

# Lexical Complexity in The Writings of Iraqi, English L2, and English L1 Writers

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**Abstract:** Lexical complexity is an essential construct in L2 writing studies. It has been widely utilized to evaluate writing quality and writers' proficiency. Measures of lexical complexity were considered reliable indicators of writing quality. The more lexical complexity measures score, the more high-quality rating writing. Since the measures of lexical complexity are correlated with writing quality, investigating lexical complexity in the writing of Iraqi writers, and comparing it with the writing of other groups of writers, such as English L2 and L1 writers, intends to describe the current situation of Iraqi writers in terms of using the English language for research publication purposes. This study utilizes the corpus-based method to analyze and compare lexical complexity in the texts of linguistics research articles RAs written by Iraqi, English L2, and English L1 writers and published in international journals indexed in the Scopus database. Eight lexical complexity measures were calculated by using Lexical Complexity Analyzer LCA. The findings revealed a significant difference between Iraqi writers and other groups of writers. There is a gap between the writings of Iraqi writers and English L2 and L1 writers in terms of using complex lexical items. Iraqi writers utilized the lowest amount of lexical complexity in their texts of linguistics RAs.

**Keywords:** Lexical complexity, Linguistics research articles, Iraqi writers, Writing quality

## 1. Introduction

Lexical complexity has been perceived as an interesting research construct in L2 writing studies; this considerable attention is the result of the significant role of lexical complexity in evaluating different aspects of writings and writers, such as quality, proficiency, and development (Lee et al., 2021; Vo, 2019). Two approaches were proposed to define complexity: Relative and Absolute approaches. The relative approach defined complexity as a cognitive process, while the latter absolute approach defined complexity in terms of the lexical and syntactic components. The complexity definition proposed by the absolute approach was considered in this study to analyze and compare lexical complexity. Lexical complexity has been operationalized in L2 writing studies as a multidimensional construct; three levels have been identified to evaluate lexical complexity: density, sophistication, and diversity (Bulté & Housen, 2012; Read, 2000;

Wolfe-Quintero et al., 1998). Previous studies have proposed various measures to evaluate different dimensions of lexical complexity. It has been found that measures of lexical complexity are positively correlated with writing quality and writer proficiency; high-quality writing intends to score high lexical complexity measures, and high-proficiency writers utilize more lexical complexity in their texts (Kyle & Crossley, 2016; Nasserri & Thompson, 2021). In terms of the correlation with writing quality, measures of lexical complexity showed more correlation than measures of syntactic complexity (Lee et al., 2021). Lexical complexity measures are considered reliable indicators of writing quality. Lu (2012) found that some lexical diversity measures implemented in his computational tool Lexical Complexity Analyzer LCA are considered the best indicators of writing quality. Several other existing research also proved that lexical complexity contributes to L2 writing quality (Jarvis et al., 2003; Olinghouse & Leaird, 2009). It has been shown that utilizing more low-frequency and diverse lexical items increases writing quality. Therefore, in order to produce high-quality writings, writers are required to use advanced, less frequent, and diverse lexical items in their writings. These complex lexical items help writers to convey complex scientific issues.

Academic writers that use English as a second language are required to produce high-quality written texts to achieve their goals of publishing RAs in international journals. Most ranking systems of higher education institutions are based on publication productivity. Therefore, institutions are arguing their academics to publish RAs in international journals. Writing quality is crucial in achieving academic publication since most prestigious international journals pay considerable attention to language quality. Lillis & Curry (2015) found that 68% of the collected texts in their study receive comments on language as a significant problem in the writing of RAs. It has been noted that a large number of RAs submitted to journals suffer from writing and conceptualization issues; therefore, calls were made for more training for postgraduate students and junior academics in writing for publication (Reamer, 1992; Renck Jalongo & Saracho, 2016). In recent work that examines reviewer's reports of peer-reviewed journals, Paltridge (2017) demonstrates most of the factors that impact reviewer judgment include: having a critical comprehending of the issue, a clearly defined problem, a deep analysis of the issue, having a clear research design, originality, critical thinking of the issue and literature, and strong academic writing. These features depict strong academic writing abilities. These findings confirm the importance of writing as a primary factor that impacts reviewer decisions.

Generally, Iraqi writers of linguistics RAs publish a low number of RAs in peer-reviewed international journals. This low productivity negatively impacts the reputation of Iraqi writers and academic institutions. Jameel & Ahmad (2020) suggest that the English language is a potential factor that may negatively impact Iraqi writers' publication productivity. Currently, there is no clear evidence that the use of the English language for publication impacts Iraqi writers' publication productivity. Therefore, there is a crucial need to understand the practice of Iraqi writers in using English for publication purposes; this could be done by investigating the linguistic features of the texts of Iraqi writers, especially those constructs such as lexical complexity, which has been found to be correlated with writing quality (Crossley & McNamara, 2012; Lee et al., 2021; Lu, 2012).

This study intends to fill this gap by investigating the texts of published linguistics RAs written by Iraqi writers. It aims to analyze and compare the use of lexical complexity in the writing of published linguistics RAs by three groups of writers Iraqi, English L2, and English L1. A computational tool, Lexical Complexity Analyzer LCA, has been adopted to analyze lexical complexity measures in the texts of different groups of writers. This study adopted eight measures of lexical complexity that have been reported by Lu (2012) as the best indicators of writing quality (Number of Different Words NDW, Number of Different Words Random 50 Words NDWERZ, Number of Different Words Expected Sequence 50 Words NDWESZ, Corrected type-token ratio CTTR, Root Type-Token Ratio RTTR, Mean Segment Type-Token Ratio MSTTR, Squared Verb Variation 1SVV1, Corrected Verb Variation 1CVV1). Analyzing and comparing the writing of Iraqi writers with their peers English L2 and L1 writers intends to reveal the amount of lexical complexity utilized in the writings of each group of writers. The findings aim to reveal if the Iraqi writers utilize a significantly different amount of lexical complexity, which could be reflected in the quality of the writings of Iraqi writers. Since measures of lexical complexity are considered reliable indicators of writing quality. This study aims to answer the following questions:

1. To what extent do the Iraqi, English L2, and English L1 writers utilize complex lexical items in their writings of linguistics RAs?
2. Is there a significant difference between the writing of linguistics RAs by Iraqi, English L2, and English L1 writers in terms of lexical complexity?
3. If there is a significant difference in lexical complexity, what are the significantly different measures, and among which groups of writers Iraqi, English L2, or English L1?

## **2. Literature Review**

### **2.1 Lexical Complexity in Academic Writing**

Lexical complexity is defined in terms of using diverse, less frequent, and advanced lexical items in writing (Laufer & Nation, 1995). Lexical complexity is reflected by the amount of basic and sophisticated words that writers can access; utilizing a narrow range of basic words reflects low lexical complexity (Wolfe-Quintero et al., 1998). A more direct definition of lexical complexity has been proposed by Bulté et al. (2008) as the number of different words utilized in a written text. Previous studies have used different terms interchangeably to describe lexical complexity, such as lexical diversity, rareness, variation, and density (Yu, 2010). Therefore, many measures were utilized to evaluate different sub-constructs of lexical complexity; however, three main groups of measures have been utilized in the majority of the lexical research. These measures were mainly adopted to evaluate three lexical complexity sub-constructs: density, sophistication, and diversity (Read, 2000).

Perceiving the multidimensional nature of the lexical complexity construct, three different dimensions have been proposed in previous studies: they are lexical density, lexical sophistication, and lexical diversity (Bulté & Housen, 2012, 2014; Read, 2000; Wolfe-Quintero et al., 1998). These dimensions are seen as sub-constructs of lexical complexity. They have been adopted to evaluate different lexical aspects in written or spoken forms of language. For instance, lexical density evaluates the proportion of lexical or content words to the function words utilized in written texts (Daller & Xue, 2007; Johansson, 2008; Read, 2000). Academic texts intend to contain complex scientific information, which requires the use of more content words (dense text) to be expressed. Lexical sophistication is introduced as an external dimension of lexical complexity that gauges the use of advanced, less frequent words to the total number of words in a text. Lastly, the diversity dimension, which reflects the number of different words utilized in a text to the total number of words. Diversity shows the range of vocabularies used in written or spoken forms of language (Lu, 2012). Measures of lexical diversity are considered important indicators of writing quality (Laufer & Nation, 1995).

At the academic writing level, the lexical complexity construct played an essential role in characterizing the linguistic features of the written texts. Since they are required to be written in high-quality text, academic writings and especially texts of published research articles are intended to contain high lexical complexity. Academic writers need to utilize advanced, less frequent vocabularies in their writings of research articles to convey complex ideas, as opposed to the speech form of language, which includes more frequent words from the list of first 2000 frequent words (Laufer & Nation, 1995; Morris & Cobb, 2004).

### **2.2 Measures of Lexical Complexity**

The multidimensional nature of the lexical complexity construct requires an analysis of different lexical complexity sub-constructs. Various measures have been proposed to evaluate different dimensions of lexical complexity. Following the conceptualization of lexical complexity as a multidimensional construct (Bulté & Housen, 2012; Read, 2000), previous empirical studies have analyzed different aspects of lexical complexity, such as density, sophistication, and diversity. The density dimension is based on the proportion of the lexical or content words to the total number of words in a text (Daller & Xue, 2007; Read,

2000). The second dimension of lexical complexity is sophistication, which evaluates the use of advanced, less frequent words in a text. The last dimension is lexical diversity or variation, which is usually evaluated by calculating the ratio of type to token words and the number of different words in a specific text.

A wide variety of measures have been proposed in previous studies to evaluate dimensions of lexical complexity. These measures are classified mainly into two types: production-internal and production-external measures. Lexical density and diversity are considered production-internal measures of lexical complexity since they evaluate complex lexical features in a text. In contrast, sophistication measures are regarded as production-external measures because they depend on external factors to evaluate the lexical sophistication of a given text (Skehan, 2009). Lexical density dimension is traditionally measured by the percentage of lexical or content words per total number of words in a given text (Halliday, 1985; Ure, 1971). The second dimension is lexical sophistication which is evaluated through different measures such as sophisticated word types per word types, sophisticated lexical words per lexical words, individual lexical words per lexical words, basic word types per word types, and sophisticated verb types per verbs (Daller, 2003; Wolfe-Quintero et al., 1998). These measures gauge the percentage of less frequent advanced lexical items to the total number of lexical items utilized in a text. Lastly, the lexical diversity dimension, the simplest and straightforward way to measure it is by calculating the number of different words (NDW) in a text. (Malvern et al., 2004) stated that the NDW measure is problematic since its value is sensitive to text length; therefore, transformed mathematical measures were proposed to control the impact of text length, such as NDWZ (First 50 words), NDWERZ (Expected random 50), and NDWESZ (Expected sequence 50) (Lu, 2012). Type-token ratio (TTR) is another way to evaluate lexical diversity. It is the most comprehensive measure adopted to gauge lexical diversity in a given text. The results of the TTR measure were also found to be sensitive to sample size; therefore, new transformed versions were proposed to control the effect of sample size like Root TTR, Corrected TTR, Mean segmental TTR, and Bilogarithmic TTR (Lu, 2012).

As previous studies have confirmed the multidimensional nature of lexical complexity, different automatic tools were designed to evaluate different sub-constructs of lexical complexity, such as Lexical Complexity Analyzer LCA, which was designed by (Lu, 2012) to evaluate density, sophistication, and diversity dimensions of lexical complexity. Coh-matrix is another automatic tool proposed by (Graesser et al., 2004) to evaluate lexical complexity and cohesion. The Tool for the Automatic Analysis of Lexical Sophistication TAALES offers various measures to evaluate different aspects of lexical complexity and sophistication (Kyle & Crossley, 2015).

### **2.3 Lexical Complexity and Writing Quality**

Writing is basically the process of creating meaning in a written form (Murray, 1980). It has been found as a primary challenge faced by learners (Mat Zali et al., 2021; Voon et al., 2019). Writers are required to develop their ideas linguistically and compose their messages coherently in order to achieve their communicative goals (Halliday et al. 2014; Hayes, 1996; Kaplan, 1996). Lexical or vocabulary knowledge is essential in the writing process; vocabulary learning is also considered a multidimensional process (Yolcu & Mirioğlu, 2020). In writing studies, the quality construct has been defined as the fit of a particular text to its context, which includes such factors as the writer's purpose, the discourse medium, and the audience's knowledge (Witte & Faigley, 1981). At the level of academic writing generally and writing for publication specifically, quality of writing plays a vital role in the process of evaluating academic works in order to be accepted for publication in international journals since high-profile international journals pay considerable attention to the quality of text submitted for publication (Lillis & Curry, 2015).

Writing quality is perceived through different linguistic aspects, such as linguistic complexity construct, which analyzes the use of complex and advanced lexical items and syntactic structures (Ravid & Tolchinsky, 2002; Schleppegrell, 2001). Lexical complexity has been traditionally utilized to investigate writing features. It has been found that using advanced, less frequent lexical items increases text quality. Generally, the quality of writing is directly affected by the level of complexity utilized in linguistic production. Empirical lexical complexity studies have revealed that high-quality written texts intend to

contain more complex lexical items (Kyle & Crossley, 2016; Lu, 2012; Morris & Cobb, 2004; Qin & Uccelli, 2016). Measures of lexical complexity are found as reliable indicators of writing quality. Lee et al. (2021) found that lexical complexity measures correlate more with text quality than syntactic complexity measures. Different lexical complexity measures were reported to have a positive correlation with writing quality, especially measures of lexical diversity and sophistication (Kyle & Crossley, 2015; Lu, 2012).

### 3. Methodology

#### 3.1 Data of The Study

This study intends to analyze and compare the lexical complexity measures of the writing of Iraqi, English L2, and English L1 writers, the data of this study was derived from a corpus of published linguistics RAs. The corpus is classified into three sub-corpora: the corpora of Iraqi linguistics RAs, The corpora of English L2 linguistics RAs, and the corpora of English L1 linguistics RAs. Each sub-corpora contains 50 linguistics RAs published in international journals indexed in the Scopus database between the period 2016 to 2020. Since there are a limited number of Iraqi linguistics RAs published in international journals indexed in the Scopus database, all linguistics RAs written by Iraqi writers only (affiliated with Iraqi institutions) were included in the sub-corpora of Iraqi linguistics RAs. The two other sub-corpora of English L2 and L1 linguistics RAs were collected from five international journals they are: Applied Linguistics, Assessing Writing, English for Specific Purposes, Studies in Second Language Acquisition, and System, as illustrated in (Table.1). The selection of journals and articles followed this criterion: journal should be indexed in the Scopus database with a high cite score and published by a reputable publisher. Only open access articles written by English L2 and L1 writers were included in the corpus of the study. The criteria considered to determine the language background of article writers based on the institution affiliated. The English L2 linguistics RAs were written by writers affiliated in institutions of non-native English countries, while English L1 RAs were written by writers affiliated in institutions of native English countries. The total number of linguistics RAs is 150, all in (pdf.) format: they were all converted to (txt.) format by using an automatic software (Ant file Converter), which was designed by Anthony (2017) to convert files to plain text format, a manual check has been followed the automatic converting to check the accuracy. After converting all research article files, all tables, figures, keywords, references, and author names were removed from texts.

**Table 1.** Number of English L1 research articles from each journal

	Applied Linguistics	Assessing Writing	English for Specific Purposes	Studies in Second Language Acquisition	System
The Corpora of English L2 writers	9	9	7	12	13
The Corpora of English L1 writers	12	9	8	10	11

#### 3.2 Lexical Complexity Measures Analysis

Comprehending the positive relationship between lexical complexity and writing quality as identified in previous studies (Kyle & Crossley, 2016; Lu, 2012; Qin & Uccelli, 2016), and the importance of writing quality in the process of academic writing and especially writing RAs for publication purposes. Therefore, this study intended to analyze and compare lexical complexity measures in the texts of linguistics RAs written by Iraqi, English L2, and English L1 writers. The automatic tool, lexical complexity analyzer LCA (Lu, 2012), was adopted to analyze the lexical complexity measures in the writings of linguistics RAs. The measures of LCA were designed to evaluate the lexical complexity of academic texts written by

advanced writers (Ha, 2019; Lei & Yang, 2020). The LCA contains 25 measures of lexical complexity; these measures were designed to evaluate three sub-constructs of lexical complexity, density, sophistication, and diversity. According to Lu (2012), eight diversity measures of lexical complexity are considered reliable indicators of writing quality (NDW, NDWERZ, NDWESZ, CTTR, RTTR, MSTTR, SVV1, and CVV1), as shown in (Table.2). These measures were analyzed by using LCA to evaluate and compare lexical complexity in the texts of linguistics RAs written by Iraqi, English L2, and English L1 writers.

**Table 2.** Lexical complexity measures, labels, and formulas

Measure	Label	formula
Number of different words	NDW	T
Number of different words random 50 words	NDWERZ	Mean T of 10 random 50-word samples
Number of different words expected sequence 50 words	NDWESZ	Mean T of 10 random 50-word sequences
Corrected type-token ratio	CTTR	$T/\sqrt{2N}$
Root type-token ratio	RTTR	$T/\sqrt{N}$
Mean segment type-token ratio	MSTTR	Mean TTR of all 50-word segments
Squared verb variation 1	SVV1	$T^2_{verb}/N_{verb}$
Corrected verb variation 1	CVV1	$T_{verb}/\sqrt{2N_{verb}}$

### 3.3 Statistical Analysis

This quantitative study adopted descriptive and inferential statistics to answer this study's research questions. The three sub-corpora of the study were analyzed by using the Lexical Complexity Analyzer LCA, which is an automatic tool to evaluate the lexical complexity of written texts (Lu, 2012). The obtained values of lexical complexity measures were implemented in the statistical tool Statistical Package for the Social Sciences (SPSS) to calculate the means and standard deviations of lexical complexity measures as well as compare and reveal the potential differences between groups of writers in terms of using lexical complexity.

The descriptive statistics were utilized to answer the first research question, which aims to show the extents to which Iraqi, English L2, and English L1 writers implement complex lexical items in their writings of linguistics RAs. The second research question adopted inferential statistics; a one-way multivariate analysis of variance MANOVA was conducted to reveal if there is a significant difference between the writing of Iraqi, English L2, and English L1 writers in terms of the linear combination of the utilized lexical complexity measures. Based on the second research question results, if there is a significant difference, the third research question will conduct a series of analyses of variance (ANOVA) for each lexical complexity measure of the three groups of writers since this study contains three levels of the independent variable (Iraqi, English L2, English L1). Post hoc analysis will be processed to reveal the significant differences among the three writer's groups.

## 4. Results and Discussion

This section intends to quantitatively discuss the lexical complexity utilized in the writings of published linguistics RAs written by three groups of writers, Iraqi, English L2, and English L1. Descriptive statistics were adopted to answer the first research question, while the second and third research questions adopted inferential statistics. The texts of RAs were all analyzed by using Lexical Complexity Analyzer LCA (Lu, 2012). The values of lexical complexity measures were implemented in the Statistical Package for the Social Sciences SPSS to calculate the descriptive and inferential statistics.

#### 4.1 To what extent do the Iraqi, English L2, and English L1 writers utilize complex lexical items in their writings of linguistics RAs?

The first research question was implemented to show the extents to which Iraqi, English L2, and English L1 writers use complex lexical items in their texts of published linguistics RAs. This study has analyzed eight lexical complexity measures; these measures were all reported to be valuable indicators of writing quality (Lu, 2012). Descriptive statistics were adopted to answer this research question. The data analyzed by Lexical Complexity Analyzer LCA were processed in Statistical Package for the Social Sciences SPSS to calculate the means and standard deviations of each group of writers, as illustrated in (Table.3). The results of the descriptive statistics showed that Iraqi writers scored the lowest mean values in seven out of eight lexical complexity measures analyzed in this study. On the contrary, English L1 writers scored the highest mean values in almost all measures except CVV1, while Iraqi writers scored the highest. The third group of writers, English L2, scored medium mean values of all lexical complexity measures between Iraqi and English L1writers. The descriptive results showed that English L1 writers utilized the highest amount of complex lexical items in their writings of linguistics RAs, followed by English L2 writers, and lastly, Iraqi writers scored the lowest amount of lexical complexity.

**Table 3.** Descriptive statistics of dependent variables disaggregated by the independent variable (N=150)

	Language Background	Mean	Std. Deviation	N
NDW	Iraqi	955.18	251.588	50
	English L1	1415.64	234.369	50
	English L2	1332.58	195.434	50
	Total	1234.47	303.084	150
NDWERZ	Iraqi	39.988	1.3498	50
	English L1	41.484	1.2658	50
	English L2	41.168	1.0613	50
	Total	40.880	1.3834	150
NDWESZ	Iraqi	37.868	2.0528	50
	English L1	39.540	1.1980	50
	English L2	39.116	1.3289	50
	Total	38.841	1.7163	150
MSTTR	Iraqi	.7520	.03169	50
	English L1	.7902	.01545	50
	English L2	.7834	.01923	50
	Total	.7752	.02844	150
CTTR	Iraqi	9.9322	1.35135	50
	English L1	11.1316	1.10902	50
	English L2	10.4304	1.04708	50
	Total	10.4981	1.26856	150
RTTR	Iraqi	14.0468	1.91038	50
	English L1	15.7418	1.56862	50
	English L2	14.7512	1.48104	50
	Total	14.8466	1.79370	150
SVV1	Iraqi	6.1846	.81734	50
	English L1	6.6668	.76133	50
	English L2	6.2552	.69543	50
	Total	6.3689	.78414	150

	Language Background	Mean	Std. Deviation	N
CVV1	Iraqi	.3354	.05369	50
	English L1	.2798	.04378	50
	English L2	.3136	.05781	50
	Total	.3096	.05660	150

#### 4.2 Is there a significant difference between the writing of linguistics RAs by Iraqi, English L2, and English L1 writers in terms of lexical complexity?

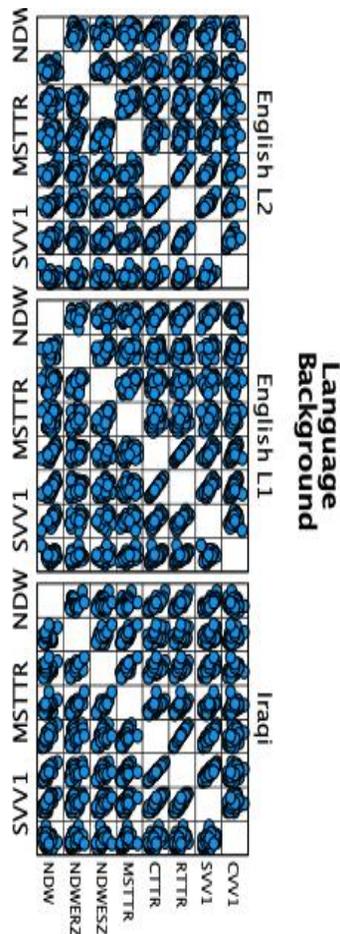
The second research question was implemented to identify if there is a significant difference between the writings of linguistics RAs written by Iraqi, English L2, and English L1 writers in terms of lexical complexity measures analyzed in this study. A one-way MANOVA test was conducted to reveal if there is a difference. A preliminary assumptions check was performed to ensure the validity of conducting the MANOVA test, and the result is robust. These assumptions include sample size, normality, linearity, and homogeneity of variance-covariance matrices. This study included 150 observations of linguistics RAs texts written by three groups of writers classified based on language background as follows: Iraqi, English L2, and English L1 writers. The normality is assumed based on the results of skewness and kurtosis, as illustrated in (Table. 4). The acceptable skewness value is between 2 to -2, while for kurtosis value is between 7 to -7 (Byrne, 2013). Therefore, we can conclude that multivariate normality is tenable. The univariate normality was also assumed based on boxplot results; they showed no presence of extreme outliers. Linearity assumption was also assumed based on scatterplot results which indicate that dependent variables were linearly related in writer's groups (See Figure. 1). Box's M results showed that the assumption of homogeneity of covariance matrices was violated,  $p = .001$ . In contrast, the homogeneity of variance was tenable according to Leven's test results. Since most of the assumptions of the one-way MANOVA test were tenable, therefore, this study will process by utilizing parametric tests to achieve this research objective. Box's M results showed that homogeneity of covariance is not assumed; the results of Box's M are sensitive to sample size. One-way MANOVA test is robust towards the violation of the homogeneity of covariance. As a result of homogeneity of covariance violation, this study will report Pillai's Trace result since its value is more robust in case of violation of homogeneity of covariance. Garson (2012) suggests that when most assumptions are met, and the data size is large enough, a parametric test could be used, and the results will be highly accurate.

**Table 4.** Skewness and Kurtosis Results of Lexical Complexity Measures

	N	Mean	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
NDW	150	1234.47	-.284	.198	-.546	.394
NDWERZ	150	40.880	-.020	.198	-.474	.394
NDWESZ	150	38.841	-.472	.198	.260	.394
MSTTR	150	.7752	-.612	.198	.435	.394
CTTR	150	10.4981	.086	.198	-.015	.394
RTTR	150	14.8466	.087	.198	-.011	.394
SVV1	150	6.3689	.074	.198	-.376	.394
CVV1	150	.3096	.596	.198	.919	.394
Valid N (listwise)	150					

A one-way multivariate analysis of variance MANOVA was conducted to reveal if there is a significant difference between three writer's groups (Iraqi, English L2, and English L1) in terms of the

lexical complexity utilized in their writings of linguistics RAs. A statically significant MANOVA effect was perceived Pillai's trace = 1.220,  $F(16,282) = 27.594$ ,  $p < .001$ , Partial  $\eta^2 = .610$ , observed power = 1.00. The effect size was large. The observed power is 1.00, which indicates that there is 100 % that the result is significant. The result of the MANOVA test showed the presence of significant differences in utilizing complex lexical items in the writing of published RAs by three groups of writers investigated in this study. Since the result of the one-way MANOVA test does not reveal which lexical measures are significant and between which groups of writers, this study performed a series of one-way ANOVAs to identify significant measures and Tukey post hoc to reveal significantly different groups of writers.



**Fig. 1** Scatter Plots of Lexical Complexity Measure in Each Group of Writers

**4.3 If there is a significant difference in lexical complexity, what are the significantly different measures, and among which groups of writers Iraqi, English L2, or English L1?**

The third research question was implemented to identify the significantly different lexical complexity measures and between which groups of writers. Based on the significant difference obtained from the result of the one-way MANOVA test, therefore a series of one-way ANOVAs of each lexical complexity measure were performed by using the Bonferroni method at .006 (.05/ 8) alpha level to identify lexical complexity measures that contributed to the significant difference of one-way MANOVA test. The results showed that all ANOVA's were statistically significant, with effect sizes (Partial  $\eta^2$ ) ranging from a low of .074 (SVV1) to a high of .440 (NDW), as illustrated in (Table.5). These significant ANOVA results

revealed significant differences in terms of using complex lexical items in the writing of linguistics RAs by groups of writers. These differences are reflected in the writing quality since the analyzed measures are considered reliable indicators of writings quality (Lu, 2012).

**Table 5.** ANOVA results of a lexical complexity measure

<b>Measure</b>	<b>Result</b>
NDW	F (2,147) – 57.754, p < .001, Partial $\eta^2$ - .440, observed power - .100
NDWERZ	F (2,147) – 20.494, p < .001, Partial $\eta^2$ - .218, observed power - .100
NDWESZ	F (2,147) – 15.283, p < .001, Partial $\eta^2$ - .172, observed power - .999
MSTTR	F (2,147) – 38.623, p < .001, Partial $\eta^2$ - .344, observed power - .100
CTTR	F (2,147) – 13.115, p < .001, Partial $\eta^2$ - .151, observed power - .997
RTTR	F (2,147) – 13.098, p < .001, Partial $\eta^2$ - .151, observed power - .997
SVV1	F (2,147) – 5.876, p = .004, Partial $\eta^2$ - .074, observed power - .869
CVV1	F (2,147) – 14.461, p < .001, Partial $\eta^2$ - .164, observed power - .999

The results of ANOVA's tests showed that all measures of lexical complexity are significantly different between at least two groups of writers. In order to identify significant measures between which groups of writers, this study performed a Tukey post hoc analysis to examine individual mean difference comparisons across three groups of writers. The results showed that all lexical complexity measures significantly differed between the Iraqi and English L1 writers. These findings revealed that in terms of lexical complexity measures that correlate with writings quality (Lu, 2012), Iraqi writers significantly utilized a lower amount of complex lexical items than English L1 writers, as illustrated in (Table.6). This finding indicates the significant difference in terms of writing quality between linguistics RAs written by Iraqi and English L1 writers. Iraqi writers were also found to be significantly different from the English L2 writers in utilizing complex lexical items. These significant differences were shown in four lexical complexity measures (NDW, NDWERZ, NDWESZ, MSTTR). These findings revealed that the writing of Iraqi writers is significantly different from not only English L1 writers but also their peers, English L2 writers, in terms of the use lexical complexity.

**Table 6.** Tukey post hoc results of lexical complexity measure among groups of writers

Dependent Variable	(I) Language Background	(J) Language Background	Mean Difference (I-J)	Std. Error	Sig.
NDW	Iraqi	English L1	-460.46*	45.668	.000
		English L2	-377.40*	45.668	.000
	English L1	Iraqi	460.46*	45.668	.000
		English L2	83.06	45.668	.167
	English L2	Iraqi	377.40*	45.668	.000
		English L1	-83.06	45.668	.167
NDWERZ	Iraqi	English L1	-1.496*	.2463	.000
		English L2	-1.180*	.2463	.000
	English L1	Iraqi	1.496*	.2463	.000
		English L2	.316	.2463	.407
	English L2	Iraqi	1.180*	.2463	.000
		English L1	-.316	.2463	.407
NDWESZ	Iraqi	English L1	-1.672*	.3144	.000
		English L2	-1.248*	.3144	.000
	English L1	Iraqi	1.672*	.3144	.000
		English L2	.424	.3144	.371
	English L2	Iraqi	1.248*	.3144	.000
		English L1	-.424	.3144	.371
MSTTR	Iraqi	English L1	-.0382*	.00464	.000
		English L2	-.0314*	.00464	.000
	English L1	Iraqi	.0382*	.00464	.000
		English L2	.0068	.00464	.310
	English L2	Iraqi	.0314*	.00464	.000
		English L1	-.0068	.00464	.310
CTTR	Iraqi	English L1	-1.1994*	.23530	.000
		English L2	-.4982	.23530	.090
	English L1	Iraqi	1.1994*	.23530	.000
		English L2	.7012*	.23530	.009
	English L2	Iraqi	.4982	.23530	.090
		English L1	-.7012*	.23530	.009
RTTR	Iraqi	English L1	-1.6950*	.33274	.000
		English L2	-.7044	.33274	.090
	English L1	Iraqi	1.6950*	.33274	.000
		English L2	.9906*	.33274	.009
	English L2	Iraqi	.7044	.33274	.090
		English L1	-.9906*	.33274	.009
SVV1	Iraqi	English L1	-.4822*	.15193	.005
		English L2	-.0706	.15193	.888
	English L1	Iraqi	.4822*	.15193	.005
		English L2	.4116*	.15193	.021
	English L2	Iraqi	.0706	.15193	.888
		English L1	-.4116*	.15193	.021
CVV1	Iraqi	English L1	.0556*	.01042	.000
		English L2	.0218	.01042	.095
	English L1	Iraqi	-.0556*	.01042	.000
		English L2	-.0338*	.01042	.004
	English L2	Iraqi	-.0218	.01042	.095
		English L1	.0338*	.01042	.004

## 5. Conclusion

Lexical complexity, among other constructs, has been found to be correlated with writing quality. So, the investigation of lexical complexity utilized in the writing of Iraqi writers helps to identify writing quality. Since writing quality is considered a crucial factor in achieving academic publication in international journals (Lillis & Curry, 2015), analyzing and comparing lexical complexity and writing quality intend to reveal the impact of using English on publication productivity. Revealing the potential differences intends to identify the needs required to increase the quality and productivity of Iraqi RAs in international peer-reviewed journals. The results of the descriptive statistics showed that Iraqi writers produce linguistics RAs with the lowest amount of complex lexical items. The amount of lexical complexity utilized in the texts of linguistics RAs written by Iraqi writers is not equal to the lexical complexity utilized by their peers, English L2 and L1 writers; Iraqi RAs texts lack more complex lexical items. These results reflect the gap between the writing of Iraqi writers and other groups of writers investigated in this study. This low amount of lexical complexity could impact the quality of Iraqi texts since the amount of lexical complexity is positively correlated with writing quality (Kyle & Crossley, 2016; Lu, 2012; Morris & Cobb, 2004; Qin & Uccelli, 2016).

On the other hand, the inferential statistics revealed that the difference between groups of writers in terms of lexical complexity measures is significant. The significant result of one-way MANOVA indicates that there is a significant difference between at least two groups of writers regarding lexical complexity. The series of ANOVAs test have revealed that all measures of lexical complexity are significantly different between groups of writers. The Tukey post hoc analysis revealed that Iraqi writers differed significantly from English L1 writers in terms of all measures. Iraqi writers were also found to differ from English L2 writers in four lexical complexity measures (NDW, NDWERZ, NDWESZ, MSTTR). These findings confirmed the gap between Iraqi writers and other writer's groups in using lexical complexity in their writings of RAs. The significant differences between Iraqi and English L1 writers could be interpreted in terms of the differences between English L1 and L2 writers. On the other hand, since Iraqi and English L2 groups are considered L2 writers of the English language, differences between them are interpreted in terms of proficiency and writing quality.

Based on this study's findings, we can conclude that texts of linguistics RAs written by Iraqi writers are not lexically complex as texts written by other groups of writers English L2 and L1. This significant difference could lead to a significant difference in terms of writing quality. Iraqi writers are producing low-quality texts of linguistics RAs. This situation interprets the current situation of using English for research publication purposes and the low publication productivity of Iraqi writers. International peer-review journals pay considerable importance to writing quality (Lillis & Curry, 2015). Therefore, linguistics RAs written by Iraqi writers intend to receive low chances of being accepted for publication in international journals. Iraqi writers need to utilize more complex lexical items to convey complex scientific issues in their texts of published RAs. Using more lexical complexity increase the rating quality of the texts of Iraqi writers.

## 6. Co-Author Contribution

The authors affirmed that there is no conflict of interest in this article. The first corresponding author carried out the overall plan and manuscript writing, and the second corresponding author reviewed and edited the manuscript writing.

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