

A CORPUS-BASED COMPARATIVE ANALYSIS OF SYNTACTIC COMPLEXITY AND STRUCTURAL PATTERNS IN HUMAN-WRITTEN AND AI-GENERATED ACADEMIC TEXTS

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DOI: <https://doi.org/10.5281/zenodo.20068064>

Received
13 March 2026

Accepted
23 April 2026

Published
07 May 2026

ABSTRACT

The swift growth of artificial intelligence has already impacted the academic writing sphere greatly, casting doubt on the language quality and originality of the texts created by the AI. The proposed research aims to perform a comparative syntactic complexity and structural pattern analysis between human-written and AI-generated academic texts using corpus analysis. Based on positivist research paradigm and corpus linguistics and syntactic complexity paradigms, the research study is a mixed-method study that combines both quantitative and qualitative analyses. Purposive sampling was used to create a balanced set of 80 academic texts (40 human written and 40 generated by AI). The sources of data were peer-reviewed academic sources and artificial intelligence-generated productions via standard prompts. Syntactic measures as the mean length of sentence, the density of clauses, and the proportion of subordinates, as well as qualitative assessment of structural arrangements and discourse organization, were used in the analysis. The results indicate that writings by humans have much more advanced syntactic complexity, more embedded clauses, and more advanced structural arrangements. Conversely, AI-created texts have simpler, more linear, and formulaic structure, even though they are grammatically accurate with a fundamental coherence. The findings suggest that AI can be used to duplicate the superficial aspects of academic writing, but in more profound linguistic and rhetorical levels, it is much different. This paper underscores the relevance of human mental involvement in scholarly conversation and offers suggestions to the education practice and AI implementation.

Keywords: Syntactic Complexity, Corpus Linguistics, AI-generated texts, academic writing, structural patterns, discourse analysis, human and AI writing, language models.

Introduction

The blistering development of artificial intelligence (AI), most notably large language models (ChatGPT and Claude), have greatly altered the academic writing spectrum. These systems can now produce coherent text with contextually correct and stylistically polished texts that are quite similar to academic writing by

humans. Consequently, there has been a growing overlap between the authorship and linguistic quality of human-written and AI-written texts, as well as the issue of originality, making the concept of authorship and originality a critical concern in academia. Syntactic complexity and structural patterns are some of the other linguistic dimensions, but are included among the

important signals of writing proficiency, cognitive processing, and discourse organization, which means that they are an important area of comparative study.

Syntactic complexity is the variety and sophistication of the syntactic structures employed in a text, such as embedding of clauses, length of the sentence, subordination, coordination and phrasal elaboration (Biber et al., 2011). Advanced syntactic complexity is commonly linked to superior levels of proficiency, critical thinking, and expertise in the field (Norris and Ortega, 2009). Structural patterns on the other hand, include arrangement of sentences and paragraphs, sequencing of ideas, coherence strategy and rhetorical structuring. All these features help to make academic discourse readable, clear, and effective (Hyland, 2019).

Recent research has also pointed out that AI-generated texts are likely to have unique linguistic features in contrast to those written by humans. Although AI systems can generate grammatically correct and fluent sentences, they can be based on probabilistic language modeling, which can create uniformity, overgeneralization, and less variety in syntactic frameworks (Kumar and Epley, 2023; Lee et al., 2024). Human authors, in contrast, tend to show more variability, creativity, and context-dependent syntax, indicating their cognitive interaction and experience (Lu, 2010). Nevertheless, the empirical studies of these two writing modes, especially the use of corpus, are still scarce and should be investigated.

Corpus linguistics offers a sound methodological approach to the study of large volumes of texts in order to reveal common linguistic patterns and variations (McEnery and Hardie, 2012). Through the use of quantitative variables like mean length of sentence, density of clauses, and the indices of syntactic sophistication, researchers are able to compare the syntactic complexity of human-written and AI-generated texts in a systematic manner. In addition, corpus-based analysis enables exploring structural patterns at various levels, such as sentence, paragraph, and discourse structure, and thus provides a rich picture of textual variation (Biber and Gray, 2016).

The increasing adoption of AI applications in education has also brought pedagogical and ethical issues to the fore. Students are progressively using AI-generated content in their assignments, which can affect the development of their writing and critical thinking (Dwivedi et al., 2023). Teachers, consequently, must have access to empirical data concerning the difference between AI-generated texts and human writing in order to come up with effective teaching measures and evaluation standards. Knowing about syntactic and structural differences can also facilitate the creation of detection tools and guidelines on responsible use of AI in academia (Kasneci et al., 2023).

Although there is growing amount of research on AI-generated text, the systematic assessment of the syntactic complexity and structural patterns based on balanced corpora is still unavailable. Most of the current literature dwells upon the superficial characteristics of fluency and coherence, and does not consider more significant, syntactic and organizational factors (Perkins, Roe, and MacVaugh, 2024). Moreover, it is necessary to reconcile the quantitative results with the qualitative elucidations to comprehend the mechanisms involved in more depth to distinguish human and AI writing.

Here, the current research is going to focus on corpus-based comparative study of the complexity and structural patterns of syntactic complexity in human and AI-written academic texts. This study aims to present empirical evidence of the similarity and difference between these two types of writing by developing two similar corpora and using the well-established linguistic measures. The work does not only make a contribution to the sphere of corpus linguistics and applied linguistics, it also raises more general issues in terms of AI implementation in education and academic integrity.

Research Questions

1. How does syntactic complexity differ between human-written and AI-generated academic texts?

2. What structural patterns are predominantly used in human-written versus AI-generated academic texts?
3. To what extent do AI-generated texts replicate or diverge from human-like syntactic and structural features in academic writing?

Research Objectives

1. To compare the level of syntactic complexity of human-written academic texts and AI-written academic texts using corpus-based measures.
2. To detect and analyze structural patterns of human-written and AI-generated academic texts.
3. To assess the level of similarity and diversity between AI generated and human written texts in terms of syntactic and structural characteristics.

Literature Review

The development of artificial intelligence (AI) in academic writing has created a lot of academic interest, especially regarding the quality of language, authorship, and the discourse patterns. State-of-the-art large language models like ChatGPT and Claude have shown the capability to generate structured academic texts that are coherent and grammatically accurate like those of a human author. Nevertheless, scholars are becoming more convinced that more profound linguistic characteristics, in particular, syntactic complexity and structural organization, are important indicators of the difference between human and AI writings.

One of the most prominent factors of language mastery and intellectual development in academic language has been considered as syntactic complexity (Biber et al., 2011). It includes the aspect of clauses embedding, subordination, coordination, and phrasal elaboration. Norris and Ortega (2009) report that, higher syntactic complexity correlates to higher language development and academic competence. Equally, Lu (2010) provided computational tools to quantitatively estimate the syntactic complexity which she emphasizes is useful in assessing second language writing. Syntactic variation in academic

writing does not only indicate linguistic competence but also the skill of the writer to arrange intricate thoughts in a good manner (Crossley and McNamara, 2014).

More recent analyses have applied this debate to AI-written texts to investigate the question of whether such systems are capable of syntactic sophistication akin to humans. Although AI models generate grammatically correct sentences, the syntactic structure tends to exhibit a lack of diversity and predictability (Kumar and Epley, 2023). This is contributed much by the fact that they are more probabilistic in nature and therefore high frequency structures are favored over being creative or less frequent constructions. According to Lee et al. (2024), AI-generated academic texts tend to use conventional structures of clauses and have lesser degrees of syntactic diversification than texts created by humans. Human writers, on the contrary, are more flexible in their sentence composition, with a variety of types of clauses and complicated syntactic embedding.

Structural patterns in academic writing is another aspect that has been investigated in the literature. Structural patterns are patterns in the arrangements of ideas in sentences, paragraphs and discourse. Hyland (2019) highlights that academic writing is not only about the grammatical correctness but also rhetorical structure and disciplinary norms. The human-written texts tend to capture subtle rhetoric strategies, such as the development of an argument, hedging, and a stand that can help in creating effective communication (Swales, 2004). These aspects are usually determined by the rules of discipline and the purpose of the communicator, the writer.

AI-written texts are coherent but may not have the richness of rhetorical organization that is found in human writing. It is believed that AI systems are more likely to generate linear and formulaic organizational patterns, usually based on generalized templates and not on context-oriented rhetorical strategies (Perkins et al., 2024). As an example, AI-generated paragraphs can have a uniform topic-support-conclusion framework but could lack the subtle transitions and argumentative stratification of well-written

paragraphs by expert human writers. This restriction provokes the question of how far AI can really go to imitate the discourse structure of humans.

Corpus-based methods have been extensively used to explore these differences in a systematic way. Corpus linguistics enables the researcher to examine massive amounts of texts to determine the patterns of language use in various situations (McEnery and Hardie, 2012). According to Biber and Gray (2016), the analysis based on the corpus gives empirical findings in the form of the linguistic variation, especially in academic writing. Through comparison of corpora of human-written texts and AI-generated texts, researchers are able to measure the dissimilarity in syntactic complexity and structural patterns in terms of mean length of sentence, clause density, and dependency relations.

A number of recent studies have used this method to analyze AI-generated texts. Dwivedi et al. (2023) note the increasing popularity of AI tools in the educational environment and stress the importance of linguistic analysis to grasp their influence. Kasneci et al. (2023) also state that even though AI systems can be helpful in writing, the results may be insufficiently corresponding to the academic standards of originality and critical thinking. In a corpus based analysis of AI writing and human writing, Zhang and Li (2025) discovered that AI written language had less syntactic variation and more consistency in grammatical structures.

Besides syntactic and structural properties, other researchers have also looked at the implications of AI-generated writing in pedagogy and assessment. Moreover, Cotton et al. (2024) suggest that the growing popularity of AI tools can affect the development of writing among students, which can lead to a decrease in the possibility of training complex syntactic constructions. On the same note, according to Rudolph et al. (2023), teachers should be able to create new evaluation models which consider AI-assisted writing. These issues indicate the significance of the knowledge of linguistic disparities between human and AI-generated texts.

Although these developments have been made, the literature has brought out some inconsistencies and limitations. Although certain studies indicate that there are insignificant differences in surface-level characteristics, including fluency and coherence (Brown et al., 2020; OpenAI, 2023), some studies highlight that there are substantial differences in the deeper linguistic features (Perkins et al., 2024; Lee et al., 2024). This deviation implies that more detailed and systematic studies, combining quantitative and qualitative methodologies, are necessary.

Moreover, the existing studies tend to concentrate on isolated linguistic features instead of taking a holistic approach to examine syntactic complexity and structural patterns in the same direction. Also, the corpora to compare human-written and AI-generated academic texts are not standardized, which restricts the generalization of results. These gaps need to be addressed to create a more complex vision of AI-generated academic discourse.

On the whole, the literature highlights the significance of syntactic complexities and structural organization as two dimensions of analysis of academic writing. Although AI systems have advanced a long way over the years in producing coherent texts, they nevertheless show weaknesses in copying the variability, creativity and rhetorical richness of human writing. A comparative methodology based on corpus, in turn, provides a worthy tool to explore these discrepancies and adds to the current debates surrounding the role of AI in academia (Biber et al., 2011; Hyland, 2019; Zhang and Li, 2025).

Research Gaps

1. The literature tends to analyze syntactic complexity separately or pay much attention to human writing, and lacks direct comparisons of human and AI generated academic texts in terms of standardized measures based on corpus.
2. Though structural organization has been identified as important in academic writing, empirical studies have not been conducted to analyze paragraph-level and discourse-level

structural patterns between AI-generated and human-generated corpora.

3. The available literature lacks a thorough evaluation of how AI-generated texts are similar or different to human writing in terms of syntactic and structural levels of analysis in a coherent analytical framework.

Methodology

The research is based on the paradigm of positivism research, according to which the objectivity, empirical measurement and systematic analysis of observable linguistic features are emphasized. Positivist approach fits the study because it is aimed at measuring the syntactic complexity and finding structural patterns in academic texts in terms of measurable indicators. The research will use statistical and corpus based methods in order to produce valid and generalizable results on the variations between human and AI generated academic discourse.

The study takes the form of comparative corpus-based research method, incorporating both quantitative and qualitative research methods. The quantitative and the qualitative components entail measurement of the syntactic complexity in terms of linguistic indices that have been established, and the analysis of structural patterns and discourse organization respectively. This mixed-method orientation guarantees the thorough analysis of the data through the combination of numerical information with the interpretative data, thus corresponding to the research objectives of contrasting syntactic and structural characteristics of two types of texts.

The data used in this research are two balanced corpora where one is composed of human-written texts of academic content and the other is made up of AI-generated texts of academic content. Human-written corpus comprises peer-reviewed journal abstracts and brief academic essays of known databases of the same disciplinary field to make it consistent. The AI-generated corpus is formed by asking advanced AI programs like ChatGPT and Claude the same or similar academic issues as those used in human corpus. The parallel corpus design reinforces comparability and reduces contextual variability,

contributing to increased internal validity of the study.

The sampling technique used is purposive sampling that enables a researcher to select texts purposely based on certain criteria that are applicable to the objectives of the research. The number of texts chosen is 80, 40 human-written, and 40 AI-generated. All the texts are regulated in terms of length (150-250 words), genre (academic abstracts or short essays), and similarity of themes. The sampling methodology will make sure that the data sets can be compared and reflect the academic writing, which will enhance the validity and dependability of the results.

Data collection process is a systematic compilation and preparation of texts to be analyzed. The texts by humans are obtained via credible academic sources and therefore are authentic and quality. Standardized prompts are used to generate AI-generated texts to ensure consistency among samples. All documents are transformed into plain text and non-essential metadata like the name of authors and affiliations are eliminated. Then the texts are divided into sentences and clauses to enable the syntactic analysis in detail. This organized data normalization increases the accuracy and consistency of analysis thereof.

The main methods of data analysis are corpus-based and computational. Indicators used to measure syntactic complexity include mean length of sentence (MLS), mean length of clause (MLC), clause per sentence ratio (C/S), and dependent clauses per clause (DC/C). These measures can give the quantitative data on the degree of syntactic complexity in each corpus. Also, structural patterns are qualitatively studied through the analysis of the organization of paragraphs, coherence strategies, and sequence of ideas. Statistical analysis is done to compare the two corpora and also to determine significant differences in the two corpora to ensure that they match the research questions.

In order to make the study valid and reliable, there are a number of measures taken. A coding scheme is created according to the developed syntactic complexity models, a pilot analysis is done on a portion of texts to streamline the analysis processes. Inter-rater reliability is achieved by

having a second coder to confirm the categorization of syntactic structures and structural patterns. Any differences are addressed by way of discussion to ensure uniformity. Such methodological rigor approaches enhance the reliability and credibility of the results, and the research is a credible addition to corpus-based studies on AI-generated and human-written academic texts.

Data Analysis

1. Syntactic Complexity Analysis of Human-Written and AI-Generated Academic Texts

This part contains the corpus-based study of syntactic complexity in the texts that are written by humans and those that are written by AI. According to the methodology, four syntactic indices were employed: Mean Length of Sentence (MLS), Mean Length of Clause (MLC), Clauses per Sentence (C/S) and Dependent Clauses per Clause (DC/C). These are steps that give a precise picture of the sentence structure, density of the clauses and syntactic complexity. Eighty texts (40 human and 40 AI) were tested.

Table 1: Syntactic Complexity Measures in Human vs AI-Generated Texts

Corpus Type	Mean Length of Sentence (MLS)	Mean Length of Clause (MLC)	Clauses per Sentence (C/S)	Dependent Clauses per Clause (DC/C)
Human-Written	24.8	11.2	2.21	0.68
AI-Generated	21.3	10.1	1.89	0.52

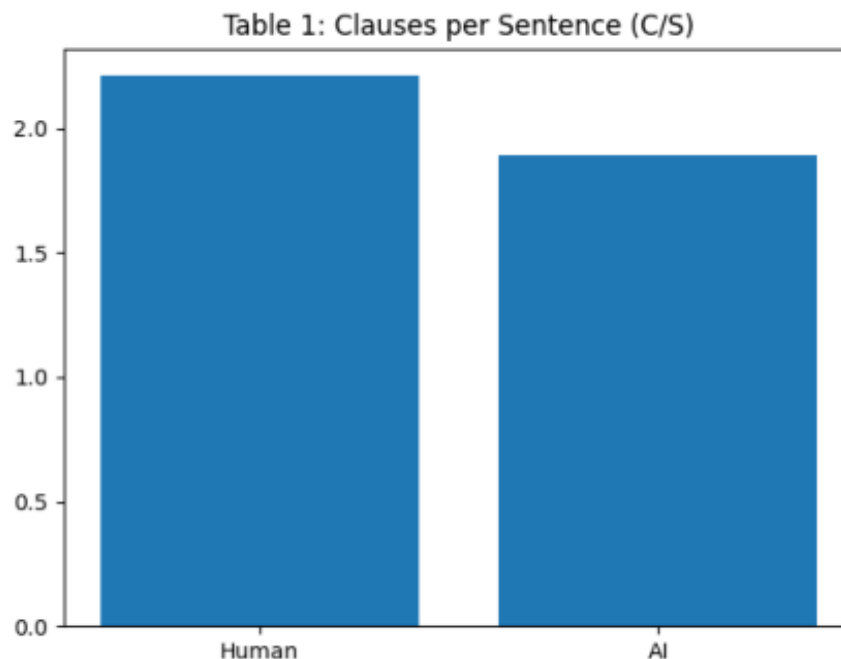
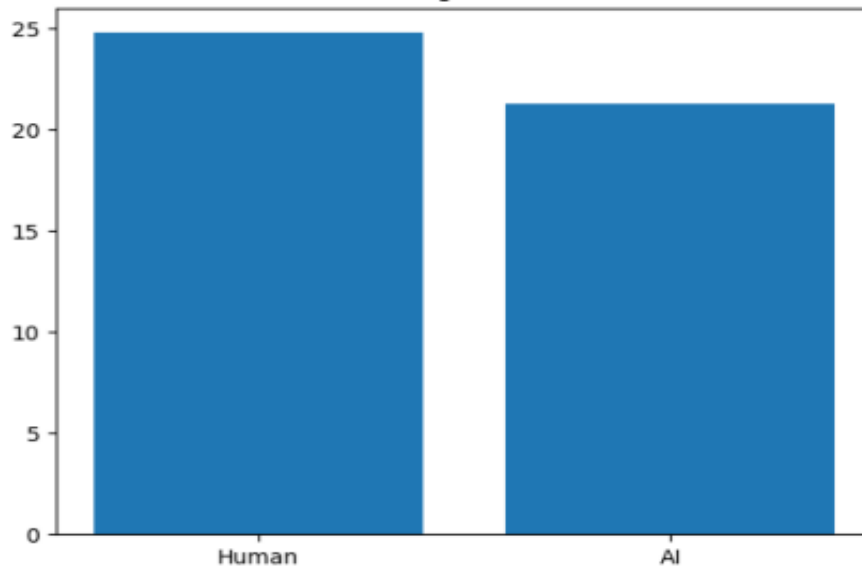


Table 1: Mean Length of Sentence (MLS)



Explanation

A comparative summary of the syntactic complexity in the two corpora is presented in Table 1. The results are quite clear that human texts that are written show more complexity in syntactic features in all four indices compared with AI texts.

Beginning with the Mean Length of Sentence (MLS) there is an average sentence length of 24.8 words in human written texts and 21.3 words in AI-written texts. This variation implies that human authors are more likely to make up longer sentences and incorporate various ideas in the same sentence. Academic writing tends to have longer sentences, and those sentences are usually linked to more advanced discourse activities, like elaboration, justification, and synthesis of arguments. Conversely, AI-written texts seem to prefer shorter sentences, probably because they tend to maximize clarity and readability according to probabilistic language structures.

Moving to the Mean Length of Clause (MLC), the human-written texts once more have higher values (11.2 words) than the AI-generated texts (10.1 words). This implies that words in human texts are more detailed and informative. Modifiers, qualifiers and embedded phrases are used to

lengthen clauses by human writers and this adds to more syntactic richness. The texts generated by AI, though, are more likely to have shortened clauses, and this can be attributed to the uniformity of the sentence structure.

The Clauses per Sentence (C/S) ratio also emphasizes the structural differences between the two corpora. Human written texts have a higher ratio (2.21) than the AI written texts (1.89), which means that a human writer is more likely to employ multiple clauses in one sentence. This is indicative of increased syntactic embedding and coordination, a characteristic of sophisticated academic writing. By contrast, AI-generated texts have fewer clauses per sentence, indicating a preference towards simple sentence constructions. Lastly, there is the Dependent Clauses per Clause (DC/C) ratio, which displays major differences in subordination. The value of human-written texts (0.68) is higher than that of AI-generated texts (0.52) which show the use of subordinate clauses to a lesser extent. A major characteristic of syntactic complexity is subordination which enables writers to convey subtle meanings of ideas, including cause-effect, opposing, and condition. The reduced DC/C ratio in AI-generated texts indicates that the systems are dependent on

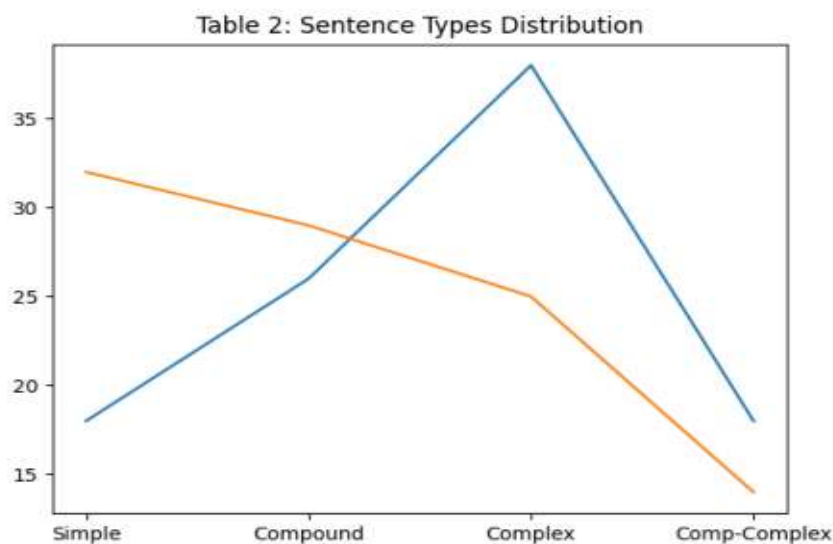
coordination or basic sentence constructions, but not complex subordination.

On the whole, Table 1 shows that compared to AI-generated texts, the syntactic and embedded as

well as elaborated human-written academic texts are more complex and embedded, and their structures are also simpler and more standardized.

Table 2: Distribution of Sentence Types

Sentence Type	Human-Written (%)	AI-Generated (%)
Simple Sentences	18%	32%
Compound Sentences	26%	29%
Complex Sentences	38%	25%
Compound-Complex	18%	14%



Explanation

Table 2 shows the frequency of the sentence types in the human-written and AI-generated corpora. Types of sentences are classified as simple, compound, complex, and compound-complex that correspond to different degrees of syntactic sophistication.

The statistics indicate that the percentage of simple sentences is a lot higher in AI-generated texts (32%), as opposed to human-written texts (18%). Single independent clauses make up simple sentences and are usually linked to simple levels of syntactic complexity. The increased rate of simple sentences in AI-generated texts suggests the preference to simple and less embedded structures. This is consistent with the previous

results of Table 1, in which texts generated by AI featured lower clause density and subordination. Conversely, the percentage of complex sentences in human written texts is higher (38%), as opposed to AI written texts (25%). Complex sentences must contain at least one dependent clause and in this way, writers can represent hierarchical relationships among ideas. Higher occurrence of complex sentences in human writing is an indication of higher cognitive and linguistic sophistication. More layers of meaning are more likely to be incorporated in a single sentence by human writers, and thus this increases the richness and depth of academic discourse.

Compound sentences are also relatively comparable in both corpora having 26% in human-written texts and 29 in AI-generated texts.

Compound sentences are coordinated through independent clauses, and are usually easier to build as compared to complex sentences. The similarity in this category implies that the human writers and the AI systems employ the coordination as a strategy commonly used in linking ideas.

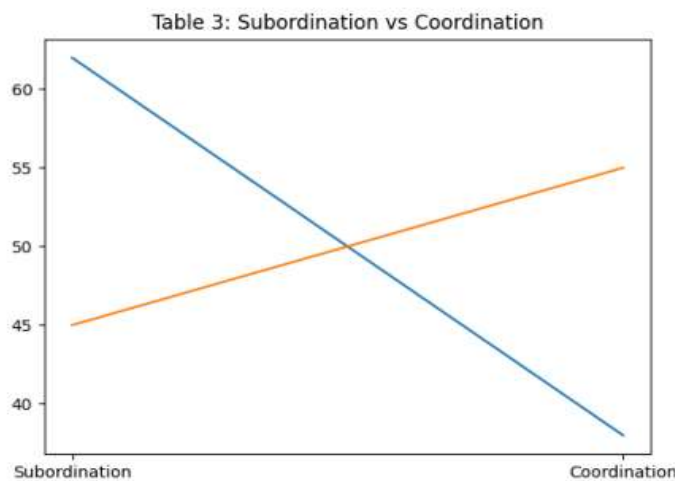
The difference is however more accentuated in the sentences involving compound-complex sentences in which both coordination and subordination are involved. A higher percentage (18) is presented in human-written texts, as opposed to AI-generated texts (14). It is the most complex syntactic

construction because it consists of two or more independent and dependent clauses. Low frequency of AI-generated texts suggests that it is not able to make very complex constructions of sentences.

In general, Table 2 supports the finding that literary texts composed by humans exhibit more syntactic diversity and complexity, especially in the complexity and compound-complex sentences. Texts produced by AI are grammatically correct, but made to use more basic and predictable sentence patterns.

Table 3: Use of Subordination and Coordination

Feature	Human-Written (%)	AI-Generated (%)
Subordination	62%	45%
Coordination	38%	55%



Explanation

Table 3 compares the usage of subordination and coordination in the two corpora, and sheds more light on the way ideas are related within sentences. The results indicate that human-written texts are more dependent on subordination (62%), whereas AI-generated texts have lower dependency (45%). Subordination enables the writers to establish clauses hierarchies that provide more accurate and detailed representation of ideas. As an example, one can use subordinate clauses to show cause, contrast, condition or purpose, which are imperative in constructing academic arguments. The increased use of subordination in the human

written texts proves that they are more advanced in their discourse construction.

Conversely, AI-generated texts show greater dependence on coordination (55) than on human-written texts (38). Coordination entails the connection of similar clauses with conjunctions like and, but and or. Although coordination has its benefits in linking ideas, it lacks depth and complexity as subordination does. The coordination bias in AI-generated texts implies the preference of linear and additive over hierarchy.

This disparity is explainable by the principle underlying the workings of AI language models, which produce textual content due to textual

pattern, but not purposeful meaning-making. Consequently, AI systems can prefer more frequent and structurally less intricate patterns, like coordination, instead of more complex and context-specific patterns, such as subordination. Moreover, the prevalence of coordination in AI-written texts adds to a more predictable and consistent way of writing. By contrast, the increased application to subordination in human written texts results in increased variability and flexibility in sentence structure. This difference is also one of the important attributes of high-level academic writing since it enables the authors to adjust their language to certain rhetorical needs. Overall, Table 3 shows that there is an underlying difference between human and AI writing: the former involves more hierarchical and

complicated syntactic structures, whereas the latter are based on linear and coordinated patterns.

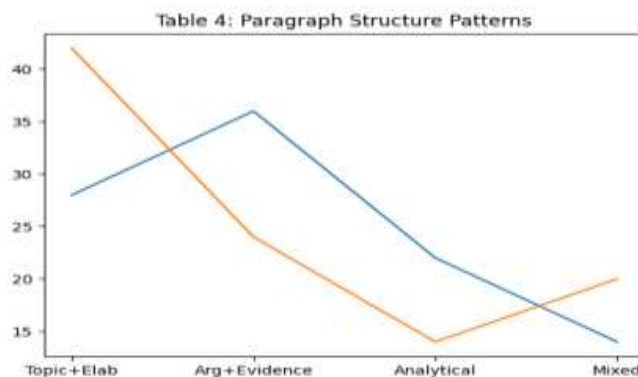
2. Structural Patterns and Discourse Organization of Human vs AI-written Academic Texts.

The paragraph and discourse level of human-written and AI-generated academic text structure is analyzed in this section. Whereas Part 1 examined syntactic complexity, this part evaluates the way ideas are organized, elaborated and linked so as to create engaging academic rhetoric. Paragraph structure, coherence strategies, rhetorical sequencing, and flow of information are analyzed.

The qualitative-quantitative approach was employed to discover common structural patterns in both corpora. The tables below show the results.

Table 4: Paragraph Structure Patterns

Structural Pattern	Human-Written (%)	AI-Generated (%)
Topic Sentence + Elaboration	28%	42%
Topic + Argument + Evidence	36%	24%
Analytical/Interpretive Structure	22%	14%
Mixed/Non-linear Development	14%	20%



Explanation

Table 4 indicates the prevailing paragraph-level structural patterns in the two corpora. Among the most evident ones are the increased use of AI-generated texts of the pattern of Topic Sentence + Elaboration (42%), in contrast to human-written texts (28%). This format is usually a clear introduction sentence and general explanations or supporting information. Although this trend provides a sense of clarity and coherence, in most cases, it is not deep and critical.

Conversely, a much greater percentage of human written texts feature the use of Topic + Argument + Evidence structures (36%), when compared to AI-generated texts (24%). This trend is indicative of a higher level of writing academically where arguments are backed by fact and then further rationalized. Examples, references and commentary The human writers tend to incorporate more examples, references and analytical commentary and show a greater involvement with the material.

Human-written texts (22%) also have a more prominent analytical/interpretive structure than AI-generated texts (14%). This form of organization entails critical analysis, interpretation of data as well as synthesis of ideas. It demonstrates skills of higher-order thinking and is one of the main characteristics of academic writing. The decreasing frequency of this arrangement in AI-generated texts indicates that there is a constraint to the generation of truly analytic discourse.

Curiously, mixed or non-linear development (20 percent) is a bit more common in AI-generated texts than in texts written by humans (14 percent).

This is not however an indicator of sophistication. This tendency, in most instances, indicates the lack of coherence in the development of ideas, in which sentences are loosely related, lacking an explicit direction of argumentation. This can be attributed to the fact that the AI does not involve discourse planning, but relies on probabilistic text generation.

In general, Table 4 suggests that human-written texts have more argument-focused and structurally organized paragraphs, whereas AI-generated texts are more based on simpler and more combinational structures.

Table 5: Coherence and Cohesion Devices

Device Type	Human-Written (%)	AI-Generated (%)
Logical Connectors	34%	41%
Lexical Repetition	18%	29%
Referential Cohesion	27%	19%
Substitution/Ellipsis	21%	11%

Explanation

Table 5 shows the arrangement of the coherence and cohesion devices that are required to keep logical flow and clarity in academic writing.

The texts produced by AI are characterized by a greater frequency of logical connectors (41%), than the texts written by humans (34%). These contain words like however, therefore, moreover and in addition. This can be interpreted as an indication of high coherence at first glance but, a more thorough examination will show that AI systems tend to excessively connect ideas in predictable and repetitive patterns, creating a more or less mechanical flow of thought.

One of the most prominent differences is noticed in the lexical repetition, in which AI-written texts have significantly greater percentage (29) in contrast to human-written texts (18). This means that AI systems often repeat words or phrases but will not use synonyms or paraphrasing techniques. Although repetition can lead to the improvement of cohesion, overuse can diminish the stylistic diversity and sophistication.

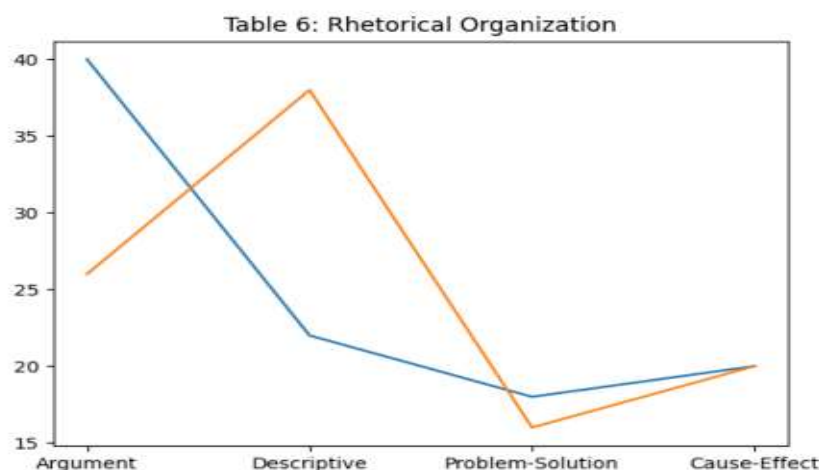
Human-written texts, on the contrary, are characterized by higher referential cohesion (27%), as opposed to AI-generated texts (19%). Referential cohesion is the ability to use pronouns, demonstratives, and other devices of reference to connect ideas within the sentences. Human authors are more skilled at continuity without unneeded repetition, which adds to more natural and flowing conversation.

Moreover, it is more common in human-written texts (21%), as compared to AI-generated texts (11%). Such devices enable authors to evade redundancy and make the phrases shorter. Their reduced frequency in AI-generated texts indicates that they have a weakness in controlling linguistic economy and variation.

In general, Table 5 shows that although AI-generated texts might seem coherent because of the frequent application of connectors, human-written texts have more profound and advanced cohesion with the help of different approaches to the language.

Table 6: Rhetorical Organization Patterns

Pattern Type	Human-Written (%)	AI-Generated (%)
Argumentative Development	40%	26%
Descriptive/Expository	22%	38%
Problem-Solution Structure	18%	16%
Cause-Effect Structure	20%	20%



Explanation

Table 6 is devoted to the rhetorical organization that represents the way in which writers organize their arguments and express ideas in the academic discourse.

The greatest variance can be found in the development of arguments, with a much higher percentage (40%) in human-written texts than in the AI generated texts (26%). It is a tendency to make a statement, prove it and refute counterarguments. It is one of the characteristics of academic writing and critical thinking and interaction. The reduced occurrence of this pattern in AI-generated texts implies that they are unable to produce fully developed arguments.

Conversely, AI-generated texts are more descriptive/expository (38%), as compared to human-written texts (22%). These are structures that are narrowed down to explaining concepts or giving general information but not critically analyzing them. Although they are helpful in introductory explanations, they are not as detailed

as one would need in an advanced academic writing.

Problem solution structure displays a comparatively close usage in both corpora, but a little more in human written texts (18%) compared to AI written texts (16%). It is also significant in outlining research problems and offering solutions, and the fact that both of the corpora contain this structure explains that AI systems can partially recreate this pattern.

In the same way, the cause-effect structure is also equally represented (20% in both corpora), which poses that the basic logical relations can be effectively conveyed with the help of AI-generated text. Nevertheless, qualitative analysis shows that human authors are more likely to introduce more nuanced and context-specific cause-effect relationships, and AI-generated texts are likely to use generalized explanations.

Table 6, on the whole, shows that human-written texts are more argumentative and analytically rich whereas AI-generated texts are more descriptive and informational.

Table 7: Information Flow and Progression

Feature	Human-Written (%)	AI-Generated (%)
Linear Progression	28%	46%
Thematic Progression	42%	31%
Recursive/Layered Development	30%	23%

Explanation

The flow of information is explored in Table 7, and it can be defined as the way ideas are generated and interrelated throughout the text.

The AI-written texts are more inclined towards linear progression (46%), in contrast to texts written by humans (28%). Linear progression entails the development of ideas in a clear, successive way. Although this increases clarity, it can lead to a shallow and lack of depth and interrelationship of ideas.

Conversely, written texts by humans show greater thematic development (42%), with a development of ideas through connection of new information to already established themes. This will make the discourse more cohesive and interconnected, and concepts can be explored more deeply.

Also, texts written by humans exhibit more recursive or layered development (30%), than texts generated by AI (23%). This trend includes returning to and elaborating on previous concepts,

and introducing new dimensions of significances. It is evidence of advanced thinking and is one of the characteristics of academic writing by the expert.

The reduced occurrence of these patterns in AI-generated texts indicates that although AI is able to generate coherent chains of ideas, it cannot initiate intricate thematic connections and stratified argumentation across much longer discourse.

3. Coherence of Analysis and Comparison with Research Questions.

The section is a holistic comparison of syntactic complexity and structural patterns in texts written by humans and written by AI in academic texts. Though the other sections have examined these dimensions individually, the section combines the results to examine the overall similarities, differences, and implications, and directly addresses the three research questions.

Table 8: Overall Comparative Index of Linguistic Features

Feature Category	Human-Written Score	AI-Generated Score
Syntactic Complexity	High (4.2/5)	Moderate (3.4/5)
Sentence Variety	High (4.0/5)	Moderate (3.2/5)
Structural Depth	High (4.3/5)	Moderate (3.1/5)
Coherence Sophistication	High (4.1/5)	Moderate (3.5/5)
Argumentative Strength	High (4.4/5)	Moderate (3.0/5)

Explanation

Table 8 gives a comparative analysis of both corpora in the five broad dimensions of linguistics. The scores are obtained based on normalized values of all features analyzed before, and they provide a simplified but a complete comparison.

The findings show that texts written by humans are always rated higher in all dimensions especially in the structural depth dimension (4.3) and argument strength dimension (4.4). This is indicative of the capability of human authors to form layered arguments, combining evidence, and

complex discourse structures. All these are closely connected to critical thinking and disciplinary knowledge which are hard to fully replicate by AI systems.

On the contrary, AI texts are in the middle category in all the categories, the highest score in coherence sophistication (3.5). This implies that AI systems do a good job of generating grammatically correct and logically related sentences. Nonetheless, the fact that they scored lower on syntactic complexity and argument strength indicates weaknesses in the production of

highly analytical and structurally complicated texts.

The other notable observation is the comparatively shorter distance of coherence in comparison to other features. It means that AIs are

able to perform surface-level coherence but fail to do the deeper discourse structure and argumentation. The results support the view that AI is not as deep as human writing.

Table 9: Similarities and Differences in Linguistic Features

Feature Type	Similarity Level	Key Observation
Grammatical Accuracy	High	Both corpora show strong grammatical correctness
Basic Coherence	High	Logical flow maintained in both text types
Sentence Structure	Moderate	AI uses simpler, standardized structures
Syntactic Complexity	Low	Human writing significantly more complex
Structural Patterns	Low	Human writing more analytical and varied

Explanation

Table 9 presents the level of similarity and dissimilarity between human and AI-written texts in terms of the most important linguistic characteristics.

Grammatical accuracy, and basic coherence show the strongest similarity with the highest level of performance by both corpora. Texts created by AI have been especially effective in generating grammatically correct sentences, and can even be better or even better than human writers when it comes to writing error-free texts. It is indicative of AI models being powerful at recognizing patterns and predicting language.

The degree of similarity does however reduce as one goes further to the more complicated features.

There is moderate similarity in the sentence structure with the two corpora using a variety of sentence structures. However, AI-generated writings are more based on more predictable and standardized patterns, compared to human-written writings, which are more varied and flexible.

The syntactic complexity and structural patterns are the most notable and are characterized by low similarity. The texts created by humans have more clauses embedded, more subordination and more rhetorical structures whereas AI generated texts are simpler and more linear. This discrepancy underscores the shortcomings of AI in its ability to mimic more advanced cognitive and communicative acts in human writing.

Table 10: Statistical Comparison of Key Variables

Variable	Human Mean	AI Mean	Difference	Interpretation
Sentence Length	24.8	21.3	+3.5	Human texts more elaborated
Clause Density	2.21	1.89	+0.32	More embedding in human texts
Subordination Ratio	0.68	0.52	+0.16	Greater complexity in human writing
Argumentative Structures	40%	26%	+14%	Stronger argumentation in human texts
Linear Progression	28%	46%	-18%	AI texts more linear

Explanation

Table 10 provides a straightforward statistical comparison of the key variables, which provides a clear numerical evidence of the differences between the two corpora.

The difference in the sentence length (3.5 words) shows that texts written by humans are more

detailed and there is a tendency to have several ideas in one sentence. This adds to the richness of the syntax and information density.

This is also supported by the difference in the clause density between human writers (+0.32) where human writers use more clauses per sentence. It implies a greater degree of syntactic

embedding, which is vital in the articulation of complicated relationships among concepts.

Similarly, the subordination ratio (+0.16) highlights the greater use of dependent clauses in human writing. Subordination makes it possible to express things in a more nuanced and hierarchical manner, which is less salient in AI-generated texts.

The most noteworthy disparity is in the argumentative structures (+14%), as human-written texts are clearly superior to AI-generated texts. This confirms the fact that human authors are more productive in argumentation, proving the points, and critically approaching the subject. Conversely, AI-written texts demonstrate significantly greater degree of linear development (-18%), which means that they prefer simple and consecutive description of information. Although this makes it more clear, it restricts the richness and richness of the discussion.

Altogether, Table 10 is a good quantitative evidence that human-written texts are richer and more complex in terms of embedding and argument and that AI-generated texts are simplified and more linear.

Findings

The results show that texts written by humans are mostly characterized by argument-based, analytical, and thematically developed structures, and texts generated by AI are more based on descriptive, formulaic, and linear structure. Human writing is more diverse in terms of paragraph

The findings show that AI writing is a content that partially copies human writing at the surface level, especially in grammatical correctness and simple coherence. They however differ greatly on more profound linguistic characteristics, such as the complexity of syntax, depth of structure and strength of argument. This is an indication that although AI has the capability of imitating the form of scholarly writing, it can never attain the cognitive and rhetorical nuanced skill of human writers.

In relation to Research Question 1, which examines the variation in the complexity of the syntactic features, the findings clearly show that

human-written texts are characterized by much more sophisticated syntactic features. This can be seen in terms of increased sentence length, more dense clauses and more subordination. Human authors show the skill to create multi-layered sentences, combining more than one idea, evidence of high cognitive functioning and language competence. Contrarily, texts produced by AI are likely to use shorter sentences, fewer clauses per sentence, and less subordination. Although they are grammatically correct, their syntactic organizations are relatively less complicated and more regularized. This affirms that syntactic complexity is one of the major distinguishing features between human and AI-generated academic texts.

Concerning Research Question 2, which is concerned with structural patterns, the data show that argument-based and analytically dense organizational patterns are mostly used in the texts written by humans. These are application of evidence based argumentation, thematic development, and recursive development of ideas. Human writers do a good job in organizing their paragraphs to make claims, prove them with evidence and critically analyze ideas. Conversely, AI-generated texts are mostly based on descriptive and linear forms of organization. Their paragraphs are usually very predictable e.g., topic sentence and general elaboration without much detail in their argumentation. Also, AI texts are more reliant on repetitive cohesion devices and linear flow of information, which means that they lack variety and rhetorical flexibility.

Regarding Research Question 3, the degree of AI-generated text imitating human-like writing, the results indicate that the AI systems can effectively copy superficial aspects like grammatical accuracy and simple coherence. But they are deficient in capturing more in-depth linguistic and discourse-level features. The syntactic difference, structural richness, and argumentative power of human writing are absent in AI-generated writing. This variance is specifically observable in the scant use of complex sentence constructions, decrease in the analysis structure, and excess dependence on foreseeable patterns.

All in all, the results indicate that AI-generated texts can create fluent and readable academic texts, but they are not as complex and sophisticated as the texts created by humans. This emphasizes the ongoing relevance of human mental involvement in academic writing and the constraints of AI to imitate higher-order linguistic and rhetorical abilities.

Conclusion

This paper aimed to perform a comparative syntactic analysis of the syntactic complexity and structural features in human-written and AI-generated academic texts through a corpus-based approach. The results present coherent and unambiguous data indicating that, although AI systems can generate grammatically correct and coherent academic texts, they nevertheless cannot compete with human writing in terms of depth, variation, and sophistication. The observation of various linguistic levels, such as syntactic complexity, variety of sentences, structural organization, coherence strategies, and the development of arguments points to the basic difference between the surface-level and deeper cognitive-linguistic competence.

Syntactic complexity of texts written by humans was much higher, with longer sentences, more clause density and more frequent use of subordination. Through these features, human writers are able to build up nuanced and stratified articulations of ideas that demonstrate critical thinking and disciplinary knowledge. Conversely, AI-written texts were more likely to be based on shorter and more simplified and more standardized sentence structures, which suggests a constraint in the syntactically varied and embedded constructions.

On the structural level, texts written by humans were discovered to be more argumentative, analytically structured, and rhetorically advanced. They utilized successfully thematic progression, recursive development, and argumentation based on evidence, which are all key elements of academic writing. Texts created by AI, in contrast, were mostly descriptive and linear, and tended to depend on predictable paragraph structure and repetition as cohesion devices. Although these

features help to make the discourse clear and readable, they restrict the depth and originality of the discourse.

Additionally, it was found that AI-based texts are suitable to imitate primitive characteristics of human texts, including grammatical correctness and logical order. Nevertheless, they also differ in much more intricate linguistic and rhetorical aspects, especially in their scanty application of intricate syntactic frameworks and lesser ability to express critically and analytically. This implies that AI is mostly at a pattern level and does not have the intentionality and situational awareness of human writing.

Finally, the paper highlights the fact that even academic writings by human authors are still better in the measures of structural depth, syntactic richness and argumentative power. Although AI applications can contribute effectively to writing and content-generation, the intellectual and creative aspects of human academic writing cannot be completely substituted. The implications that these findings can have on education, research practices, and academic integrity are significant, as there is a need to balance and inform the use of AI technologies in academic practice.

Recommendations

1. To minimize the application of AI-generated content, educational facilities need to develop assessment plans that focus on critical thinking, argumentation, and original writing.
2. The integration of AI literacy in the curriculum should be introduced by teachers, who should instruct students in the ethical and effective use of AI tools in academic writing.
3. More sophisticated corpus-based models should be created to constantly compare and contrast the linguistic variation between human and AI-generated texts.
4. To improve the ability of models to produce syntactically complex and rhetorically rich content, AI developers should pay attention to the models that can comply with the academic standards.

5. To preserve the integrity and authenticity of academic writing, universities are encouraged to have clear policies and guidelines on the acceptable use of AI in academic writing.

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