. “The study corroborates Aijmer's assertion that corpora are highly useful tools and sources to make observations about the *functional spectrum, positions, collocations, and prosody of pragmatic markers.*” (NNW26)
4. “The ACs helped the participants *improve their knowledge of punctuation rules, develop positive attitudes towards online learning, and stay engaged with the exercises.*” (NNW36)
5. “Following the same line of argument, the significant and positive relationships between *the four aspects of engagement* and *perceived instrumentality* can also be inferred because students *highly value their schoolwork* and *are more task-oriented* when they perceive their learning-related efforts as instrumental to attain their future goals.” (NNW31)

As for overall sentence length and mean length of T-unit, native writers have used significantly longer sentences as illustrated by the examples below. The first example contains longer T-units and the second sentence, despite having one complex T-unit, is more concise.

6. “Consequently, these findings advocate that FSL educators in positions of power should consider listening to school-based stakeholders explain what they understand about the AIM-related policy in place, and then work together with teachers to describe the implementation of AIM taking place in as many different classrooms in their context as possible, eventually arriving at a representation that reflects the dynamic use of the method across multiple local contexts.” (NW31)

7. “Following the same line of argument, the significant and positive relationships between the four aspects of engagement and perceived instrumentality can also be inferred because students highly value their schoolwork and are more task-oriented when they perceive their learning-related efforts as instrumental to attain their future goals.” (NNW31)

Another holistic metric that has provided higher frequency scores in the corpus of articles authored by native writers is the index measuring verb phrases. This is another finding that resonates with the results in Wu et al.'s (2020) study where native writers were reported to have used significantly more verb phrases.

8. “The convergence of opinion across all participants that the use of AIM has the potential to help CF teachers make French the language of the classroom and develop students' oral French fluency also responds to the need to reverse the documented trend of English use in CF classrooms, as well as calls for implementing classroom-based ideas to improve CF programming.” (NW31)

Below is another example, where the sentence is relatively short but packed with eight verb phrases.

9. “The impact of high-stakes exams was evidenced in the data presented above as teachers grappled with the weight of the Regents Exam which restructured class time and facilitated a move to 'teaching to the test,' often displacing other teaching strategies and learning goals.” (NW46)

While verbs phrases were more common in native writers' articles, in that same study by Wu et al. (2020), non-native (ELF) writers made use of considerably more complex nominals. In the current study, complex nominal frequencies portray a relatively balanced result, however, it is worth mentioning that although not significantly different, non-native writers have used more complex nominals within clauses while native writers have a higher score of complex nominals per T-unit.

4.3.2 Fine-grained clausal and phrasal indices

Fine-grained indices that reveal meaningful differences are also further explored with examples illustrating their in-context use. Statistical analyses have revealed significant variation between the two groups of writers in two specific indices measuring clause complexity: the average number of dependents per clause and the frequency of adjective complements per clause (see Table 9). The index that measures the total number of dependents in a clause suggests that non-native writers exhibit a higher mean in comparison to native writers. Despite being insignificant, a similar trend is also observable in the mean differences for the most frequently occurring dependent types per clause in the whole corpus, which include metrics related to the numbers of nominal subjects, direct objects, prepositions, and clausal complements (please refer to Appendix B for descriptive statistics). The examples below illustrate how non-native writers use heavily packed clauses with multiple dependents per clause.

10. “Last but not least, the hypotheses of the present study could be tested in a further study in which the relationship between L1 and L2 WM capacities is investigated in connection with both L1 and L2 reading comprehension, (in)validating in due course the claim that WM for reading is independent of language.” (NNW46)
11. “The full mediating role of perceived instrumentality in the relationship between incremental beliefs about second language aptitude and graded performance can be explicated based on the distinctive nature of the EFL students as attendees of an IEP.” (NNW31)

On the other hand, native writers have used significantly more adjective complements in their clauses. Kyle and Crossley (2018) have defined the index as an adjective that functions as a complement in a copular clause. These structures are generally formed by a combination of a copular verb + Adj. (all underlined in the

examples) and describe the subject of the clause. Below are a couple of examples from the research articles in the native writers group:

12. “As Kane et al. (1999) suggest, the evaluation inference is fundamental in the validation ofthen there is little confidence that the additional inferences in the interpretive argument are plausible.” (NW01)
13. “While E-learning is fast expanding, understanding the mediation that happens between a CALL tool, a learner and a task, becomes even more critical.” NW36

A quick scan across the articles has revealed that the use of this structure is centered around the verb ‘be’ as the majority of the adjective complements in the articles are used with either ‘is’ or ‘are’.

The last part of this section provides examples that illustrate how the two groups of writers use different kinds of dependents (dependencies) to construct complex noun phrases. As demonstrated by the statistical analyses (see Table 11), both native and non-native writers construct complex noun phrases with a similar number of dependents (modifiers). This indicates that the overall syntactic density of the noun phrases is comparable; however, there are differences regarding the specific type of dependents preferred. In general, non-native writers demonstrated a higher reliance on adjectival modifiers, particularly when modifying direct objects and the objects of prepositions. They also made more frequent use of possessives and the conjunction ‘and’ as a dependent of the object of the preposition in nominal phrases.

For instance, combinations such as ‘adjective + direct object’ (e.g. “guiding pre-service teachers to become familiar with available technologies (NNW6)), “The overarching discussion in this paper reveals three interrelated and unique insights about the EMI phenomenon in the local sociolinguistic context ... (NNW21) are significantly more frequent in the non-native corpus. The structure, ‘determiner + adjective + adjective + direct object’ is used nearly twice as often in the non-native

corpus. This pattern, as illustrated in the following sentences, demonstrates how non-native writers use layered adjectival modifiers for elaboration, reflecting their preference for clear and detailed descriptions when building noun phrases. A similar pattern was observed in Wu. et al. 's study (2020) where non-native (ELF) writers, especially in the field of social science and humanities, exhibited frequent use of coordinate adjectives as noun modifiers. Wu et al. (2020) have attributed this pattern to a strategy that aims to promote comprehensibility.

14. “Additionally, students follow a unique informational trace and select a unique sequence of links to information when they try to solve a problem.” (NNW11),
15. “To welcome the upcoming integrative stage, teachers ' roles are becoming crucial in guiding the dynamics of technology-enhanced classrooms.” (NNW6)

Another frequent use of adjectives is to modify the object of a preposition in a noun phrase as in the following examples:

16. “As part of a larger case study, this single exploratory case study aims to explore the potential of genre-based pedagogy to allow L2 writing instructors to enact their writing assessment literacy and feedback literacy.” (NNW1)
17. “... and as stated by Johns, this view helps L2 writers understand the relationship between the linguistic features and communicative purpose of text.” (NNW1)
18. “Pragmatic markers are multifunctional and identification of their salient functions necessitates meticulous work through different contexts based on attested language use in corpora.” (NNW26)

Two other frequently used dependents in nominal phrases which appeared to be more common in the non-native corpus were possessives and the conjunction ‘and’. These are very widely used elements in both corpora, but statistically they are significantly more frequent in the articles written by non-native writers. The conjunction ‘and’ was commonly used as a dependent in noun phrases, particularly with objects of

prepositions. They are widely used to combine nouns (e.g., *literacy teaching and learning*) and pre-modifiers (e.g., *less controllable and non-traditional*) within nominal phrases. The sentences below are examples of the use of possessives and the conjunction “and” from the corpus of non-native writers.

19. Possessive + direct object + preposition:

“... more specifically with the information in the text, and readers’ integration of this information into their own knowledge.” (NNW11)

20. Possessive + adjective + direct object: “...in order to reconstruct the writer’s intended meaning, the reader must incorporate into many cognitive processes such as ...” (NNW11)

21. “With its pedagogical tools and emphasis on classroom assessment, GBP can be considered to align with increased focus on effective classroom-based assessment of writing to further ...” (NNW1)

22. “With all these in mind, faculties face with demanding requests for qualified courses and/or programs with recent advancements, skills, and knowledge to ...” (NNW6)

In contrast, native writers’ articles displayed more frequent instances of embedded structures like relative clauses, verbal modifiers (non-finite verb/verb phrase) and adverbs as adverbial pre-modifiers to add precision and contextual depth to noun phrases when compared to non-native writers’ articles. The sentences and sentence fragments below provide examples of verbal modifiers and relative clauses, occasionally appearing together within a single sentence.

23. “... it is important for them to know whether the rating scales **they use** are adequate and appropriate to consistently capture.” (NW1)

24. “Their broader understanding of technology as a way to connect with the target language and culture came at least in part from the trip **taken to** Quebec the previous year, which established connections between the students that were subsequently nurtured via digital means.” (NW6)

25. “However, with the module **validated** for imminent delivery....” (NNW16)

26. "...the gaps between learners ' current skill and knowledge levels and those required to operate effectively within the discipline." (NW16)
27. "A text box designed to capture qualitative feedback was provided for respondents to indicate specific language attitudes towards cities." (NW21)

A more detailed analysis of relative clause patterns reveals that both native and non-native writers predominantly use reduced forms of the relative clauses which are also partially captured by the index 'verbal modifier'. Statistical analysis also showed that verbal modifiers have a higher mean compared to the relative clauses. However, the tool (TAASSC) does not differentiate between the types of reduced relative clauses that are more common. An analysis of MAT-tagged corpus files using AntConc revealed the following ranking where present participles are used more frequently than past participles.

28. Reduced relative clause with present participial verb/verbal modifiers + -ing

V:

- a number of students choosing a language for ... (NW11)
- research investigating the relationship between WM capacity and ... (NNW46)
- yes-no questions consisting of a negatively-marked verb with n't (NW26)

29. Reduced relative clause with a past participial verb/verbal modifier + -ed:

- trends observed in the surveys (NW6)
- objectives targeted in the instructional context (NW1)
- the proposition expressed by the utterance (NNW26)

These two types of reduced relative clauses/non-finite verbal modifiers are the most commonly used across both corpora. These are followed by "wh" relative clauses that modify the subject or the object in the nominal phrase. The verbal modifier index in TAASSC counts infinitive verbs as well, however the index offers a

cumulative calculation and the MAT tagger does not offer a tag that specifically allows a search for the specific structure, so these examples are limited to participial verbs only.

The last index that showed significant variation is related to adverbials as modifiers. These are relatively scarce structures in the corpus. The sentence snippets below illustrate the use of adverbial modifiers, and they are the only type of pre-modifier that resulted in higher frequency in the native writers group compared to non-native writers.

30. “Highly mediatized civil unrest, occasionally escalating into full-scale riots, is the result of this tense climate, aggravated by harsh policing practices.” (NW21)
31. “Firstly, phonetically reduced tag variants could be considered non-standard in that they...” (NW26)
32. “...a fairly clear increase compared to previous testing...” (NW36)

Both holistic and fine-grained indices indicate that native and non-native writers use complex and elaborate language in their articles, with few notable differences in certain aspects. While this section highlights examples from the corpus where specific structures occur more frequently, it is essential to note that these structures are also widely used across the whole corpus with similar ranks within corpora, only at different frequency rates for several of the modifiers. A more comprehensive frequency analysis of all the indices in TAASSC (Kyle, 2016), which falls outside the scope of this study, reveals that the majority of clausal and noun phrase structures are similarly distributed across both corpora. Nonetheless, it is interesting to see how certain linguistic elements display significant variation, indicating a preference for specific structures.

CHAPTER 5

DISCUSSION & CONCLUSION

5.1 Discussion

The current study explored the syntactic complexity of research articles written by native English speakers and Turkish EFL writers, focusing on both large-grained measures of sentence-level complexity and fine-grained indices of clausal and phrasal sophistication. By employing computational tools and qualitative analyses, the research aimed to identify similarities and differences in the use of syntactic structures between the two groups of writers.

The first research question addressed syntactic complexity features in research articles written by native and non-native writers based on traditional large-grained measures. To answer the question both corpora were analyzed using the Syntactic Complexity Analyzer (SCA; Lu, 2010) which provides mean and frequency calculation for 14 measures with regards to length of production unit (MLS, MLT, MLC), amount of subordination (C/T, CT/T, DC/C, DC/T), amount of coordination (CP/C, CP/T, T/S), degree of phrasal sophistication (CN/C, CN/T, VP/T) and overall sentence complexity (C/S) (see Table 3 for more details). The second question of the study sought answers as to how native and non-native writers used clausal and phrasal elements to create more sophisticated and complex academic prose. In order to get a more detailed representation of complexity features, the corpora were analyzed based on fine-grained indices of phrasal and clausal complexity. These indices are part of a computational system, the Tool for the Automatic Analysis of Syntactic Sophistication and Complexity (TAASSC; Kyle, 2016) and were selected based on previous studies that have verified their

effectiveness in complexity measurements. The third question, which is in a way complementary to the first two questions, entailed a qualitative analysis of the structures that showed significant differences between the groups.

The overall results obtained for the first research question highlight both similarities and differences in the way native and non-native writers construct syntactically complex academic texts. The measurements of the Syntactic Complexity Analyzer (SCA) indices align with findings from other studies on academic writing, particularly research articles (e.g., Casal et al., 2021; Wang & Soler, 2023; Wu et al., 2020). This alignment demonstrates that the corpus of the study as a whole is representative of its genre and disciplinary field, lending credibility to the relevance of the analyses. The corpus also exhibits high frequencies of complex nominals and verb phrases (as shown by group and total mean data,) but fewer embedded clauses. This distribution in the corpus used in this study reflects the well-established observation that research articles rely more on phrasal embedding than clausal subordination (Biber et al., 2011). A comparison of the analysis results with reported findings obtained from academic texts written by university students (e.g., Dong et al., 2023; Lu, 2011) also reinforces the idea that as writers gain experience, academic writing becomes increasingly reliant on nominal phrases for elaboration and information density (Biber et al., 2011).

While both groups of writers demonstrate a strong command of complex syntactic structures, statistical analyses have revealed several significant differences in their preferences for elaborating ideas. One key finding is the higher frequency of subordination in the native writers' corpus, demonstrated by their more frequent use of dependent clauses and higher mean lengths of sentences and T-units. This suggests that native writers tend to prefer layered sentence structures and connect

ideas through subordination. Such patterns are consistent with other studies comparing native and non-native academic writing, which have found that native writers produce longer syntactic units with more extensive subordination (Ai & Lu, 2015; Nasser, 2021). Nasser's (2021) study, which examined syntactic structures across different sections of MA theses and L1 backgrounds, found that native speakers' theses included significantly more dependent clauses and complex T-units than those written by EFL writers. On the other hand, Wu et al. (2020) reported that the ELF corpus in their study featured longer production units compared to a corpus consisting of articles written by native speakers. Wu et al. (2020) have acknowledged that this might stem from the fact that the articles in the SciELF corpus are unpublished articles, whereas the articles in COCA have been subject to tight criteria. On the other hand, there are also notable similarities between the ELF corpus in Wu et al.'s study and the non-native corpus in the current study. Both groups of non-native writers have used more coordinate phrases in each clause and T-unit, but fewer verb phrases. As the tool (SCA) counts reduced clauses as verb phrases, the verb phrase index is also indicative of clause embedding. In other words, the combination of more coordinate phrases and a lower number of verb phrases suggest that non-native writers tend to rely more on phrasal embedding rather than clausal embedding. Wu et al. (2020) have attributed this to ELF writers' strategy to enhance clarity and transparency.

Conversely, clausal indices have portrayed a rather similar distribution of dependent types per clause with the only significant differences being in the average number of dependents and the use of adjective complements in clauses. Non-native writers, on average, exhibit a higher number of dependents within their clauses. This matches with the higher mean length of their clauses and the significantly more

frequent use of coordinate phrases (CP/C) within them. All the metrics mentioned so far are indicators that non-native writers have employed more phrasal complexity rather than sentence level complex structures. The finding is also interesting as the MLC mean in the non-native group (MLC= 15.39) also exceeds the mean found in applied linguistics articles in Casal et al.'s study (2021).

Although in general, native writers exhibited higher means in sentence and T-unit length and more frequent use of dependent clauses, it is not possible to make a conclusive assumption about superiority in terms of complexity. In other words, these are not necessarily indicators of higher complexity levels since Kyle and Crossley (2018) observed that MLC (mean length of clause) and CP/C (coordinate phrases per clause) perform better in measuring overall syntactic complexity. Similarly, in Lu's (2011) study, university students with higher proficiency levels produced longer clauses and more coordinated phrases which corroborate Kyle and Crossley's observation.

On the other hand, native writers exhibited more frequent use of adjective dependents per clause, which are adjectives following copular verbs such as be, seem, and appear, as in "*the pedagogical tools that are inherent to GBP*", "*it is important to further..*". Although the tool used in this study does not provide detailed information about how these adjectives are complemented, grammatically they can be followed by a variety of clauses and phrases but are rarely left uncomplemented. This assumption also aligns with the higher mean scores for dependent clauses in the native writers' group. In summary, the statistical test results for clause complexity indices did not reveal much difference in the type of dependents native and non-native writers use in their clauses. However, they reinforce the results of the large-grained indices which showed that native writers demonstrate greater complexity at

sentence-level (e.g. longer sentence, T-units, embedded clause) and more frequent use of dependent clauses, whereas non-native writers score higher in measures such as clause length and the use of coordinate phrases, suggesting more elaboration within the clause.

Noun phrase indices revealed slightly more nuances between the two groups of writers. As mentioned earlier, they measure both the number of dependents and the dependent types used to modify the nominal in the phrase. The means suggest that, on average, non-native writers have used slightly more dependents per nominals, nominals subjects, direct object, and preposition objects, with the exception of nominal complements (See Appendix B for mean scores). These are not significantly discriminating features, as indicated by the statistical tests, however the differences in the means are explanatory with regard to other significant differences found in overall lengths of production units.

While the general distribution of phrasal elements is comparable, there are also phrasal elements that showed significant variation between the groups of writers. Attributive adjectives are the most common modifier type in both corpora, however non-native writers have used them significantly more frequently when compared to their native counterparts. Similar results were observed in other studies which reported frequent use of attributive adjectives in academic writing regardless of expertise levels and L1 background (Ansarifar et al., 2018; Staples & Reppen, 2016; Taguchi et al., 2013). Studies, specifically exploring academic writing in Turkish populations have revealed comparable results (e.g., Atak, 2019) suggesting that the higher number of adjectives in this study might be attributed to a general tendency among Turkish EFL writers. The tendency to use adjectives and nouns can also be influenced by Turkish as nouns phrases are formed by adding pre-modifiers.

While attributive adjectives are considered to belong to early stages of noun phrase complexity (Biber et al., 2011) they are also considered to be highly characteristic of academic prose, especially when used in multiple word combinations with other adjectives and noun premodifiers (Biber & Gray, 2011; Biber et al., 2011, 2014; Parkinson & Musgrave, 2014). The qualitative analysis done to answer the third question has revealed that most instances of pre modification consist of a combination of multiple elements with a much higher frequency of ‘adjective+adjective’ combinations in the non-native writers’ corpus. However, there is one limitation of automated tools that needs to be mentioned. They do not differentiate between descriptive and participial (-ed/-ing) adjectives which is considered to be an important distinctive feature (Parkinson & Musgrave, 2014) so a more detailed follow-up analysis can also reveal the type of adjectives used by native and non-native writers.

Noun phrase indices revealed that native writers have used significantly more verbal and adverbial modifiers, and relative clauses compared to non-native. These are relatively less frequent structures in the whole corpus and except for adverbials, the remaining two are post modifiers. Verbal modifiers, also defined as participial clauses and are considered to be typical of academic writing (Biber et al., 2011) however, these structures have also produced varying results. Parkinson & Musgrave (2014) for instance, reported rather low instances of participial clauses and complement clauses in their study which compared EAP and MA students. A similar distribution is found in the current study as well, where both relative clauses and verbal modifiers are among the least used dependent types.

Apart from the significant differences, it is also important to mention that both groups have shown great reliance on prepositional phrases and have also used a

fair amount of premodifying nouns which is similar to findings in many other studies where these structures were common as well (e.g. Ansarifard et al., 20018; Taguchi et al., 2013; Wu et al., 2020). Different from adjective modifiers, prepositional phrases belong to more advanced stages (stages 3 & 4) in Biber et al.'s (2011) proposed index of noun modifiers so it can be argued that both native and non-native writers use a balanced combination of pre and post modifiers that reflect different levels of complexity.

Research on syntactic complexity in Turkish EFL academic writing, with a special focus on research articles, is limited. A considerable number of corpus-based studies have researched lexical bundles and formulaic language (e.g., Bal, 2019; Güngör & Uysal, 2023; Öztürk, 2014; Ucar, 2017). However, the reported results of a high number of lexical bundles in Turkish writers' texts (e.g. Güngör & Uysal, 2016; Yakut et al., 2021) might be relevant to the current study as the findings have suggested that Turkish writers use more embedding at phrasal level and use more words within clauses and noun phrases. The findings of the current study partially align with the results of Selvi (2021) who compared unpublished research articles written by L1 Turkish writers with articles written by native English writers. Native writers in both studies have exhibited longer production units and more subordination through the use of embedded clauses suggesting a consistency in those two dimensions. However, unlike the non-native writers in Selvi's study, the group of non-native writers in the current study scored comparable frequencies of complex nominals and used more coordinate phrases than their native counterparts. It is important to mention that the research articles in Selvi's study were final drafts and may have undergone editorial processes. Additionally, it is unclear whether these

articles were eventually published; comparing the final drafts with the published, presumably reviewed versions of the articles would be interesting.

On the other hand, populations with the same L1 backgrounds can perform differently based on the genre of the written text as is the case in a study that has investigated conference abstracts written by international and Turkish writers (Göktürk & Saricaoglu, 2024). Abstracts by Turkish writers exhibited limited use of complex nominals but more finite dependent clauses, whereas the Turkish writers' group in the current study has exhibited fewer dependent clauses and more phrasal embedding. Such differences emphasize the importance of exploring different academic genres as they might have an impact on the linguistic choices writers make.

Finally, based on Biber and Gray's (2010, pp. 5–6) identification of two distinct structural styles, the significantly higher frequency of adjectives as postmodifiers and the lower rate of subordinate clause usage — both finite and non-finite — in the non-native writers' corpus indicate that L1 Turkish writers demonstrate a preference for structural compression. In contrast, native writers exhibit greater structural elaboration through increased use of subordination and verb phrases. While this difference might stem from L1 influence, it is also possible that non-native writers aim for more compact prose, as it is considered more genre-appropriate, thereby increasing the likelihood of publication.

5.2 Conclusion

The comparative corpus-based analysis in the study explored how native and non-native Turkish writers compared in their use of syntactic complexity features, both at global and fine-grained scales. The quantitative and qualitative analyses, conducted through the use of automated tagging tools and analysis programs (L2SCA,

TAASSC, MAT, and AntConc) revealed that native writers used longer production units (C/S, MLS, and MLT) and more subordination through dependent clauses and verb phrases. In contrast, non-native writers' articles featured more elaboration within clauses using coordinate phrases, complex nominals, and a higher number of dependents in their clauses.

Regarding nominal phrases, the major differences were in the frequencies of pre-modification elements, such as adjectives and possessives, which were used significantly more by non-native writers. In contrast, native writers showed higher frequencies of post-modifiers, such as relative clauses and verbal modifiers. Despite the seemingly low use of adverbials in both corpora, pre-modifiers were significantly more frequent in the articles of native writers. The tendency of L1Turkish writers to rely more on attributive adjectives in forming complex noun phrases could be a direct impact of Turkish as it allows nouns to be modified only through the use of defining elements that precede the nouns.

The overall corpus frequencies provided by fine-grained phrasal indices revealed that phrasal complexity in research articles is heavily reliant on attributive adjectives, prepositional phrases, and nominal modifiers, a finding that aligns with many studies on academic writing (e.g., Ansarifard et al., 2018; Biber & Gray, 2011; Biber et al., 2014; Kyle & Crossley, 2018; Staples & Reppen, 2016). As the study aims to explore how writers vary, rather than identifying strengths or weaknesses, it can be concluded that both groups of writers reflect genre-specific uses of language while exhibiting their own stylistic choices, which might stem from a variety of factors. A more in-depth analysis could be useful in identifying how L1 impacts the choices non-native writers make, as complexification patterns were found to vary

depending on the writers' L1, even if they are at similar proficiency levels (Kuiken & Vedder, 2019).

With regard to Biber et al.'s (2011) index of noun phrase modifiers (see Table 1, p. 24), both native and non-native writers have mainly used attributive adjectives, which belong to Stage 2 and prepositional phrases, which are dispersed across Stages 3, 4 and 5. The third most frequent modifier is the noun, used as a pre-modifying element and is typical of Stage 3 in the developmental path. The distribution of these modifiers mirrors those in Ansarifard et al.'s study (2018) where both L1 English and non-native L1 Persian writers relied heavily on attributive adjectives and prepositional phrases to form complex nominals.

5.3 Implications of the study

Based on the findings of the study, there are a few pedagogical implications regarding syntactic complexity and the way it is taught in EAP (English for Academic Purposes) classes, especially at tertiary level in the Turkish EFL context. As the results have suggested, non-native writers in the current study have displayed a tendency to use significantly more adjectives than their native counterparts. Also, while native writers used more dependent clauses and subordination, non-native writers often relied on coordinate phrases and complex nominals. Although complex structures exhibit a similar distribution in both corpora, the overuse or underuse of certain structures can be avoided to achieve a more balanced and varied writing style. In this regard, EAP classes can encourage Turkish EFL learners to balance sentence-level complexity with phrasal sophistication. For this purpose, clausal and phrasal complexity could be taught explicitly and/or systematically in university-level academic writing courses in order to raise students' awareness of disciplinary

conventions and help them make informed stylistic choices. This is echoed in many studies in the field as such explicit instruction is believed to be an important part of EAP and English for Research Publication Purposes (ERPP) programs (Flowerdew, 2013; Mazgutova & Kormos, 2015; Yin et al., 2021).

The materials used for EAP can be designed to target specific structures that can help students incorporate both sentence-level complexity and phrasal elaboration into their writing. Additionally, the study revealed that non-native writers tend to use adjectives as pre-modifiers, whereas native writers rely more on post-modifiers like relative clauses and verb phrases. EAP classes can help students diversify their writing by introducing post-modification strategies to enhance sentence variety. Given the influence of L1 on writing, which has been evidenced in many comparative studies, teachers should also raise awareness of how syntactic patterns in students' native language may affect their English writing choices. By focusing on these areas, EAP instruction can better equip students with the skills needed to write academically sophisticated and genre-appropriate texts.

5.4 Limitations of the study

The study has several limitations that may have influenced the results. The small, self-compiled corpus consists of 100 research articles, which is relatively small sized compared to corpora that consist of millions of words. Additionally, all selected articles are from the field of applied linguistics, so the results apply to only one specific discipline. Another limitation of the study that is relatively hard to control or change is the fact that all articles are from high-ranking journals that subject articles to an editorial process that might vary based on policy differences. The process of publishing a research article has been depicted as one involving not only the writer

but a number of parties that include reviewers, proofreaders, and editors (Burrough-Boenisch, 2003;) which poses a limitation to the conclusiveness of the results. Future research might take such factors and journal specific differences into consideration and follow a different path of journal and article selection.

Another factor that might be considered as a limitation is the lack of control over the automated analyses carried out by the tools. To avoid any discrepancies that might occur during the analyses of the indices, all the recommendations in the tool manual were carefully followed. However, there is still a margin for miscalculations that might yield faulty results.

5.5 Suggestions for further research

Future research could include a more comprehensive selection of the fine-grained linguistic measures in TAASSC (Kyle, 2016) to obtain more detailed results. By expanding the scope of the study, comparisons involving additional levels of expertise and subdividing writers into groups based not only on their L1 but also their level of expertise could yield a better understanding of complexity differences and developmental patterns. An in-depth analysis of emerging writers in comparison to expert ones could capture developmental patterns in L1 Turkish writers, particularly since writing research articles requires "specialized competence" that is acquired through immersion in the norms and conventions of the genre (Omidian et al., 2021). Such studies could further investigate how these developmental patterns vary across disciplines and find out more about the interplay between L1 background, disciplinary conventions and writing expertise.

Future research could also benefit from assembling comparable corpora comprising articles from a diverse range of hard and soft sciences to investigate

whether Turkish expert writers exhibit variations in their construction of linguistic complexity across disciplines. Moreover, it would be of value to conduct a more detailed analysis of significantly varying linguistic indices, focusing on specific sections of research articles (part genres like introduction, method, discussion) to identify where these variations occur most frequently and why.

Studies that have examined clause and /or noun phrase complexity by comparing L1 English and L2 English writers have revealed consistent results that confirm L1 impact (e.g., Lan et al., 2022; Lu & Ai, 2015; Staples & Reppen, 2016). Further research could benefit from investigating the potential impact of L1, Turkish in our case, by comparing characteristics of academic prose, clause and noun phrase structures that might have an influence on the linguistic choices the writers make.

Regarding the tools utilized in the current study, future research could improve the reliability of calculated scores by incorporating an additional verification process. For example, to validate the results of automated analyses, a subset of the texts could be manually reviewed, and any discrepancies could be corrected to ensure greater accuracy. Additionally, examining the precision and consistency of different computational tools could offer valuable insights into the robustness and reliability of automated methods for measuring linguistic complexity.

Lastly, artificial intelligence (AI), a relatively new phenomenon, is transforming all aspects of education, including learning and teaching practices, as well as academic work (Barros et al., 2023; Feng, 2024). The emergence of numerous AI-powered tools has had a significant impact on academic writing practices, and researchers are now exploring how AI redefines the way scholars design, conduct, and report their research (e.g., Belcher, 2024; Golan et al., 2023; Khalifa et al., 2024). Further studies could investigate how AI influences the

linguistic and rhetorical features of academic writing and examine how, and to what extent, writers prefer to use AI-powered tools to aid the process of writing for publication.



APPENDIX A

ARTICLES COMPRISING THE CORPORA

Articles written by L1 Turkish writers

1. Alptekin, C. & Ercetin, G. (2011), Effects of working memory capacity and content familiarity on literal and inferential comprehension in L2 reading. *TESOL Quarterly*, 45: 235-266. <https://doi.org/10.5054/tq.2011.247705>
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3. Polat, N. & Cepik, S. (2016), An exploratory factor analysis of the sheltered instruction observation protocol as an evaluation tool to measure teaching effectiveness. *TESOL Quarterly*, 50: 817-843. <https://doi.org/10.1002/tesq.248>
4. Tozlu Kılıç, E. & Balaman, U. (2023), Facilitating students' learning of a target construction through teacher interactional resources in EFL kindergarten classrooms. *TESOL Quarterly*, 57: 656-669. <https://doi.org/10.1002/tesq.3209>
5. Uysal, H. (2022), Standardized tests and within-group segregation: The not-so-optimal ESL classroom for long-term English learners. *TESOL Quarterly*, 56: 1471-1485. <https://doi.org/10.1002/tesq.3187>
6. Cabaroglu, N. (2014). Professional development through action research: Impact on self-efficacy. *System*, 44, 79–88. <https://doi.org/10.1016/j.system.2014.03.003>
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8. Razi, S. (2023). Emergency remote teaching adaptation of the anonymous multi-mediated writing model. *System*, 113, 102981. <https://doi.org/10.1016/j.system.2023.102981>
9. Sak, M. (2022). Dynamicity of language teacher motivation in online EFL classes. *System*, 111, 102948. <https://doi.org/10.1016/j.system.2022.102948>
10. Sali, P. (2014). An analysis of the teachers' use of L1 in Turkish EFL classrooms. *System*, 42, 308–318. <https://doi.org/10.1016/j.system.2013.12.021>
11. Bakla, A. (2018). A mixed-methods study of tailor-made animated cartoons in teaching punctuation in EFL writing. *ReCALL*, 31(01), 75–91. <https://doi.org/10.1017/s0958344018000046>

12. Saricaoglu, A. (2018). The impact of automated feedback on L2 learners' written causal explanations. *ReCALL*, 31(2), 189–203. <https://doi.org/10.1017/s095834401800006x>
13. Çiftçi, E. Y., & Savaş, P. (2017). The role of telecollaboration in language and intercultural learning: A synthesis of studies published between 2010 and 2015. *ReCALL*, 30(3), 278–298. <https://doi.org/10.1017/s0958344017000313>
14. Satar, H. M. (2016). Meaning making in online language learner interactions via desktop videoconferencing. *ReCALL*, 28(3), 305–325. <https://doi.org/10.1017/s0958344016000100>
15. Adnan, M. (2017). Professional development in the transition to online teaching: The voice of entrant online instructors. *ReCALL*, 30(1), 88–111. <https://doi.org/10.1017/s0958344017000106>
16. Eren, A., & Rakıcioğlu-Söylemez, A. (2023). Language mindsets, perceived instrumentality, engagement and graded performance in English as a foreign language students. *Language Teaching Research*, 27(3), 544–574. <https://doi.org/10.1177/1362168820958400>
17. Keles, U., & Yazan, B. (2023). Representation of cultures and communities in a global ELT textbook: A diachronic content analysis. *Language Teaching Research*, 27(5), 1325–1346. <https://doi.org/10.1177/1362168820976922>
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APPENDIX B

DESCRIPTIVE STATISTICS FOR ALL INDICES USED IN THE STUDY

Table B1. Descriptive Statistics for 14 SCA Indices (Lu, 2010)

Measure	NNW (50)		NW (50)	
	Mean	SD	Mean	SD
MLS (Mean Length of Sentence)	26.66	3.71	28.75	5.05
MLT (Mean length of T-unit)	25.02	3.82	26.48	4.25
MLC (Mean Length of Clause)	15.39	2.29	14.85	1.98
C_S (Clauses per Sentence)	1.74	0.20	1.95	0.29
VP_T (Verb Phrase per T-unit)	2.42	0.31	2.66	0.44
C_T (Clauses per T-unit)	1.63	0.19	1.79	0.23
DC_C (Dependent Clauses per Clause)	0.39	0.06	0.43	0.06
DC_T (Dependent Clauses per T-unit)	0.64	0.18	0.78	0.22
T_S (T-unit per Sentence)	1.07	0.04	1.08	0.05
CT_T (Complex T-unit Ratio)	0.46	0.09	0.52	0.09
CP_T (Coordinate Phrases per T-unit)	0.87	0.26	0.80	0.22
CP_C (Coordinate Phrases per Clause)	0.54	0.19	0.45	0.13
CN_T (Complex Nominals per T-unit)	3.64	0.70	3.76	0.72
CN_C (Complex Nominals per Clause)	2.24	0.42	2.11	0.38

Table B2. Descriptive Statistics for 12 Clause Complexity Indices (TAASSC; Kyle, 2016)

	Index name	Description	NNW (50)		NW (50)	
			Mean	SD	Mean	SD
1	av_deps_cl	dependents per clause	2.57	0.11	2.51	0.15
2	cl_ndeps_std_dev	dependents per clause (st. dev.)	1.36	0.07	1.34	0.09
3	acomp_per_cl	adjective complement	0.06	0.02	0.08	0.02
4	advcl_per_cl	adverbial clause that modifies a verb phrase	0.06	0.01	0.06	0.01
5	cc_per_cl	clausal coordinating conjunction	.002	.003	.003	.002
6	ccomp_per_cl	clausal complement	0.10	0.03	0.10	0.02
7	conj_per_cl	conjunction	0.09	0.03	0.08	0.03
8	csubj_per_cl	clausal subject	0.01	0.00	0.01	0.00
9	ncomp_per_cl	nominal complement	0.05	0.02	0.05	0.01
10	xcomp_per_cl	open clausal complement	0.08	0.02	0.09	0.02
11	prep_per_cl	preposition /prepositional modifier	0.44	0.07	0.42	0.07
12	advmod_per_cl	adverbial modifier	0.18	0.04	0.19	0.03

Table B3. Descriptive Statistics for 17 Noun Phrase Complexity Indices (TAASSC; Kyle, 2016)

Index name	Description	NNW (50)		NW (50)	
		M	SD	M	SD
1 av_ncomp_deps	dependents per nominal complement	2.82	0.44	2.92	0.39
2 av_dobj_deps	dependents per direct object	1.71	0.19	1.66	0.18
3 av_nominal_deps	dependents per nominal	1.48	0.11	1.44	0.12
4 av_pobj_deps	dependents per object of the preposition	1.47	0.11	1.44	0.12
5 av_nsubj_deps	dependents per nominal subject	1.13	0.17	1.12	0.18
6 amod_dobj_deps_NN_	adjective modifier per direct object	0.40	0.09	0.35	0.08
7 det_all_nominal_deps_NN_	determiners per nominal	0.33	0.05	0.33	0.05
8 amod_pobj_deps_NN_	adjective modifier per object of the preposition	0.32	0.06	0.29	0.06
9 amod_all_nominal_deps_NN_	adjective modifiers per nominal	0.32	0.06	0.28	0.06
10 prep_all_nominal_deps_NN_	prepositions per nominal	0.27	0.03	0.26	0.04
11 prep_pobj_deps_NN_	preposition per object of the preposition	0.25	0.03	0.24	0.03
12 nn_all_nominal_deps_NN_	noun as nominal dependent per nominal	0.18	0.05	0.18	0.05
13 conj_and_pobj_deps_NN_	conj. “and” as a dependent per object of the preposition	0.09	0.03	0.08	0.02
14 poss_all_nominal_deps_NN_	possessives per nominal	0.06	0.02	0.05	0.03
15 vmod_all_nominal_deps_NN_	verbal modifiers per nominal	0.04	0.01	0.04	0.01
16 rcmmod_all_nominal_deps_NN_	relative clause modifiers per nominal	0.03	0.01	0.04	0.01
17 advmod_all_nominal_deps_NN_	adverbial modifiers per nominal	0.01	0.00	0.01	0.01

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