

The Relationship between Text Formality and Writing Quality: An Evaluation Based on Coh-Metrix

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Abstract: *This study seeks to investigate the relationship between text formality and writing quality by quantifying text formality in EFL English writing. In order to conduct the research, 548 English argumentation compositions were evaluated in terms of the five Coh-Metrix text formality dimensions: narrativity, syntactic simplicity, word concreteness, referential coherence, and deep cohesion. Based on the study, there is only a weak relationship between text formality and writing quality, and some facets of text formality, such as narrativity, word concreteness, syntactic simplicity, and deep cohesion, have varying degrees of influence on writing quality and, consequently, on English writing scores. As per statistics, narrativity has a detrimental effect on writing quality; word concreteness has a significant positive correlation with writing quality; syntactic simplicity shows a relatively small negative correlation with writing quality; deep cohesion has a modestly negative correlation with writing quality; and referential coherence has no correlation with writing quality. It is intended that the findings of this study will have some bearing on how English argumentative writing is taught and learned.*

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Introduction

THE Coh-Metrix, a computational facility that analyzes texts on most of the levels of multilevel theoretical frameworks, was “developed, refined, and tested between 2002 and 2011 at the University of Memphis” (McNamara et al., 2014, P.1) (Graesser et al. 2004). Coh-Metrix, an automated text analysis tool, includes a plethora of indices that can comprehensively examine textual features and is freely available on the website (<http://www.cohmetrix.com>). Numerous studies have been conducted since the introduction of the Coh-Metrix to validate its use in assessing the features of texts. These studies collectively used Coh-Metrix to differentiate a wide range of texts (Louwerse et al., 2004; Graesser et al., 2007; Crosssley & McNamara, 2011; Graesser et al., 2011). Recently, some Chinese scholars have used Coh-Metrix to conduct in-depth studies on the relationship between textual features and writing quality. For example, see the relationships between lexical proficiency and writing quality (Gui, 2010); the relationship between cohesive devices, lexical and syntactic features, and language proficiency (Wang, 2012); the relationship between readability, lexical frequency, and cohesion with writing quality (Du & Cai, 2013); the relationship between lexical diversity, syntactic complexity, and coherence with writing quality (Li et al., 2014); and the relationship between coherence and writing (Diao, 2019). Some of these studies suggest that textual features such as lexical and syntactic features, coherence, and so on can reflect the quality of English writing. However, Coh-Metrix’s analysis of the relationships between text formality and writing quality is still in its infancy. In light of this, the current study uses Coh-Metrix to measure the formality of 548 English argumentative compositions across five dimensions: narrativity, syntactic simplicity, word concreteness, referential coherence, and deep cohesion. The goal is to figure out the relationship between text formality and writing quality.

Text Formality

The Notion of Text Formality

In the 1970s, Labov first asserted that formality is a universal dimension of stylistic variation (Graesser et al., 2014). This was followed by a significant amount of textual

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formality research that concentrated on discourse diagnostics (Chafe, 1982; Biber, 1988; Heylighen & Dewaele, 2002), the classification of texts into formal and informal language or style (Olson, 1977; Richards et al., 1997), and the definition of formality (Atkinson, 1982; Bussmann, 1996; Richards et al., 1997; Andren et al., 2010; Heylighen & Dewaele, 2002). In this study, the Coh-Metrix measurements are used to examine text formality. To make sure everyone understands, it is important to define important terms used in the article.

- **Narrativity**

A narrative text is one that tells a story using well-known characters, plot points, settings, and objects. Daily, oral conversation is intimately related to narrative. This element is closely related to vocabulary, general knowledge, and oral language. On the other end of the spectrum are works that don't tell a story and focus on less well-known topics (McNamara et al., 2014).

- **Syntactic Simplicity**

This element measures how many words are used in each sentence and how many simple, well-known syntactic structures are used in each sentence, both of which make reading the text easier. Texts with longer sentences and more complicated, foreign syntactic patterns fall on the other end of the spectrum (McNamara et al., 2014).

- **Word Concreteness**

Content words are concrete and meaningful, and they have the ability to evoke mental images. Texts with more content words are easier to understand and process. Abstract words are used to express ideas that are difficult to visualize. Texts that contain more abstract words are more difficult to understand (McNamara et al., 2014).

- **Referential Coherence**

Words and ideas that overlap across sentences and the entire text form explicit threads that connect the text to the reader in texts with high referential cohesion. Texts with low cohesion are typically more difficult to process because there are fewer connections that connect ideas for readers (McNamara et al., 2014).

- **Deep Cohesion**

When there are causal and logical relationships within the text, this component reflects the degree to which the text contains causal and intentional connectives. These connectives assist the reader in developing a deeper and more coherent understanding of the text's causal events, processes, and actions. When there are many relationships in a text but no connectives, the reader must infer the relationships between the ideas in the text. (McNamara et al., 2014) say that a text's relationships and global cohesion are made clear if it has a high level of deep cohesion.

The Measurement of Text Formality

The formality score (F-score), the adjective density formality score (ADF-score), and the composite formality score (CF-score) are three regularly used computer metrics of text formality. A formality indicator called the F-score was developed by Heylighen and Dewaele in 2002. It rises when pronouns, adverbs, verbs, and interjections are used less frequently than nouns, adjectives, articles, and prepositions. According to Fang and Cao

(2009), an adjective density formality score may accurately predict how formal a text will be when it is read by humans who are classifying it. Li et al. (2014) investigated what characteristics predict formality as people understand the concept, and the findings supported the idea that formality, a significant aspect of stylistic diversity, is related to linguistic qualities spanning multiple levels of discourse. According to Graesser et al. (2014), there is a composite formality score that incorporates the five main Coh-Matrix dimensions. The PCNARz (z-score of Text Easability PC Narrativity), the PCSYNz (z-score of Text Easability PC Syntactic Simplicity), the PCCNCz (z-score of Text Easability PC Word Concreteness), the PCREFz (z-score of Text Easability PC Referential Cohesion), and the PCDCz (z-score of Text Easability PC Deep Cohesion). According to this definition, a z-score is “a standard score that reflects how many standard deviations an observation or data point is above or below the mean, where the mean is fixed at 0.” (McNamara et al., 2014, p84). The formula for calculating a text’s formality score, according to Graesser et al. (2014), is $\text{formality} = [\text{referential coherence} + \text{deep cohesion-narrativity-syntactic simplicity-word concreteness}]/5$. So, it’s clear that the composite measure of formality is more than just adding up the values of the five dimensions.

Methodology

Research Questions

The following questions will be addressed by this study:

- (1) What is the relationship between text formality and writing quality?
- (2) How and to what extent does text formality affect writing scores?

Research Subjects

The selection of reasonable and representative research materials is important in order to provide scientifically sound answers to the research questions. A total of 548 argumentative compositions, each with roughly 300 words, were chosen from the Written English Corpus of Chinese Learners (WECCL 2.0) in order to ensure the validity of the data gathered (Wen et al., 2009). More than 20 Chinese institutions are the sources for the compositions in WECCL 2.0, which are of various types and academic levels and were written by English and non-English majors.

Research Instruments

Two corpus-based technologies, Coh-Mix 3.0 and Juku Correcting Network, are used in this study to make sure that the results are pretty accurate.

Coh-Merix 3.0, a free online automated computational evaluation tool, is used to extract a large set of data from large text corpora reflecting linguistic features. In this study, Coh-Matrix is used to calculate the values of the five critical indices of text formality: PCNARz, PCSYNz, PCCNCz, PCREFz, and PCDCz (McNamara et al., 2014).

Juku Correcting Network (Juku) is a large-scale corpus of native English speakers that is used as a benchmark or reference to evaluate the disparity between Chinese students’ essays and texts in the established corpus. It could provide comprehensive, analytic scores on a 100-point scale, as well as diagnostic feedback. This online

service software allows users to revise their essays multiple times based on analytic and diagnostic comments and suggestions for improvement. In this study, Juku was used to rate all of the compositions that were chosen.

Research Procedure

First, Juku and two college writing instructors graded a total of 548 argumentative essays. The graders individually assessed the pieces using a holistic, analytical scoring rubric in accordance with the grading profile developed by Jacobs et al. (1981). The marks for human rating were determined by averaging the two graders' evaluations of each essay. Then, the final score was made by taking the average of the scores given by Juku and human graders to show how well the argumentative essay was written.

Then, based on the final average score from Juku and human assessors, all of the argumentative writing samples were split into three categories (the full mark is 100). The compositions in the high-score group ($x \geq 81.5$) had scores that were in the top 25%. The low-score group ($x \leq 77$) consisted of the bottom 25% of performers. And the remainder of them comprised the middle-score group ($x = \text{score}, 77 < x < 81.5$). As a consequence, there are 141 compositions with a low score, 259 compositions with a middle score, and 148 compositions with a high score.

The textual features of these argumentative essays were then analyzed using Coh-Metrix in three groups. They were put into Coh-Metrix 3.0, and the results were saved as an Excel spreadsheet so they could be used later.

Finally, after obtaining the data for the variables of text formality for all of the argumentative essays, SPSS 19.0 was used to conduct the statistical analysis. To be more specific, one-way ANOVA was used to determine whether or not there were any discernible differences in writing scores between the three groups. Then, Pearson Correlation Analysis was used to figure out how the five text formality indices and writing quality were related to each other.

Results and Discussions

Differences in the Indices of Text Formality among the Three Groups

One-way ANOVA was used to look at these five text formality indices and see how the three groups were different. The results are shown in **Table 1**.

According to the test of homogeneity of variances of the six text formality variables, all of the significance values are greater than 0.05 ($p = 0.370$, $p = 0.234$, $p = 0.090$, $p = 0.869$, $p = 0.214$, and $p = 0.110$, respectively), indicating that each index in the three groups has the same variance. As a result, the data from the One-way ANOVA analysis shown below are correct. According to the One-way ANOVA analysis results, there are significant differences in four text formality indices (PCNARz, PCSYNz, PCCNCz, PCDCz) and text formality itself (with $p = 0.000$, $p = 0.001$, $p = 0.000$, $p = 0.026$, and $p = 0.000$, respectively). Also, PCREFz doesn't show any big differences between the three groups, which means that this text formality index can't tell the difference between good and bad writing.

Post-hoc tests were used to determine which two groups had statistically significant differences in the four indices. **Table 1** summarizes the findings.

Table 1. Comparisons of the Five Indices of Text Formality of the Three Groups.

	Group1 (n=148)		Group2 (n=259)		Group3 (n=141)		F (2, 545)	Post Hoc
	M	SD	M	SD	M	SD		
PCNARz	0.20638	0.433663	0.37897	0.489220	0.56334	0.491860	20.341*	Group1<Group2 Group1<Group3 Group2<Group3
PCSYNz	-0.06414	0.644012	0.15278	0.647669	0.20489	0.772123	6.718*	Group1<Group2 Group1<Group3
PCCNCz	0.14779	0.890424	-0.15834	1.024769	-0.71691	0.961938	29.419*	Group1>Group2 Group1>Group3 Group2>Group3
PCREFz	-0.12415	0.752105	-0.07679	0.772617	0.00009	0.844723	0.920	
PCDCz	1.05170	1.003139	0.95704	1.018328	1.25408	1.135157	3.689*	Group2<Group3
Text Formality	0.14575	0.334636	0.10137	0.306195	0.24057	0.346718	8.398*	Group1<Group3 Group2<Group3

* The mean difference is significant at the 0.05 level.

Group1=the High-Score Group; Group2=the Middle-Score Group; Group3=the Low-Score Group

First, in terms of PCNARz, there are distinct differences between three groups [$F(2,545) = 20.341$, $p < 0.05$]. This demonstrates that PCNARz can distinguish between writing quality. It is possible to conclude that narrativity has a significant influence on the quality of argumentative writing. Furthermore, as shown in **Table 1**, the mean value of PCNARz in the high-score group ($M = 0.20638$) is lower than in the middle- and low-score groups ($M = 0.37897$, $M = 0.56334$). As a result, the higher the PCNARz value, the lower the writing score, as reported by Graesser et al. (2011).

Regarding PCSYNz, there is a major difference between Group 1 and Group 2 and Group 1 and Group 3 [$F(2,545) = 6.718$, $p < 0.05$], indicating that PCSYNz differs significantly between the high- and middle-score groups as well as the high- and low-score groups. However, there is no distinction between Group 2 and Group 3 in PCSYNz. Thus, it is evident that syntactic simplicity can discriminate between groups with high and low scores but cannot distinguish between groups with moderate and low scores. In addition, the mean value of PCSYNz in the group with the highest scores ($M = -0.06414$) is 0.26903 lower than that of the group with the lowest scores ($M = 0.20489$). This shows that the writing score will decrease as PCSYNz increases. Texts with longer sentences and unusual, complicated grammatical structures are likely to receive better marks. This conclusion fits with what Graesser et al. (2011) found, which is that texts with lower scores tend to have syntax that is easier to understand.

There are statistically significant variations between the three groups in terms of PCCNCz [$F(2,545) = 29.419$, $p < 0.05$]. It indicates that there are significant variations in this index not only between groups with high and low scores or high and middle scores, but also between groups with middle and low scores. This shows that PCCNCz can differentiate writing quality and can serve as a predictor of writing scores. In addition, according to **Table 1**, the mean value of PCCNCz in the high-score group ($M = 0.14779$) is 0.8647 greater than that in the low-score group ($M = -0.71691$), indicating

Table 2. Correlation between the Indices of Text Formality and Writing Scores.

		PCNARz	PCSYNz	PCCNCz	PCREFz	PCDCz	Text Formality
Writing Score	Pearson Correlation	-0.267**	-0.189**	0.332**	-0.045	-0.128**	-0.131**
	Sig. (2-tailed)	0.000	0.000	0.000	0.292	0.003	0.002
	N	548	548	548	548	548	548

* The correlation is significant at the 0.05 level.

** The correlation is significant at the 0.01 level.

that the writing scores will be higher as PCCNCz increases. This also suggests that texts with more concrete and meaningful content words are thought to be of higher quality.

For PCREFz, there is no statistically significant difference between the three groups [$F(2,545) = 0.920, p > 0.05$]. And only between Groups 2 and 3 is there a significant difference in PCDCz [$F(2,545) = 3.689, p < 0.05$]. These results indicate that PCREFz and PCDCz cannot be utilized to distinguish between groups with high and low scores. This conclusion seems to be in line with earlier findings that “referential coherence and deep cohesion did not differ systematically or significantly across grade levels” (McNamara et al., 2014, p.86).

Lastly, when it comes to the overall formality of text, there is a significant difference between Group 1 and Group 3 [$F(2,545) = 8.398, p < 0.05$], but there is no difference between Group 1 and Group 2. The results indicate that text formality differs significantly between groups with high and low scores, as well as between groups with intermediate and low scores. However, there is no difference in text formality between high-and middle-scoring groups.

Text Formality and Writing Quality have a Relationship

Table 2 shows a weak negative correlation between text formality and writing scores ($r = -0.131^{**}, p < 0.01$). Also, among the five text formality indices, PCNARz, PCSYNz, PCCNCz, and PCDCz have statistically significant relationships with writing quality.

First, it is discovered that there is a negative correlation between PCNARz and writing quality ($r = -0.267^{**}, p < 0.01$). The evidence suggests that narrative may have a detrimental effect on writing quality and that the amount of narrative in an argumentative essay will determine its writing score. This is probably because the corpora put more weight on argumentative essays, which put argument over story.

Looking at PCCNCz, a more significant positive correlation between word concreteness and writing scores is found ($r = 0.332^{**}, p < 0.01$), indicating that texts with more concrete and meaningful words may receive higher scores than those with more abstract words. The findings are consistent with previous research (Graesser et al., 2011).

In terms of PCSYNz, there is a weak negative correlation between syntactic simplicity and writing quality ($r = -0.189^{**}, p < 0.01$). Even though this result is slightly different from the finding that “syntactic simplicity was the dimension most highly correlated with grade level” (McNamara et al., 2014, p.87), both agree that syntactic simplicity is related to writing quality.

Table 3. Results of Unitary Regression Analysis on the Five Predictive Variables and Writing Quality.

Predictive Variables	R	R ²	Adjusted R ²	F	Unstandardized Coefficients	Standardized Coefficients	t
PCNARz	0.267	0.071	0.070	41.904***	80.009 -1.812	-0.267	459.991*** -6.473***
PCSYNz	0.189	0.036	0.034	20.135***	79.420 -0.916	-0.189	559.372*** -4.487***
PCCNCz	0.332	0.110	0.108	67.515***	79.559 1.083	0.332	577.294*** 8.217***
PCDCz	0.128	0.016	0.015	9.125**	79.753 -0.408	-0.128	396.358*** -3.021**
Text Formality	0.131	0.017	0.015	9.523***	79.519 -1.329	-0.131	511.396*** -3.086**

** $p < 0.01$, *** $p < 0.001$

For PCDCz, its correlation coefficient ($r = -0.128^{**}$, $p < 0.01$) is so low ($r < 0.20$) that it is plausible to assume that there is a weak correlation between deep cohesion and writing quality.

Regarding PCREFz, there is clearly no correlation between referential coherence and writing scores ($r = 0.045$, $p > 0.05$). This is consistent with prior studies demonstrating that cohesion does not explain writing quality. Instead, McNamara et al. (2014) found a link between good writing and measures of text difficulty and use of advanced language.

Linear Regression of Relationships between Text Formality and Writing Scores

A linear regression analysis to explain the linear relationships between text formality and writing quality was conducted in order to answer the research question “How and to what extent does text formality affect writing scores?”

The PCNARz, PCSYNz, PCCNCz, PCDCz, and text formality are the five factors that were found to be correlated with writing quality in the latter phase of the study (the five independent variables). Unitary linear regression analysis is used in the current study to determine the degree to which each independent variable impacts writing scores. The dependent variable in this study is writing score.

The total impact of text formality on writing quality is negligible, as seen in **Table 3**, as it can only accurately predict 1.5% (Adjusted $R^2 = 0.015$) of the variance in writing scores. PCNARz, PCSYNz, PCCNCz, and PCDCz may explain 7% (Adjusted $R^2 = 0.070$), 3.4% (Adjusted $R^2 = 0.034$), 10.8% (Adjusted $R^2 = 0.108$), and 1.5% (Adjusted $R^2 = 0.015$) differences in writing scores, respectively. In other words, writing scores are influenced to varying degrees by narrativity, grammatical simplicity, deep cohesion, and word concreteness. Thus, it may be argued that narrativity, grammatical simplicity, deep cohesion, and word concreteness may all have weak but potential predictive effects on writing quality. This result does not quite agree with Wang’s (2012)

claim that there are no indications of syntactic complexity that have demonstrated their capacity to predict the caliber of writing. Furthermore, according to Du and Cai (2013), cohesiveness is strongly connected with writing scores, with their Coh-Metrix indices accounting for 17% of the variance in writing scores. However, this investigation was unable to find any such proof.

Summary

Based on the findings of this study, the formality of the text has little bearing on the caliber of the writing. We can suppose that text formality has a relatively minor detrimental effect on writing scores because it can only predict 1.5% of the variance of writing scores. With the exception of PCREFz, the specific indices of text formality PCNARz, PCSYNz, PCCNCz, and PCDCz have demonstrated statistically significant correlation with writing scores, which can be used as writing score indicators. In particular, PCCNCz has a comparatively substantial positive impact on writing scores, while PCNARz, PCSYNz, and PCDCz exhibit obvious negative relationships with writing scores. This implies that the argumentative essays with better scores may have lower PCNARz, PCSYNz, and PCDCz values but higher PCCNCz values. It is therefore reasonable to draw the conclusion that word concreteness and writing quality are positively correlated, but narrativity, grammatical simplicity, and deep cohesion are negatively correlated. In conclusion, there is a little inverse relationship between text formality and writing caliber. Additionally, among the five textual characteristics, narrativity and word concreteness, which can explain 7% and 10.8% of the differences in writing scores, respectively, are confirmed to be able to differentiate between writing quality in different score groups. Writing quality is slightly impacted negatively by syntactic simplicity and deep cohesion, which predict 3.4% and 1.5% of writing score variations, respectively. However, this study did not find a relationship between referential coherence and writing quality.

Limitations

Although the findings may be useful for future research, the following limitations should be acknowledged:

First, this study has focused on only one textual feature, text formality, which the author believes has the greatest pedagogical value. However, writing is a complex process that includes other factors (such as grammatical and semantic features) that influence writing quality. These aspects were not addressed in this study.

Further, human grading involves many subjective factors that influence the assessment of writing quality. Even though the samples were scored by two professional evaluators with a lot of experience, a larger group of evaluators may improve the reliability and validity of the research findings.

Third, because this study only includes argumentative essays written by a specific group of Chinese EFL learners, the findings cannot be generalized to other discourse genres (e.g., narrative, expository, or descriptive) or other types of learners (e.g., native English learners). Without a doubt, it will be helpful to look at more genres or study more people with different levels of proficiency to learn more about how formality of text affects the quality of writing.

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